

Orbital Motion

How does gravity affect orbital motion in the solar system? The Sun's gravity continuously pulls the planets toward the Sun. But the planets also have a natural tendency to move forward in their orbits at a constant speed and in a straight line until acted upon by an outside force. These two motions – forward motion and motion toward the Sun under the influence of gravity – keep the planets traveling in curved paths in elliptical (oval shaped) orbits around the Sun. If the gravitational force pulling on a planet is bigger, in addition to the planet's tendency to continue moving forward, then its orbital velocity will be bigger too. Without the Sun's gravity, all objects in the solar system would move a straight line into outer space.

All planets orbit the Sun in a counterclockwise direction (as seen from Earth's North Pole) with those planets closest to the Sun traveling the shortest distance. Because the planets and the Sun originally were formed from the same rotating disk of dust and gas, it is logical that the counterclockwise direction of planetary revolution coincides with the Sun's counterclockwise rotation. Most of the planets rotate in a counterclockwise direction as well. Venus is an exception because it is tilted nearly 180° onto its axis. This means that from the Earth's North Pole, Venus appears to rotate in a clockwise, or retrograde, direction.

Unbalanced Forces Defined

Unbalanced forces are forces that cause a change in the motion of an object. Any push or pull is a **force**. A force can do three things to an object: cause an object to start moving, stop moving or change direction. To describe a force, you must know two things. You must know the size of the force and the direction of the force. Suppose two teams are playing tug of war. Each team is pulling with equal force, but in opposite directions. Neither team can make the other team move. Forces that are equal in size but opposite in direction are called **balanced forces**.



Balanced forces

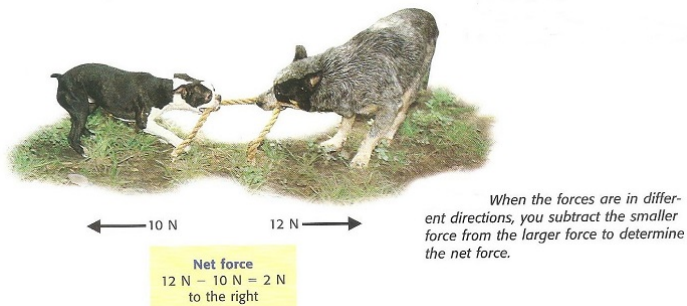
Balanced forces do not cause a change in motion. When balanced forces act on an object at rest, the object will not move. If you push against a wall, the wall pushes back with an equal but opposite force. Neither you nor the wall will move. Forces that cause a change in the motion of an object are **unbalanced forces**. Unbalanced forces are not equal and opposite. Suppose that one of the teams in tug of war pulls harder than the other team. The forces would no longer be equal. One team would be able to pull the other team in the direction of the larger force.

Force and Motion

More than one force can act on an object at the same time. If you hold a paper clip near a magnet, you, the magnet and gravity all exert forces on the paper clip. The combination of all the forces acting on an object is the **net force**. When more than one force is acting on an object, the net force determines the motion of the object. In this example, the paper clip is not moving, so the net force is zero.

How do forces combine to form the “net force”? If the forces are in the same direction, they add up together to form the net force. Suppose you and a friend are asked to move a piano for the music teacher. To do this, you pull on one end of the piano, and your friend pushes on the other end. Together, your forces add up to enough force to move the piano. This is because your forces are in the same direction. *Because the forces are in the same direction, they can be added together to determine the net force.*

If two forces are in opposite directions, then the net force is the difference between the two forces, and it is in the direction of the larger force. Consider two dogs playing tug of war with a short piece of rope. Each is exerting a force, but in opposite directions. Notice that the dog on the left is pulling with a force of 10 N, and the dog on the right is pulling with a force of 12 N. *Because the forces are in opposite directions, the net force is determined by subtracting the smaller force from the larger one.* In this case, the net force is 2 N in the direction of the dog on the right. Give that dog a treat!



Unbalanced Forces in Action

Unbalanced forces can change the motion of an object in two ways. When unbalanced forces act on an object at rest, the object will move. Unbalanced forces are necessary to cause a non-moving object to start moving. Second, when unbalanced forces act on a moving object, the velocity of the object will change. Remember that a change in velocity means a change in speed, direction, or both speed and direction.

For example, consider a soccer game. The soccer ball is already moving when it is passed from one player to another. When the ball reaches the second player, the player exerts an unbalanced force - a kick - on the ball. After the kick, the ball moves in a new direction and with a new speed.



Reading Questions: Answer in complete sentences in your spiral -

- Describe a “balanced force” and give an example of one.
- Describe an “unbalanced force” and give an example of one.
- What is the definition of “force”?
- List 3 things that a force can **do** to an object?
- Is a soccer ball being kicked balanced or unbalanced?