

# Rutherford's Pillow Fight

**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, yet occasionally, the particles were deflected. Why? The subatomic particles were hitting the nucleus, or the location of an atom's protons and neutrons. This small dense structure in a nucleus is near the center, with mostly empty space and zooming electrons surrounding the dense core. Students can set up their own experiment at home to replicate similar findings- and they'll 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	
<ul style="list-style-type: none"> <li>• Pillow (more, optionally)</li> <li>• Rope</li> </ul>	<ul style="list-style-type: none"> <li>• Blindfold</li> <li>• Yardstick or other long pole</li> </ul>
Resources Used	
Khan Academy: <a href="https://www.youtube.com/watch?v=bVlwH1kfDeg&amp;feature=youtu.be">https://www.youtube.com/watch?v=bVlwH1kfDeg&amp;feature=youtu.be</a>	

## 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 (choose a safe place for the activity, away from breakables!). 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 of 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 " $\text{He}^{2+}$ " as they are identical to a helium nucleus) are positively charged. If they hit an atomic nucleus they are repelled due to the positive charge of protons in the nucleus. The physicists were expecting to see the particles bend this way, 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 know 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.