

Material Needed

- Fabric, stretchy, at least 2 ft² but the larger the better (old shirts or swimwear can be sources of stretchy fabric)
- Weights (rocks, fish line sinkers, or equal)
- Small ball, marble, or another spherical object
- 2-4 other people
- (Note: the activity can be done by one person if the fabric can first be attached with clothespins to the edges of an open-top boxed with high enough sides)

Grade Range

3-5
6-8

Topics/Skills

Science: The Universe and Its Stars, Earth and the Solar System, Developing and Using Models

Learning Standards

NGSS: [Earth & Space Science](#)

Duration

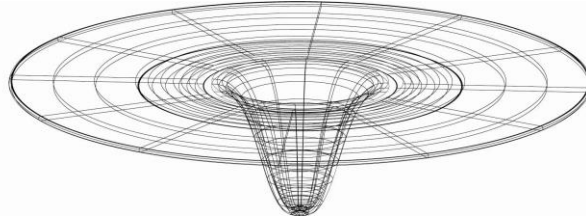
15 minutes

Prep Time

10 minutes

Fabric Gravity Wells

Exploring the curvature of space



What causes gravity? How does gravity affect the movement of objects? Students will investigate these questions by modeling gravity wells.

Activity Challenge

Use a piece of stretchy fabric, weights, and a small ball to illustrate why an object in motion will follow a curved path in space when passing near a planet or moon.

Preparation

1. Review materials list and gather needed items.
2. If needed, cut the stretch fabric to at least 2 ft. x 2 ft.

To Do

1. Stand with the fabric piece in the center and hold onto the fabric edges. Spread out around the fabric section and pull lightly to stretch the fabric out horizontally (level above the floor).
2. Roll a small ball, or equivalent object, **gently** across the fabric. Note the path of the ball. Repeat in by rolling the ball in different directions.
3. Place enough of a heavy weight or weights into the center of the fabric to create a pit/depression, see top illustration. The depression in the fabric will model a **gravity well**, a conceptual model of the gravitational field surrounding objects in space.
4. Gently roll the ball to pass near the edge of the depression, the “gravity well”, and note the ball’s path.
5. Repeat step 4 several times but aim the ball to pass closer to the center of the depression each time.

Observations

- When the fabric is positioned horizontal with no weights, what is the path of the rolling ball?
- How does having a depression in the fabric change the path of the rolling ball? How does the path change as the ball rolls nearer to the center of the depression?
- How might this model be used to describe the motion of planets in our Solar system or stars in our Milky Way Galaxy?

Extensions

- Place two or more weights, or groups of weights, in different places on the stretched fabric to create multiple gravity wells. Note the effect on the ball's path as the ball rolls by more than one gravity well.
- Make a larger model and use multiple balls. View this video for a large model demonstration: <https://bit.ly/2Ws34J9>
- View this Earth-Moon gravity animation: <https://bit.ly/2ZBxRp6>
- How can obsolete satellites be made to burn up?

The Science behind the Activity

Gravity is an attractive force that exists between any two objects, pulling them toward each other. The attractive force is greater if an object is more massive (related to being heavier). The attractive force is also greater when the objects are nearer to each other. When we jump up gravity pulls the Earth and us "together". Since the Earth is enormously more massive than we are it is we who are pulled back to the Earth, not the other way around!

The depressed fabric around the weight models the gravity field around the Earth. The depression, or well, is deeper the closer the fabric is to the weight. In the same way the gravity field of the Earth is stronger as one moves nearer the Earth. When the ball rolls near the depression the ball will follow a curved path.

When the ball is rolled close enough to the depression the ball's path can curve into a circular path around the weight. The ball may circle the weight several times before falling to the bottom of the "well". Because of friction the ball will slow down and eventually collide with the weight. Why does the Moon go around the Earth and not fall to the Earth? In space there is nothing to slow the Moon from moving forward. The Moon will continue to "roll" around the Earth's gravity well.

This model illustrates why the planets follow curved paths around the Sun: they are following the curvature of space caused by the Sun's very deep gravity well. Similarly, the Moon follows the curvature of space around Earth, caused by the Earth's gravity well. In the vacuum of space there is nothing to slow down the Earth while going around the Sun nor the Moon going around the Earth.

