Name _____
Chemistry Lab #2 Rutherford's Backscattering Experiment
Mrs. Rankin

Read the following:

A key experiment in understanding the nature of atomic structure was completed by Ernest Rutherford in 1911. He set up an experiment that directed a beam of alpha particles (helium nuclei) through a gold foil and then onto a detector screen. According to the "plum-pudding" atomic model, electron float around inside a cloud of positive charge. Based on this model, Rutherford expected that almost all of the alpha particles should pass through the gold foil and not be deflected. A few of the alpha particles would experience a slight deflection due to the attraction to the negative electrons (alpha particles have a charge of +2). Imagine his surprise when a few alpha particles deflected at all angles, even nearly straight backwards.

According to the "plum-pudding" model, there was nothing in the atom massive enough to deflect the alpha particles. Rutherford's reaction was that this was "…almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you." He suggested that the experimental data could only be explained if the majority of the mass of the atom was concentrated in a small, positively charged central nucleus. This experiment provided the evidence needed to prove the nuclear model of the atom. In this experiment, you will make observations similar to those of Professor Rutherford.

Log into your computer. Click on "Start" → "Applications" → "Virtual Chem Lab".
Click on the workbook and select experiment 2-3: Rutherford's Backscattering Experiment.

1. In your notebook, copy/complete the heading, purpose, and materials.

Lab #2: The Gold Foil Experiment **Today's Date**

Purpose: The purpose of this experiment is to demonstrate how Ernest Rutherford discovered the atomic nucleus.

Materials: (mouse over the three pieces of equipment on the lab table and write them down)

2. Sketch the locations of the equipment in your notebook.

3. The gray box on the left side of the table contains a sample of the element americium-241, called the source in this experiment.

   (a) What does the number 241 represent? _____

   (b) What particles are emitted from the source? _____

   (c) According to your reading, what are alpha particles? _____

   _____

4. Mouse over the metal foil stand in the middle of the table.

   (a) What metal foil is used? _____

5. Point the cursor to the detector on the right.

   (a) What detector is used in this experiment? _____

6. Turn on the detector by clicking on the red/green light switch. The phosphor screen detects charged particles and lights up momentarily when particles hit the screen.

(a) What does the signal in the middle of screen represent? _____

_____

(b) What do the other signals on the screen represent? _____

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7. *In your notebook,* draw a rectangle to represent the phosphor screen. Label this diagram as "Phosphor Screen in Original Position". Click the "Persist" button on the phosphor screen. Draw a dot on your phosphor screen diagram for each dot that appears on the screen during one minute.

(a) According to the plum-pudding model, what is causing the slight deflection of the alpha particles?

_____

(b) Make a general observation about the number of alpha particles that hit the screen in one minute.

_____

_____

8. Click on the main laboratory window to bring it to the front. Grab the phosphor screen by its base and move it to the spotlight in the top right corner of the table. *In your notebook,* draw a rectangle to represent the phosphor screen. Label this diagram as "Phosphor Screen in Top Right Corner". The "Persist" button should still be on. Draw a dot on your phosphor screen diagram for each dot that appears on the screen during one minute.

(a) Make a general observation about the number of alpha particles that hit the screen in one minute.

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9. Click on the main laboratory window to bring it to the front. Grab the phosphor screen by its base and move it to the spotlight in the top center of the table. *In your notebook,* draw a rectangle to represent the phosphor screen. Label this diagram as "Phosphor Screen in Top Center". The "Persist" button should still be on. Draw a dot on your phosphor screen diagram for each dot that appears on the screen during one minute.

(a) Make a general observation about the number of alpha particles that hit the screen in one minute.

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10. Click on the main laboratory window to bring it to the front. Grab the phosphor screen by its base and move it to the spotlight in the top center of the table. *In your notebook,* draw a rectangle to represent the phosphor screen. Label this diagram as "Phosphor Screen in Top Left Corner". The "Persist" button should still be on. Draw a dot on your phosphor screen diagram for each dot that appears on the screen during one minute.

(a) Make a general observation about the number of alpha particles that hit the screen in one minute.

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Students often ask, “Why did Rutherford use gold foil?” The most common response is that gold is soft and malleable and can be made into very thin sheets of foil. There is another reason, which you can discover for yourself.

11. Turn off the phosphor detection screen. Double-click the base of the metal foil holder to move it to the stockroom window. Click on the “Stockroom” to enter. Click on the metal sample box on the top shelf. Click on Mg to select magnesium. Click on the “Return to Lab” arrow.

12. Move the metal foil stand to the center of the table. Move the phosphor screen back to its original position on the right side of the table and turn it on. *In your notebook,* draw a rectangle to represent the phosphor screen. Label this diagram as “Phosphor Screen with Magnesium Foil”. Click the “Persist” button on the phosphor screen. Draw a dot on your phosphor screen diagram for each dot that appears on the screen during one minute.

    (a) How does the number of hits seen when magnesium foil is used compare to the number of hits seen when gold foil is used? _____

    _____

Use your observations and your knowledge of chemistry to answer the following questions. Use complete sentences.

1. What two conclusions did Rutherford make after the gold foil experiment?

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_____

2. What caused the alpha particles to deflect backwards?

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3. How does the gold foil experiment show that almost all the mass in a atom is concentrated in the nuclus?

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4. How would the results of the gold foil experiment be different if the nucleus had a negative charge instead of a positive charge?

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5. Why did Rutherford choose gold foil instead of magnesium foil?

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