POPPY SCHOLARS · CHEMISTRY IN THE EARTH SYSTEM

Home lab 2 · Unit 2 · about 45 minutes

How can you find the size of an object you can never see, the way Rutherford found the size of the nucleus?

Name _____ Date _____

MATERIALS

You supply everything. Tick each item as you gather it.

- ☐ A shallow cardboard box or tray about 30 cm wide, with low sides
- ☐ A sheet of cardboard or a book cover to hide part of the tray
- ☐ A small round object to hide (a jar lid, a bottle cap or a coin) that a partner places without telling you its size
- ☐ A marble or small ball, about 1.6 cm across, and tape
- ☐ A ruler in centimeters, paper and pencil

SAFETY

No special safety concerns. Keep marbles away from young children and pets, who may swallow them, and pick up any that roll onto the floor.

PROCEDURE

1. Have a partner stick the hidden object near the middle of the tray and cover the middle section with the cardboard so you cannot see it. Tape the cover down. You must not know the object's size.
2. Mark 30 start positions along one open edge of the tray, 1.0 cm apart, numbered 1 to 30.
3. From position 1, roll the marble straight across the tray, and note whether it comes out straight, in line with where it started, or deflected (it comes out at an angle, or comes back).
4. Repeat from every position, 1 to 30. A marble that goes through the covered region and hits the object is deflected.
5. Count the positions that gave a deflection (N). Estimate the width of the hidden object: width = N × 1.0 cm − the marble's diameter.
6. Only now lift the cover and measure the object. Calculate your percent error.

RECORD YOUR DATA

Start positions (cm)	Marbles rolled	Deflected	Straight through
1 to 5	5		
6 to 10	5		
11 to 15	5		
16 to 20	5		
21 to 25	5		
26 to 30	5		

Also write the marble's diameter, N, your estimated width, the measured width, and your percent error.

LAB REPORT

Write a report that gives your table, shows how you estimated the object's width from the fraction of marbles deflected, compares your estimate with the measured width, and explains how this models Rutherford's gold foil experiment. Include a scale calculation that shows how small the nucleus is compared with the atom.

Report the numbers you actually got, even when they disagree with the lesson. Write on the lines, or type your report on the website and send it to a teacher there.

Question and hypothesis *State the question in your own words, what you expect to happen, and why you expect it.*

Method *What you changed, what you measured, what you kept the same, and how many trials you ran.*

Observations *Describe what you saw, including anything unexpected. Your data tables are added to the report automatically.*

Calculations *Show each calculation step by step, with units.*

Claim and reasoning *Answer the question using your numbers, then explain why, using the science from the unit.*

Limits and next step *What could have affected your results, and one change you would make next time.*