

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons (purple spheres), neutrons (grey spheres), and electrons (blue dots). On the right, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', and a black arrow points to the '1+' in the charge '1+'. The text 'Mass number' is next to the blue arrow, and 'Ignore' is next to the black arrow.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three containers for protons, neutrons, and electrons, each with a slider to adjust the count. The protons container is set to 1, neutrons to 0, and electrons to 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The bottom of the window shows the 'ExploreLearning' logo and a 'COPY SCREEN' button.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue spheres). Each container has a slider to add or remove particles. The central area displays a 3D model of an atom with a nucleus and electron shells. The nucleus is labeled 'Stable' and 'This isotope makes up 99.985% of the element.' Below the model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there is a chemical symbol 'H' with a mass number '1' and a charge '1+'. A pointer icon is pointing to the mass number '1'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. The 'Show element symbol' checkbox is checked. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', labeled 'Mass number'. A black arrow points to the '1+' in the charge '1+', labeled 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The 'PROTONS' container has 1 proton, 'NEUTRONS' has 0 neutrons, and 'ELECTRONS' has 0 electrons. The central atom model shows a nucleus with 1 proton and 0 neutrons, and 0 electrons in the shells. On the right, the 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. The mass number '1' is shown to the upper left of the symbol, and the charge '1+' is shown to the upper right. A pointer is pointing to the mass number '1'. The 'isotope' checkbox is unchecked. At the bottom, there are controls for the simulation, including a play button, a pause button, and a reset button. The ExploreLearning logo is at the bottom left.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. The central part of the screen displays a 3D model of an atom with a nucleus and electron shells. To the left of the atom are three sliders for adding protons, neutrons, and electrons. The 'Protons' slider is set to 1, 'Neutrons' to 0, and 'Electrons' to 0. Below these sliders are control buttons for play, pause, and reset. To the right of the atom model are several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). The element symbol 'H' is shown with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1', and a black arrow points to the charge '1+'. At the bottom of the interface, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large atom model is shown with a nucleus and electron shells. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons (purple spheres), neutrons (grey spheres), and electrons (blue dots). On the right, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there are controls for the simulation, including a play button, a pause button, and a reset button. The bottom status bar shows 'ExplorLearning', 'TOOL TIPS: OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

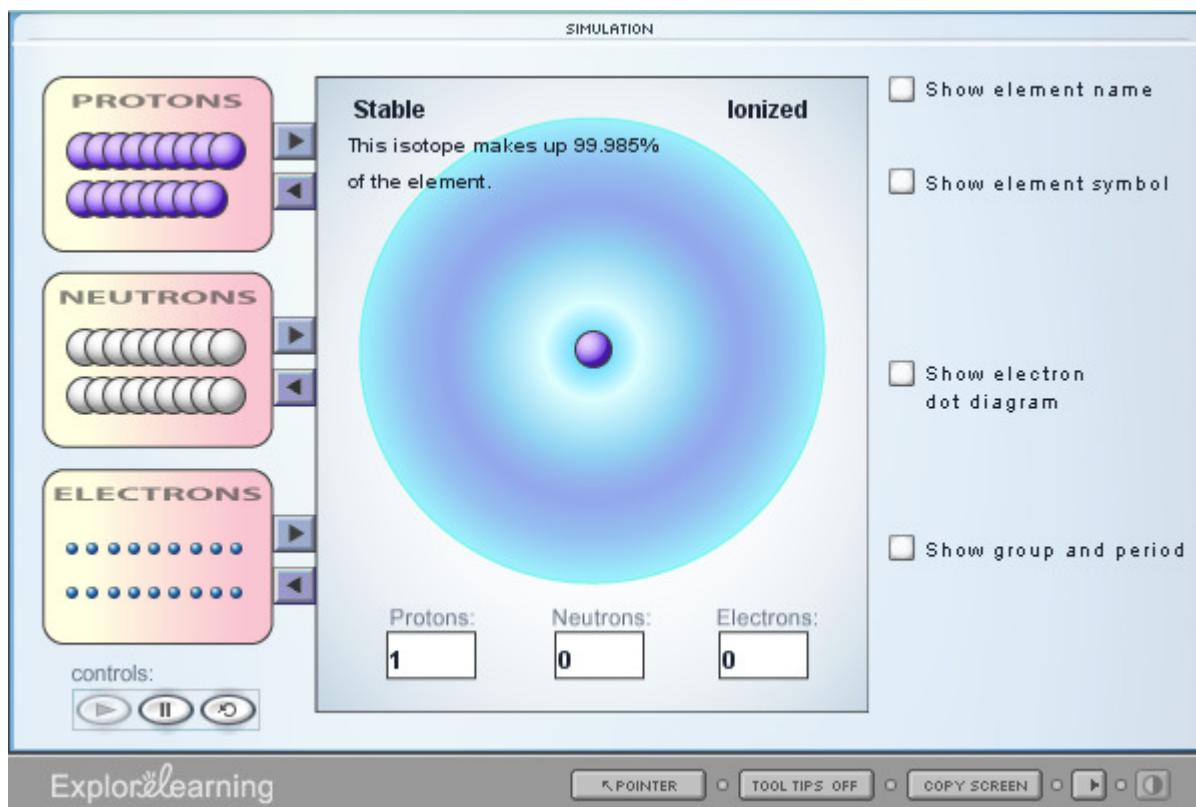
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has a slider set to 1, the neutrons container to 0, and the electrons container to 0. In the center, there is a large blue sphere representing the atom. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner has the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

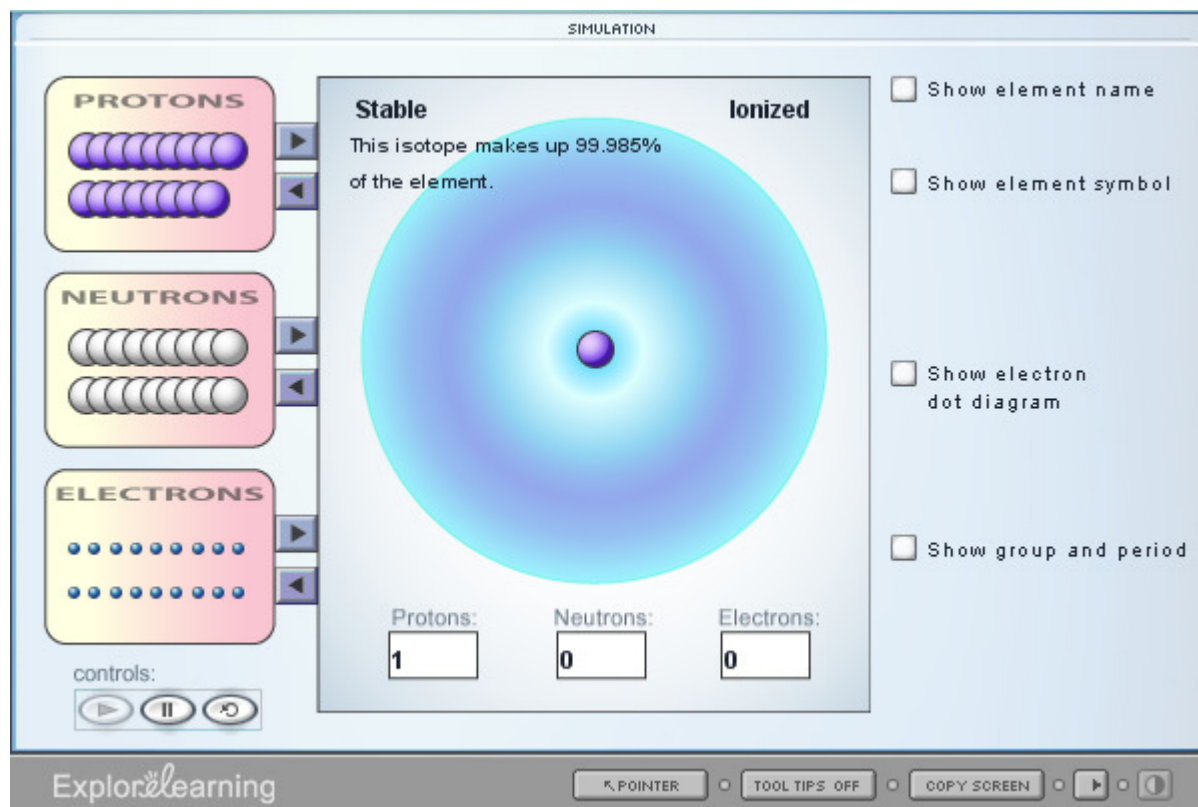
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A pointer is shown pointing to the mass number '1'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

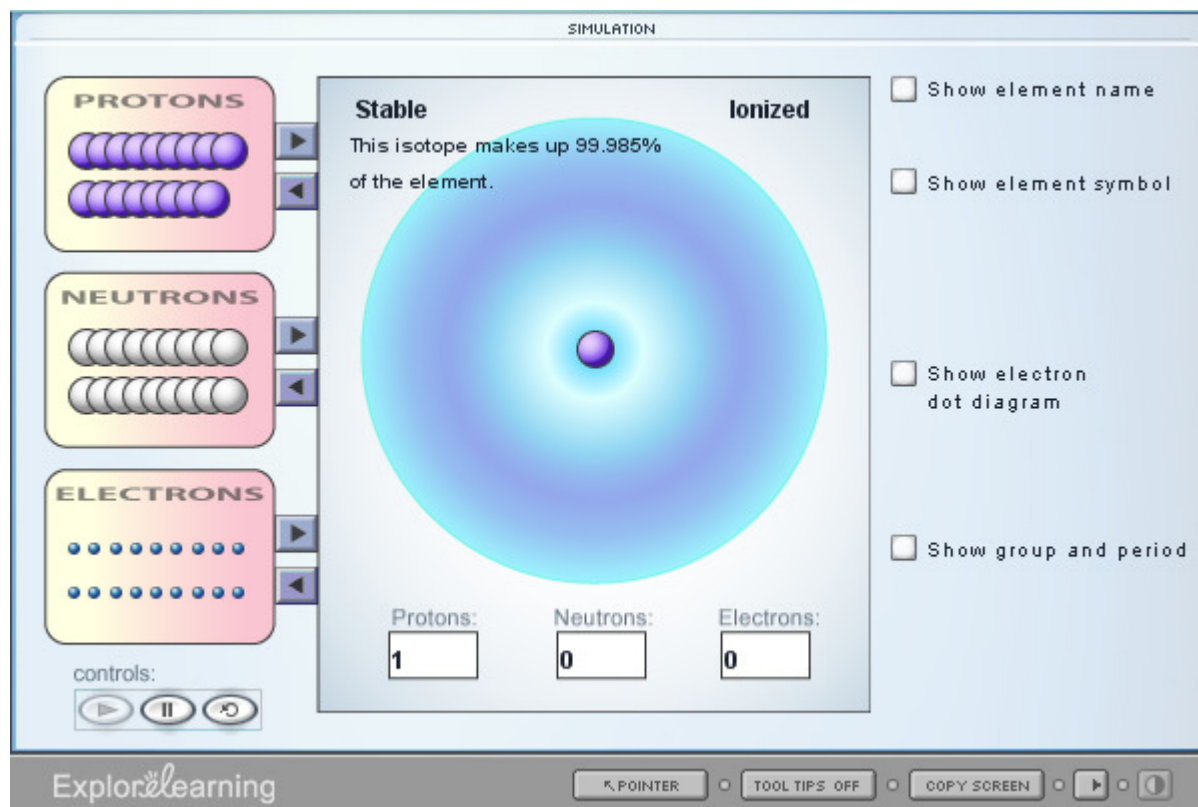
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. The central part of the screen displays a 3D model of an atom with a nucleus and electron shells. To the left of the atom are three sliders for adding or removing subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these sliders are control buttons for play, pause, and reset. To the right of the atom model are several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). The element symbol 'H' is displayed, with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1', and a black arrow points to the charge '1+'. At the bottom of the interface, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A pointer is shown pointing to the mass number '1'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

