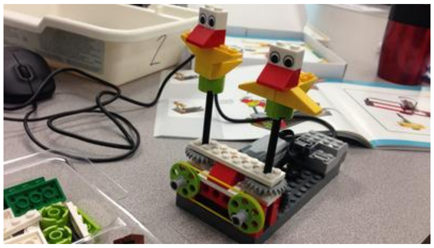
Engineering

Physical Science | Lesson Guide

Photo Description



This image shows LEGO engineering creations that students have built, including moving vehicles with wheels and standing figures with movable parts. The builds display colorful bricks assembled into structures that can move or rotate, along with black cords and connection pieces that help parts work together.

Scientific Phenomena

Anchoring Phenomenon: How can we build things that move using simple materials?

Students are observing mechanical engineering in action—the process of designing and building structures and machines that work. The vehicles and figures demonstrate basic machine principles: wheels reduce friction and allow movement; axles help things spin; stacked bricks create stability. This happens because when objects are properly designed and assembled, forces (pushing, pulling, rotating) can be transferred through connected parts to create motion. Students naturally ask, "Why does it move?" and "How can I make it move differently?"—questions that drive engineering design.

Core Science Concepts

* Simple Machines & Movement: Wheels, axles, and lever systems help us move things more easily. The green wheels with ridges in the photo help the vehicle grip and roll smoothly.

* Force & Motion: A push or pull (force) causes objects to move, stop, or change direction. When students push the LEGO vehicles, they are applying a force that creates motion.

* Stability & Structure: Wider bases and careful stacking of blocks create balanced, stable builds that don't tip over easily.

* Design & Iteration: Engineers test their designs, observe what works and what doesn't, then make changes to improve them—just like students do when building.

Pedagogical Tip:

Third graders are natural engineers! Rather than showing students the "correct way" to build, ask them to predict what will happen, test their builds, and describe what they observe. This inquiry-based approach builds confidence and deeper understanding. Celebrate "failures" as learning opportunities: "Your tower fell—what did you discover about balance?"

UDL Suggestions:

Multiple Means of Representation: Provide visual building instructions AND let students sketch their own designs before building. Some students learn better by watching a peer build first.

Multiple Means of Action & Expression: Allow students to explain their builds verbally, through drawings, or by demonstrating how the machine works rather than requiring written descriptions.

Multiple Means of Engagement: Partner students so they can collaborate, discuss ideas, and share the building experience together.

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Zoom In / Zoom Out

Zoom In: What happens inside the wheel when it spins?
At a close-up level, the wheel's surface is covered with tiny ridges and bumps (the green circles visible in the photo). When the wheel rolls, these ridges grip the table surface, creating friction that helps the vehicle move forward without slipping. If we could zoom in even more, we'd see that both the wheel and the table are made of tiny particles that are always moving and bumping into each other—this movement creates the grip that keeps wheels from sliding around. The axle (the rod through the center) lets the wheel spin smoothly because it reduces the friction between the wheel and the base.

Zoom Out: How do simple machines like wheels help us in the real world?
When we zoom out to the bigger picture, we see that wheels and axles are used everywhere in our communities. Cars, buses, skateboards, shopping carts, and wheelchairs all use wheels to help people and things move more easily. Cities are designed with roads and sidewalks for wheeled vehicles to travel on. Engineers and city planners work together to make sure these transportation systems are safe and efficient. Without simple machines like wheels, people would have to carry everything by hand, and travel would be much slower and harder. Wheels connect us to our communities and help goods, services, and people move around our world.

Discussion Questions

1. What do you think will happen if we make the wheels bigger? Why? (Bloom's: Predict | DOK: 2)

2. How is building a LEGO vehicle like building a real car? What is the same and what is different? (Bloom's: Compare/Contrast | DOK: 3)

3. If your LEGO tower keeps falling over, what could you change to make it stronger? (Bloom's: Analyze | DOK: 2)

4. Explain what happens inside a wheel when it spins. Why do wheels help things move? (Bloom's: Explain | DOK: 3)

Potential Student Misconceptions

Misconception 1: "Bigger wheels always make things go faster."
Clarification: While bigger wheels can sometimes help a vehicle travel farther with each rotation, they don't automatically make it faster. Speed depends on several factors: how much force is applied, how heavy the object is, and how much friction there is. A light push with big wheels might move slower than a hard push with smaller wheels. Encourage students to test this by comparing their LEGO vehicles and measuring which one actually travels farthest or fastest, rather than just guessing based on wheel size.

Misconception 2: "The wheel spins because we push it, so the push makes it keep spinning forever."
Clarification: Students often think that one push should make a wheel spin continuously. In reality, friction and air resistance slow things down. Eventually, a pushed object will stop unless we keep pushing it. When students test their vehicles, help them notice that the vehicle slows down and stops—this is because friction is constantly working against the motion. This is a perfect opportunity to ask: "What would happen if there was no friction at all?"

