Satellite Communications

Graphic of 2nd generation GOES satellite in orbit. Courtesy NOAA.

What You Will Do

Demonstrate two of the basic principles that make satellites useful

What…

- has helped rescue more than 20,000 people since 1982;
- shows the location of fires, snow cover, thunderstorms, and erupting volcanoes everywhere on Earth;
- lets you watch the lights go on all over North America as the sun sets?

Satellites, of course! But what keeps satellites in place? And how do they help send information all over the world? Here are two simple demonstrations that answer these questions.

What You Will Need

- ❒ Empty three pound coffee can
- ❒ Poster board, at least 22-inches square
- ❒ String, about 12 inches long
- ❒ Pencil
- ❒ Scissors
- ❒ Marble
- ❒ Masking tape
- ❒ Flashlight
- ❒ Mirror
- ❒ Sheet of light-colored paper
- ❒ Two rooms connected by a doorway
- ❒ A partner

Warnings

Be careful with sharp scissors!

How to Do It

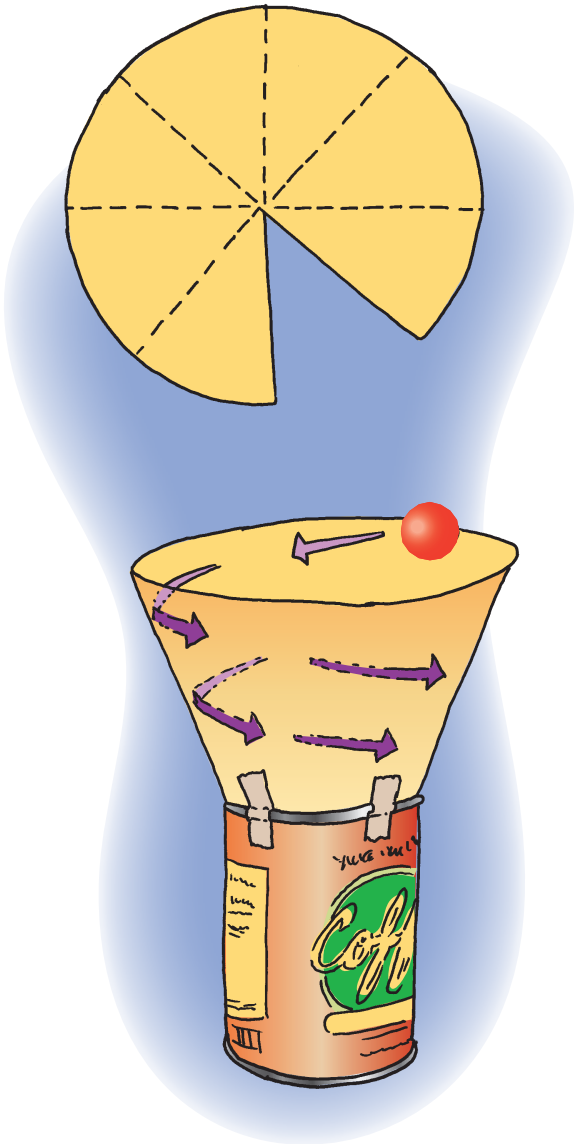
To show how satellites stay in orbit:

1. Tie one end of the string around the pencil. Hold the other end near the center of the poster board, and draw a circle about 22 inches in diameter.

2. Cut the circle out of the poster board, then cut a wedge (pie shape) that is 1/8 of the circle.

3. Overlap the two edges of the circle where the wedge was removed to form a cone, and tape the edges together so that the cone holds its shape.

4. Put the pointed end of the cone in the coffee can, and tape the cone to the sides of the can.



5. Roll the marble around the inside top of the cone as fast as possible, and observe the movement.

   When you push the marble forward and release it, the cone applies a continuous resistance to the marble's movement and causes it to move in a circle. As the speed of the marble decreases, the gravity pulls the marble down to the bottom of the cone. If you could keep the marble moving at a constant speed, it would resist the pull from gravity and continue circling in the same place. When a satellite is launched, it moves away from Earth. Gravity causes a continuous pull on the satellite that keeps it from continuing to move out into space. Instead, the forward motion of the satellite keeps it moving in a circle around the Earth.