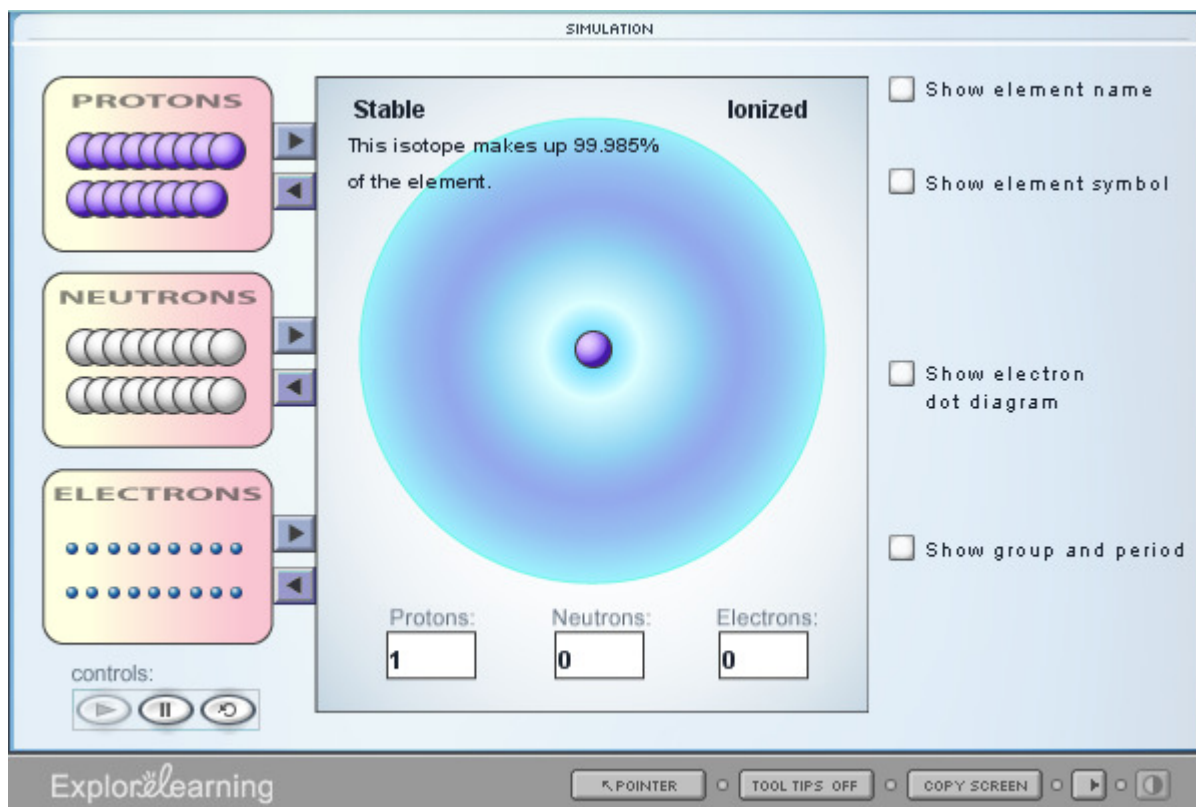
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). The central area displays a 3D model of an atom with a nucleus and electron shells. Below the model, there are input fields for the number of protons, neutrons, and electrons. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface for building an atom. The central part of the interface displays a large atom model with a nucleus and electron shells. To the left of the atom are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these containers are controls for play, pause, and reset. To the right of the atom are several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). Below the atom model are three input fields: 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom of the interface are 'DRAG POINTERS' and a status bar with buttons for 'POINTER', 'TOOL TIPS: OFF', and 'COPY SCREEN'. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for subatomic particles: PROTONS (1), NEUTRONS (0), and ELECTRONS (0). The central area displays a 3D model of an atom with a nucleus and electron shells. The nucleus is labeled 'Stable' and 'This isotope makes up 99.985% of the element.' The right side of the interface has several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has a slider set to 1, the neutrons container to 0, and the electrons container to 0. In the center, there is a large blue sphere representing the atom. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below these, the element symbol 'H' is displayed with a mass number '1' and a charge '1+'. A pointer is shown pointing to the mass number '1'. At the bottom, there are controls for the simulation, including a play button, a pause button, and a reset button. The ExploreLearning logo is at the bottom left.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and a 'TOOL TIPS OFF' button. The bottom of the window shows the 'ExploreLearning' logo and a 'COPY SCREEN' button.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface for building an atom. The central part of the interface displays a 3D model of an atom with a nucleus and electron shells. To the left of the atom are three containers for adding subatomic particles: Protons (purple spheres), Neutrons (grey spheres), and Electrons (blue dots). Each container has a plus/minus button to adjust the count. Below these containers are control buttons: a play button, a pause button, and a reset button. To the right of the atom model, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', and a black arrow points to the '1+' in the charge '1+'. The text 'Mass number' is next to the blue arrow, and 'Ignore' is next to the black arrow. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom of the interface, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'POINTER' button is currently selected.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for subatomic particles: PROTONS (1), NEUTRONS (0), and ELECTRONS (0). The central area displays a 3D model of an atom with a nucleus and electron shells. The nucleus is labeled 'Stable' and 'This isotope makes up 99.985% of the element.' The right side of the interface has several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

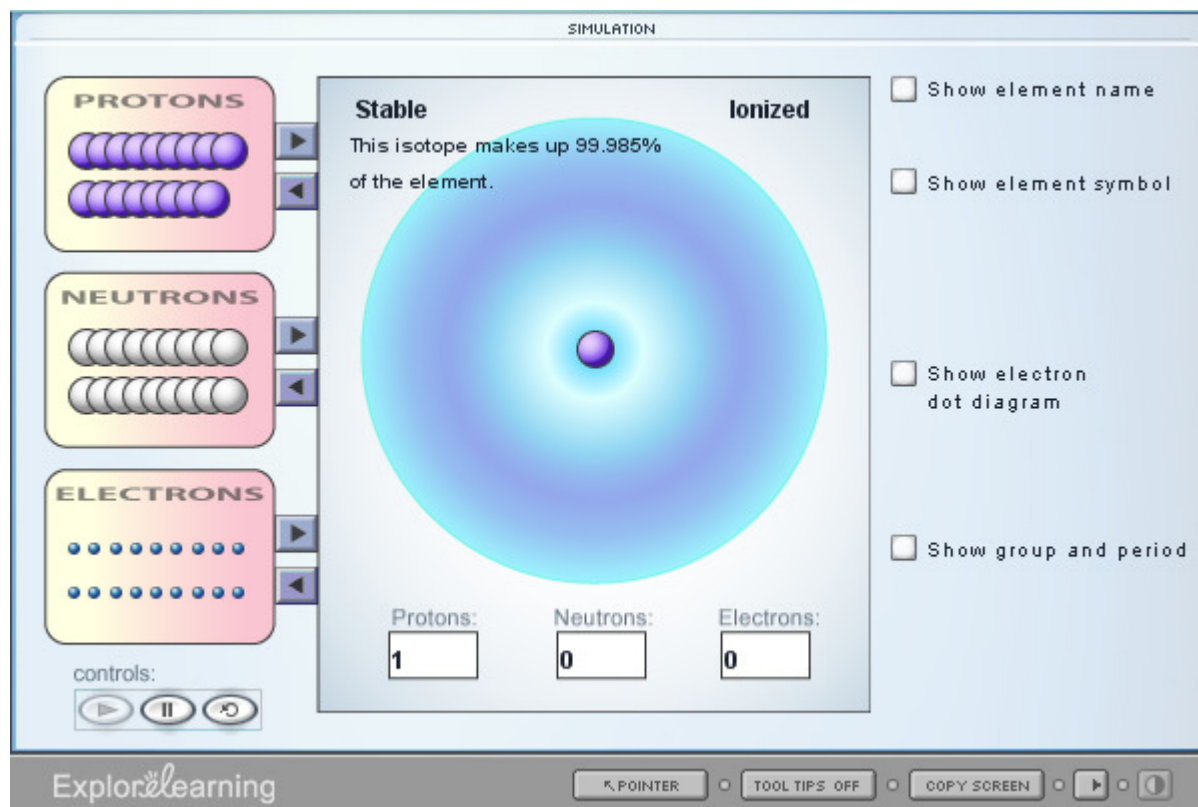
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Each container has a slider to add or remove particles. The central area displays a 3D model of an atom with a nucleus and electron shells. The nucleus is labeled 'Stable' and 'This isotope makes up 99.985% of the element.' Below the model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there is a chemical symbol 'H' with a mass number '1' and a charge '1+'. A pointer icon is pointing to the mass number '1'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The 'Protons' container has a slider set to 1, 'Neutrons' is set to 0, and 'Electrons' is set to 0. In the center, there is a large blue sphere representing the atom. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'POINTER' button is highlighted, and an arrow points to the '1' in the element symbol 'H' on the right, which is labeled 'Mass number'. Another arrow points to the 'H' symbol, which is labeled 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for play, pause, and reset. In the center, there is a large atom model with a nucleus and electron shells. Below the model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there are 'DRAG POINTERS' and a status bar with 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN' buttons. A chemical symbol 'H' is shown with a mass number '1' and a charge '1+'. Arrows point to the mass number and the charge, with labels 'Mass number' and 'Ignore' respectively.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of protons change the identity of the element you have built?
- b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of neutrons change the identity of the element you have built?
- b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The central atom model shows a nucleus with 1 proton and 0 neutrons, and 0 electrons in the shells. On the right, the 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', labeled 'Mass number'. A black arrow points to the '1+' in the charge '1+', labeled 'Ignore'. The 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0' input fields are visible at the bottom of the atom model.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

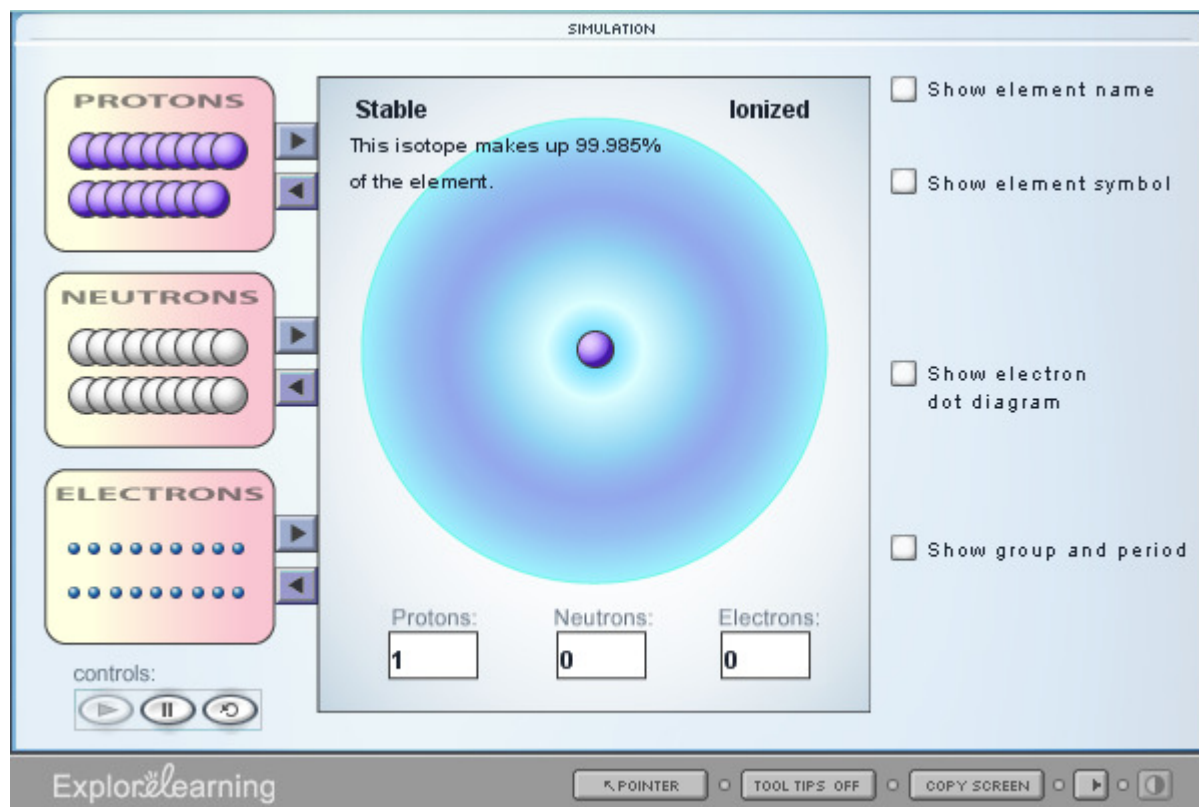
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons (purple spheres), neutrons (grey spheres), and electrons (blue dots). On the right, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there are controls for the simulation, including a play button, a pause button, and a reset button. The bottom bar includes the ExploreLearning logo and buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for the simulation. In the center, there is a large atom model with a nucleus and electron shells. Below the atom model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and 'TOOL TIPS OFF' and 'COPY SCREEN' buttons. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for play, pause, and reset. In the center, there is a large atom model with a nucleus and electron shells. Below the model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there are 'DRAG POINTERS' and a status bar with 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN' buttons. A chemical symbol 'H' is shown with a mass number '1' and a charge '1+'. Arrows point from the text 'Mass number' and 'Ignore' to the '1' and '1+' respectively.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

