### 3A: Newton’s Laws Overview

- **balanced forces** - when the sum of the forces acting on an object are equal the object will remain at rest, or it will move at a constant velocity.
- **force** - a push or pull.
- **net force** - the sum of all of the forces acting on an object.
- **Newton’s 1st Law of Motion** - an object at rest remains at rest unless an external unbalanced force acts on it; an object in motion remains in motion unless an external unbalanced force acts on it.
- **Newton’s 2nd Law of Motion** - an object accelerates in the direction of the net force acting on it.
- **Newton’s 3rd Law of Motion** - for every action, there is an equal yet opposite reaction.
- **unbalanced forces** - when the sum of the forces acting on an object are not equal, the object will accelerate or decelerate.

### 3B: Free Body Diagrams

- **balanced forces** - when the sum of the forces acting on an object are equal the object will remain at rest, or it will move at a constant velocity.
- **force** - a push or a pull.
- **free body diagram** - a figure used to visualize the forces acting on an object in a given condition.
- **net force** \( F_{\text{net}} \) - the sum of all of the forces acting on an object.
- **unbalanced forces** - when the sum of the forces acting on an object are not equal, the object will accelerate or decelerate.

### 3C: Newton’s Second Law Part 1

- **contact force** - a push or pull transmitted across objects touching one another; examples are the applied force, spring force, and the normal force.
- **field force** - pushes or pulls that occur between two objects without the objects touching one another; examples are gravity and the electrostatic force.
- **friction** - a force that resists motion.
- **gravity** \( F_G \) - one of the four fundamental forces of the universe; is exerted by anything that has mass on anything else that has mass.
- **inverse-square law** - any law stating that a quantity decreases with the inverse square of a physical parameter such as distance.
- **net force** \( F_{\text{net}} \) - the sum of all of the forces acting on an object.
newton (N) - a derived unit of measurement for force; one newton is equal to one kilogram times meters divided by seconds squared (kgm/s²).

Newton’s 2nd Law of Motion - an object accelerates in the direction of the net force acting on it.

normal force (Fₙ) - the support force exerted upon an object by a surface; is always perpendicular to the surface.

weight (w) - the force due to gravity acting on an object; equal to the mass of an object multiplied by the acceleration due to gravity on Earth.

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coefficient of friction (μ) - a ratio of the amount of resistance between two objects.

friction - the resistive force between two objects.

static friction (Fₛ) - Friction that occurs when two objects are at rest relative to each other.

kinetic friction (Fₖ) - the slowing force between two objects moving past each other; one object, or both, can be moving.

net force (Fₙₑₜ) - the sum of all of the forces acting on an object.

newton (N) - a derived unit of measurement for force; one newton is equal to one kilogram times meters divided by seconds squared (kgm/s²).

Newton’s 2nd Law of Motion - an object accelerates in the direction of the net force acting on it.

normal force (Fₙ) - the support force exerted upon an object by a surface; is always perpendicular to the surface.

weight (w) - the force due to gravity acting on an object; equal to the mass of an object multiplied by the acceleration due to gravity on Earth.

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action-reaction pairs - pairs of objects in which one object exerts a force, known as the action, on another object, and the other object reacts to that action in a way in which the force is equal in magnitude but opposite in direction.

Newton’s 3rd Law of Motion - for every action there is an equal and opposite reaction.
### Unit 3: Forces

#### 3F: Gravity

- **air resistance** - the frictional force that air exerts on objects; also known as drag, $F_D$.
- **gravity** ($F_G$) - one of the four fundamental forces of the universe; is exerted by anything that has mass on anything else that has mass.
- **Newton’s Universal Law of Gravitation** - the gravitational force between two objects increases with and is proportional to the increasing mass and decreases with the square of the distance between them.
- **terminal velocity** - when the force due to gravity equals the force due to air resistance acting on a falling object and the object stops accelerating and moves at a constant velocity.
- **weight** ($w$) - the force due to gravity acting on an object; equal to the mass of an object multiplied by the acceleration due to gravity on Earth.

#### 3G: Circular Motion

- **centripetal acceleration** ($a_c$) - the acceleration of an object moving in a circle that is directed toward the center of the circle.
- **centripetal force** ($F_c$) - any force that causes an object to move in a circle.
- **circular motion** - anytime an object moves in a way that traces out a circular path.
- **period** ($T$) - the time it takes to go around a circle once.
- **tangential velocity** ($v_T$) - the velocity of an object in its circular path that is directed tangent to the circle at that given point.