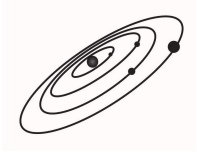
2.2 Gravity and Inertia (6.1.2)

Standard 6.1.2

Develop and use a model to describe the role of gravity and inertia in orbital motions of objects in our solar system.

TABLE 2.5:



As you read, focus on systems, an organized group of related objects. In this section, it is important to examine how the objects in our solar system are affected by gravity and inertia.

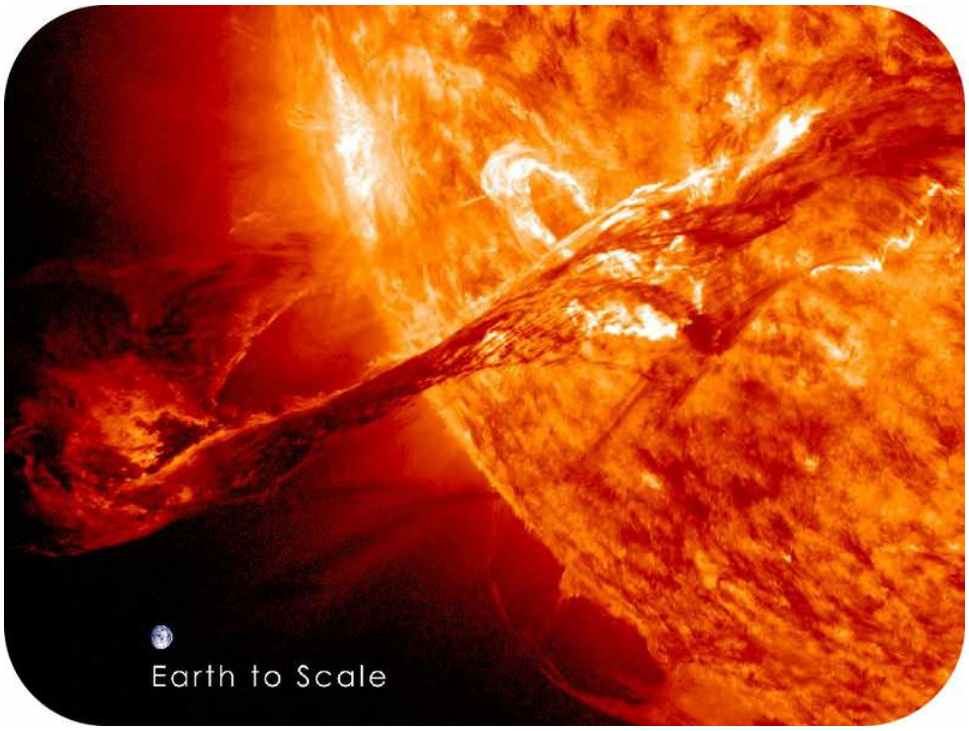
The Role of Gravity and Inertia

Most of the objects that are part of our solar system are constantly orbiting the Sun, the star of our solar system. Mass is a measure of the amount of matter in an object. Everything that has mass also has gravity. Gravity is the attraction of one particle or body to another. You have gravity. Your pencil has gravity.

Larger masses have a stronger gravitational force, or the measurement of the pull of gravity, than smaller masses. The greater the mass of an object, the greater the gravitational pull it has on other objects.

The Sun is the most massive object in our solar system and so it exerts the greatest force of gravity on all the planets. Since the Sun is the largest mass in our solar system, its gravitational force holds Earth and other planets in orbit around it. This force of gravity makes all the planets move in an orbital motion around the Sun instead of moving in a straight line.

The distance between the Sun and each of its planets is very large. The greater the distance between objects, the smaller the force of attraction. The force of gravity is dependent upon the mass of objects and the distance between the two objects. Gravity keeps each planet orbiting the Sun because, despite the large distances, the star and its planets have very large masses. We wouldn't be here without gravity.

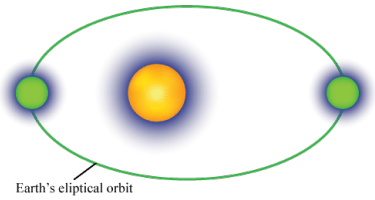


As you can see in this NASA photo, Earth is tiny compared with the massive sun. The Sun's gravity is relatively strong because the force of gravity between two objects is directly proportional to their masses. Gravity pulls Earth toward the Sun, but Earth never falls into the Sun. Instead, it constantly revolves around the Sun, making one complete revolution every 365.25 days, or one year.

The reason the Earth revolves around the Sun instead of falling into it is because of inertia. Inertia is the tendency of an object to resist a change in its motion. All objects have inertia and the inertia of an object depends on its mass. Objects with greater mass also have greater inertia. The Earth's inertia keeps it moving forward at the same time that it is pulled by the Sun's gravitational force. Working together, inertia and gravity cause Earth to orbit the Sun.

Orbital Motion

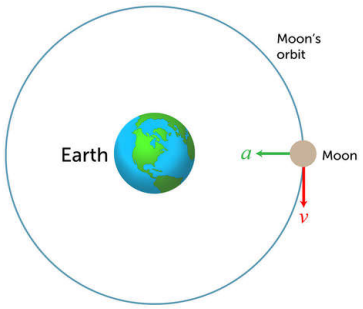
Earth and many other bodies—including asteroids, comets, and the other planets—move around the Sun in curved paths called orbits. Generally, the orbits are elliptical, or oval, in shape. You can see the shape of Earth's orbit in the figure below. Because of the Sun's strong gravity, Earth and the other bodies constantly fall toward the Sun, but they stay far enough away from the Sun because their forward movement causes them fall around the Sun instead of into it. As a result, they keep orbiting the Sun and never crash to its surface. The motion of Earth and the other bodies around the Sun is called orbital motion. Orbital motion occurs whenever an object is moving forward and at the same time is pulled by gravity toward another object.



Orbital Motion of the Moon

Just as Earth orbits the Sun, moons also orbit planets. The Moon is affected by Earth's gravity more than it is by the Sun's gravitational pull because the Moon is much closer to Earth. The Earth's gravity pulls the Moon toward Earth. At the same time, the Moon has forward movement, or inertia, that partly counters the force of Earth's gravity. This inertia causes the Moon to orbit Earth instead of falling toward the surface of the planet.

The figure below shows the forces involved in the Moon's orbital motion around Earth. In the diagram, (v) represents the forward movement, or velocity, of the Moon, and(a) represents the gravity between Earth and the Moon. The line encircling Earth shows the Moon's actual orbit, which results from the combination of v and a.



Focus Questions

- Why is the Sun called the center of the solar system?
- Why doesn't Earth crash into the Sun?
- Why does the Moon maintain its orbit around Earth?

Putting it Together

The picture above shows the Earth in orbit around the Sun.

Consider what you have learned in this section. Develop a revised model to explain why objects in the solar system stay in orbit around the Sun.