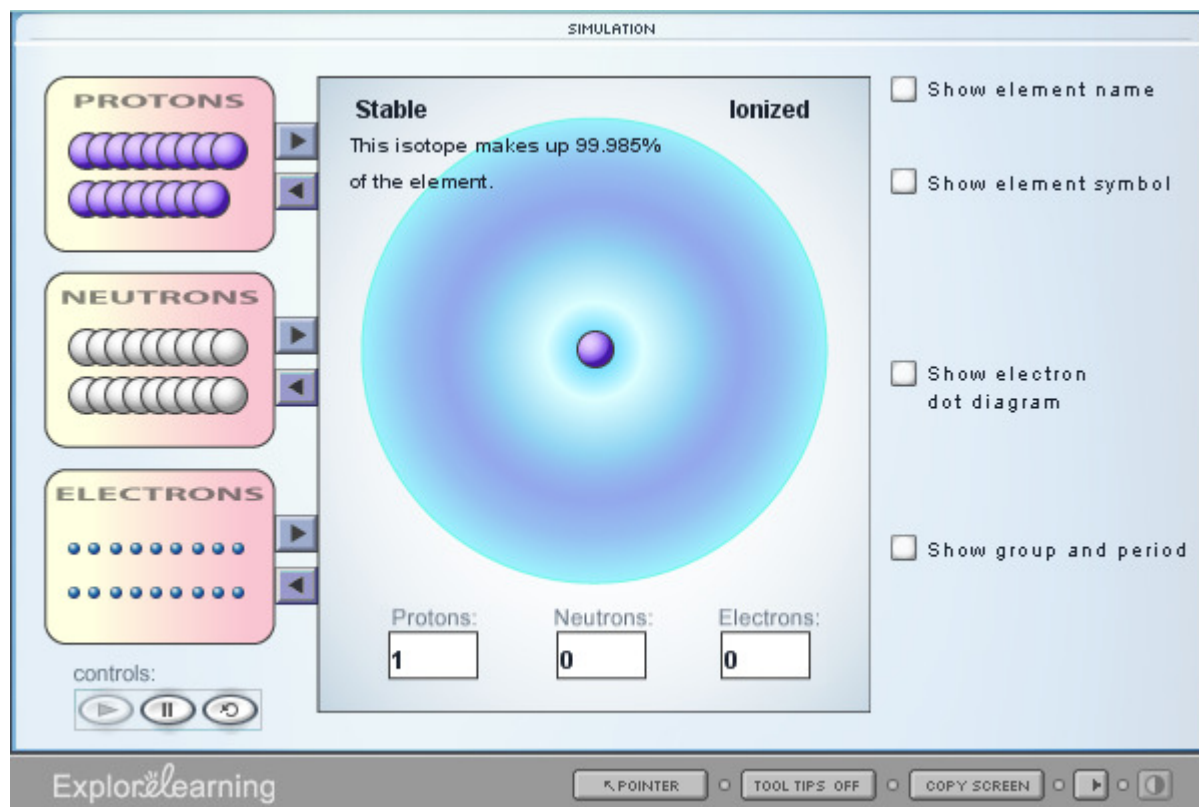
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (1), Neutrons (0), and Electrons (0). The central area displays a 3D model of an atom with a nucleus and electron shells. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for Protons (1), Neutrons (0), and Electrons (0). At the bottom, there are controls for the simulation, including a play button, a pause button, and a reset button. The bottom bar shows the ExploreLearning logo and buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three panels for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Each panel has a slider and a button to add or remove particles. In the center, a large blue sphere represents the atom's electron cloud, with a small purple sphere in the center representing the nucleus. Below the atom, there are three input fields for the number of protons, neutrons, and electrons. The current values are 1 proton, 0 neutrons, and 0 electrons. On the right, there are checkboxes for "Show element name", "Show element symbol", "isotope", "Show electron dot diagram", and "Show group and period". The "Show element symbol" checkbox is checked, and the element symbol "H" is displayed. Above the symbol, the mass number "1" is shown with a blue arrow pointing to it, and the charge "1+" is shown with a black arrow pointing to it. The text "Mass number" and "Ignore" are also present. At the bottom, there are buttons for "POINTER", "TOOL TIPS OFF", and "COPY SCREEN".

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has a slider set to 1, the neutrons container has a slider set to 0, and the electrons container has a slider set to 0. In the center, there is a large blue sphere representing the atom. On the right, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the 'H' symbol, labeled 'Mass number'. A black arrow points to the '+' in the 'H' symbol, labeled 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

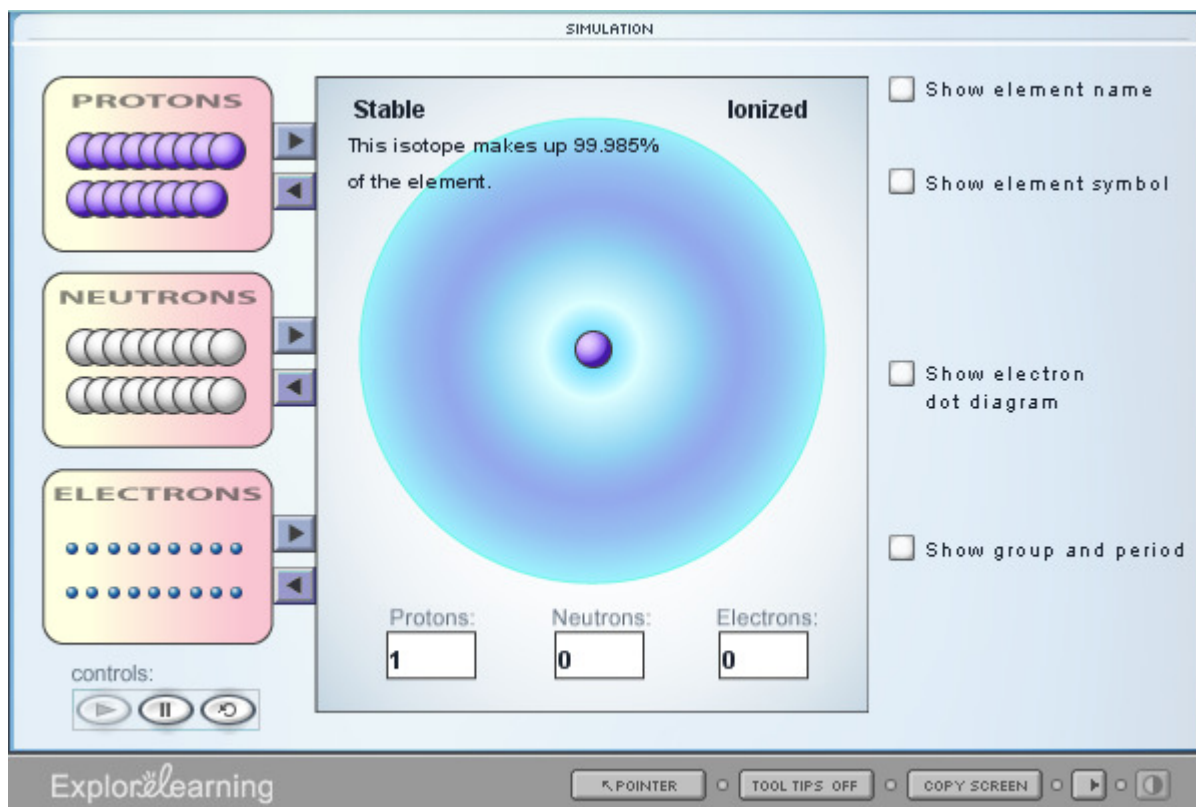
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for play, pause, and reset. In the center, there is a large atom model with a nucleus and electron shells. Below the model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there are 'DRAG POINTERS' and a status bar with 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN' buttons. A chemical symbol 'H' is shown with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

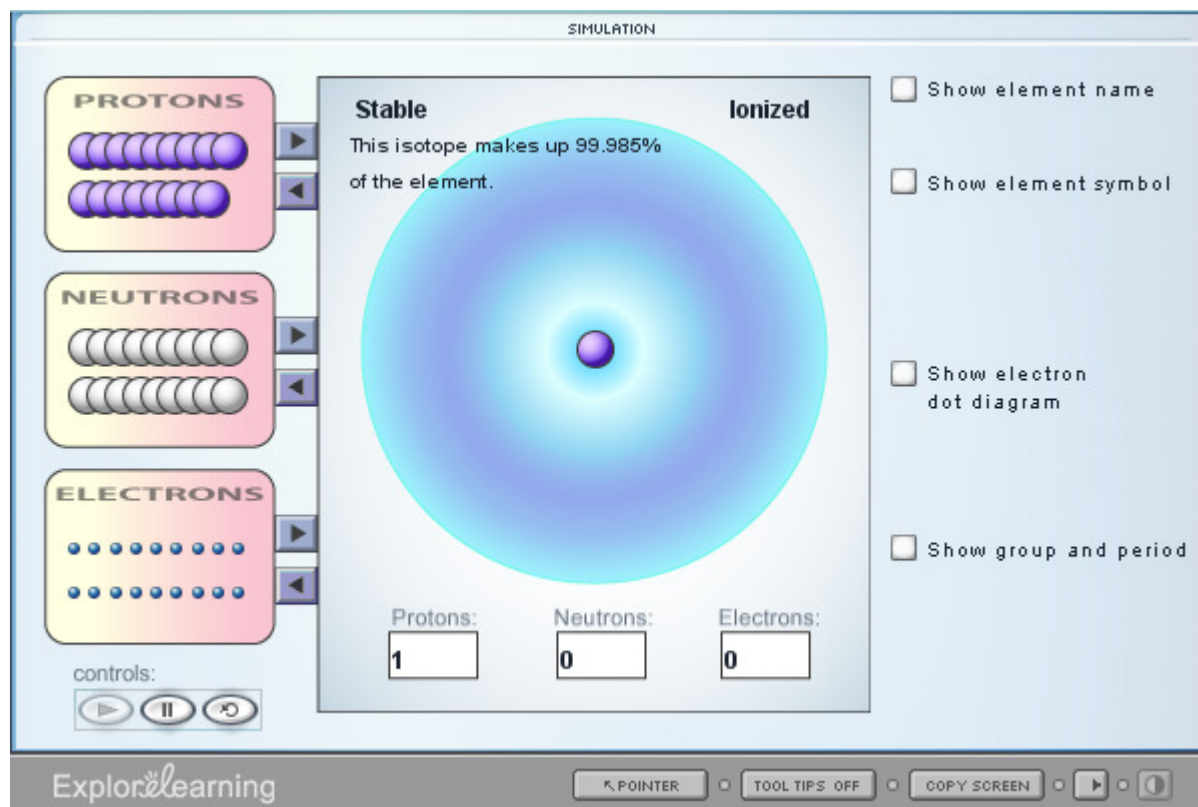
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

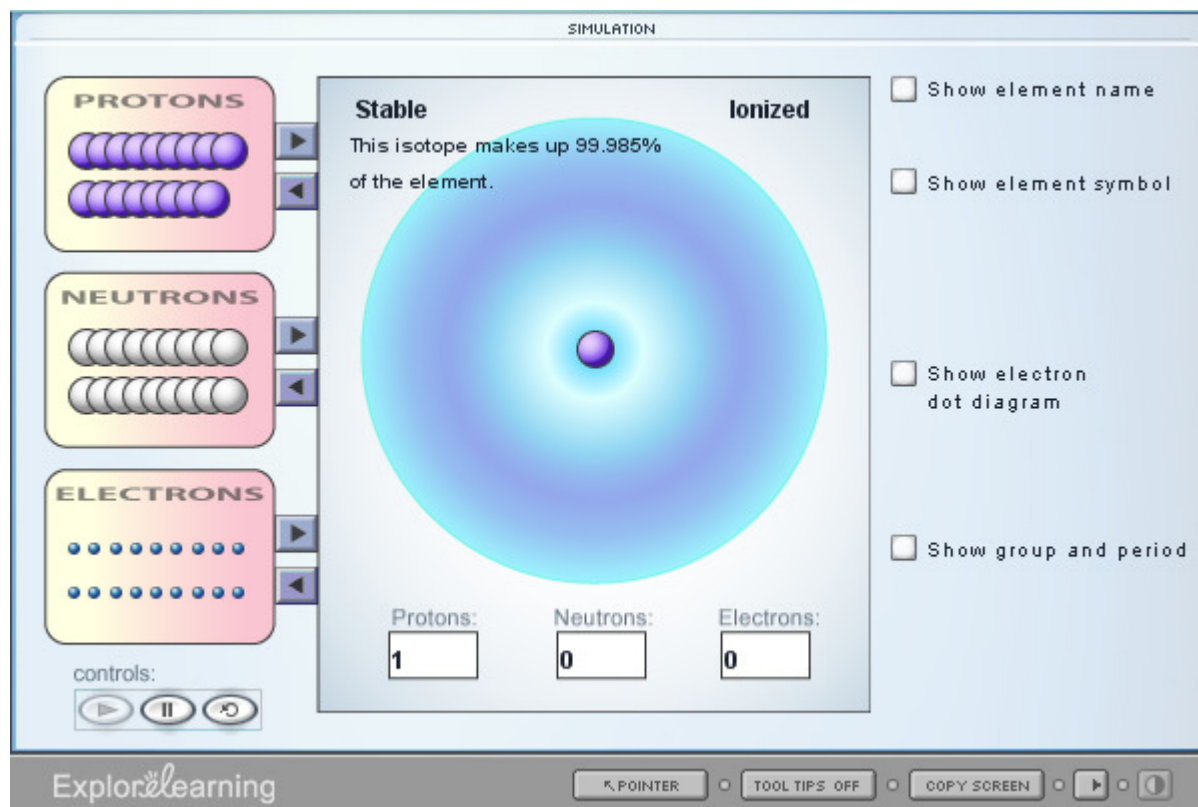
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for the simulation. In the center, there is a large atom model with a nucleus and electron shells. Below the atom model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and 'TOOL TIPS OFF' and 'COPY SCREEN' buttons. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for the simulation. In the center, there is a large atom model with a nucleus and electron shells. Below the atom model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and 'TOOL TIPS OFF' and 'COPY SCREEN' buttons. A chemical symbol 'H' is shown with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. The element symbol 'H' is displayed with a mass number '1' and a charge '1+'. A pointer is shown pointing to the mass number '1'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