To show how satellites help send messages between two points on Earth:

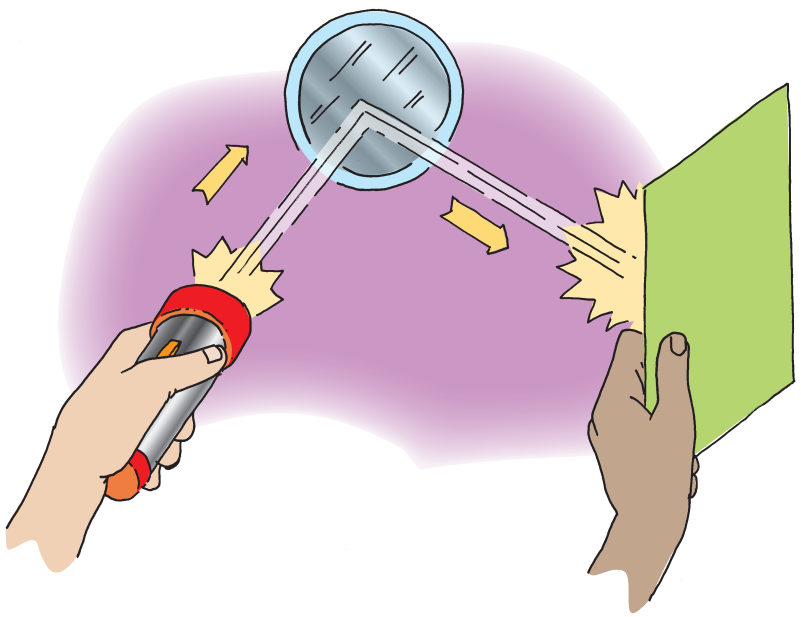
1. Have your partner stand in one room facing the doorway and holding a piece of paper. Your demonstration will work best if your partner is about six feet away from the wall that has the doorway.

2. Set up a mirror near the doorway in the other room so that the mirror is angled toward the doorway.

3. Shine a flashlight toward the mirror. The light will reflect into the other room so that your partner can catch it on the piece of paper.

The light is like messages containing information about Earth's oceans, atmosphere, ecosystems, the location of people needing rescue, etc. These messages can be sent to satellites that relay the information to other locations on Earth that are thousands of miles away.

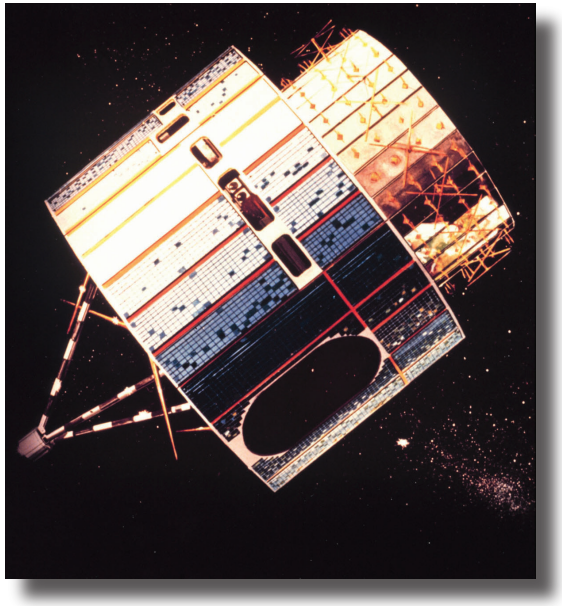
Before satellites were available, messages were sent by bouncing radio signals off of Earth's atmosphere. But because the atmosphere is constantly changing, radio signals don't always bounce to the place that the sender wants them to go. Satellites are above Earth's atmosphere, and are a much more reliable way to communicate.



There are two types of satellites. Geosynchronous satellites are about 22,240 miles above the equator, an travel at a speed (about 6,800 miles per hour) that matches the Earth's rotation. This allows them to hover continuously over one position on the surface. Because they stay above a fixed spot on the surface, they provide a constant lookout for the atmospheric conditions that trigger severe weather events such as tornadoes, flash floods, hail storms, and hurricanes. Polar orbiting satellites circle the Earth 14 times a day, at an altitude of about 500 miles. These satellites pass almost directly over the North and South Poles, and view all regions of the Earth in a single day.

Want to Do More?

1. Visit *http://npoesslib.ipo.noaa.gov/IPOarchive/ED/k-12/IPO/unit01/satellitesAndOrbits.swf* for a Shockwave Flash presentation on artificial satellites.
2. See *http://www.nesdis.noaa.gov/About/onepagers/onepagers.html* for some one-page posters about NOAA's Satellite and Information Service.
3. See *http://www.bu.edu/satellite/classroom/model.html* for directions for making a model of an artificial satellite.
4. See *http://www.sarsat.noaa.gov/* for information about how satellites are used for search and rescue.



Graphic of the Synchronous Meteorological Satellite, a geosynchronous satellite that was the forerunner of the GOES (Geostationary Operational Environmental Satellite) satellites. Courtesy NOAA.