

Section 1 Newton's Second Law

- A. Force and motion are connected.
1. An object will have greater acceleration if a greater force is applied to it.
 2. The mass of an object and the force applied to it affect acceleration.
- B. **Newton's second law of motion** connects force, mass, and acceleration in the equation *acceleration equals net force divided by mass*.
- C. **Friction**—force that opposes motion between two surfaces that are touching each other
1. Microwelds, areas where surface bumps stick together, are the source of friction.
 2. Friction between two surfaces that are not moving past each other is called static friction.
 3. Sliding friction—force that opposes the motion of two surfaces sliding past each other
 4. Friction between a rolling object and the surface it rolls on is called rolling friction.
- D. Air resistance opposes the motion of objects that move through the air.
1. The amount of air resistance depends on an object's shape, size, and speed.
 2. **Terminal velocity**—forces on a falling object are balanced and the object falls with constant speed

Discussion Question

What three variables does Newton's second law of motion connect?

Acceleration, net force, and mass



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Content Outline
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Forces

Underlined words and phrases are to be filled in by students on the Note-taking Worksheet.

Section 2 Gravity

- A. Law of gravitation—any two masses exert an attractive force on each other.
1. Gravity is one of the four basic forces that also include the electromagnetic force, the strong nuclear force, and the weak nuclear force.
 2. Gravity is a long-range force that gives the universe its structure.
- B. Due to inertia, all objects fall with the same acceleration regardless of mass.
- C. Weight—gravitational force exerted on an object
1. Weight decreases as an object moves away from Earth.
 2. Weight results from a force; mass is a measure of how much matter an object contains.
- D. Objects in the space shuttle float because they have no force supporting them.
- E. Projectiles have horizontal and vertical velocities due to gravity, and follow a curved path.
- F. Acceleration toward the center of a curved path is called **centripetal acceleration**; it is caused by **centripetal force**, an unbalanced force.

Discussion Question

How do weight and mass differ? Weight is a result of a force; mass is a measurement of matter in an object.

END

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Section 3 The Third Law of Motion

- A. **Newton's third law of motion**—to every action force there is an equal and opposite reaction force.
1. Action-reaction forces act on different objects and differ from balanced forces.
 2. Rocket propulsion is based on Newton's third law of motion.
- B. Before it was discovered, the existence of the planet Neptune was predicted based on gravitational forces and Newton's laws.
- C. Momentum—related to how much force is needed to change an object's motion; momentum equals mass times velocity.
- D. Law of conservation of momentum—momentum can be transferred between objects; momentum is not lost or gained in the transfer.

Discussion Question

What does the law of conservation of momentum state? Momentum is not lost or gained when transferred between objects.

