

WHAT A PULL!

BENCHMARK and TASK

SC.E.1.2.4 The student knows that the planets differ in size, characteristics, and composition and that they orbit the Sun in our Solar System.

- The student identifies gravity as one of the forces that keeps planets arranged in orbits around the sun and the moon in orbit around the earth.

KEY QUESTION

How does the pull of gravity affect the planets in our solar system?

BACKGROUND INFORMATION

Gravity is the **force** that pulls objects downward toward the center of the earth. Gravity, the force of attraction, is what keeps the planets in orbit around the sun. Gravity is also the force that keeps moons and all smaller satellites in orbit around the planets.

The earth and other heavenly bodies, such as other planets and the moon, all exert gravitational force. The pull of the gravitational force depends on the **mass** of the heavenly body. The more massive the object, the stronger the gravitational force.

The shape of a satellite's orbit is determined by the gravitational attraction between it and the object it is orbiting and somewhat by the **gravitation** between it and other nearby objects.

MATERIALS

Per student

1 calculator
What's My Weight? activity sheet

Per group

1 washer
1 small, foam ball
1 one-meter length of string
1 rigid tube, like a straw

TEACHING TIPS

1. Prepare a model of the gravitational orbiter model prior to the lesson. (See directions in Explore Part 1.)
2. Be sensitive to weight issues. This information should not be shared aloud.
3. Poke holes through the foam balls so students will be able to easily thread the string through them.
4. Caution students to spin the orbiters carefully in an open area, taking care not to hit other students.

ENGAGE

Spin your gravitational orbiter model for the class. Ask students if they can guess what kind of model it is. Tell them they will be making a model like yours to demonstrate an important science concept.

EXPLORE

1. Display your model and show students how to construct their own:

- Thread the one-meter length of string through the tube.
 - Tie a washer to the end of the string. Make sure the string is securely fastened!
 - Thread the other end of the string through the hole in the foam ball and fasten it securely.
2. Explain that the ball represents a satellite (e.g., earth or any planet) and the fist represents the sun.
 3. Hold the orbiter by the tube and spin it so that the ball representing the earth or any planet goes around. *Does the washer rise?*
 4. Try it again so that the washer remains level and does not move up and down. It takes practice! To maintain an orbit, the outward pull caused by the rotation of the satellite must be balanced by the pull of gravity – the lower object.
 5. Have students in each group take turns using the model orbiter.

EXPLAIN

1. Discuss:
 - What holds the planets in orbit around the sun?* (gravity)
 - What would happen if the sun's gravity were to disappear?* (Planets would fly off into space.)
 - What keeps the sun and the planets from flying off into space?* (gravitational attraction)
 - What effect does earth's gravity have on your body?* (It keeps us on the ground.)
2. Hold a foam ball at shoulder level and let it fall to the floor. Ask: *What caused the ball to fall to the floor?* (Gravity acts between the ball and the earth, just as it acts between the sun and the earth. Gravity caused the ball to fall to the floor.)

EXTEND/APPLY

If you go to a place where the force of gravity is different, your weight will be different, too. Have students weigh themselves at home using a bathroom scale, and then use a calculator to determine their weight on other planets (e.g., 100 lbs. x .16 = 16 lbs.). Use the student activity sheet *What's My Weight?*

EXTENSION

Change the radius (the length of string) of the orbit. Spin it in a larger circle. *Does the satellite have to go faster or slower for the washer to remain level?*

ASSESSMENT

Have students respond to this question:

What is gravity and how does gravity affect the planets in our solar system?

What's My Weight?



Weight is the force of gravity acting on an object. We consider the surface gravity of the earth to have the gravitational pull of 1. Look at the chart of surface gravities for the moon and other planets in our solar system. Predict your weight first and then use a calculator to determine your actual weight and the difference.

	Estimated Surface gravity	Predicted Weight	Actual Weight	Difference
Moon	.16			
Mercury	.39			
Venus	.91			
Mars	.38			
Jupiter	2.60			
Saturn	1.07			
Uranus	.90			
Neptune	1.15			
Pluto	.03			