Science Benchmark: 03 : 04

Forces cause changes in the speed or direction of the motion of an object. The greater the force placed on an object, the greater the change in motion. The more massive an object is, the less effect a given force will have upon the motion of the object. Earth's gravity pulls objects toward it without touching them.

Standard IV:

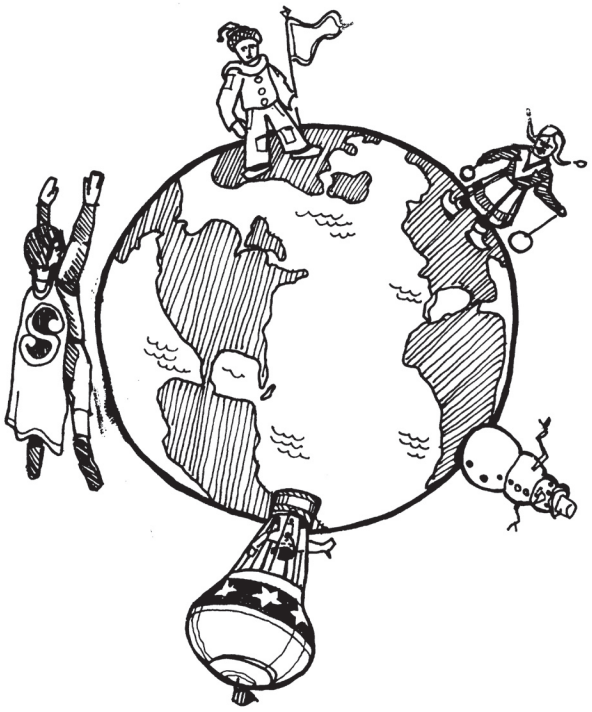
Students will understand that objects near Earth are pulled toward Earth by gravity.

STUDENT BACKGROUND INFORMATION

Gravity - What Goes Up, Must Come Down

Jump up in the air and you will fall back down again. Try to stay up above the ground. Pretend you are a super hero getting ready to save the world from evil. Flap your arms a little and see if it helps. Can't do it? That's because of an invisible *force* called *gravity.* You can't see it, but it is a powerful force that affects all things on Earth.

Earth's gravity is strong and pulls objects without touching them. As you stand still or run as fast as you can, Earth's gravity is pulling down on you all the time. Skyscrapers, elephants, apples and even you cannot get away from Earth's gravity. Even when you jump up into the air and you are not touching the ground, Earth's gravity will pull you back!



force - *a push or pull*

gravity - *the force that pulls objects on or near Earth toward its center*

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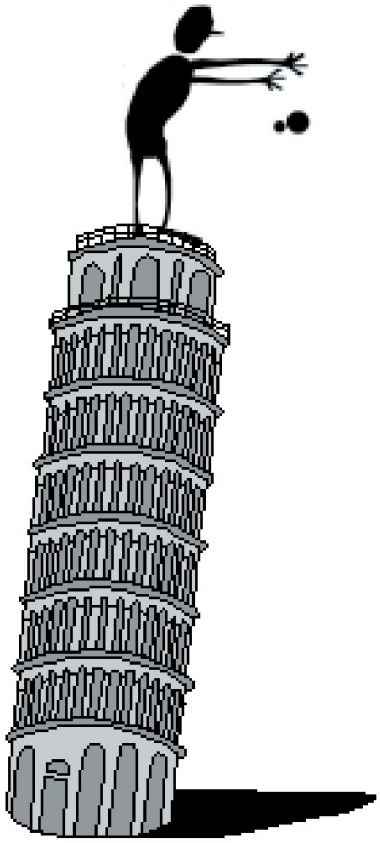
The measurement of the force it takes to work against gravity is called *weight*. You can measure weight on a scale. If you try to pick up heavy objects, you might need to be as strong as a super hero to lift them. Lifting overcomes the pull of gravity. Heavier objects need to have a strong force to lift them. Try lifting a bag of cement and see if it's easy or hard. Can you get it to move, even when you pretend to be a super hero? Try something lighter, like a book. You can lift lighter objects without huffing and puffing. But be careful! Gravity is very strong, and once you stop lifting, gravity will pull the object back to the ground no matter how heavy or light it may be. Make sure your feet are not in gravity's path! Even super heroes can smash their toes!



