Balanced And Unbalanced Forces

Physical Science | Lesson Guide

2nd Grade

Photo Description

This image shows a large yellow backhoe (a digging machine) with its bucket and arm extended. A man stands beside it, and another person sits in the operator's seat. The backhoe uses powerful machines to move heavy objects like dirt and rocks that people cannot move by hand alone. The machine demonstrates how forces can push, pull, and lift things.

Scientific Phenomena

Anchoring Phenomenon: How can machines help us move things that are too heavy to move by ourselves?

Why This Is Happening:
A backhoe uses balanced and unbalanced forces to move heavy materials. When the operator moves the controls, hydraulic power (fluid pressure) pushes metal arms and buckets. These machines create very large forces that can overcome the weight of heavy rocks, dirt, and debris. The unbalanced forces created by the machine's arms are strong enough to lift and move objects that would require many people to move by hand. This demonstrates Newton's Second Law: the more force applied, the more an object will move.

Core Science Concepts

* Push and Pull Forces: The backhoe uses pushing and pulling motions to move heavy objects. A push or pull is a force that makes something move.

* Simple Machines: The backhoe's arm works like a lever—a simple machine that helps us lift heavy things by using a pivot point. The longer the arm, the easier it is to lift heavy loads.

* Effort and Load: The backhoe reduces the effort (work) needed by the operator to move a heavy load (the dirt or rocks). What would take many people working together, one person can do with the machine.

* Overcoming Resistance: Gravity pulls objects down, and friction resists movement. The backhoe creates enough force to overcome both of these resistances.

Pedagogical Tip:

Use the "before and after" strategy: Ask students to imagine 10 people trying to move a pile of rocks with their hands, then show them how one person with a backhoe can do the same job. This concrete comparison helps Second Graders understand why machines are useful and connects to their real-world experiences.

UDL Suggestions:

Multiple Means of Engagement: Some students may feel intimidated by large machinery. Consider showing videos of smaller, child-sized simple machines (ramps, levers with blocks) alongside the backhoe image. This scaffolds understanding and builds confidence. Additionally, provide tactile models of levers that students can manipulate themselves to feel how effort changes with lever length.

Discussion Questions

1. What do you think would happen if the backhoe tried to lift something even heavier than these rocks? (Bloom's: Predict | DOK: 2)

2. Why do you think people invented machines like backhoes instead of always moving rocks by hand? (Bloom's: Analyze | DOK: 3)

3. How is the backhoe's arm like your own arm when you pick something up? (Bloom's: Compare | DOK: 2)

4. What other machines have you seen that use pushing or pulling to move things? (Bloom's: Recall/Apply | DOK: 1-2)

Extension Activities

1. Lever Investigation Station: Provide students with rulers, pencils (as fulcrums), and blocks or objects of different weights. Have them experiment with moving the "load" (blocks) by changing where they place the fulcrum under the ruler. Ask: "Where does the fulcrum need to be to make lifting easier?" This hands-on activity lets students discover that longer levers require less effort.

2. Class Ramp Challenge: Set up a ramp (a board tilted at an angle). Have students predict which objects will roll down, how far they'll go, and how much force they need to push objects up the ramp. This connects to the backhoe's work of moving objects against gravity.

3. Design Your Own Simple Machine: Give students paper, straws, paper cups, and tape. Challenge them to design a simple machine (a lever, pulley system, or ramp) that can move a small object across the table. Have them test and improve their designs, discussing which parts help create the necessary force.

NGSS Connections

Performance Expectation:
2-PS2-1: Plan and conduct an investigation to provide evidence that a push or a pull can change the speed or direction of an object.

Disciplinary Core Idea:
2-PS2.A - Forces and Motion

Crosscutting Concepts:
* Cause and Effect
* Systems and System Models

Science Vocabulary

* Force: A push or pull that makes something move, stop, or change direction.

* Machine: A tool that helps people do work by making tasks easier or faster.

* Lever: A simple machine with a long arm that helps lift or move heavy things.

* Load: The heavy object that needs to be moved or lifted.

* Effort: The amount of work or force a person has to use to move something.

* Hydraulic: A system that uses liquid (usually oil) under pressure to move and control machines.

External Resources

Children's Books:

Click, Clack, Moo: Let's Do Construction* by Doreen Cronin (shows farm animals using construction equipment)

Big Red Barn* by Margaret Wise Brown (features farm machinery and work)

Machines Go to Work* by William Low (colorful illustrations of machines in action)

YouTube Videos:

* "How Hydraulics Work - Simple Explanation" by DK Find Out (2:45 minutes) - Uses animations to show how liquid pressure moves backhoe arms. https://www.youtube.com/watch?v=JEYwM_nk1Aw

* "Construction Vehicles for Kids" by Learn English Kids (4:30 minutes) - Shows backhoes, dump trucks, and other machines with clear narration and engaging visuals. https://www.youtube.com/watch?v=CtMJd6F5jOI