

**ND RET 2009 – Evaluation**

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## **Rutherford's Atomic Interaction "Atomic Target Practice"**

**\*Adapted Flinn ChemTopic Labs –Atomic & Electron Structure Vol. 3**

### **Background:**

Ernest Rutherford came across the presence of "atoms" indirectly. Using an "alpha-cannon" to shoot alpha particles (Helium nuclei - 2+ charge) at a metallic foil, Rutherford noticed that the particles did not go through the foil, as expected. The fact that the particles scattered randomly, led Rutherford to believe that some "hard" core within the foil was present. He later concluded this core to be the "nucleus" of the atom (which he proposed was also positively charged) and the open spaces between the atoms, which allowed the particles to pass through the foil, was a "cloud" of sorts (electron cloud).

### **The Exercise:**

With this exercise, the students are mimicking the experiment of Rutherford. As Rutherford was projecting alpha particles at unseen objects, the students will be rolling marbles at covered objects, and based on the paths of the marbles, the location, shape, and size of the object can be discovered.

### **Purpose:**

The purpose of this exercise is to develop an understanding as to how interactions determine the existence of matter

### **Objective:**

By indirect means, determine the size, shape and location of an unseen object using a rolling marble.

### **Materials:**

- Cardboard/Pegboard box covers (Around 8.5" x 11") \*consider using box tops/edges
- Rubber stoppers (serve as supports) about an inch in length
- Various shapes (cubed, rectangular, triangular, cylinder, hexagonal, etc)
- Marbles/Steel balls
- Printer paper
- Pencils
- Glue
- Velcro Adhesives

**Set up:**

The apparatus consists of a 3-dimensional objects (cube, cylinder, triangular prism, etc.). A "cover" (cardboard, pegboard, some type of rigid, flat surface) is mounted upon rubber stoppers, screws, or other supports that are about an inch in length. On the bottom side of the "cover" attach the 3-D (the target) object. Attaching with small Velcro adhesives or with glue works effectively. Centering the objects is easiest for students to locate. A piece of printer paper will be needed as well.

**Procedure:**

The whole apparatus is given to the students WITHOUT them seeing the shape of the object. Using a pushpin, attach a piece of printer paper on top of the cover. Students are to roll the marble under the cover to hit the target. As the marble is rolled, the path, from when it entered to the cover to when exited the cover, is to be traced out on the printer paper. Rolling from different angles should provide the location, shape, and size of the object.

**Follow-Up:**

Students can prepare "whiteboards" or presentations of their findings, how they came about their conclusions, sources of error, and answer questions to help conclude the lab and tie in the concepts addressed.

**Some Follow-Up Questions:**

- Discuss if marble size compared to the target size could be a factor.
- Why is it important to trace ALL of the marble paths?
- How was the speed of the marble a factor?
- Provide some limitations/sources of error.

**Helpful Hints:**

- Attaching a "grass skirt" to each cover, that drapes down will help the concealing of the object as the set-ups are being passed around and used during the lab.
- Try to keep the height of the objects to an inch so as to keep a lower profile and more difficult to see.
- Provide examples on the board as to how a marble will be deflected if it hits a side at particular angles.
- Each group was given two marbles. Have extra is some are lost or do not roll smoothly.
- Using a pushpin to hold the tracing paper on top of the cover will keep the tracing paper in place.