Rutherford's Pillow

Estimated Time: 20-30 minutes

SUMMARY
The modern understanding of the atom with its small nucleus and cloud of electrons was supported by an early experiment by a group of scientists. It involved throwing subatomic particles at a very thin sheet of gold and noticing that the particles mostly flew through because of the empty space. Students can set up their own experiment at home to repeat this and have some fun too!

WHAT YOU'LL LEARN

- How scientists discovered the size and location of atomic nuclei.
- How to use your senses to determine something logically.

Materials Used	
• Pillow (more, optionally) • Rope	• Blindfold • Yard stick or other long pole
Resources Used Khan Academy: https://www.youtube.com/watch?v=bVlwH1kfDeg&feature=youtu.be	

WHAT TO DO

1. Have the student leave the room while you set up the demonstration. Before they enter the room, put a blindfold on the student so that they cannot see what you set up.
2. For the activity set up, take the pillow and tie a rope around it. Using furniture or just having someone holding it, hang the pillow in the air.
3. Give the yard stick to the blindfolded student and have them swing the stick slowly. After they connect with the pillow a few times, have the student guess how big the pillow is and what the shape is.
4. If time and materials permit, try different pillows to find different sizes and shapes.

TIPS

- The Geiger-Marsden experiment, usually called the "Rutherford Gold Foil Experiment" was crucial to understanding atoms. Two physicists named Hans Geiger (who invented the "Geiger counter" for detecting radiation) and Sir Ernest Marsden worked under Ernest Rutherford's direction to fire *alpha particles* at the gold foil. These particles (sometimes written "He^{2+}" as they are identical to a helium nucleus) are positively charged and if they hit an atomic nucleus they repelled since that it also positively charged. The physicists were expecting to see the particles bend this way or that so seeing one bounce back was a real surprise! It meant, though, that most of the atom was empty but there was a solid core that was charged. Now we now those parts correspond to the electron cloud and nucleus!

- An especially fun variation would be to turn this game into a piñata rather than a pillow. This can be used for parties and other events, though the analogy works well to show how breaking open a nucleus releases radiation.