Misconception 3: "All the pieces in a machine do the same job."
Clarification: Third graders might think that because a LEGO vehicle is made of the same colored bricks, all parts work the same way. In reality, different parts have different jobs: wheels help it move, the axle lets wheels spin, the base holds it together, and the cord or connector might steer it. Help students label and identify the different parts and discuss what each one does. This builds understanding of how complex machines are made of simpler parts that work together.

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Extension Activities

1. Build & Test Challenge: Give students a design challenge: "Build a LEGO vehicle that can travel across the floor. What parts help it move farthest?" Have them test different wheel sizes, materials, and weights. They can record predictions and results on a simple chart.

2. Redesign for Speed: After building their first vehicle, challenge students to modify it to make it go faster or slower. Ask: "What did you change? How did it work differently?" This introduces the engineering cycle of testing and improving.

3. Machine Observation Walk: Take students on a "machine hunt" around the classroom and school to find real-world examples of wheels, levers, and other simple machines (doorknobs, cart wheels, scissors, seesaws). Have them photograph or sketch examples and label the simple machine type.

Cross-Curricular Ideas

Math Connection: Measurement & Distance
Have students build LEGO vehicles and then measure how far they travel when pushed with the same force. Use rulers or tape measures to record distances in inches or centimeters. Create a simple bar graph or chart showing which vehicle design traveled the farthest. Ask: "If this vehicle travels 12 inches, how many times would it need to roll to cross the classroom?" This connects measurement, graphing, and multiplication/division concepts.

ELA Connection: Descriptive Writing & Instruction Writing
Ask students to write detailed descriptions of their LEGO creations using descriptive words (colorful, sturdy, round, tall). Then have them write step-by-step instructions for building a simple LEGO vehicle so a friend could follow their directions. This practices procedural writing and helps students organize information logically—a key engineering skill. Students can also read and follow each other's instructions to test clarity.

Social Studies Connection: Transportation & Community
Discuss how vehicles with wheels (cars, buses, trains, bicycles) help people in the community. Take a "transportation walk" around the school or neighborhood and observe different types of wheels in use. Students can create a poster or presentation about "Wheels in Our Community" showing how transportation helps people get to work, school, and activities. This connects simple machines to real-world applications and community helpers.

Art Connection: Design & Color
Have students sketch their own LEGO vehicle designs before building, focusing on how they will arrange colors and shapes. After building, they can create a detailed drawing or painting of their creation with labels for each part. Students could also create a "blueprint" (top-down view) of their vehicle design showing where each colored brick goes. This combines engineering thinking with artistic expression and spatial reasoning.

STEM Career Connection

Mechanical Engineer — Average Annual Salary: $88,000
A mechanical engineer designs machines and devices that move and work. They might design the wheels, axles, and engines that go into cars, toys, or robots. Mechanical engineers ask questions like "How can we make this move faster?" and "Will this part be strong enough?" They use drawings and computers to plan their designs, then test them to see if they work. The LEGO vehicles in your photo are like small versions of what mechanical engineers create!

Toy Designer — Average Annual Salary: $65,000

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A toy designer creates fun toys and building sets like LEGO. They think about what kids enjoy, what makes a toy safe and durable, and how to make it fun to build and play with. Toy designers test their ideas with real children to see if they like the colors, shapes, and how the pieces fit together. They combine creativity with engineering knowledge to make toys that teach and entertain at the same time.

Roboticist — Average Annual Salary: $92,000
A roboticist designs and builds robots that can move and do tasks. Robots use wheels, motors, sensors, and computer programs to move around and interact with the world. Some robots help in factories, hospitals, or even explore distant planets! A roboticist combines knowledge of simple machines (like wheels and levers), electricity, and computer coding to make robots that can solve real-world problems. Your LEGO creations are the first step toward understanding how robots work!

NGSS Connections

Performance Expectation:
3-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Disciplinary Core Ideas:
- 3-PS2.A Forces and Motion—Pushes and pulls can change the speed or direction of objects.
- 3-ETS1.A Engineering Design—Defining and delimiting engineering problems involves asking questions, making observations, and gathering information about a situation people want to change to define a simple design problem.

Crosscutting Concepts:
- Patterns Students notice repeating patterns in how wheels rotate and how structures balance.
- Cause and Effect Pushing a LEGO vehicle (cause) makes it move across the table (effect).

Science Vocabulary

* Simple Machine: A tool with few or no moving parts that helps us do work more easily (like wheels, levers, or ramps).

* Wheel: A round object that spins on a rod called an axle to help something move.

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

* Axle: A rod or stick that goes through the center of a wheel so it can spin.

* Stability: When something stays balanced and doesn't fall over easily.

* Design: A plan that shows what something will look like and how it will work.

External Resources

Children's Books:
- Simple Machines by David Adler (explains wheels, levers, ramps, and more with clear illustrations)
- The Way Things Work Now by Macaulay (engaging, visual introduction to simple machines)
- Rosie Revere, Engineer by Andrea Beaty (inspiring story about a girl who designs and builds)

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Teacher's Note: This lesson naturally connects to math (measurement of distance traveled, comparing sizes), literacy (following directions, explaining designs), and social-emotional learning (perseverance, collaboration). Celebrate student creativity and encourage them to ask "What if?" questions—that's the heart of engineering!

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