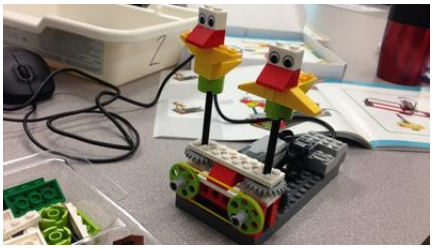
Engineering

Physical Science | Lesson Guide

2nd Grade

Photo Description



This image shows LEGO constructions that demonstrate simple machines and engineering design. Students have built colorful structures with wheels, axles, and moving parts, along with figurines that appear to "operate" or interact with the machines. The creations include wheeled vehicles and articulated characters, showing how building blocks can be combined to create moving objects.

Scientific Phenomena

Anchoring Phenomenon: How can we build things that move?

Students are observing and creating examples of simple machines in action—specifically wheels and axles. When wheels spin around an axle (the rod through the center), they roll and help objects move more easily. The figurines demonstrate that machines can be designed to perform tasks or actions. This is happening because of friction and force—the wheels reduce friction between the structure and the surface, making movement possible with less effort. Engineering is the practical application of science to solve real-world problems, and these student designs show how planning, building, and testing lead to working solutions.

Core Science Concepts

* Simple Machines (Wheels & Axles): A wheel is a circular object that spins around a center rod called an axle. Wheels help things move smoothly and reduce the effort needed to move heavy objects.

* Force and Motion: A force is a push or pull that makes things move. When students build with wheels, they are using force to make their machines go forward, backward, or spin.

* Engineering Design Process: Engineers plan, build, test, and improve their creations. These LEGO structures show students thinking like engineers—they designed what they wanted to build, constructed it with materials, and tested whether it works.

* Structure and Stability: Building something that stands up and moves requires understanding how to balance pieces and connect them securely. Different building choices affect whether a machine works well or falls apart.

Pedagogical Tip:

Before this lesson, have students predict what will happen when the wheel spins. After building, have them observe and compare their predictions to what actually occurred. This "predict-observe-compare" routine builds scientific thinking habits and metacognition. Encourage students to say things like, "I thought the wheel would roll fast, but it rolled slow because..." This honors their ideas while deepening their understanding of cause and effect.

UDL Suggestions:

Multiple Means of Representation: Provide visual building instruction cards with pictures (not just words) so students can follow along. Use actual models or videos showing wheels spinning, not just verbal descriptions.

Multiple Means of Action & Expression: Allow students to show their learning through building, drawing labeled diagrams, or physically demonstrating how their machine works—not just writing or talking about it.

Multiple Means of Engagement: Let students choose what machine they want to build (a car, a spinner, a pusher) so they feel ownership. Celebrate effort and creative problem-solving, not just "perfect" results.

Discussion Questions

1. What happened when you spun the wheel? (Bloom's: Remember | DOK: 1)
   Students describe the observable motion.

2. Why do you think the wheels helped your machine move? (Bloom's: Explain | DOK: 2)
   Students begin reasoning about function and purpose.

3. If you wanted your machine to move faster, what could you change or build differently? (Bloom's: Analyze | DOK: 2)
   Students think critically about cause-and-effect relationships and redesign.

4. How is your machine like real machines you see every day (like a toy car or a shopping cart)? (Bloom's: Apply | DOK: 3)
   Students connect classroom learning to the world outside school.

Extension Activities

1. Design Your Own Machine Challenge: Give students a new building challenge: "Build a machine that pushes something across the table" or "Build a machine that spins." Have them sketch their plan first, build it, test it, and explain what worked or what they would change. This reinforces the engineering design cycle.

2. Wheel Race: Set up a simple race track. Have pairs build two different wheel designs (big wheels vs. small wheels, or wheels close together vs. far apart) and predict which will move faster. Race them and discuss results. Students see how design choices affect performance.

3. Real-World Machine Hunt: Take students on a "machine walk" around the school or classroom. Find and photograph/sketch real wheels and axles (door handles, shopping carts, toy bins on wheels, playground equipment). Create a class poster showing "Wheels & Axles We Found!" connecting engineering to everyday life.

NGSS Connections

Performance Expectation:
K-2-ETS1-1: Ask questions, make observations, and gather information about a situation that people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Disciplinary Core Ideas:
- K-2-ETS1.A — Define a simple design problem
- K-2-ETS1.B — Develop a simple solution through the engineering design process

Crosscutting Concepts:
- Cause and Effect — When wheels spin, the object moves (cause !' effect)
- Structure and Function — The shape and arrangement of wheels and axles determine how the machine works

Science Vocabulary

* Wheel: A round, flat piece that spins around a center rod to help things move smoothly.

* Axle: The rod or stick that goes through the center of a wheel and lets it spin.

* Machine: A tool made of parts that work together to do a job or make something move.

* Engineer: A person who designs and builds machines or structures to solve problems.

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

* Simple Machine: A basic tool with few or no moving parts that helps us do work more easily.

External Resources

Children's Books:
Simple Machines* by David Adler (explains wheels, levers, and pulleys in kid-friendly language)
How Do Wheels Work?* by Christopher Harbo (part of the "How It Works" series, with clear illustrations)
Rosie Revere, Engineer* by Andrea Beaty (inspiring story about a girl who loves to build and solve problems)

YouTube Videos:
* "Wheels and Axles | Simple Machines for Kids," Crash Course Kids (~5 minutes)
Shows real-world examples of wheels and axles in action with clear explanations.
https://www.youtube.com/watch?v=OD2sTcgWM1w

* "LEGO Simple Machines: Wheels and Axles," LEGO Education (~4 minutes)
Direct demonstration of building wheels and axles with LEGO bricks.
https://www.youtube.com/watch?v=X7PZLJnuL8M

Instructional Note: This lesson sequence works best as a 2–3 day unit. Day 1: Introduce wheels/axles with the image and discussion. Day 2: Student building time with the engineering design process. Day 3: Testing, sharing, and reflection. Scaffold student thinking by asking, "What do you notice?" before "Why do you think that happened?"