Free Fall

What do falling down an elevator shaft and orbiting Earth have in common? Try these experiments to find out.

Watch Your Weight

Try This:

Stand on a bathroom scale and notice where the needle stops. Watch the needle as you quickly squat down. It will wobble, but which way does it go first? Try this a few times to be sure of your observations.

Hint: *A digital scale won't work for this experiment.*

Materials

- **Bathroom scale**
- **You!**

WHAT'S GOING ON?

Gravity is constantly pulling you against whatever you're standing or sitting on. A chair supports you and keeps you from falling. If the chair suddenly disappears, you fall to Earth. For that split second as you fall, you are in a state known as free fall.

When you stood on the bathroom scale, it supported your weight. When you squatted quickly, for a brief instant you approached free fall and seemed to have no weight. That's why the reading quickly dropped.

If you tried to stand on a scale while falling in an elevator or orbiting Earth, the scale would give you a reading of zero. You might think it's broken, but if you squeezed the scale with your hands, the needle would move. So why wouldn't the scale measure your weight? You and the scale would be in free fall with no support.

Falling Fluids

Try This:

Poke a hole in the side of a plastic bottle. Hold your finger over the hole while you fill the bottle with water. Leave the cap off the bottle and uncover the hole. What do you think is pushing or pulling the water?

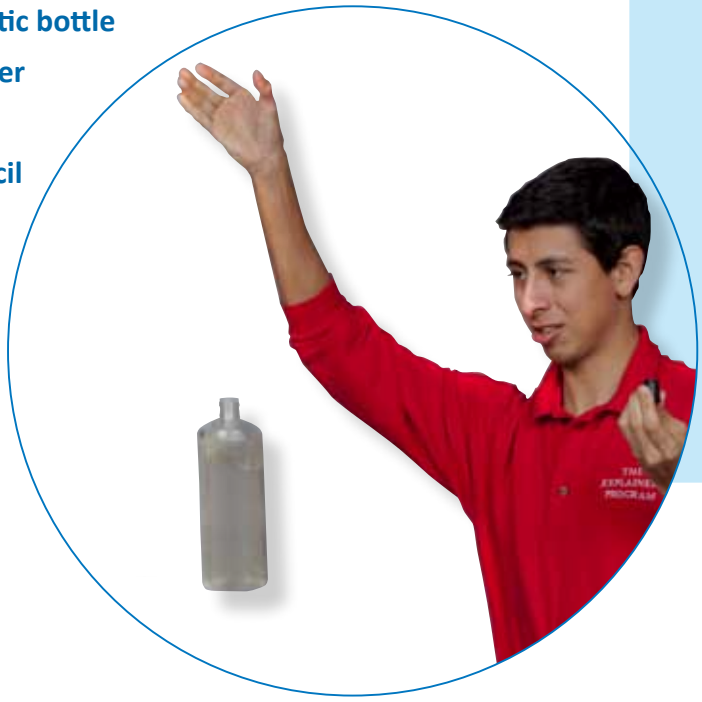
Now Try This:

Fill the bottle again, and while keeping your finger over the hole and the cap off, hold the bottle high and drop it. Pay close attention to what happens. What happens to the stream of water if you jump into the air while holding the bottle? What happens when you toss the bottle into the air? (Be careful not to spin the bottle.)

Hint: *This is a wet activity, so try it outside. Also, ask an adult to help you poke the hole in the bottle. Make the hole first with a straight pin, then widen it with a pencil point.*

Materials

- **Plastic bottle**
- **Water**
- **Pin**
- **Pencil**



WHAT'S GOING ON?

While you were holding the leaky bottle, gravity was pulling both the bottle and water toward Earth, but only the water was falling. You held the bottle against the pull of gravity. When you dropped the bottle, both the water and bottle were in free fall. The only force was the pull of gravity, which acted equally on the water and the bottle. Why did the water stop squirting when you tossed the bottle or when you jumped? Even though the bottle was going up, the bottle and the water were still in a state of free fall because they were no longer supported by anything.

If you poked a hole in the side of a bottle while free falling in an elevator, or while orbiting Earth, the water would remain in the bottle. The only force acting on the bottle and the water is gravity.

Spring Thing

Try This:

Hold the Slinky high in the air by one end. What does it look like? Drop it, while you watch and listen as it falls. What do you notice? Try this with a friend and take turns dropping and watching the Slinky.

Hint: *You'll need to shorten your Slinky for this activity by winding tape around two-thirds of it or having an adult snip the Slinky into thirds.*

Materials

- **Slinky**
- **Wire cutters or tape**

WHAT'S GOING ON?

As you supported one end of the Slinky, you became a force that worked against gravity. When you let go, you took away that force. The Slinky fell and its springiness snapped it shut.

If you tried this in a falling elevator or in orbit around Earth, your Slinky would bunch up while you held it. You could no longer be a force against gravity. You and the Slinky would be in free fall.

WHAT DOES THIS HAVE TO DO WITH FLIGHT?

The effects of being in free fall on Earth are the same as in space. Being in orbit, like most space travel, is a type of free fall. Many people think astronauts are weightless because there is no gravity in space, but this is not true. Gravity is everywhere in our universe. Astronauts or spacecraft in orbit seem weightless because they are in free fall. When in orbit around Earth, a spacecraft is constantly falling. It never hits the ground because it is moving forward and its curving fall matches the curve of the Earth. Understanding free fall is the key to understanding weightlessness!