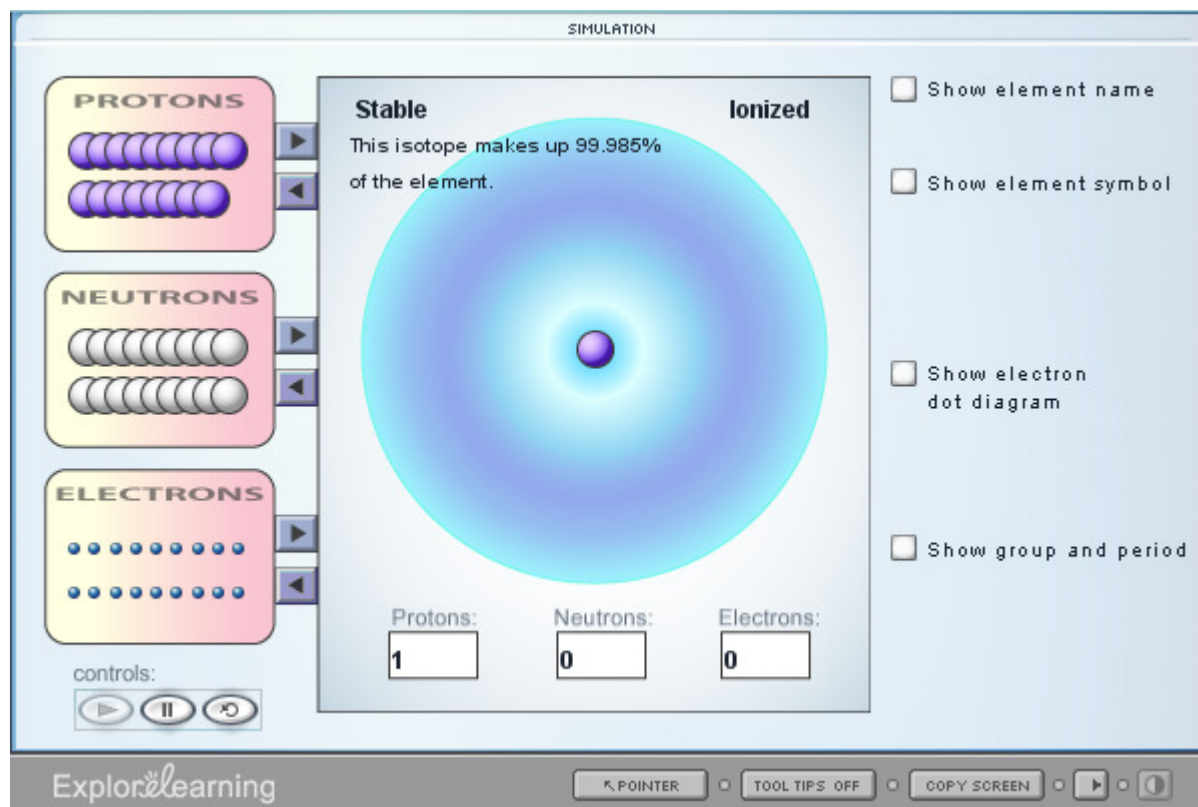
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for play, pause, and reset. In the center, there is a large atom model with a nucleus and electron shells. Below the model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there are 'DRAG POINTERS' and a status bar with 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN' buttons. A chemical symbol 'H' is shown with a mass number '1' and a charge '1+'. Arrows point from the text 'Mass number' and 'Ignore' to the '1' and '1+' respectively.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Each container has a slider to add or remove particles. The central area displays a 3D model of an atom with a nucleus and electron shells. The nucleus is labeled 'Stable' and 'This isotope makes up 99.985% of the element.' Below the model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there is a chemical symbol 'H' with a mass number '1' and a charge '1+'. A pointer icon is pointing to the mass number '1'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Each container has a slider to add or remove particles. The central area displays a 3D model of an atom with a nucleus and electron shells. Below the model, there are input fields for the number of protons, neutrons, and electrons. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there is a chemical symbol 'H' with a mass number '1' and a charge '1+'. A pointer icon is pointing to the mass number '1'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

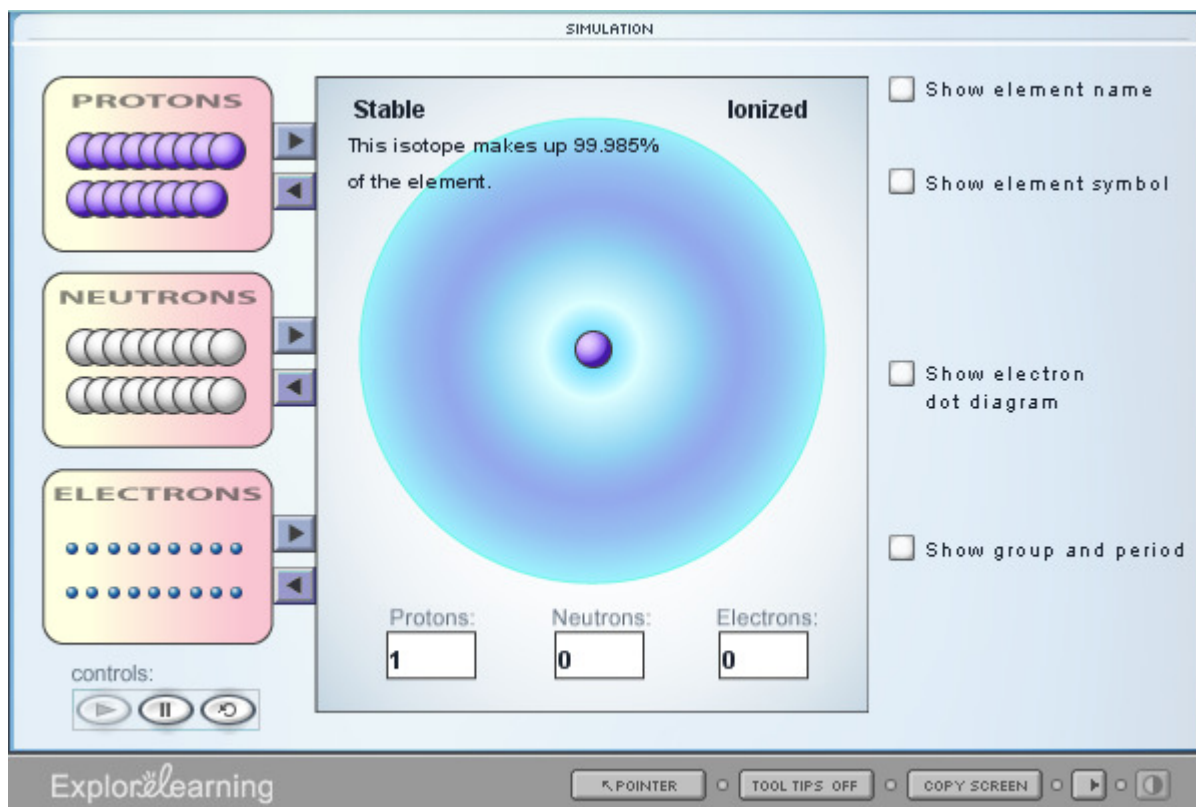
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface for building an atom. The central part of the interface displays a 3D model of an atom with a nucleus and electron shells. To the left of the atom model are three containers for adding subatomic particles: Protons (purple spheres), Neutrons (grey spheres), and Electrons (blue dots). Each container has a plus/minus button to add or remove particles. Below these containers are control buttons: a play button, a pause button, and a reset button. To the right of the atom model are several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). Below the atom model, there are three input fields for the number of protons, neutrons, and electrons. The current values are Protons: 1, Neutrons: 0, and Electrons: 0. At the bottom of the interface, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', labeled 'Mass number'. A black arrow points to the '1+' in the charge '1+', labeled 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A pointer is shown pointing to the mass number '1'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. Arrows point to the '1' and '1+' with labels 'Mass number' and 'Ignore' respectively. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons (purple spheres), neutrons (grey spheres), and electrons (blue dots). On the right, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', and a black arrow points to the '1+' in the charge '1+'. The text 'Mass number' is next to the blue arrow, and 'Ignore' is next to the black arrow.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons (purple spheres), neutrons (grey spheres), and electrons (blue dots). On the right, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', and a black arrow points to the '1+' in the charge '1+'. The text 'Mass number' is next to the blue arrow, and 'Ignore' is next to the black arrow.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three containers for subatomic particles: Protons (purple spheres), Neutrons (grey spheres), and Electrons (blue dots). Each container has a slider to adjust the count. Below these are control buttons (play, pause, reset). On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. In the center, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: Protons (purple spheres), Neutrons (grey spheres), and Electrons (blue dots). Each container has a plus/minus control. Below these are 'controls' buttons: play, pause, and reset. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). In the center, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. Below these is a 'DRAG POINTERS' section with several colored arrows. At the bottom, there is a status bar with 'ExplorLearning' logo, a 'POINTER' button, 'TOOL TIPS OFF', and a 'COPY SCREEN' button. An element symbol 'H' is shown with a mass number '1' and a charge '1+'. Arrows point to the '1' and '1+' with labels 'Mass number' and 'Ignore' respectively.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

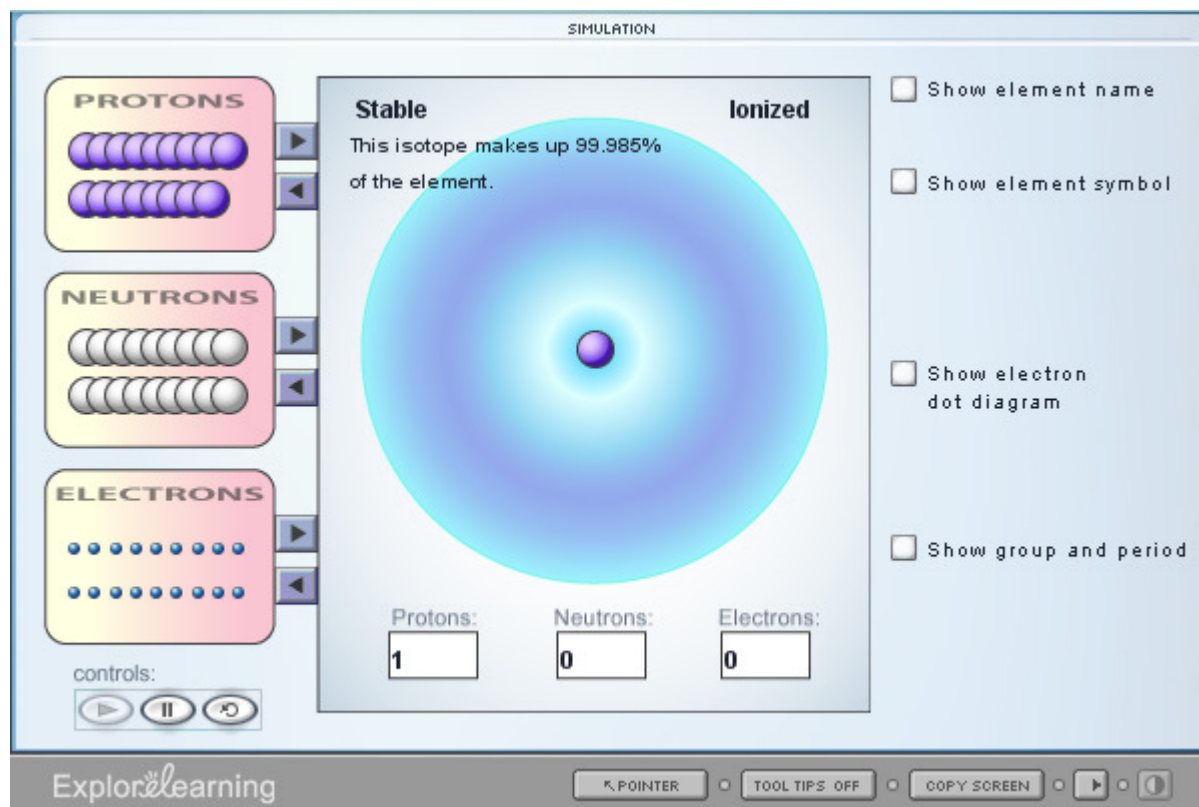
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Each container has a slider to add or remove particles. The central area displays a 3D model of an atom with a nucleus and electron shells. The nucleus is labeled 'Stable' and 'This isotope makes up 99.985% of the element.' Below the model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there is a chemical symbol 'H' with a mass number '1' and a charge '1+'. A pointer icon is pointing to the mass number '1'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: Protons (purple spheres), Neutrons (grey spheres), and Electrons (blue dots). Each container has a plus/minus control. Below these are 'controls' buttons: play, pause, and reset. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). In the center, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there are 'DRAG POINTERS' and a status bar with 'ExplorLearning', 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

