Teacher Guide

Going in Circles

Key idea: An object is held in orbit when its forward motion is balanced with its falling motion.

Time: Ten minutes

Objective
Students swing a stuffed toy on a string to represent an object orbiting Earth. They swing the object more quickly and then more slowly and observe how its orbit changes. Students apply their observations to understanding how forward motion and falling motion work together to keep an object in orbit.

STANDARDS ALIGNMENT

NGSS **MS-ESS1.A.1:** The Universe and Its Stars: Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.
MS-ESS1.B.1: Earth and the Solar System: The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

CCSS **RTS.6-8.3:** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
W.6-8.1: Write arguments to support claims with clear reasons and relevant evidence.

MATERIALS

For each student group:

- Safety goggles for each student
- String (1 meter)
- Small stuffed toy

Do the activity
Before students begin the activity, have them read "Understanding orbits" on the *Going in Circles* Student Handout. Then have all students put on their safety goggles.

Divide students into groups and have them move to different parts of the classroom so they have room to swing an object on a string without getting in the way of other groups. Have each group designate one student to swing the stuffed toy. Then have groups follow the steps on the handout to conduct the activity.

The designated student in each group will swing the toy in a circle. The student will swing the toy more quickly and then more slowly. Students will observe and record how the toy's orbit changes. Then they will answer the interpretation questions about how changes in motion affect an object's orbit.

Answer Key

Before you begin the activity, put on your safety goggles.

1. Tie a 1-meter piece of string to a small stuffed toy.
2. Have one student swing the toy in a circle around his or her head so that the toy is in orbit. The toy represents an object such as a satellite orbiting the Earth.
3. Have the student swing the toy more quickly. What happens to the toy's orbit when the toy speeds up? *[When the student swings the toy more quickly, its orbit moves higher.]*
4. Have the student swing the toy more slowly. What happens to the toy's orbit when the toy slows down? *[When the student swings the toy more slowly, its orbit moves lower.]*

Interpret your results

1. Did the toy's orbit change when the student swung the toy more quickly and then more slowly? If so, why did it change? *[Sample answer: Yes, the toy's orbit changed when the student swung the toy at different speeds. When the student swung the toy more quickly, the toy had more forward motion, so it moved farther out, or into a higher orbit. When the student swung the toy more slowly, it had less forward motion, so it fell a bit, or moved into a lower orbit.]*

2. If the toy represents something orbiting Earth, what does the string tied to the toy represent? *[The string represents the force of gravity balancing the toy's forward motion and holding the toy in orbit.]*

3. If the student let go of the string while the toy was orbiting around his or her head, what would happen to the toy? Why? *[If the student let go of the string while swinging the toy around her head, the toy would go flying off in a straight line because the toy would still have forward motion, but it would no longer have the string (gravity) to balance its forward motion and hold it in orbit. If an orbiting object escapes the pull of gravity, it flies off in a straight line because its inertia causes it to keep moving at the same speed in the same direction. The toy flies away in a straight line, but eventually it falls because Earth's gravity pulls it to the floor.]*