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Lesson 7
Force and Motion

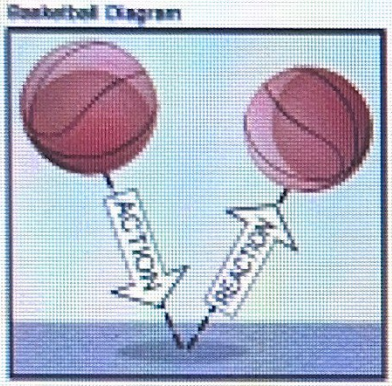
Perhaps you recall Sir Isaac Newton as the individual who made a significant discovery thanks to a falling apple. However, his masterwork, **Principia**, published in 1687, goes much further. In this extraordinary manuscript, Newton amalgamated his hypotheses regarding the movement of things with theories proposed by numerous other scientific minds.

To begin, we must understand that a **force**, which is a push or a pull that possesses both magnitude and direction, plays a central role in the motion of objects. An instance of this would be the wind's force capable of shifting a sheet of paper. Force can also be exerted by your own arms when pulling on a rope. Meanwhile, **friction** is the force that hampers the motion of one surface gliding past another. **Kinetic friction**, or what is sometimes known as *sliding friction*, works against the movement of a mobile object. When you slide or ski down a hill blanketed with snow, you are experiencing kinetic friction. Contrarily, **static friction** obstructs movement from a stationary position, thereby preventing any motion.

Moving on, we delve into Newton's **first** law of motion, often referred to as the law of **inertia**. This principle stipulates that, unless acted upon by a force, a moving object will persist in moving with a consistent speed and direction, while a stationary object remains at rest. Picture a soccer ball at a standstill. The ball would stay put until some force, perhaps your foot kicking it, instigates its movement. It will then persist in moving until it meets a force that modifies its **velocity**, such as friction from the ground or striking the soccer net. The law of inertia is the reason seatbelts are indispensable in a moving car. When the vehicle brakes suddenly, the force applied alters the car's speed. However, your body's inertia continues to move at the vehicle's previous speed, making you feel as though you're being thrust forward.

Next comes Newton's **second** law of motion, which states that a force instigates an object's acceleration. Acceleration refers to the modification of an object's movement. The acceleration of an object correlates with the object's mass, which is the measure of matter, and the amount of force exerted on the object. Objects with more substantial mass have lesser acceleration, while objects subjected to a greater force exhibit higher acceleration. If you find a box of books too cumbersome to shift, you could lessen the mass by taking out a few books or boost the force by asking another person to assist in moving the box.

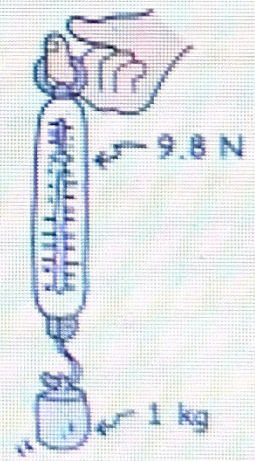
Basketball Diagram



Newton's **third** law of motion describes the principle of action and reaction. When a force is exerted on an object, that object retaliates with an equivalent force in the opposite direction. This concept can be easily grasped by imagining a basketball hitting the ground. The basketball exerts a force on the ground, and simultaneously, the ground reacts with a force on the basketball.

In addition to these laws, Isaac Newton also elucidated the laws of momentum. **Momentum** is a measure that takes into account both the mass of an object and its velocity. A massive truck possesses more momentum than a compact car moving at the same speed due to its larger mass. Nevertheless, the car could surpass the truck in momentum if it travels fast enough.

Furthermore, Newton explored the concept of **gravitational force**, which is the force of attraction between any two objects in the universe. He explicated that the gravitational force is stronger between objects with larger masses and increases as objects draw nearer to each other. The Earth's gravitational force exerted on an object can be gauged by weighing it, thereby determining the object's **weight**. The unit of force is the **Newton (N)**, with one Newton being the force necessary to alter the speed of a one-kilogram object by one meter per second every second.



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1. What does the word **force** mean in the context of the passage?
   - **A.** A group of people
   - **B.** A unit of weight
   - **C.** A push or a pull with size and direction
   - **D.** A type of motion

2. What is kinetic friction?
   - **A.** The force that opposes movement from a resting position
   - **B.** The force that hampers the motion of one surface gliding past another
   - **C.** The force that opposes the motion of a mobile object
   - **D.** The force that resists the movement of two objects coming closer

3. What does Newton's first law of motion, also known as the law of inertia, state?
   - **A.** Force causes an object to accelerate
   - **B.** Object exerts an equal force in the opposite direction when force is applied
   - **C.** Unless a force is applied, an object in motion continues to move with a constant velocity, while a motionless object remains still
   - **D.** The quantity of momentum is dependent on the mass and velocity of an object

4. How does Newton's second law of motion relate to an object's mass and the amount of force applied to the object?
   - **A.** Objects with a greater mass have more acceleration
   - **B.** Objects with a greater mass have less acceleration
   - **C.** Objects given a lesser force have greater acceleration
   - **D.** Objects given a greater force have less acceleration

5. What does Newton's third law of motion state?
   - **A.** A moving object will continue to move unless a force is applied
   - **B.** When force is applied to an object, the object exerts an equal force in the opposite direction
   - **C.** The gravitational force increases as objects draw nearer to each other
   - **D.** Force causes an object to accelerate

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6. What is momentum?
   - A. The measure of how much force an object can exert
   - B. The measure that takes into account both the mass of an object and its velocity
   - C. The measure of the resistance of an object to change in its motion
   - D. The measure of how quickly an object can accelerate

7. What does gravitational force refer to?
   - A. The force needed to move an object
   - B. The force of attraction between any two objects in the universe
   - C. The force that opposes the motion of a mobile object
   - D. The force that changes the velocity of an object

8. How can one measure the Earth's gravitational force on an object?
   - A. By observing the object's speed
   - B. By observing the object's direction
   - C. By measuring the object's acceleration
   - D. By weighing the object

9. How much force does one Newton represent?
   - A. The force needed to change the speed of a one-kilogram object by two meters per second each second
   - B. The force needed to change the speed of a one-kilogram object by one meter per second each second
   - C. The force needed to move a one-kilogram object by one meter
   - D. The force needed to stop a one-kilogram object moving at one meter per second

10. How would the measurement of weight change at a place with less gravity?
   - A. The weight would increase
   - B. The weight would stay the same
   - C. The weight would decrease
   - D. The weight would double