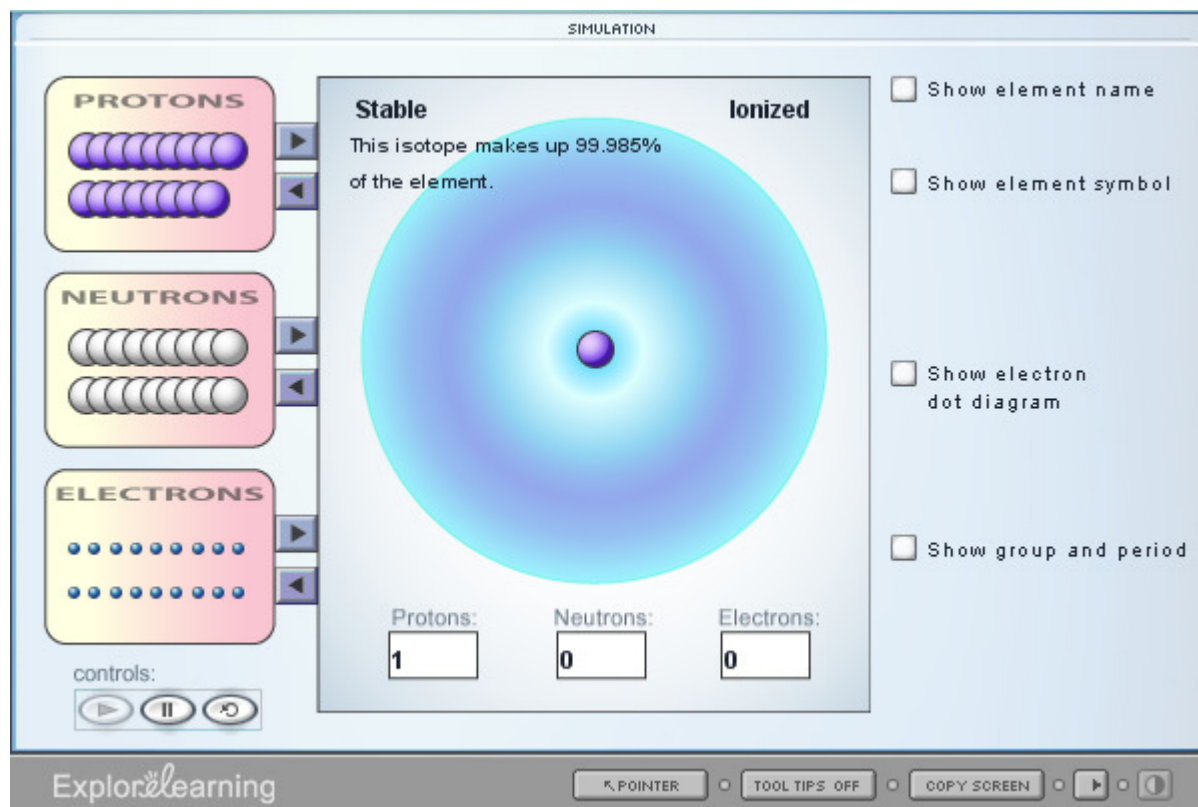
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. Arrows point to these values with labels 'Mass number' and 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

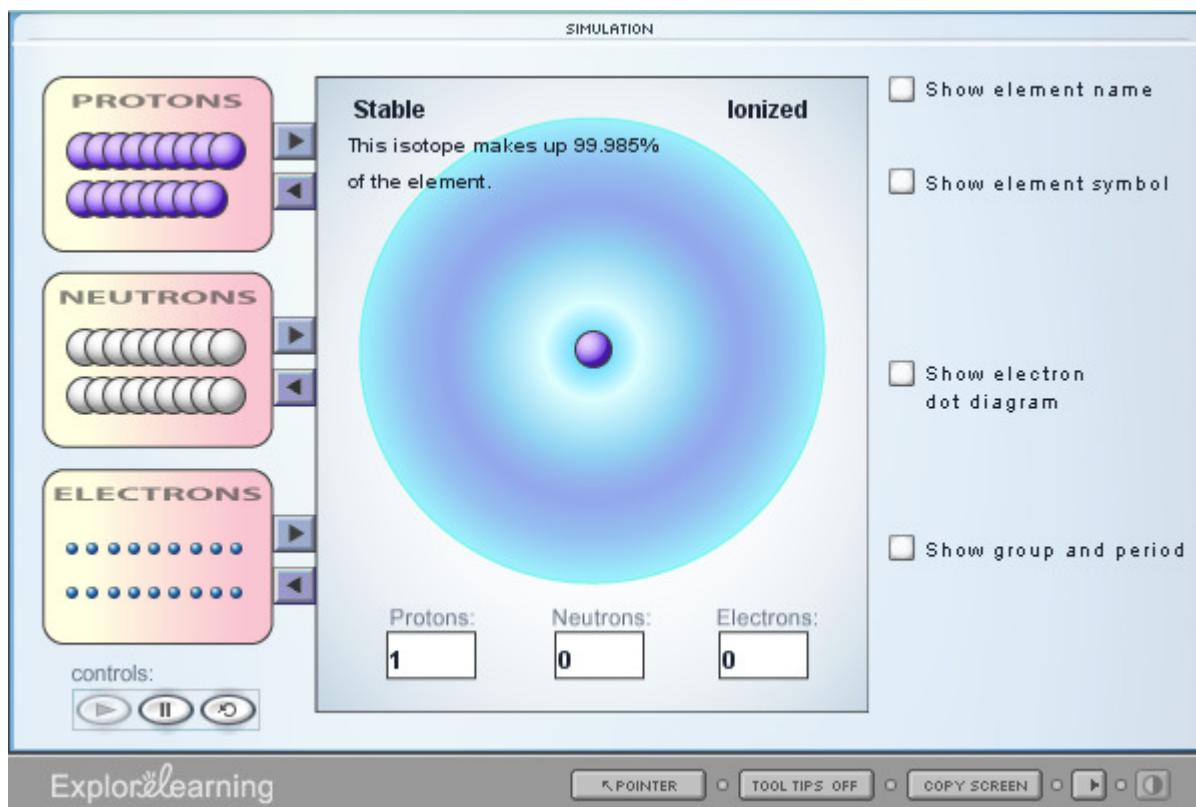
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large atom model is shown with a nucleus and electron shells. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. Arrows point to the '1' and '1+' with labels 'Mass number' and 'Ignore' respectively. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

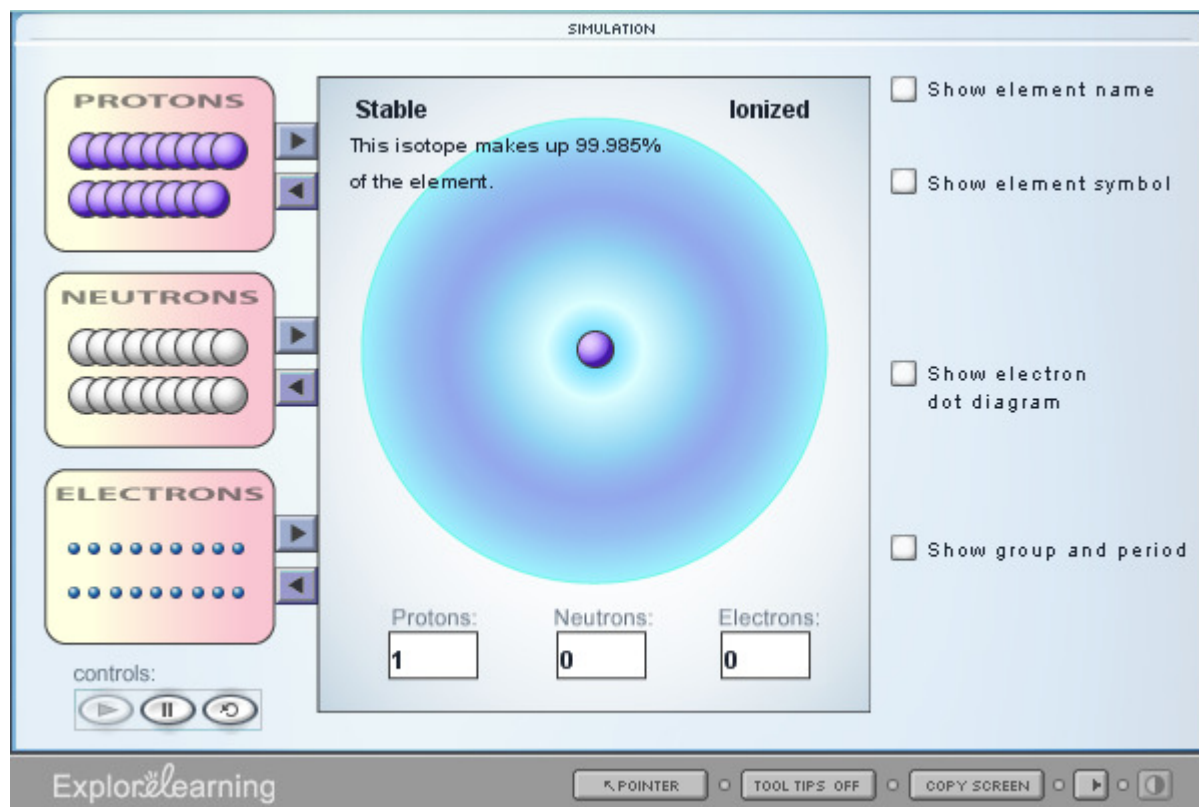
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). The central area displays a 3D model of an atom with a nucleus and electron shells. Below the model, there are input fields for Protons (1), Neutrons (0), and Electrons (0). On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

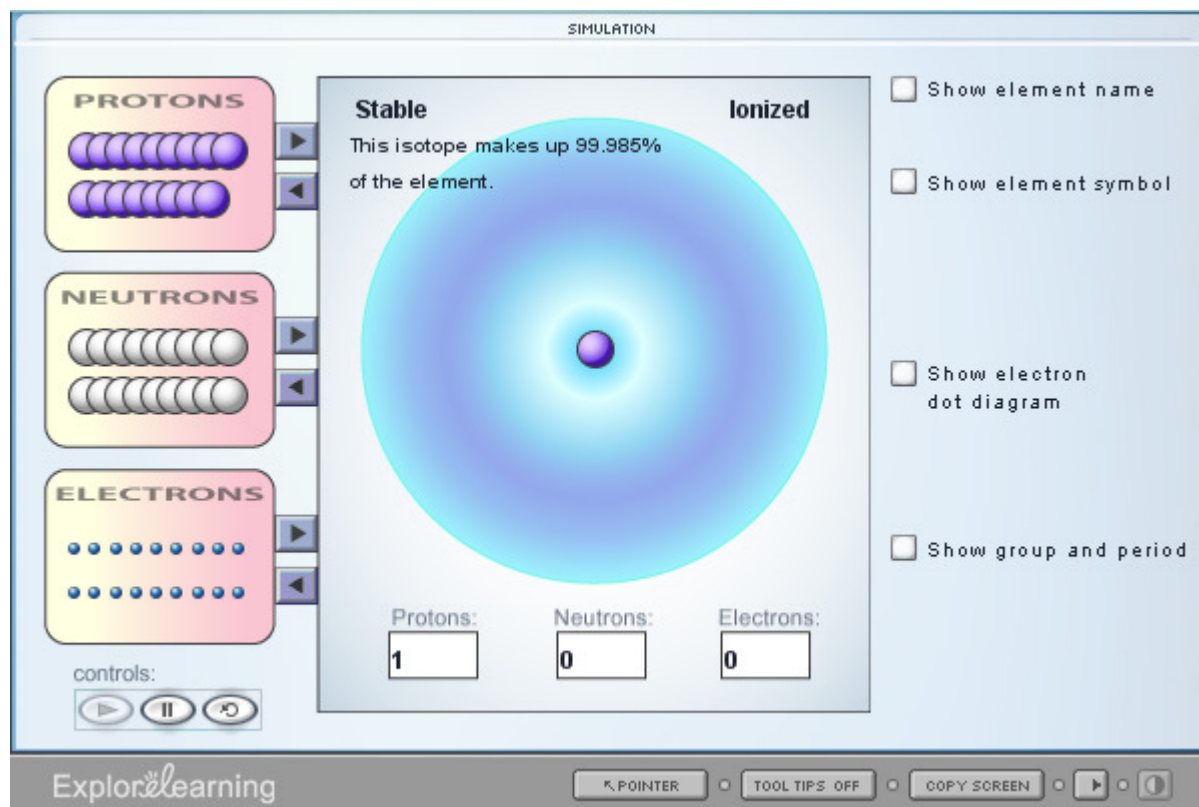
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The central atom model shows a nucleus with 1 proton and 0 neutrons, and 0 electrons. The right panel has checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', and a black arrow points to the '1+' in the charge '1+'. The text 'Mass number' is next to the blue arrow, and 'Ignore' is next to the black arrow. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The central atom model shows a nucleus with 1 proton and 0 neutrons, and 0 electrons. On the right, the 'Show element symbol' checkbox is checked, and the chemical symbol 'H' is displayed. The mass number '1' is shown to the upper left of the symbol, and the charge '1+' is shown to the upper right. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'. The 'isotope' checkbox is unchecked. At the bottom, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. The 'DRAG POINTERS' section at the bottom includes a 'POINTER' button and a 'TOOL TIPS OFF' button.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for the simulation. In the center, there is a large atom model with a nucleus and electron shells. Below the atom model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and 'TOOL TIPS OFF' and 'COPY SCREEN' buttons. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The 'PROTONS' container has 1 proton, 'NEUTRONS' has 0 neutrons, and 'ELECTRONS' has 0 electrons. The central atom model shows a nucleus with 1 proton and 0 neutrons, and 0 electrons in the shells. On the right, the 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. The mass number '1' is shown to the upper left of the symbol, and a pointer is shown pointing to it. The charge '1+' is shown to the upper right of the symbol. The 'isotope' checkbox is unchecked. The 'Show electron dot diagram' and 'Show group and period' checkboxes are also unchecked. At the bottom, there are controls for the simulation, including a play button, a pause button, and a reset button. The ExploreLearning logo is at the bottom left.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for the simulation. In the center, there is a large atom model with a nucleus and electron shells. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. In the center, there is a chemical symbol 'H' with a '1' above it and a '1+' to its right. An arrow points to the '1' with the label 'Mass number', and another arrow points to the '1+' with the label 'Ignore'. At the bottom, there is a status bar with 'ExplorLearning', 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. Arrows point to the '1' and '1+' with labels 'Mass number' and 'Ignore' respectively. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The 'PROTONS' container has 1 proton, 'NEUTRONS' has 0 neutrons, and 'ELECTRONS' has 0 electrons. The central atom model shows a nucleus with 1 proton and 0 neutrons, and 0 electrons in the shells. On the right, the 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', labeled 'Mass number'. A black arrow points to the '+' in the charge '1+', labeled 'Ignore'. At the bottom, there are controls for the simulation, including a play button, a pause button, and a reset button. The ExploreLearning logo is at the bottom left.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

