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LESSON PLAN

BALANCED AND UNBALANCED FORCES GRADES 3-5

SUMMARY

Students identify and explain how strength and direction of forces can lead to motion.



3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Science & Engineering Practices	Connections to Classroom Activity
Planning and Carrying Out Investigations Connections to Nature of Science Scientific Investigations Use a Variety of Methods	<ul style="list-style-type: none">• Students conduct an investigation, varying strength and direction of forces through a number of trials to produce data as the basis of evidence that balanced and unbalanced forces affect the motion of objects.• Students use tug of war as a method for their experiment.
Disciplinary Core Ideas	Connections to Classroom Activity
PS2.A: Forces and Motion Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero	<ul style="list-style-type: none">• Through a variety of examples students observe and experience that forces have strength and direction, an object at rest has balanced forces acting on it, and an object in motion has unbalanced forces on it and the strength and direction of those forces

can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)

PS2.B: Types of Interactions

Objects in contact exert forces on each other.

affect the object's direction of motion.

- Students observe balanced and unbalanced contact forces and non-contact forces through a variety of scenarios.

Crosscutting Concepts

Cause and Effect

Connections to Classroom Activity

- Students observe and write about how unbalanced forces cause motion.

DURATION

One to two 45-minute classroom periods

PRE-ASSESSMENT QUESTIONS

Please see Discussion Questions. These can be discussed as a group or answered individually in student science notebooks.

MATERIALS

- Science notebooks
- Pencils
- Water
- String
- Scissors
- Plastic cups (at least one per four students)
- Eggs (at least one per four students)
- Metal or plastic plate (e.g. pie pan—at least one per four students)
- Toilet paper tubes (at least one per four students)
- Bouncy ball



ENGAGE

Demonstrate, or show a video, of a tablecloth being pulled off a table without disturbing the place settings. Explain to students that through this lesson they will be exploring how pushes and pulls—forces—on objects cause them to move or not move.



EXPLORE

Explain to students that to understand what is happening in the tablecloth phenomena, they must first understand how forces work together. To do this they will use a game called “tug of war.” Pair off students and assign them partner A or B. Give them a ~2 foot piece of string or rope. Explain that they will each pull on the string and adjust the forces (independent variable) to test out what happens to the motion of their partner's hand (dependent variable) through the following scenarios. **Emphasize safety and do this outside or in the gym.** In their science notebooks they should make a prediction about which way, if any, each partner's hand will move during each scenario.

- Partner A pulls with the same amount of force as Partner B (neither partner will move)
- Partner A pulls with more force than Partner B (Partner B will move in the direction of Partner A)
- Partner B pulls with more force than Partner A (Partner A will move in the direction of Partner B)
- While both partners are pulling, the rope is cut (they will both move)

Organize the students into pairs and run through the scenarios. After each scenario, they should record their actual observations of what happened next to their prediction for that scenario. Were their predictions correct? Why or why not?



EXPLAIN

Explain to students that they will now watch the Generation Genius episode where a full explanation of what happened will be provided.



WATCH THE GENERATION GENIUS BALANCED AND UNBALANCED VIDEO AS A GROUP.

Then facilitate a conversation using the Discussion Questions.



ELABORATE

Provide materials for students to try Zoe's DIY Activity egg drop. Allow them to experiment with the amount of force applied to the plate, and to stack additional materials. What works and what does not? Why?



EVALUATE

In their science notebooks, have students individually explain the forces involved in the egg drop demo. Ask them to compare this to the tablecloth demo from the Engage portion of the activity. Students should also write a short paragraph explaining how cause and effect relationships are demonstrated by unbalanced forces and motion of an object. (*Gravity is pulling the table settings down, while the table cloth and table underneath are pushing them up. Forces are balanced. When the tablecloth is pulled out with enough force, the forces on the place settings are no longer balanced and they fall to the table. There are no forces pulling the place settings to the side so they remain where they were sitting.*)* (*Cause and Effect: Motion of an object is caused by unbalanced forces acting upon it. If an object is not moving, it is because the forces on it are balanced. When the forces become unbalanced, the effect is the object moves in the direction of the larger force.*)

**This is an early understanding of the concept of inertia based on Newton's First Law of Motion.*