

FYI Orbiting

There is a significant gravitational force between Earth and the sun. It is this force that keeps Earth, and all the other planets, in orbit around the sun.

When a ball is dropped from the hand of someone who is standing on Earth, the gravitational force between Earth and the ball pulls the ball toward the center of Earth, causing the ball to fall to the ground. Now consider a thrown ball. The gravitational force between Earth and the ball still pulls the ball toward Earth, but the forward motion caused by the throw means that the ball falls to the ground at a distance from the thrower. Finally, consider a ball thrown so hard that it never falls to the ground! The gravitational force between Earth and the ball still pulls the ball toward Earth, but Earth is a sphere, and the ground curves away from the ball as it falls. The ball actually falls around the planet. It is in orbit, both pulled perpetually toward Earth and moving forward.

When the space shuttle orbits Earth, it acts like the ball that is thrown so hard it never falls to the ground. When the shuttle is launched, its path is not straight up. Instead, the shuttle climbs in a curve that gets flatter and flatter over time. The shuttle ends up having a horizontal speed of about 7.7 kilometers per second. This horizontal speed is enough to make the shuttle—like the ball described above—fall *around* the planet.

The shuttle uses rockets to propel itself into orbit, and it uses its engines to maneuver for special purposes such as docking with the International Space Station, changing to a different orbit, and beginning re-entry. The rest of the time, however, the engines are not used. The horizontal speed achieved as a result of the launch is enough to keep the shuttle falling around Earth. No horizontal force is needed once the shuttle is in orbit.

In the same way, each planet is continually falling around the sun, pulled toward the sun by the gravitational force between them but also moving at high speed along its orbital path. This combination causes the planet to stay in a uniform and unchanging orbit around the sun.

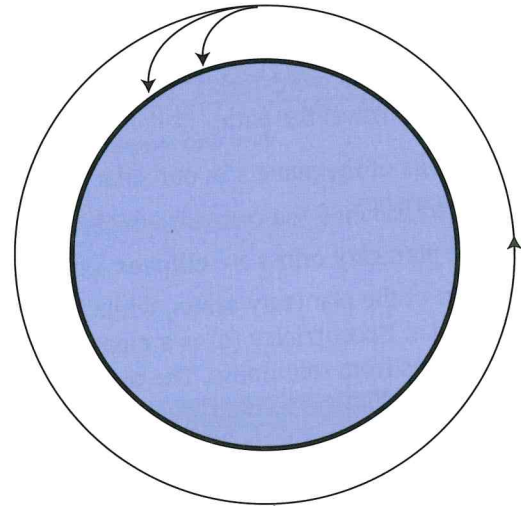


Figure 2-5: Diagram showing hypothetical paths of a ball that is dropped, thrown, and launched into orbit.



Checking In

1. In what way is the shuttle orbiting Earth similar to a planet orbiting the sun?
2. How does the shuttle stay in orbit without constantly using rocket fuel?