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TEACHER GUIDE

BALANCED AND UNBALANCED FORCES GRADES 3-5

COMMON MISCONCEPTIONS

- **Gravity is only a force when something is falling (in motion).**
Student understanding of gravity may be limited to objects that are falling, not objects that are at rest. Students need to understand that gravity is always pulling objects toward the Earth, and if they are not moving in a downward direction, it is because the downward force of gravity is balanced by an upward force.
- **The Earth pushing up on an object is not a force.**
It may be difficult for students to visualize the Earth (or a table, desk, etc.) as a contact force pushing up against an object that is being pulled down due to gravity. Students need to learn to consider all contact and non-contact forces acting within a system and identify the upward force of a surface on which an object rests.

FORCES

By third grade, students should have already been introduced to the concept of forces, at least as pushes and pulls. At this level, students should solidify their understanding that forces have both strength and direction. The golf section of the video does a great job explaining this concept. When only direction is considered, Izzy applies too much strength. When only strength is considered, Zoe hits the ball in the wrong direction. Both strength and direction are necessary to hit the ball into the cup.

At this level, we take student understanding of strength and direction into new territory by considering forces acting in opposite directions that cancel each other out. Examples are qualitative, not quantitative. We only focus on the fact that if forces are equal and opposite, the object is at rest; if forces are unbalanced, the object moves.

Forces involved in this lesson are both contact and non-contact (gravity). Students need to begin to visualize gravity as an ever-present (on Earth) force that is always acting upon an object. If the object is not moving towards the Earth, it is due to balanced forces—something is pushing up on it. If it is moving due to gravity, the forces must be unbalanced.

EGG DROP AND TABLECLOTH PHENOMENON

Newton's First Law of Motion states that objects at rest remain at rest, while objects in motion stay in motion unless acted upon by an unbalanced force. Newton's Second Law can be paraphrased such that the motion of an object is directly proportional to the magnitude of the net force in the same direction of the net force (and is inversely proportional to the object's mass). Although not explicitly stated, the concepts put forth through both of these laws are inherent in the Disciplinary Core Idea addressed here.

Initially, during both the egg drop and tablecloth activities, the forces are balanced. The key to this is the speed at which the plate/tube and tablecloth are removed. If either were removed with less force, it would cause them to move in the same direction as the tube or tablecloth (try it slower and you will observe this). However, with enough strength applied to the force, the plate/tube or tablecloth are removed so quickly that the force with which they were pushing up against (the egg or place settings) is simply removed, resulting in unbalanced forces on and downward motion of those objects.

