

RAFT IDEAS

Topics: Gravity, Space-time Curvature, Orbits

Materials List

- ✓ A large piece of stretch fabric, at least 1 m x 1 m (~3 ft x 3 ft) larger is better. Optional: use checkered cloth or draw grid lines on fabric
- ✓ Weights (such as fish line sinkers, rocks, or heavy balls)
- ✓ A small ball

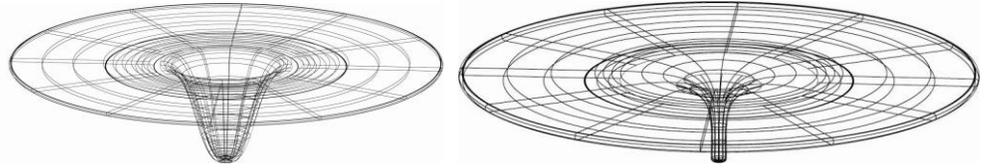
This activity can be used to teach:

- Speed and kinetic energy (Next Generation Science Standards: Middle School, Physical Science 3-1)
- Role of Gravity within galaxies and the solar system (Next Generation Science Standards: Middle School, Earth and Space Science 1-2)



The Fabric of the Universe

Exploring the curvature of space and gravity wells



A piece of stretch fabric and a small ball can illustrate how an object in motion will follow the curvature of space.

To Do and Notice

1. Standing around the stretch fabric, students hold each corner and edge, holding it flat, but not stretching it.
2. Roll a small ball **gently** across the fabric and observe its path. Is the path straight? Repeat in several different directions and have students notice the path. Is it a straight line, following the shape of the fabric surface?
3. Place a weight on the fabric so as to create a depression (gravity well). Alternately, pull the fabric into a funnel shape.
4. Gently roll the ball near the depression and notice how its path has changed. Repeat from different angles.

The Science Behind the Activity

Einstein theorized that both light and objects in motion in space follow the curvature of space. Gravity wells around objects will **distort** the shape of space, causing objects to deviate from a straight line path as they follow the **curvature** of space. In 1917, a total solar eclipse showed displaced positions of stars near the sun, due to the curvature of space near the sun - exactly as Einstein predicted.

The fabric simulates a **slice** of space-time. As the ball rolls near the depression, it follows a curved path. This model illustrates why the planets follow curved paths around the Sun: they are following the curvature of space caused by the Sun's gravity. Similarly, the Moon follows the curvature of space around Earth, caused by the Earth's gravity.

Taking it Further

With a larger piece of fabric, place two or more weights in the fabric to create more than one gravity well. By gently rolling the ball, it can be seen to move in a more complex path due to the presence of multiple gravity wells. By carefully controlling the speed and angle of the ball a "figure 8" path can be achieved.

Web Resources (Visit www.raft.net/raft-idea?isid=141 for more resources!)

- Geometry of the Universe
<http://csep10.phys.utk.edu/astr162/lect/cosmology/geometry.html>