**Early Models of the Atom**

**Learning Goal 11**: I can draw and describe early models of the atom and explain the experimental results that led to their development.

* **Ask your teacher for the handout titled “Early Models of the Atom”.**

**Part 1: Dalton’s Model of the Atom**

**The “Billiard Ball” Model**

* **Look at the handout titled “Early Models of the Atom”.**

This handout illustrates four early models of the atom using three

different elements.

* Examine the examples of Dalton’s model of the atom.
* What are you able to learn about atoms from the illustrations of

Dalton’s model of the atom?

* **Dalton also developed several postulates about the existence and**

**behavior of atoms.**

These postulates laid the groundwork for the development of modern

atomic theory.

* + The table below describes and illustrates four postulates of

Dalton’s atomic theory. You will need to memorize these

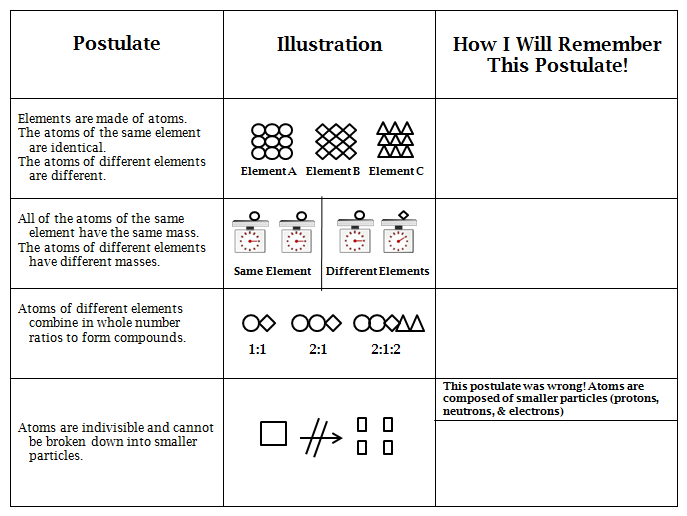
postulates.

* For each postulate, create a tool to help you remember it.

Your tool can be a song, a poem, a mnemonic, or any other device

that you think will help you to remember the postulate.

If you choose to create a picture, you must create a different

 picture than the one already shown

**Part 2: Thomson’s Model of the Atom**

**Negatively charged electrons**

**Diffuse positive charge**

**The “Plum Pudding” Model**

* **Return to the handout titled “Early Models of the Atom”.**
* **Compare the examples of Thomson’s model of the atom to the**

**examples of Dalton’s model of the atom.**

* **Identify two things that Thomson added to the model of the**

**atom.**

**Thomson’s Experiment**

* **In order to understand Thomson’s experiment, your teacher will**

**perform the following demo:**

* Go to a sink and turn on the water so that it is falling in a gentle

stream. Water particles have a positive side and a negative side.



**Water Particle**



* Rub a latex balloon on your hair for several seconds – this creates

negative charges on the balloon.



**Negative Charges**

* Hypothesize! What do you think will happen when you put the

negatively charged balloon next to the stream of water?

* Place the balloon next to the stream of water, but don’t let it touch

the water.

* Describe what happened in words and pictures.
* **Why** do you think this happened? Develop an explanation for what you

observed. (Hint! Think about the charges!)

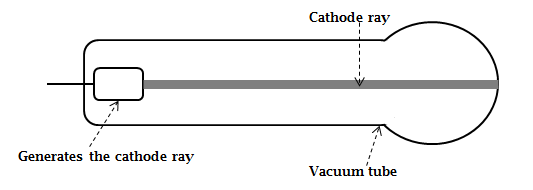
* **Thomson performed an experiment using a cathode ray tube.**

A cathode ray is composed of small parts of atoms.

* Normally a cathode ray will travel in a straight line when generated

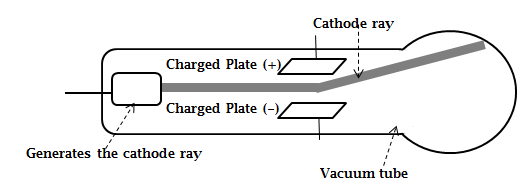
in a vacuum tube as show below. (A vacuum tube is a tube

without any air in it.)



* When positively and negatively charged plates are applied to the

cathode ray, the ray bends as shown below.



* Why do you think the cathode ray bent towards the positive plate?

(Hint! Think about what happened when you placed the charged

balloon next to the water.)

* How do you think the results of this experiment led Thomson to

conclude that the atom contained negatively charged particles

(electrons)?

* Thomson also concluded that if there were negatively charged

particles in the atom, there must be positive charge in the atom as

well.

What do you think would happen if there were ONLY negatively

charged particles in the atom? (Hint! Think about what happens

when you put negatively charged things together.)

