

Rutherford Revisited: Hidden Geometry

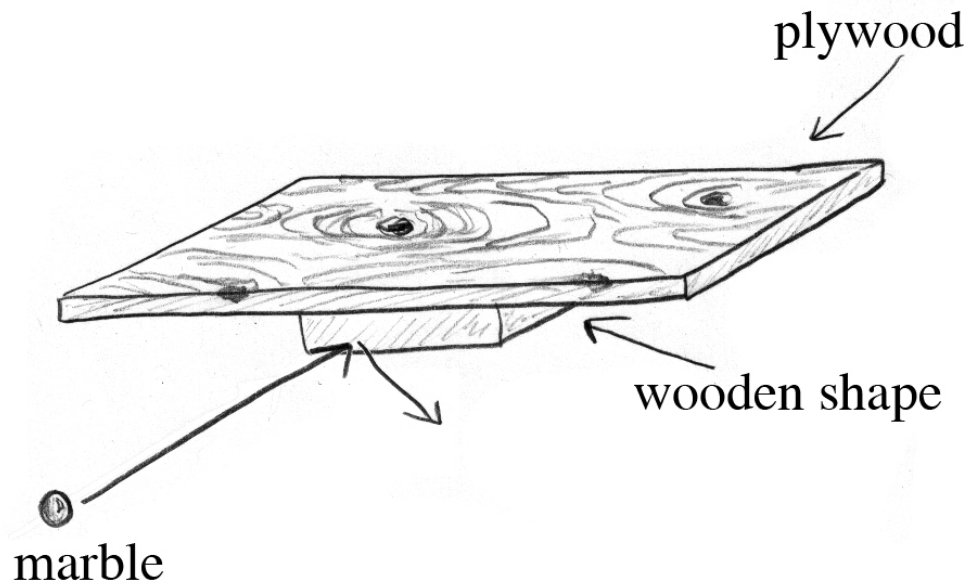
Commentary

Ernest Rutherford was the first person to deduce that the atom consisted of a “cloud” of negatively charged electrons with a dense, positively charged nucleus at the center. He was able to calculate the size of this nucleus (something we will never be able to directly observe as the laws of quantum physics forbid it) by looking at the trajectories of Alpha particles (positively charged Helium nuclei) as they were deflected by the like charge of the nucleus. He was clearly using INDIRECT OBSERVATION to learn something. With it, he was able to fashion a crude model of the atom. Such observation is a powerful and often-used tool in science, particularly when we are dealing with the very small or, in the case of astronomy, invisible dark matter. We will use this “experiment” to hone our observational skills and methodology.

Inquiry

Purpose: To determine, by investigation, the actual shape under the Rutherfordboard.

Guidance: Take note of the boards on the floor with blank paper underneath them. These boards are supported underneath by a block of wood in various geometric shapes e.g. a rectangle, a circle, a trapezoid, etc. (NO PEEKING). You will be given a small ball to roll underneath the board, and by carefully noting the in and out going trajectories one should be able to determine the exact shape. Of course, this will take many trials, as scientific undertakings usually do. This exercise will sharpen your investigative skills and also test your powers of deduction.



Procedure: First, note the number of the board: _____

• You will be supplied with paper, protractors, pencils and straightedges. Now, practice rolling the ball so that it rolls smoothly and does not bounce, especially after a rebound. After about 5 – 10 trials you should have an educated guess about the shape that lies hidden below your board. Write down your answer here:

• In a short paragraph explain your answer.

• Continue now with many trials until you are certain about the shape. Your final answer is:

- What basic scientific principle(s) did you use to deduce your answer? Explain in a short paragraph:

- If the shape had been reflective, you might have been able to use a laser to deduce the shape of the object. Explain, briefly, what a beam of light might have in common with marbles bouncing off an object and how you would use it to obtain the shape. Include a drawing. If foil and a laser or light beam is available, try it and see if you are able to quickly deduce the shape of the unknown object. What name would you give to the “Law” you are probably using to “map” the object?