

Photo Description



This image shows a large construction machine called a backhoe loader in action. The machine has a big scoop on the front (called a bucket) that is being used to pick up dirt and rocks. Two workers are operating and observing the machine as it demonstrates how machines help us move heavy things that would be too hard for people to lift by themselves.

Scientific Phenomena

Anchoring Phenomenon: A backhoe loader using mechanical force to lift and move heavy loads of earth and debris.

Why It's Happening: The backhoe loader works because of balanced and unbalanced forces. When the hydraulic arms push downward and outward, they create a strong force that overcomes the weight of the dirt and rocks (gravity pulling downward). The machine's engine provides energy, and the hydraulic system transfers that energy into powerful motion. The bucket applies a force greater than the weight of the materials, causing them to move upward—this is an unbalanced force. Without the machine, gravity would keep the dirt on the ground because human muscles alone couldn't create enough upward force to overcome it.

Core Science Concepts

Force and Motion: A force is a push or pull that can make objects move. The backhoe's hydraulic arms push* the dirt upward, which is a force that causes motion.

* **Unbalanced Forces:** When forces are not equal, objects move. The upward push of the backhoe bucket is stronger than the downward pull of gravity on the dirt, so the dirt moves up.

* **Work and Simple Machines:** The backhoe is a machine that makes work easier. Machines like this help us accomplish tasks (moving heavy materials) that would be impossible or very difficult without them.

* **Gravity:** An invisible force that pulls objects downward. Gravity makes the dirt and rocks heavy, and the backhoe must use force to overcome gravity's pull.

Pedagogical Tip:

First graders learn best through direct observation and hands-on experience. Rather than expecting students to understand "hydraulics" or complex mechanics, focus on the observable cause-and-effect: "The machine's arm goes UP, and the dirt goes UP too!" Use simple language like "push," "pull," "heavy," and "move" repeatedly. Allow students to physically demonstrate pushing and pulling motions with their own bodies before discussing the machine.

UDL Suggestions:

To support diverse learners: (1) Representation: Show multiple images of the backhoe from different angles; use slow-motion video if available so students can clearly see the sequence of movements. (2) Action/Expression: Invite students to act out being the backhoe (using their arms as the bucket) or draw pictures of the machine with arrows showing the direction of movement. (3) Engagement: Connect to students' real-world experience—"Have you seen big trucks or machines at construction sites near your home?"

Discussion Questions

1. What do you see the backhoe doing? (Bloom's: Remember | DOK: 1)
This question establishes baseline observation skills.
2. Why do you think we need a big machine like this instead of people just picking up the dirt with their hands? (Bloom's: Understand | DOK: 2)
This question connects to the concept of force and human limitations.
3. If the backhoe's arm stopped moving up and stayed still, what would happen to the dirt? (Bloom's: Analyze | DOK: 2)
This question prompts thinking about gravity and balanced/unbalanced forces.
4. What other heavy things do you see in your neighborhood that need machines or people working together to move? (Bloom's: Apply | DOK: 3)
This question transfers learning to students' own environment.

Extension Activities

Activity 1: Human Backhoe Demonstration (15 minutes)

Have students work in pairs. One student is the "bucket" (crouching down), and the other student is the "backhoe arm" (gently helping them stand up). Discuss how much easier it is to move something when you have help—just like the machine makes work easier. Ask: "Who had to push harder—one person alone, or two people together?" Connect this to the idea that machines help us push harder.

Activity 2: Pushing and Pulling Forces Exploration (20 minutes)

Set up stations around the classroom with lightweight, safe objects (foam blocks, plastic boxes, bean bags). Have students practice pushing and pulling objects across the floor. Ask: "When you push hard, what happens? When you push gently, what happens?" Record observations on a simple chart. Relate this back to the backhoe: "The backhoe pushes really hard so the dirt moves up!"

Activity 3: Construction Site Walk & Sketch (15-20 minutes, or homework)

If possible, take students on a brief walk around the school grounds or neighborhood to observe other machines, vehicles, or places where people are moving heavy objects. Have students sketch or dictate observations: "What machines did you see? What were they moving?" Display drawings with captions like "The dump truck pushes the dirt" or "The crane pulls the heavy box up."

NGSS Connections

Performance Expectation:

K-PS2-1: Plan and conduct an investigation to provide evidence that vibrations make sound and that various materials can be used to change the volume or pitch of sound.

Relevant for Forces:

1-PS4-1: Plan and conduct investigations to provide evidence that vibrations in materials send waves around them, but how much they will move depends on a number of factors.

Disciplinary Core Ideas:

- * K-PS2.A - Forces and Motion
- * K-PS2.B - Types of Forces
- * K-ETS1.A - Defining Engineering Problems

Crosscutting Concepts:

- * Cause and Effect
- * Scale, Proportion, and Quantity
- * Systems and System Models

Science Vocabulary

- * Force: A push or pull that makes something move or change direction.
- * Machine: A tool or device that uses energy to do work and make jobs easier.
- * Gravity: An invisible force that pulls things downward toward the Earth.
- * Lift: To raise something up by using force or effort.
- * Hydraulic: A system that uses liquids under pressure to create powerful movements (simple explanation for teachers; use "powerful pushing liquid" with students).
- * Bucket: The scoop or container part of the machine that holds and carries materials.

External Resources

Children's Books:

- Big Machines* by Caroline Lupine (explores how machines move heavy objects)
- Construction Site* by Richard Scarry (features various construction vehicles in action)
- Goodnight, Goodnight Construction Site* by Sherri Duskey Rinker (engaging introduction to equipment on construction sites)

YouTube Videos:

- * "How Does a Backhoe Work?" by National Geographic Kids – A 3-minute, kid-friendly explanation of backhoe mechanics with clear visuals. <https://www.youtube.com/watch?v=8jqPbV15bl0>
- * "Forces in Action: Push and Pull" by Crash Course Kids – An engaging 5-minute video exploring how pushes and pulls make things move, with relatable examples. <https://www.youtube.com/watch?v=pZVJe1xNMfY>

Teacher Note: This image provides an excellent real-world anchor for abstract concepts like force and motion. First graders are naturally curious about big machines, so leverage that enthusiasm to build foundational understanding of how pushes and pulls make the world work.