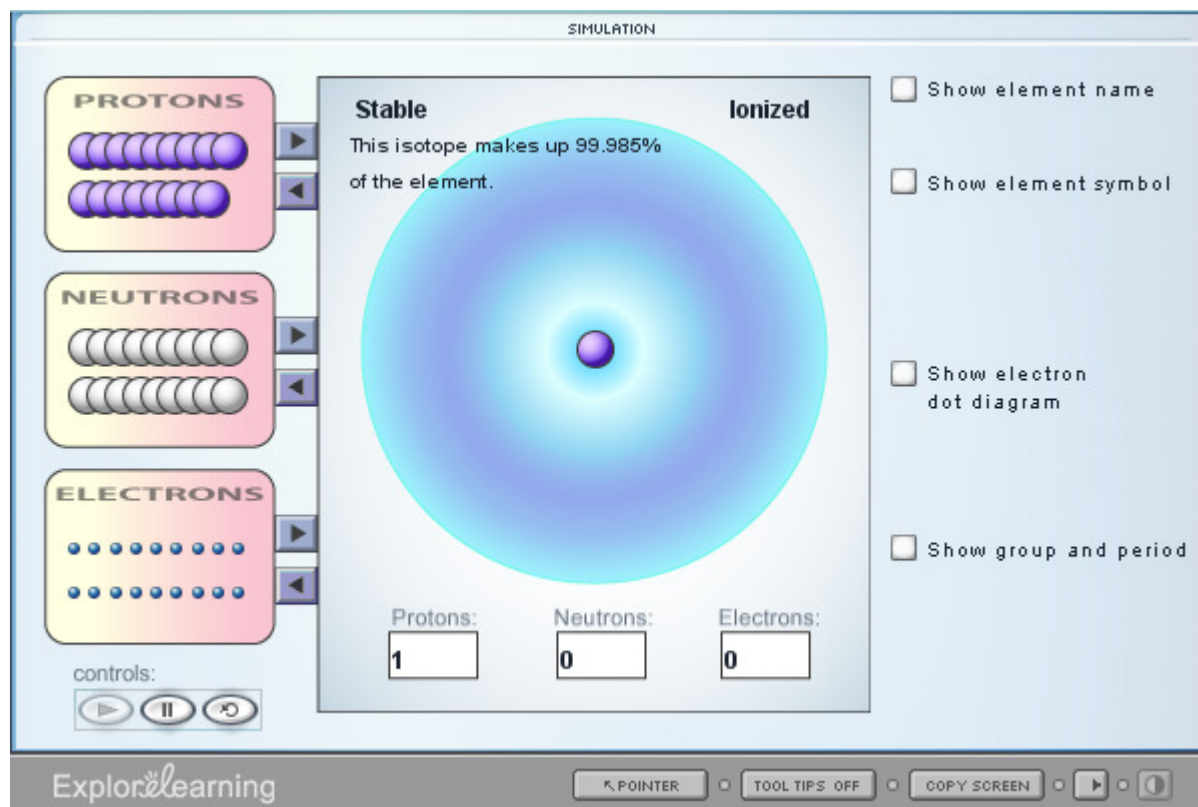
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface for building an atom. The central part of the interface displays a 3D model of an atom with a nucleus and electron shells. To the left of the atom are three containers for adding subatomic particles: Protons (purple spheres), Neutrons (grey spheres), and Electrons (blue dots). Below these containers are controls for play, pause, and reset. To the right of the atom are several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). Below the atom model are three input fields: 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom of the interface, there are 'DRAG POINTERS' and a status bar with 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN' buttons. A chemical symbol 'H' is shown with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and a 'TOOL TIPS OFF' button. The bottom of the window shows the 'ExploreLearning' logo and a 'COPY SCREEN' button.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). In the center, there is a large atom model with a nucleus and electron shells. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). The central area displays a 3D model of an atom with a nucleus and electron shells. Below the model, there are input fields for the number of protons, neutrons, and electrons. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. A chemical symbol 'H' is shown with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

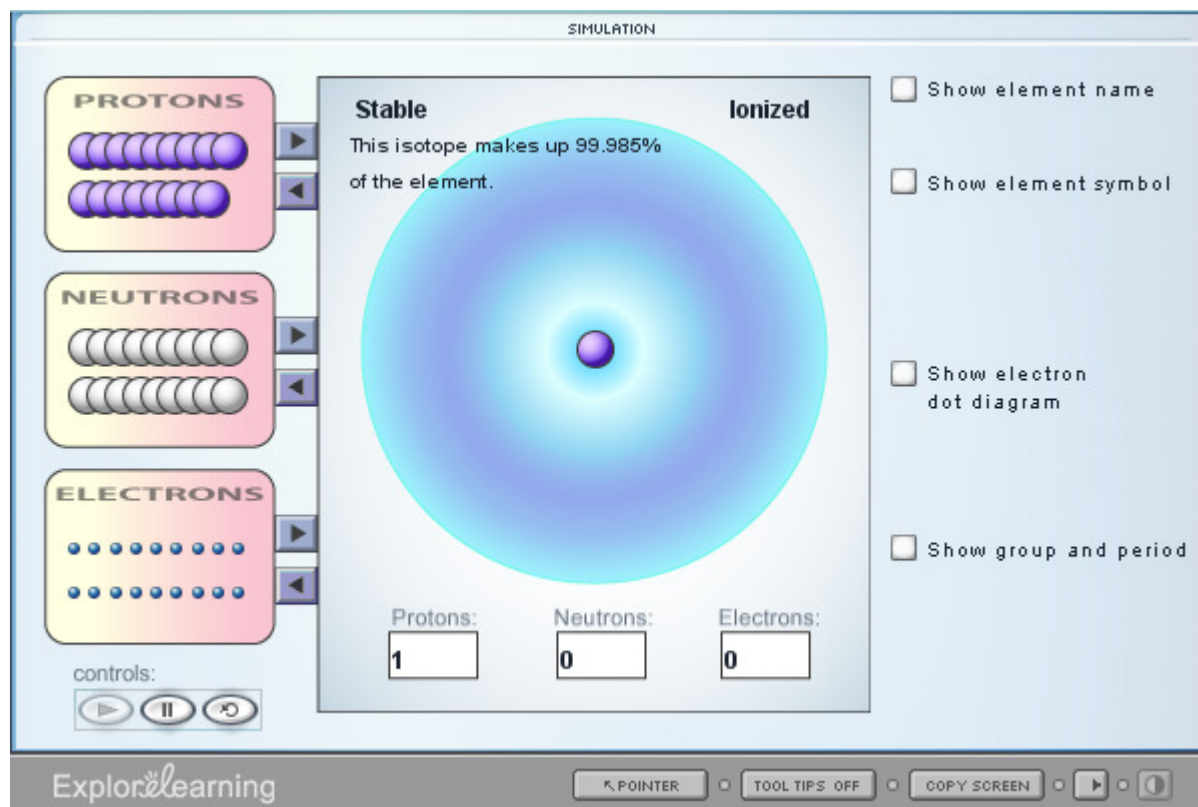
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The central atom model shows a nucleus with 1 proton and 0 neutrons, and 0 electrons. On the right, the 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', and a black arrow points to the '1+' in the charge '1+'. The text 'Mass number' is next to the blue arrow, and 'Ignore' is next to the black arrow. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

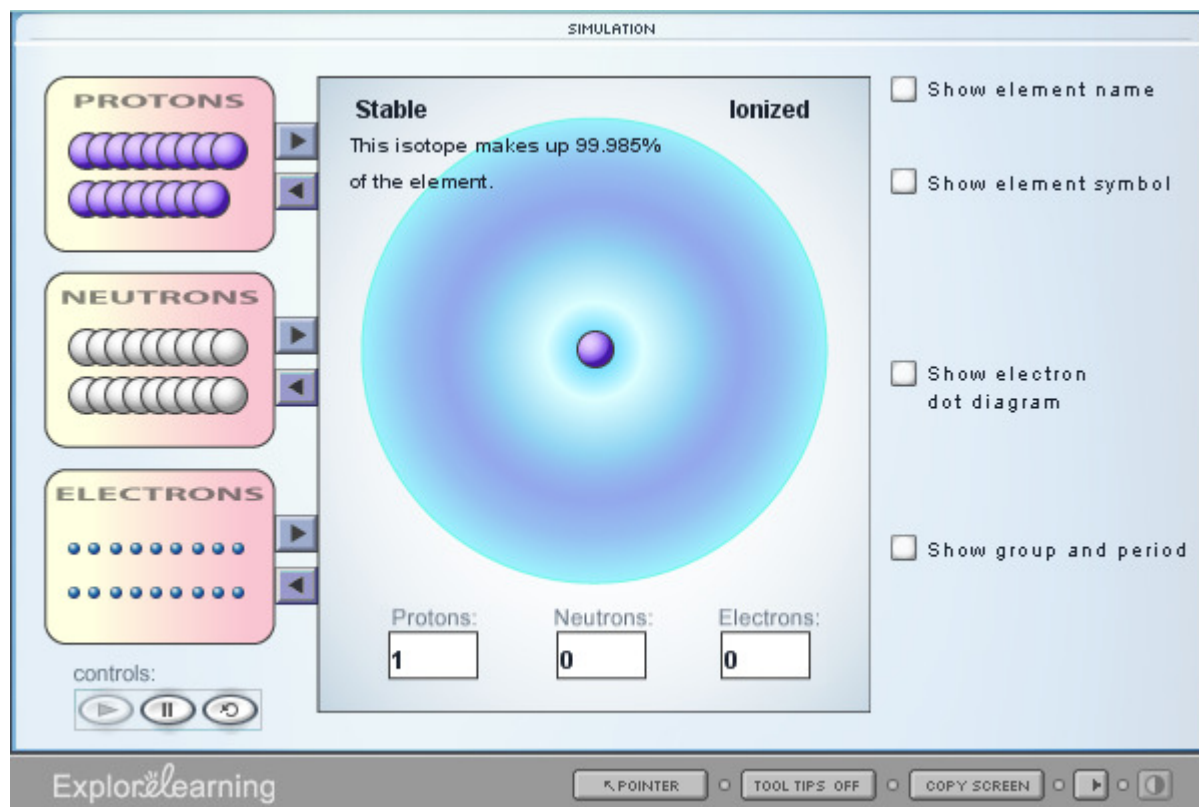
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has a slider set to 1, the neutrons container to 0, and the electrons container to 0. In the center, there is a large blue sphere representing the atom. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner has the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface for building an atom. The central part of the interface displays a large atom model with a nucleus and electron shells. To the left of the atom are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these containers are controls for play, pause, and reset. To the right of the atom are several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). Below the checkboxes, a chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'. At the bottom of the interface, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. Below these fields are 'DRAG POINTERS' and a status bar with 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN' buttons.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A pointer is shown pointing to the mass number '1'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