**Part 3: Rutherford’s Model of the Atom**

**Dense positive charge**

**(nucleus of the atom,**

**containing protons)**

**Negatively charged electrons**

**The “Planetary” Model**

* **Return to the handout titled “Early Models of the Atom”.**
* **Compare the examples of Rutherford’s model of the atom to the**

**examples of Thomson’s model of the atom.**

* **Identify the main change that Rutherford made to the model of**

**the atom.**

* **Rutherford performed an experiment using positively charged**

**particles and a piece of gold foil.**

Gold foil is like aluminum foil except that it is composed of gold atoms

instead of aluminum atoms.

* Rutherford shot the positively charged particles through the gold

foil and recorded where they ended up.

**Stream of pos. charged**

**particles (+)**

**Gold Foil**

**Generates pos. charged**

**particles (+)**

**Records where particles end up**

* **Open the envelope labeled “Rutherford Card Set”.**

Each card in this set shows the path of one of the positively

charged particles through the gold foil.

* Shuffle the cards and place them face down in a pile.
* Draw one card at a time and look at the path of the particle

on the card. Draw the particle’s path on the picture below.

If more than one particle travels along the same path, make

the line for that path thicker each time.

* What path do the particles take most often when they hit the

foil?

* What happens to the particles on rare occasions?
* The results of this experiment led Rutherford to conclude

that atoms contain a small, dense, positively charged area

surrounded by mostly empty space and extremely tiny,

negatively charged particles.

How do you think the results of this experiment led

Rutherford to these conclusions?

**Part 4: Chadwick’s Model of the Atom**

**Dense positive charge**

**(nucleus of the atom,**

**containing protons AND**

**neutrons)**

**Negatively charged electrons**

**The “Planetary Model” – Revised**

* **Return to the handout titled “Early Models of the Atom”.**
* **Compare the examples of Chadwick’s model of the atom to the**

**examples of Rutherford’s model of the atom.**

* **Identify the main change that Chadwick made to the model of**

**the atom.**

* **Chadwick performed experiments on the radiation of beryllium**

**atoms.**

As the result of his experiments, Chadwick was able to confirm the

existence of neutral particles in the nucleus of the atom (neutrons).

* **Draw the Dalton, Thomson, Rutherford , and Chadwick Models for**

**each of the following atoms.**

Use the following symbols to represent the subatomic particles in your

drawings.

**negatively charged subatomic particle (electron)**

**positively charged subatomic particle (proton)**

**neutral subatomic particle (neutron)**

**diffuse positive charge**

**dense positive charge**

**Beryllium (Be)** – 4 negative subatomic particles (electrons)

4 positive subatomic particles (protons)

5 neutral subatomic particles (neutrons)

Dalton’s Model Thomson’s Model Rutherford’s Model Chadwick’s Model

**Oxygen (O)** – 8 negative subatomic particles (electrons)

8 positive subatomic particles (protons)

8 neutral subatomic particles (neutrons)

Dalton’s Model Thomson’s Model Rutherford’s Model Chadwick’s Model

**Carbon (C)** – 6 negative subatomic particles (electrons)

6 positive subatomic particles (protons)

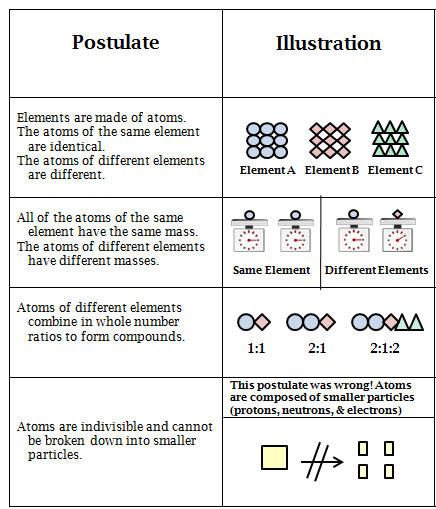
6 neutral subatomic particles (neutrons)

Dalton’s Model Thomson’s Model Rutherford’s Model Chadwick’s Model

**Early Models of the Atom**

**Study Sheet**

**Dalton’s Model Thomson’s Model**

 **The “Billiard Ball” Model The “Plum Pudding” Model**

**The Experiment: Cathode Ray Tube Experiment**

Led to the discovery of negatively charged particles (electrons). Implied

the existence of positive charge in the atom.

**Rutherford’s Model**

**The “Planetary” Model**

**The Experiment: Gold Foil Experiment**

Led to the discovery of a small, dense, positively charged area at the center

of the nucleus (later determined to be protons in the nucleus). Implied that

most of the atom was empty space and that the negatively charged

particles (electrons) were extremely tiny.

**Chadwick’s Model**

**The Planetary Model – Revised**

**The Experiment: Beryllium Radiation**

Led to the discovery of small neutral particles in the nucleus (neutrons)