



SCIENCE
Fusion Physical Science
HOLT McDUGAL

PowerNotes

Unit 1 Lesson 3 Forces

A Tour de Forces

What is a force, and how does it act on an object?

- In science, a **force** is a push or a pull.
- All forces are vectors. This means they have both a size and a direction.
- The unit used to express force is the newton (N).
- Forces do not always cause motion.



What is a force, and how does it act on an object?

- Forces can act on objects that are in contact with each other. Such a force is called a contact force.
- *Friction* is an example of a contact force between two surfaces that are touching.
- Car tires rely on friction to keep a moving car from sliding off a road. Cars may slide on icy roads because ice lowers the force of friction on the tires.



What is a force, and how does it act on an object?

- Forces can also act on objects that are at a distance.
- Gravity is a force that pulls objects toward Earth.
- Magnetic forces can also act at a distance. Magnetic force can be a pull, as when a magnet holds paper to a metal refrigerator door, or a push, as when like poles of two magnets push each other apart.



In the Balance

What happens when multiple forces act on an object?

- The **net force** is the combination of all the forces acting on an object.
- When forces act in the same direction, they are added to determine net force.
- When forces act in opposite directions, the smaller force is subtracted from the larger force.



What happens when multiple forces act on an object?

- A net force of zero means the forces are balanced and will not cause a change in motion.
- Unbalanced forces produce a change in an object's motion. The object could change speed, direction, or both. This change in motion is called an acceleration.
- Acceleration is always in the direction of the net force.



What happens when multiple forces act on an object?

- What forces are acting on this box? How could you determine whether the forces are balanced or unbalanced?



It's the Law

What is Newton's First Law of Motion?

- Sir Isaac Newton described three laws of motion that explain the relationship between force and motion.
- Newton's first law describes the motion of an object that has a net force of 0 N acting on it.
- The law states: *An object at rest stays at rest, and an object in motion stays in motion at the same speed and direction, unless it experiences an unbalanced force.*



What is Newton's First Law of Motion?

- Newton's first law is also called the law of inertia.
- **Inertia** is the tendency of all objects to resist any change in motion.
- The law of inertia explains why a chair will not slide across the floor unless a force pushes the chair, and why a golf ball will not leave the tee until a force pushes it off.



What is Newton's First Law of Motion?

- Use Newton's first law to explain why the dishes remain in place when the magician pulls the cloth out from under them.



What is Newton's Second Law of Motion?

- Newton's second law states: *The acceleration of an object depends on the mass of the object and the amount of force applied.*
- force = mass \times acceleration ($F = ma$)



Newton's Second Law and You

- Have you ever been on a roller coaster? Did you feel like you were going to float out of your seat when you went over a big hill?
- When a roller coaster is going up a hill, there are two important forces acting on you: the force of gravity and the upward force exerted by the roller coaster seat.
- Once the roller coaster starts down the other side of the hill, it accelerates downward, and your seat does not support your full weight.



Newton's Second Law and You

- The airplane's path looks like a roller coaster hill. As the plane accelerates downward, the passengers lose contact with the plane and fall toward Earth. This condition is called free fall.



It's the Law

What is Newton's Third Law of Motion?

- Newton's third law states: *Whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first.*
- In other words, all forces act in pairs.
- Action and reaction forces are present even when there is no motion.



What is Newton's Third Law of Motion?

- Even though action and reaction forces are equal in size, their effects are different.
- An object can have multiple forces acting on it at once. When this happens, each force is part of a force pair.

