

## Section 4

### Understanding Earth and Space Systems

# EXPLORATION 2

## Free Fall

Relate weightlessness to gravity.



*We are floating and feel weightless out here in space.*

The moon orbits our Earth because of Earth's gravitational pull. This means that Earth's gravity definitely exists in space, but why is it that astronauts float around in space and feel weightless? How does weightlessness happen and what is the relationship between weightlessness and gravity?



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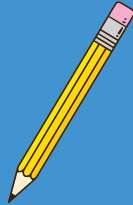
## Free Fall

Try this experiment to explore free fall under gravity.

### Materials:



a pin



a pencil



a water bottle

### Steps:

Use the pin to poke a hole in one side of the water bottle, closer to the bottom, and widen the hole a bit using the pencil. Cover the hole with your finger and fill the bottle three-quarters full with water. Uncover the hole while holding the bottle and leaving the cap off. Observe the flow of water.

Fill the bottle again while keeping your finger over the hole. Hold the bottle high while leaving its cap off. Then drop the bottle. Observe.



*Do this experiment in the backyard or over the bathtub to avoid making a mess.*

When you held the bottle, you stopped the force of gravity from pulling the bottle but the water flowed out because you were not able to stop gravity from pulling the water out through the hole. In contrast, when the bottle was dropped, the water did not flow out. This was because gravity pulled on both the bottle and the water at the same speed; the water was falling with the bottle instead of escaping through the hole. In this situation, both the water and the bottle were in free fall.

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Being in free fall means an object is not supported by anything and the only force exerted on it is gravity. In space, astronauts and the spacecraft with all its contents are actually falling toward Earth. However, they are moving at a speed that keeps them orbiting Earth instead of falling straight toward it, which gives the astronauts the feeling of weightlessness in space.

You may have experienced the sensation of weightlessness while speeding over some rolling hills during a car ride. If you are adventurous enough, you can experience this sensation on a roller coaster. Many roller coasters create short periods of thrilling weightlessness as they rush downward, allowing riders to experience free fall.

*I feel weightless when rushing downward. Woohoo!*

