

Earth, Moon, and Sun ▪ Section Summary

Gravity and Motion

Guide for Reading

- What determines the strength of the force of gravity between two objects?
- What two factors combine to keep the moon and Earth in orbit?

Earth revolves around the sun in a nearly circular orbit. The moon orbits Earth in the same way. But what keeps Earth and the moon in orbit? Why don't they just fly off into space? The first person to answer these questions was the English scientist Isaac Newton. Newton told a story about how watching an apple fall from a tree in 1666 had made him think about the moon's orbit. Newton realized that there must be a force acting between Earth and the moon that kept the moon in orbit. A **force** is a push or a pull.

Newton hypothesized that the force that pulls an apple to the ground also pulls the moon toward Earth, keeping it in orbit. This force, called **gravity**, attracts all objects toward each other. In Newton's day, most scientists thought that forces on Earth were different from those elsewhere in the universe. Although Newton did not discover gravity, he was the first to realize that gravity occurs everywhere. Newton's **law of universal gravitation** states that every object in the universe attracts every other object.

The strength of gravity is measured in units called newtons, named after Isaac Newton. **The strength of the force of gravity between two objects depends on two factors: the masses of the objects and the distance between them.** According to the law of universal gravitation, all of the objects around you are pulling on you. Why don't you notice this pull? Because the strength of gravity depends, in part, on the masses of the objects. **Mass** is the amount of matter in an object.

Because Earth is so massive, it exerts a much greater force on you than a book does. Similarly, Earth exerts a gravitational pull on the moon, large enough to keep the moon in orbit. The force of gravity on an object is known as its **weight**. An object's weight can change depending on its location. For example, on the moon, you would weigh about one-sixth of your weight on Earth. This is because the moon is much less massive than Earth, so the pull of its gravity on you would be much less.

The tendency of an object to resist a change in motion is **inertia**. Isaac Newton stated his ideas about inertia as a scientific law. **Newton's first law of motion** says that an object at rest will stay at rest and an object in motion will stay in motion with a constant speed and direction unless acted on by a force.

Why do Earth and the moon remain in their orbits? **Newton concluded that two factors—inertia and gravity—combine to keep Earth in orbit around the sun and the moon in orbit around Earth.** Earth's gravity keeps pulling the moon toward it, preventing the moon from moving in a straight line. At the same time, the moon keeps moving ahead because of its inertia. If not for Earth's gravity, inertia would cause the moon to move off through space in a straight line. In the same way, Earth revolves around the sun because the sun's gravity pulls on it while Earth's inertia keeps it moving ahead.

Gravity and Motion

Understanding Main Ideas

Answer the following questions in the spaces provided.

1. How are gravity and weight related? _____

2. How does Newton's law of universal gravitation apply to Earth and the moon? _____

3. Use Newton's first law of motion to explain why a basketball rolls across the court. _____

4. How does distance affect the strength of the force of gravity? _____

Building Vocabulary

Write a brief description of each of the following.

5. force _____

6. gravity _____

7. law of universal gravitation _____

8. mass _____

9. weight _____

10. inertia _____

11. Newton's first law of motion _____