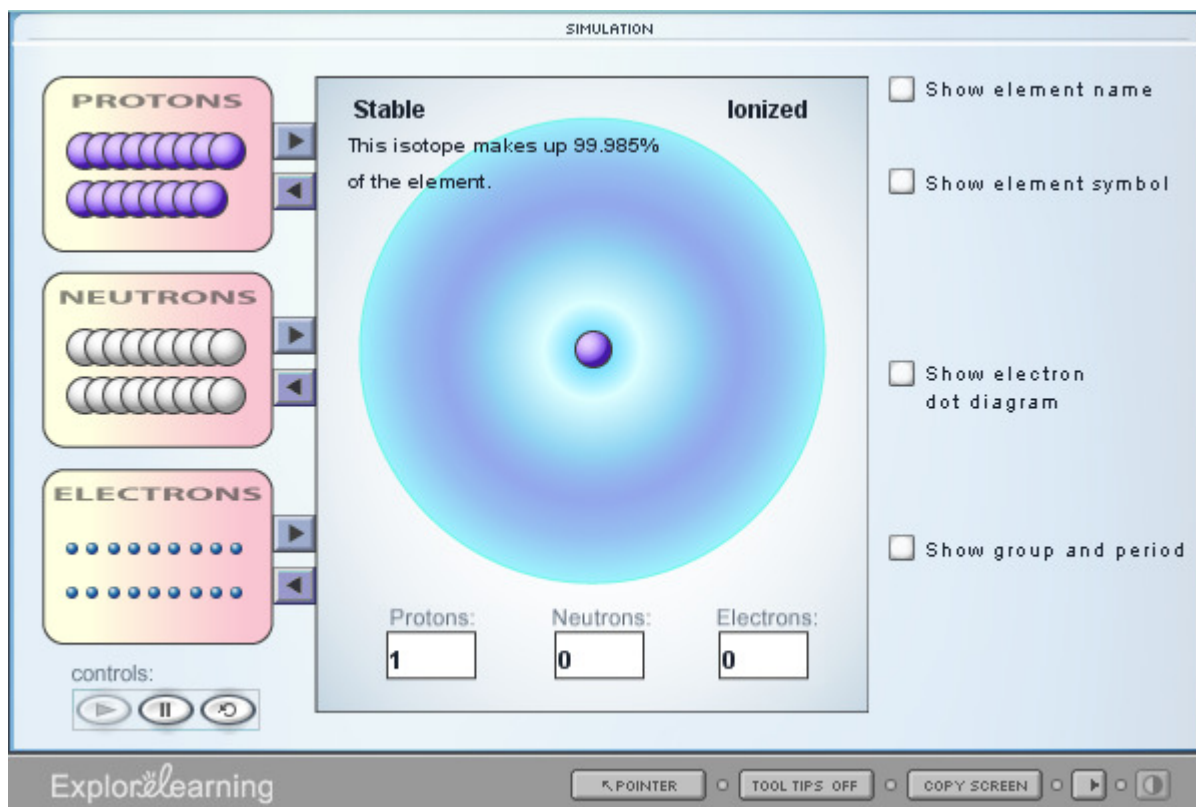
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The 'PROTONS' container has 1 proton, 'NEUTRONS' has 0 neutrons, and 'ELECTRONS' has 0 electrons. The central atom model shows a nucleus with 1 proton and 0 neutrons, and 0 electrons in the shells. On the right, the 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A mass number '1' is shown to the upper left of the symbol, and a charge '1+' is shown to the upper right. A pointer is shown pointing to the mass number '1'. The 'isotope' checkbox is unchecked. At the bottom, there are controls for the simulation, including a play button, a pause button, and a reset button. The ExploreLearning logo is at the bottom left.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

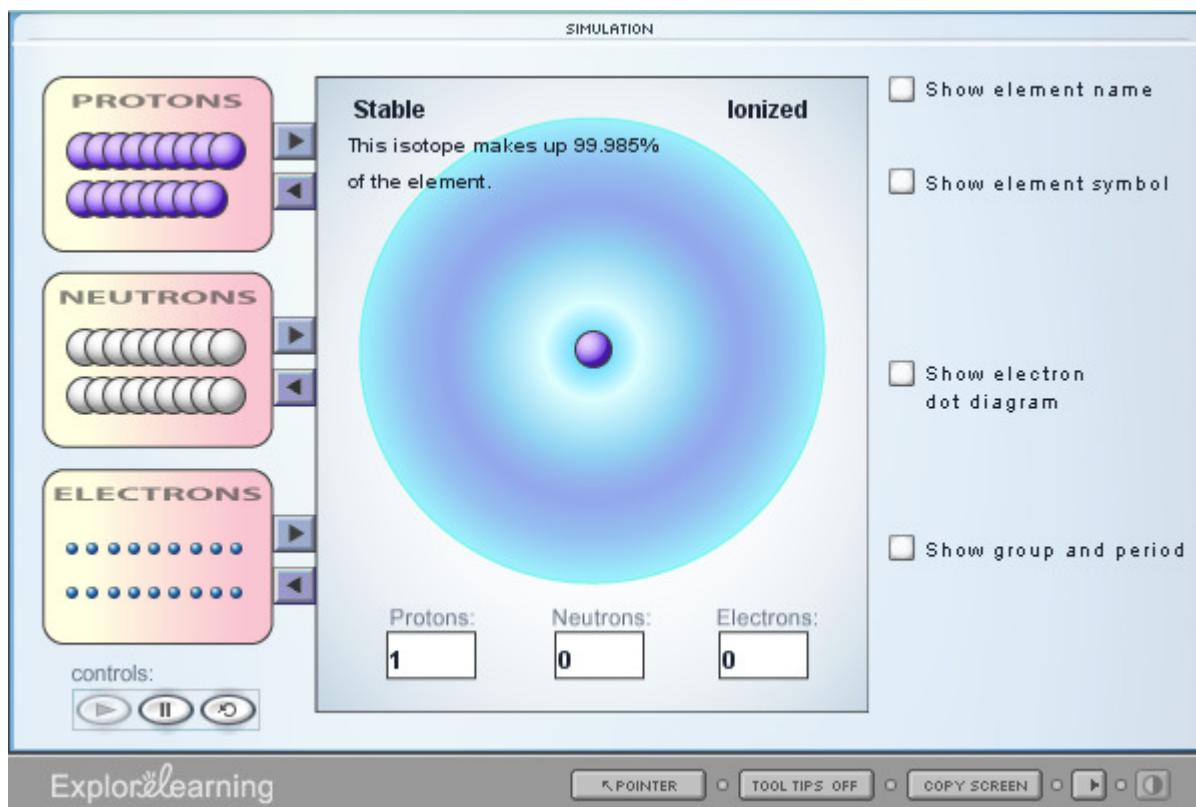
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. Arrows point to the '1' and '1+' with labels 'Mass number' and 'Ignore' respectively. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

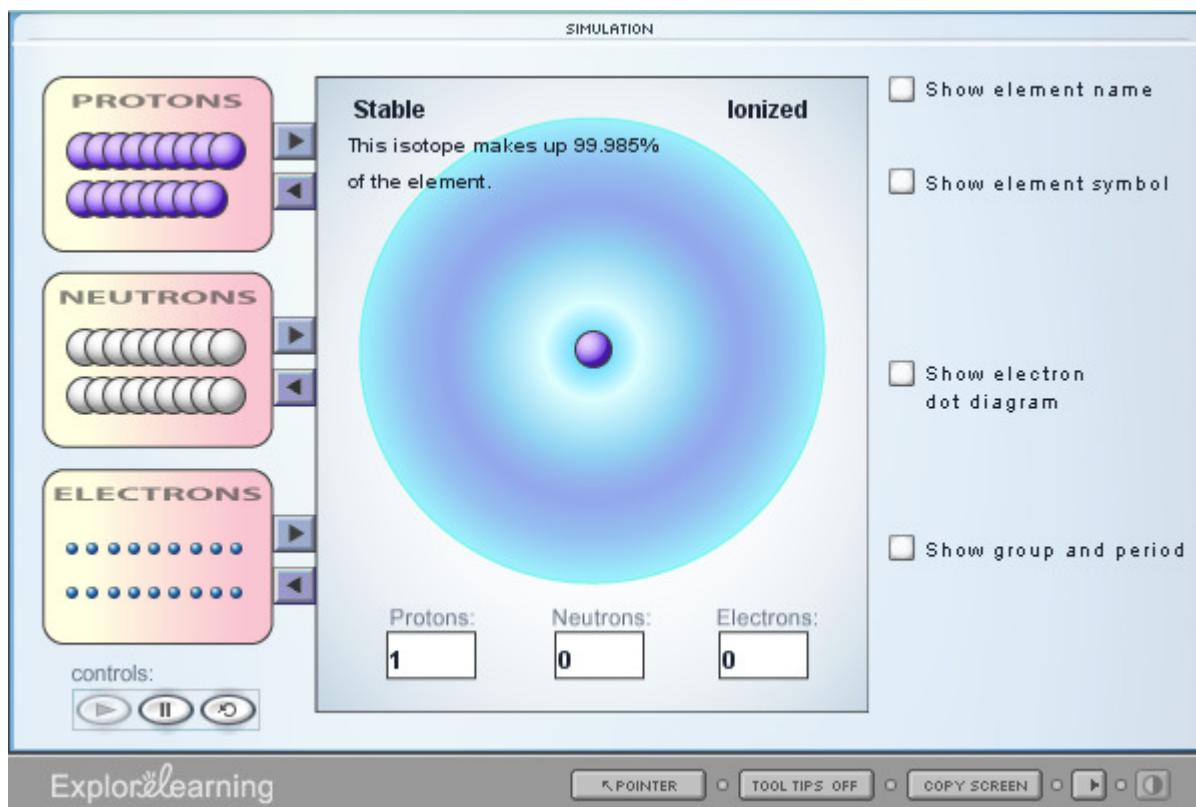
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container is set to 1, neutrons to 0, and electrons to 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'POINTER' button is highlighted, and a pointer is shown pointing to the mass number '1' in the element symbol 'H'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

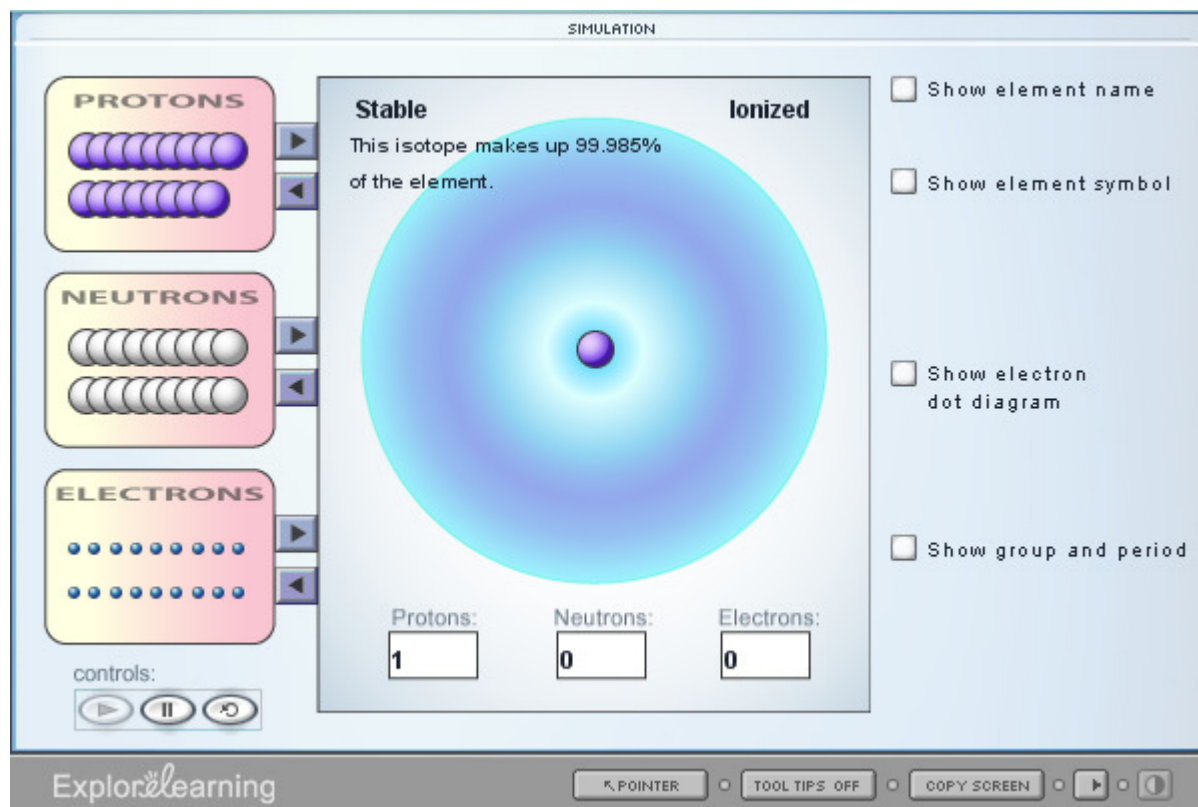
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The 'Protons' container has a slider set to 1, 'Neutrons' is set to 0, and 'Electrons' is set to 0. In the center, there is a large atom model with a nucleus and electron shells. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'POINTER' button is highlighted, and a pointer is shown pointing to the mass number '1' in the element symbol 'H'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface for building an atom. The central part of the interface displays a 3D model of an atom with a nucleus and electron shells. To the left of the atom are three containers for adding subatomic particles: Protons (purple spheres), Neutrons (grey spheres), and Electrons (blue dots). Each container has a plus/minus control. To the right of the atom are several checkboxes: 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). Below the atom model, there are three input fields: 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom of the interface, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. A blue arrow points to the '1' in the mass number '1H', and a black arrow points to the '1+' in the charge '1+'. The text 'Mass number' is next to the blue arrow, and 'Ignore' is next to the black arrow.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Each container has a slider to add or remove particles. The central area displays a 3D model of an atom with a nucleus and electron shells. The nucleus is labeled 'Stable' and 'This isotope makes up 99.985% of the element.' Below the model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there is a chemical symbol 'H' with a mass number '1' and a charge '1+'. A pointer icon is pointing to the mass number '1'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon and buttons for 'TOOL TIPS OFF' and 'COPY SCREEN'. The bottom left corner shows the 'ExploreLearning' logo.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

