

Learning Target (S8P3.b): I can construct an explanation using Newton's Laws of Motion to describe the effects of balanced and unbalanced forces on the motion of an object.

FSI Reading for Meaning: How Forces Control Motion - Balanced and Unbalanced Forces

Every moving object on Earth is affected by forces. A force is a push or a pull that can change an object's speed, direction, or position. Whether or not an object's motion changes depends on how the forces acting on it interact. These forces can be classified as **balanced** or **unbalanced**, and their effects can be explained using **Newton's Laws of Motion**.

When forces acting on an object are **balanced**, they are equal in strength and opposite in direction. Balanced forces result in a **net force of zero**. According to **Newton's First Law of Motion**, an object at rest will remain at rest, and an object in motion will continue moving at a constant speed in a straight line unless acted upon by an unbalanced force. This means balanced forces do not cause a change in motion. For example, a book resting on a table remains still because the downward force of gravity is balanced by the upward force from the table.

In contrast, **unbalanced forces** occur when the forces acting on an object are not equal, resulting in a **nonzero net force**. Unbalanced forces cause a change in motion, such as speeding up, slowing down, stopping, or changing direction. **Newton's Second Law of Motion** explains this relationship by stating that an object's acceleration depends on the net force acting on it and the object's mass. This law helps explain why pushing a lightweight object causes it to accelerate more than pushing a heavier object with the same force.

Newton's Laws also explain how forces act in pairs. **Newton's Third Law of Motion** states that for every action force, there is an equal and opposite reaction force. These force pairs act on different objects, not the same one. For example, when a runner pushes backward on the ground, the ground pushes forward on the runner, allowing the runner to move forward.

Understanding how balanced and unbalanced forces affect motion allows scientists and engineers to predict movement in real-world situations, from vehicle safety systems to sports performance. By analyzing forces and applying Newton's Laws, motion can be explained using clear cause-and-effect relationships supported by evidence.

1. (DOK 3) A skateboarder moves at a constant speed in a straight line across smooth pavement. Which conclusion best explains this motion?

- A. The skateboarder has no forces acting on them
- B. The forces acting on the skateboarder are balanced
- C. The skateboarder is accelerating forward
- D. The skateboarder's mass is increasing

2. (DOK 3) Two students push identical carts with different amounts of force. One cart accelerates faster than the other. Which statement best explains this observation?

- A. The cart with greater mass accelerates more
- B. Acceleration depends on the net force applied
- C. Balanced forces cause changes in motion
- D. Newton's First Law explains acceleration

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3. (DOK 3) A student pushes a box across the floor. The box starts moving, then gradually slows down and stops. Which explanation best describes why the motion changes?

- A. Balanced forces cause the box to slow down
- B. Gravity stops the box from moving
- C. Unbalanced forces act in the opposite direction of motion
- D. The box loses mass as it moves

4. (DOK 3) Which situations describe balanced forces acting on an object?

Select all that apply.

- A. A book resting on a table
- B. A car accelerating forward
- C. A skydiver falling at constant speed
- D. A soccer ball being kicked
- E. A hockey puck sliding at constant speed

5. (DOK 4) A stationary soccer ball is kicked and begins moving forward. Which statements correctly describe the forces involved? Select all that apply.

- A. The force from the foot creates an unbalanced force
- B. The ball experiences a change in motion due to net force
- C. The force on the ball and the force on the foot act on the same object
- D. Newton's Second Law explains the acceleration of the ball
- E. Balanced forces cause the ball to move forward

6. (DOK 4) Which explanation best uses Newton's First Law to describe why a rolling ball eventually stops on grass?

- A. The ball stops because gravity increases
- B. Balanced forces keep the ball moving
- C. Friction creates an unbalanced force that changes motion
- D. The ball loses inertia

7. (DOK 3) A truck and a bicycle are pushed with the same force. The bicycle accelerates more. What is the best explanation?

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| A. The truck experiences more friction | B. The bicycle has less mass |
| C. The bicycle has balanced forces | D. The truck has greater speed |

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8. (DOK 4) A runner pushes backward against the ground to move forward. Which statements correctly explain this using Newton's Laws? *Select all that apply.*

- A. The ground pushes forward on the runner
- B. The forces act on different objects
- C. The forces cancel each other out on the runner
- D. This is an example of Newton's Third Law
- E. The net force on the runner must be zero

9. (DOK 4) Which scenario best demonstrates unbalanced forces causing a change in direction?

- A. A parked car
- B. A train moving at constant speed
- C. A car turning a curve
- D. A book resting on a desk

10. (DOK 4) Why is understanding balanced and unbalanced forces important in vehicle safety design? *Select all that apply.*

- A. It helps engineers predict how vehicles will stop
- B. It explains how acceleration changes during collisions
- C. It prevents Newton's Laws from applying
- D. It helps design seatbelts and airbags
- E. It ensures forces are always balanced during crashes