Chemistry Name _____ Period____

U4L1 Atomic Target Practice Lab — Rutherford's Gold Foil Experiment

Purpose: To model Rutherford's Gold Foil Experiment and use the results to discuss the validity of using models in science.

Materials: Hula-Hoop, Tennis Ball, String, ~100 Ping Pong Balls

Introduction: Ernest Rutherford was a chemist who lived in New Zealand. He is known for creating the Gold Foil experiment which led to the discovery of the atomic nucleus. Rutherford used a radioactive substance to launch alpha particles at a sheet of gold foil. **Alpha particles are a positive form of radioactive energy**. Most of Rutherford's particles went straight through the gold foil. A small percentage went through, but came out at an angle, meaning they had turned. An even smaller percentage of the particles appeared to bounce off the foil, just like a ball would bounce if thrown at a wall. What did this tell Rutherford about the atom? First, the current atomic model needed an upgrade from the Plum Pudding model. Second, it told him that the atom is mostly empty space, and contains a small, dense, positive nucleus.

Procedure:

1) Make the Rutherford model:
   - **a)** Tie the tennis ball to the hula hoop with the string so that the ball hangs in the middle of the hoop.
   - **b)** Someone needs to hold it above their head or you can hang it somewhere in the room.
2) Gather Data:
   - **a)** Each student gets 1 ping pong ball.
   - **b)** Throw the ping pong ball at the tennis ball. The goal is to hit the tennis ball.
   - **c)** If the ping pong ball goes through the hoop or outside of the hoop, count that as a "**miss**".
   - **d)** If the ping pong ball hits the hula hoop, count that as a "**Deflection/Bounce**".
   - **e)** If the ping pong ball hits the tennis ball in the middle, count that as a "**hit**".
3) Analyze the Data:
   - **a)** Add up the raw data to get the total number of ping pong balls thrown.
   - **b)** Find the percentage of hits, misses, and deflections. You do not have to show work.
   - **c)** Compare those percentages to Rutherford's actual experimental data (last column).

Data:

	Raw Data	Percent	Rutherford's Data
Hits			0.02 %
Deflections			0.05 %
Misses			99.93 %
Total			

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4) What does the Hula Hoop represent? _____

5) What does the Tennis Ball represent? _____

6) What do the Ping Pong Balls represent? _____

7) If most of the balls go through the hoop, what does that mean about atoms? _____

_____

8) If some balls bounce off the nucleus, what does that tell you about the nucleus? _____

_____

9) How do your results compare to Rutherford's results? _____

_____

10) Why were your results different from Rutherford's? _____

_____

11) Do you think this activity was a good model for the atom? (Did you learn anything about the atom?) Explain your answer. _____

_____

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12) How can you improve this lab's atomic model? _____

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13) A lithium atom has a diameter of about 300 picometers, while the nucleus of the lithium atom has a diameter of approximately 0.005 pm. If the nucleus was the size of a tennis ball (diameter = 6.75cm), how big does the Hula Hoop actually need to be? Calculate the hoop's diameter using this ratio, where **x = diameter of Hula Hoop**. Convert your answer into miles (1 mile = 1.609km).

$$\frac{atom's\ diameter}{nucleus'\ diameter} = \frac{x}{ball's\ diameter}$$