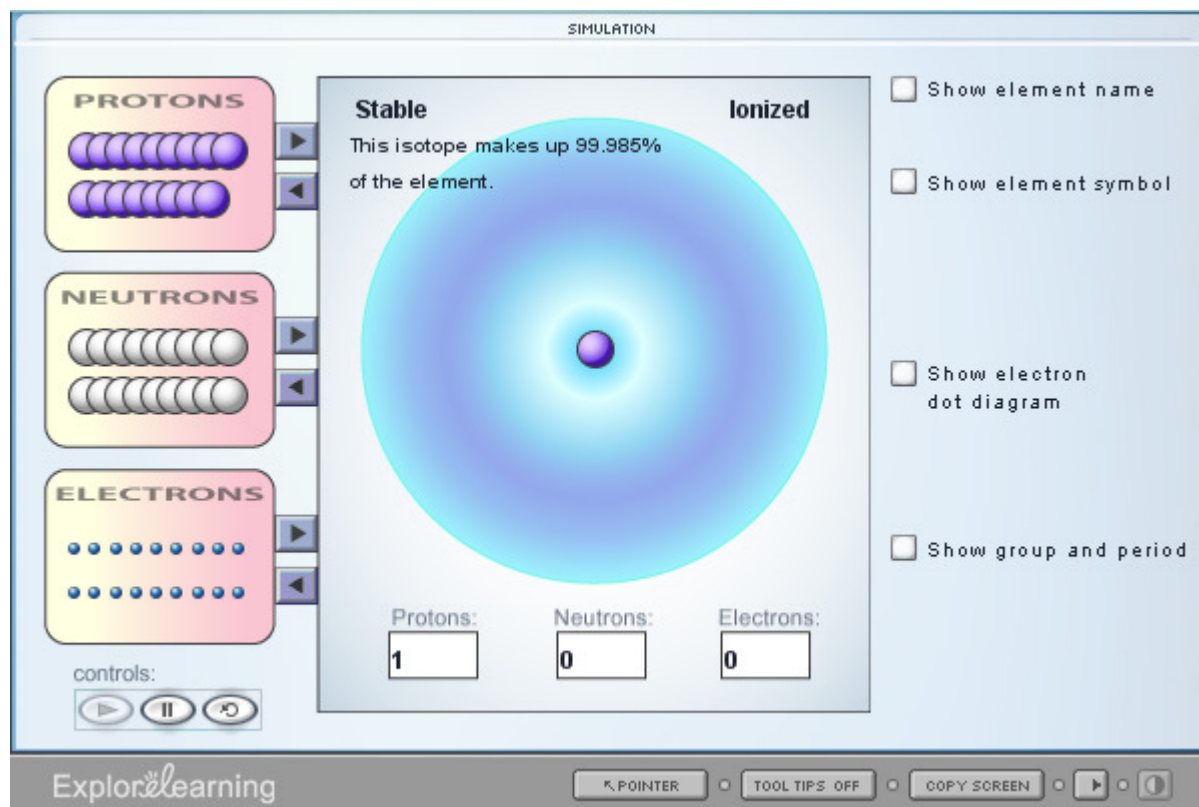
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three containers for protons, neutrons, and electrons. The protons container has 1 proton, neutrons has 0, and electrons has 0. On the right, there are checkboxes for 'Show element name', 'Show element symbol', 'isotope', 'Show electron dot diagram', and 'Show group and period'. The 'Show element symbol' checkbox is checked, and the element symbol 'H' is displayed. Above the 'H' is a mass number '1' with an arrow pointing to it labeled 'Mass number'. To the right of the 'H' is a charge '1+' with an arrow pointing to it labeled 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for play, pause, and reset. In the center, there is a large atom model with a nucleus and electron shells. Below the model are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. At the bottom, there are 'DRAG POINTERS' and a status bar with 'POINTER', 'TOOL TIPS: OFF', and 'COPY SCREEN' buttons. A chemical symbol 'H' is shown with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Each container has a plus/minus button to adjust the count. In the center, there is a large atom model with a nucleus and electron shells. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there is a chemical symbol 'H' with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there is a 'DRAG POINTERS' section with a 'POINTER' button and a 'TOOL TIPS OFF' button.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- a. Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - b. Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - c. Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - d. Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three containers for subatomic particles: Protons (purple spheres), Neutrons (grey spheres), and Electrons (blue dots). Each container has a slider to adjust the number of particles. Below these are control buttons (play, pause, reset). On the right, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. In the center, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there is a 'DRAG POINTERS' section with a pointer icon. A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. An arrow points to the mass number '1' with the label 'Mass number', and another arrow points to the charge '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_

## Subatomic Particle Gizmo

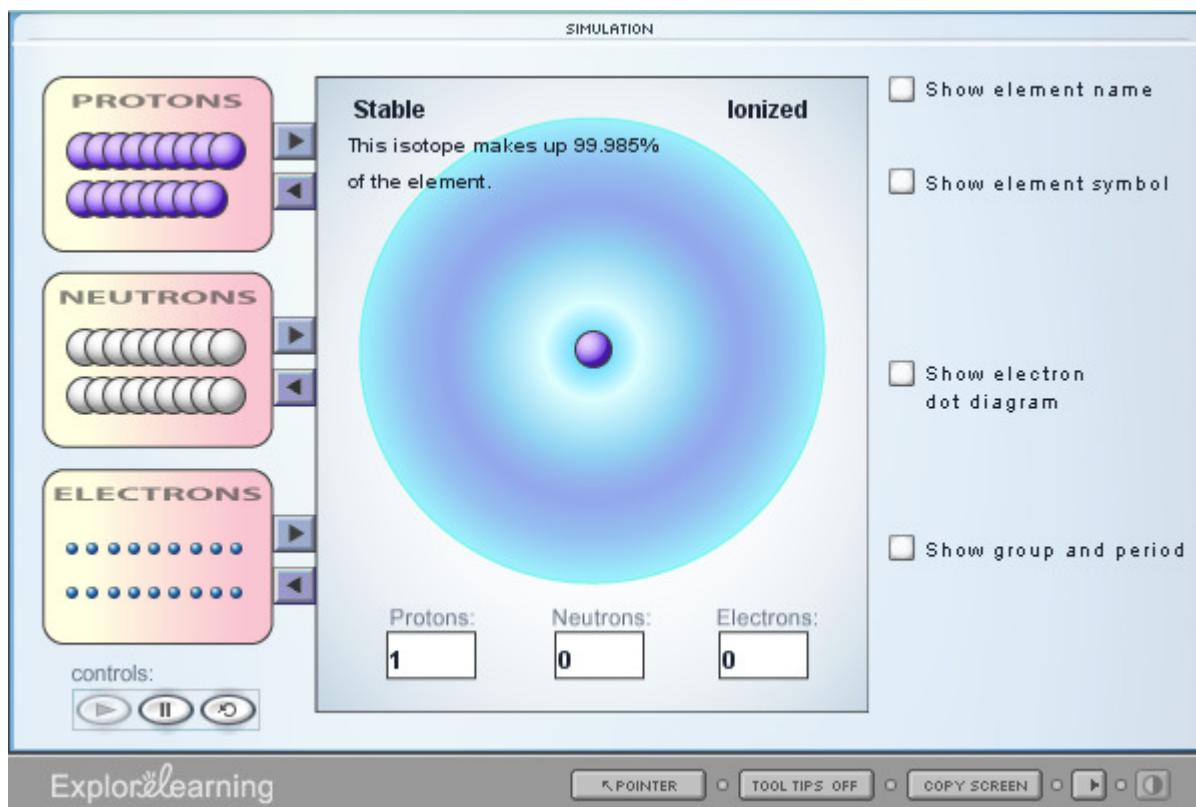
Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning atom simulation interface. On the left, there are three sliders for adding subatomic particles: Protons (set to 1), Neutrons (set to 0), and Electrons (set to 0). Below these are controls for play, pause, and reset. In the center, a large blue sphere represents the electron cloud, and a small purple sphere represents the nucleus. On the right, there are checkboxes for 'Show element name' (unchecked), 'Show element symbol' (checked), 'isotope' (unchecked), 'Show electron dot diagram' (unchecked), and 'Show group and period' (unchecked). A chemical symbol 'H' is displayed with a mass number '1' and a charge '1+'. A blue arrow points to the mass number '1' with the label 'Mass number', and a black arrow points to the charge '1+' with the label 'Ignore'. At the bottom, there are buttons for 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_



## Subatomic Particle Gizmo

Name \_\_\_\_\_ Sci # \_\_\_\_\_

Some of the greatest breakthroughs in understanding the structure of the atom were provided by J. J. Thompson during his time at the renowned Cavendish Laboratory in Cambridge, England. Thompson had a reputation for being rather clumsy with his hands, and he always needed to have assistants to set up equipment for him. Nevertheless, he was a brilliant experimental physicist. Work conducted under his watchful eye led to the first discovery of a subatomic particle, the electron.

Once you log in, find the GIZMO named "Element Builder" Gizmo and select "Launch Gizmo."

### Location of Subatomic Particles

1. In this Gizmo™, subatomic particles (protons, neutrons and electrons) can be added to an atom or removed from it by clicking the arrows next to each supply of particles. Remove any protons (the program will not let you remove the last proton), neutrons, or electrons that are currently in the atom by clicking the left arrows. You can also highlight the number with the cursor and change the numbers manually. Below is what the screen should look like when you begin. The center of the atom is the nucleus and the area around the nucleus is the electron cloud.



- a. Using the right arrows, add 1 proton, 2 neutrons, and 2 electrons to the atom so that there are 2 of each of the three particles located in the atom. Fill in the following chart.

Particle	Location
Proton	
Neutron	
Electron	

## Identity of the Atom

2. Place a check in the "Show element name" box, which is in the top right portion of the gizmo. Manipulate the number of protons to achieve the number of protons in the data table. Do not worry about the number of neutrons or electrons. Experiment with adding one and removing one proton to and from the atom. Fill in the following table. Once you have the identity of the element, look at the periodic table and write down the atomic number for the element, this is the larger number located by the element symbol.

Number of protons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of protons change the identity of the element you have built?

b. What is the relationship between the number of protons and the atomic number for an element?

3. Now you will do the same thing as step 2 except you will be changing the number of neutrons. Make sure that you begin with 2 each for the protons, neutrons, and electrons. Add one neutron to the atom to place 3 neutrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 neutrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of neutrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

a. Does changing the number of neutrons change the identity of the element you have built?

b. Does changing the number of neutrons change the affect the atomic number?

4. Make sure that you have 2 each for the protons, neutrons, and electrons. Add one electron to the atom to place 3 electrons in the atom. Record the name of the element and look at the periodic table to find the atomic number. Next, take 2 electrons away (a total of 1 should now be in the atom.) Again record the name of the atom and the atomic number from the periodic table.

Number of electrons	Name of element	Atomic Number from Periodic Table
2		
3		
1		

- a. Does changing the number of electrons change the identity of the element you have built?

**KEY FACT:** Now looking at questions 2a, 3a, and 4a, which subatomic particle is responsible for the identity of an atom?

### Mass of an atom

5. Build an atom again with exactly 2 protons, 2 neutrons, and 2 electrons. Check "Show element symbol." Be sure "isotope" is not selected. Make adjustments to the atom to attain the number of protons, neutrons, and electrons as shown in the data table. Then finish filling in the table. **The number to the upper left of the symbol indicates the mass of the atom.** (See where the pointer is pointing in the screen shot.)

The screenshot shows the ExploreLearning simulation interface. On the left, there are three containers for adding subatomic particles: PROTONS (purple spheres), NEUTRONS (grey spheres), and ELECTRONS (blue dots). Below these are controls for play, pause, and reset. In the center, there is a large atom model with a nucleus and electron shells. To the right of the atom model, there are checkboxes for 'Show element name', 'Show element symbol' (checked), 'isotope', 'Show electron dot diagram', and 'Show group and period'. Below the atom model, there are input fields for 'Protons: 1', 'Neutrons: 0', and 'Electrons: 0'. At the bottom, there are 'DRAG POINTERS' and a status bar with 'ExplorLearning', 'POINTER', 'TOOL TIPS OFF', and 'COPY SCREEN'. On the right side of the atom model, there is a chemical symbol 'H' with a '1' above it and a '1+' to its right. An arrow points to the '1' with the label 'Mass number', and another arrow points to the '1+' with the label 'Ignore'.

Number of protons	Number of neutrons	Number of electrons	Identity of atom (give name)	Mass of atom
2	2	2		
3	2	2		
2	3	2		
2	2	3		

- Does the proton affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above .
  - Does the neutron affect the mass of an atom? You **MUST** justify your answer. You **MUST EXPLAIN** by referring to an example or data from above.
  - Does the electron affect the mass of an atom? You **MUST EXPLAIN** by referring to an example or data from above.
  - Looking at the atom in the Gizmo, where is most of the mass of an atom concentrated? Explain.
5. Which 2 subatomic particles affect the mass of an atom?

**KEY FACT:** Write a mathematical formula to show the relationship between the number of protons, the number of neutrons, and the mass number for an atom.

SUMMARY: Based on this gizmo, the number of protons equals the \_\_\_\_\_ from the periodic table. The number of protons determines the \_\_\_\_\_ of an atom. The \_\_\_\_\_ and \_\_\_\_\_ determines the mass of an atom. The protons and neutrons are located in the \_\_\_\_\_ of an atom and electrons are in the \_\_\_\_\_.

- How many protons are in the nucleus of an atom of Carbon (C)? \_\_\_\_\_
- What is the formula for finding the mass number of an atom? \_\_\_\_\_
- If an atom of C has 7 neutrons in the nucleus, then it would have a mass number of \_\_\_\_\_ (see previous 2 questions).
- How many electrons would be found in the nucleus? \_\_\_\_\_