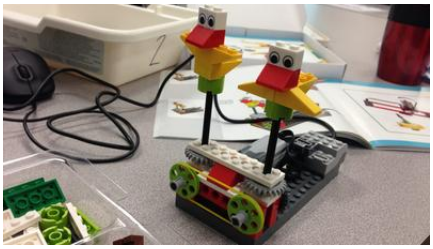
Engineering

Physical Science | Lesson Guide

4th Grade

Photo Description



This image shows LEGO constructions that include moving robot characters with googly eyes, wheels, and mechanical parts connected to a computer and electronic devices. Students have built simple machines with moving wheels and programmable elements that demonstrate how engineers combine materials, motion, and technology to create working devices.

Scientific Phenomena

Anchoring Phenomenon: How can we design and build machines that move and respond to instructions?

This image represents simple machines and basic automation. The wheeled base demonstrates how wheels reduce friction and allow objects to move more easily. The electronic connections (visible wires and components) show how engineers use electricity and programming to control motion and behavior. Students are applying the engineering design process—planning, building, testing, and improving—to create functioning robots. The phenomenon occurs because motors (powered by electricity) convert electrical energy into mechanical motion, which the wheels then use to move the entire structure.

Core Science Concepts

* Simple Machines & Mechanical Advantage: Wheels reduce friction and allow structures to move. The axles and wheels work together as a system to transfer motion from the motor to the ground.

* Energy Transformation: Electrical energy from the power source is converted into mechanical energy (motion) through the motor, demonstrating energy doesn't disappear—it changes form.

* Systems & Components: The robot is a system made of multiple parts (motor, wheels, frame, electronics, sensors) that work together. Each part has a specific function that contributes to the whole system's ability to move and respond.

* Design & Testing: Engineers build prototypes, test them, identify problems, and improve their designs. The visible adjustments and construction materials show the iterative nature of engineering.

Pedagogical Tip:

When teaching with this image, have students physically handle wheels and motors BEFORE building. Let them feel how wheels turn, observe friction differences between smooth and rough surfaces, and predict what will happen when parts connect. This tactile, concrete experience helps Fourth Graders bridge to abstract concepts like energy and systems.

UDL Suggestions:

UDL Strategy - Multiple Means of Engagement: Offer choice in how students document their learning: some may draw diagrams of their robot, others may photograph their build process, and others may verbally explain how their machine works. Provide both physical manipulatives and digital design tools so students with different learning preferences can engage deeply with engineering concepts.

Discussion Questions

1. What do you think would happen if we removed the wheels from the robot? Why? (Bloom's: Predict | DOK: 2)

2. How is this robot similar to other machines you see in your classroom or home? What do they all have in common? (Bloom's: Compare | DOK: 2)

3. If your robot isn't moving as fast as you want it to, what are three different things you could change or try to make it faster? (Bloom's: Create | DOK: 3)

4. How do you think the engineer who designed this robot used testing to make it work better? (Bloom's: Analyze | DOK: 3)

Extension Activities

1. Friction Investigation Challenge: Provide Fourth Graders with various surface materials (smooth plastic, sandpaper, carpet, tile) and have them test how quickly their robot travels across each surface. Ask them to measure distance or count seconds, record data, and explain which surface had the most and least friction. This connects directly to energy and motion concepts.

2. Redesign & Rebuild: Have students identify one "problem" with their robot (too slow, unstable, won't turn) and modify their design to solve it. They should make only ONE change at a time, test the result, and explain whether their fix worked. This teaches the iterative design process.

3. Blueprint Drawing Activity: Students sketch detailed diagrams of their robot from multiple angles, labeling each part and its function. Then, exchange blueprints with a partner and try to build a robot following their partner's instructions. This develops communication skills and shows why clear engineering documentation matters.

NGSS Connections

Performance Expectation: 4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Disciplinary Core Ideas:
- 4-PS3.A Energy can make things move; faster motion requires more energy
- 4-ETS1.A Defining and delimiting engineering problems; learning that successful design solutions require clear criteria and constraints

Crosscutting Concepts:
- Systems and System Models - The robot is a system where parts interact and depend on each other
- Energy and Matter - Energy from electricity becomes motion and movement

Science Vocabulary

* Robot: A machine that is programmed or designed to perform tasks automatically or follow instructions.

* Motor: A device that uses electricity to create spinning motion and power.

* Friction: A force that slows down or stops objects from sliding easily across a surface.

* Prototype: The first version of something that an engineer builds to test an idea.

* Energy: The power to make things move or change; it can take different forms like electricity or motion.

* System: A group of connected parts that work together to do a job.

External Resources

Children's Books:
- Simple Machines by David Adler (explores wheels, levers, pulleys, and ramps)
- How to Invent Everything by Ryan North (introduces engineering thinking for young learners)
- The Way Things Work by Macaulay (illustrated guide to machines and energy)

YouTube Videos:
- "Simple Machines: Wheels and Axles" by Crash Course Kids — Explains how wheels reduce friction and make movement easier. https://www.youtube.com/watch?v=xkyDcuy_nKU

- "Engineering for Kids: What is a Robot?" by National Geographic Kids — Defines robots and shows real examples of how engineers use them. https://www.youtube.com/watch?v=_2Yx9N0cKxg

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Teacher Tip: This hands-on engineering challenge naturally integrates mathematics (measurement, data recording) and literacy (descriptive writing, blueprint reading). Consider having students write instructional manuals for how to build their robots—a authentic writing purpose that reinforces both engineering and communication skills!