For many years, people thought that heavier objects would fall faster than lighter ones. Galileo, a famous scientist, asked: "Do all objects fall at the same speed?" A legend says that he dropped two different sized iron cannonballs off the Tower of Pisa. To his surprise, they both reached the ground at the same time. This answered his question. It also showed the importance of using experiments to find out answers to questions.

Gravity is always working. It is a constant force, which means it never stops. Before a bird or an airplane or even a super hero can fly, they must use other forces to help them overcome the gravity.

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weight - *a measure of the force of gravity on an object*

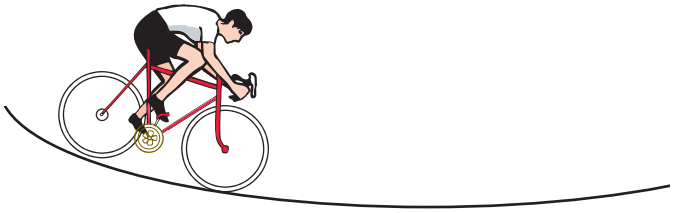
Very light objects, such as feathers or seeds, fall slowly or even float through the air. So why don't they crash to the ground? They are so light that the air can hold them up and work against the force of gravity. That's the reason that a rock and a feather will not fall and hit the ground at the same speed. Air slows down all falling objects on Earth. If you were to take lots of feathers and wad them into a large ball and drop it with the rock, they would fall at the same rate. Gravity pulls all objects toward the center of Earth no matter how much they weigh. Air can slow an object, but it can't stop gravity.

When objects are moving, gravity still pulls them toward Earth. If you drop a softball straight down, gravity will pull it straight down to the ground. What happens when you throw the same ball to your friend? The ball doesn't drop straight down. Instead, it moves forward in a curved path. A curve line is a part of a circle. When you let go of the ball it continues moving forward. But invisible gravity begins to use its force as soon as you throw the ball and pulls the ball downward at the same time it zooms to your friend. Because of the path forward and the work of gravity, the ball follows a curved path to the ground.

Have you ever ridden your bike down a hill and felt like you were flying? You almost feel like a super hero ready to take off and fight the enemies of Earth. Your secret to going so fast is the force of gravity pulling you. It pulls as you travel and helps you go faster and faster. Gravity adds to your speed as you zoom down. The steeper the hill, the faster you travel. Gravity makes objects move faster the farther they fall.

Gravity is not on your side if you want to go up the hill. It seems to pull on you from behind making your work harder. Think about how much fun it is to go sledding in the snow on a steep hill. It's always fun to zoom down screaming and speeding along. It's not so much fun, however, to make the long climb back up the hill as gravity holds you back while you pull against its force.

Gravity is something that is part of our lives, but because it is invisible we don't think of it very often. Questions about it can help us find interesting answers and information that help us understand the world around us. Think about all the plants that grow in your yard. Does gravity have an effect on how they grow? Do roots always grow down and stems grow up? How about swinging on a swing at recess? Does gravity help you go high or slow you down? Think about everyday things you do, and see if gravity makes a difference.



Science Language that Students Should Know and Use

1. force: a push or pull

2. gravity: the force that pulls objects on or near the earth toward its surface

3. weight: the measure of the force of gravity upon an object

Resources

Books:

- *Gravity Works,* by B. K. Hixson, Published by Loose in the Lab, 2001
- *Janice VanCleave's Gravity,* by Janice VanCleave, Published by John Wiley & Sons, 1993.
- *Why Doesn't the Earth Fall Up?,* by Vicki Cobb, Published by Lodestar Books, 1988.
- *The Super Science Book of Forces,* by Jerry Wellington, Published by Thomson Learning, 1994.
- *The Science of Gravity,* by John Stringer, Published by Steck-Vaugn Company, 2000.
- *Forces,* by Graham Peacock, Published by Thomson Learning, 1994.
- *Eyewitness Science Series: Force and Motion,* by Peter Lafferty, Published by Dorling Kinersley, Inc., 1992.
- *Super Science Projects About Energy and Motion,* by Allan B. Cobb, Published by the Rosen Publishing Group, 2000.
- *Experiments with Motion,* by Robert Gardner, Published by Enslow Publishers, Inc, 1995.
- *The Spinning Blackboard & Other Dynamic Experiments on Force and Motion,* by Paul Doherty and Dkon Rathjen, Published by John Wiley & Sons, 1991.

Web Sources:

- http://spaceprojects.arc.nasa.gov/Sspace Projects/SSBRP/gravity.htm