Background Information: In 1910, Ernest Rutherford bombarded a thin piece of gold foil with a stream of alpha particles. He used a zinc sulfide detector screen to detect the particles after they had struck the foil. He used these measurements to draw conclusions about the structure of an atom. In this activity, you will simulate Rutherford’s experiment and compare and contrast your experiment with Rutherford’s experiment.

Objectives: The objectives of this activity are to 1) perform a simulation of the gold foil experiment, 2) draw conclusions regarding the structure of the simulated atom, and 3) compare and contrast Rutherford’s experiment with your simulation.

Materials: ball bearing (to represent alpha particle), aluminum rod (to represent alpha particle emitter), hexagon drawn on paper (to represent zinc sulfide detector screens), marker, ruler, meterstick, protractor, small mass (to represent nucleus).

Procedure:

1. Draw a hexagon on the large paper, flat sides top and bottom. Each side should be 25 cm long. The protractor may help (each interior angle of a hexagon = ??). Starting at the upper left, letter each side A, B, etc. Draw a horizontal center line dividing the hexagon in half.

2. You will be emitting the alpha particle by placing it on the middle of line E and shooting across the paper, gradually moving from left to right across the hexagon. Based on J.J. Thomson’s atomic model, predict the percent of alpha particles you think will cross each detector. Percent must add up to 100% and this must be done before you proceed.

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<th>detector</th>
<th>predicted percent</th>
<th># of alpha particles</th>
<th>actual percent</th>
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   Total # of deflected alpha particles:________________________

3. Place your nucleus in the hexagon beyond the center line away from line E. Place the alpha particle in the middle of line E. Emit the alpha particle using the alpha particle emitter in a way similar to playing pool. Make 50 shots, gradually moving across the center line from left to right. For each shot, keep track of which detector (which line on the paper) the alpha particle crosses as it leaves the hexagon. Use tally marks in the table above. Beneath the table, make a tally mark for any time the alpha particle was deflected (so you will sometimes have to make 2 tally marks for one shot).

4. After the 50 shots, complete the actual percent column above also. Clean and organize your work station and return to your desks to work on the results questions.
Results:

1. In this simulation, what does the inside area of the hexagon represent?

2. Given that the atomic diameter of gold atom is 288 picometers (pm), while the nuclear diameter of gold is 0.0140 pm, how big should our nucleus have been? You will need to go back to lab and measure how long the center line of the hexagon is and assume this line to be the diameter of a spherical object.

3. From your answer to #3, why didn’t we use a nucleus this size?

4. From the real Gold Foil Experiment, Rutherford discovered the existence of an atomic nucleus. What other three characteristics of the nucleus and/or atom did the Gold Foil experiment reveal?

Discussion of Error:

1. On a scale of 1 to 10, how close were your predictions?

2. What were the biggest differences and/or surprises in your actual percents compared to your predicted percents? Why do you think this happened?

3. What was your percent of total particles deflected?

4. In the real Gold Foil Experiment, approximately 1 out of every 8000 alpha particles was deflected. What percentage is this?

Suggestions for Improvement: What could reasonably have been done differently so that the results we obtained were more like Rutherford’s?