Forms Of Energy

Physical Science | Lesson Guide

2nd Grade

Photo Description

This image shows a large yellow and orange diesel train engine next to a small red sports car on train tracks. The train engine is much bigger and heavier than the car, and both objects can move because they have energy. The train has words printed on it that say "Building America" and mention "Ultra Low Emissions Diesel Genset Switcher."

Scientific Phenomena

The anchoring phenomenon here is comparing the motion and energy of two very different vehicles. The train engine and the sports car both move, but they do so in different ways and with different amounts of force and energy. The train engine uses diesel fuel to create energy that moves its heavy wheels along the tracks, while the car also uses fuel to power its engine and move. Even though the car is smaller and lighter, both vehicles demonstrate how energy from fuel is converted into motion. This is a concrete, observable way for Second Grade students to understand that different objects require different amounts of force and energy to move, and that energy comes in different forms (stored in fuel and released as motion).

Core Science Concepts

1. Energy and Motion: Both vehicles have energy that makes them move. The train engine and the car both use fuel as a source of energy. When fuel burns in an engine, it creates the energy needed to push the wheels and make the vehicle move forward.

2. Force and Mass: The train engine is much heavier (more mass) than the car. Because it is heavier, it needs more force to move it, but once it is moving, it can push very hard. The car is lighter, so it needs less force to get moving.

3. Properties of Materials: The vehicles are made of different materials like metal, rubber, glass, and plastic. These materials have different properties—metal is strong and hard, rubber is flexible and grips the track, and glass is transparent so we can see through it.

4. Energy Transfer: The diesel fuel stored in the train engine's tank contains stored energy. When the engine burns the fuel, that stored energy is transferred into motion (kinetic energy), which moves the train forward.

> **Pedagogical Tip:**
> When teaching about energy and motion with young learners, use the vocabulary "energy makes things happen" and "energy makes things move." This keeps the concept concrete and relatable. Have students identify things in their classroom that move and ask, "What energy makes this move?" This scaffolds their understanding before introducing more complex energy vocabulary.

UDL Suggestions:

For Universal Design for Learning, provide multiple means of engagement and representation: (1) Allow kinesthetic learners to physically act out train and car movements while discussing force and motion; (2) Use a picture chart showing different vehicles (bus, bicycle, skateboard, train) so visual learners can compare sizes, speeds, and types of energy; (3) Provide tactile models or manipulatives of heavy and light objects so students can physically experience the difference in force needed to move objects of different masses.

Zoom In / Zoom Out

Zoom In: At the microscopic level, when diesel fuel burns inside the engine, molecules of fuel and oxygen combine in a chemical reaction. This chemical reaction releases energy in the form of heat. The heat causes gases to expand very quickly inside the engine cylinders, and this rapid expansion pushes metal pistons, which are connected to the wheels. Students cannot see molecules, but they can observe the result: the vehicle moves!

Zoom Out: At the systems level, this image represents how humans use transportation networks to move goods and people across cities and countries. The train is part of a larger system of railroads, stations, and supply chains. The car is part of a road system. Both vehicles are part of how our society moves energy (in the form of goods, people, and resources) from one place to another. Energy powers these transportation systems, which connect communities and support "Building America" (as written on the train).

Discussion Questions

1. "Why do you think the train engine is so much bigger and heavier than the sports car? What do you think it needs to do that the car might not need to do?"
   - Bloom's Level: Analyze | DOK: 3

2. "Both the train and the car move, but they move in different ways. How are their movements different, and why might they be different?"
   - Bloom's Level: Compare/Contrast | DOK: 2

3. "The train says 'Ultra Low Emissions Diesel Genset Switcher' on the side. What do you think 'diesel' means, and where do you think the energy comes from to make this train move?"
   - Bloom's Level: Understand | DOK: 2

4. "If we wanted to make the sports car move the same way a train moves, what would we need to change about the car?"
   - Bloom's Level: Apply/Create | DOK: 3

Potential Student Misconceptions

1. Misconception: "The bigger car will always go faster than the smaller car."
   - Clarification: Size and speed are not the same thing. A small sports car can actually go much faster than a large truck, even though the truck is bigger. Speed depends on how much energy the engine produces and how the vehicle is designed, not just its size.

2. Misconception: "The train moves because someone is pushing it."
   - Clarification: The train moves because fuel inside the engine burns and creates energy. This energy moves the parts inside the engine (called pistons), which turn the wheels. The wheels then roll along the tracks. No one is pushing it from behind!

3. Misconception: "Energy just disappears after something moves."

- Clarification: Energy does not disappear—it changes form. When a car or train moves, the stored energy in the fuel becomes motion energy, heat energy, and sound energy. The energy is still there, just in a different form.

Extension Activities

1. Heavy vs. Light Race: Provide students with two toy vehicles of different weights (or make them different masses by adding weights inside). Have them push both vehicles across a table or floor and observe which one needs more force to move and which one moves faster or slower. Discuss how the mass of an object affects how much force is needed to move it. Record observations: "The heavy car needed a bigger push" and "The light car moved faster with the same push."

2. Materials Investigation: Provide students with samples of materials used in vehicles (aluminum foil, rubber band, plastic cup, cloth, paper). Have them test and describe each material's properties using their senses (sight, touch—but NOT taste!). Create a chart with columns for "Hard," "Soft," "Flexible," "Shiny," and have students sort materials. Discuss why each material would be good for a specific part of a vehicle (e.g., rubber for tires because it's flexible and grips, metal for the body because it's hard and strong).

3. Build a Simple Train Track: Using cardboard tubes, blocks, and a toy train or car, let students build a simple track and test different surfaces (smooth, rough, bumpy). Push the vehicle down each track and observe which surface causes more friction and slows the vehicle down. Discuss how the properties of the track material affect motion.

Cross-Curricular Ideas

1. Math: Create a comparison chart showing the length, width, and approximate size of the train engine vs. the sports car using non-standard measurements (like blocks or hand-spans). Students can count and compare: "The train is about 20 blocks long, and the car is about 5 blocks long. The train is 4 times longer!"

2. ELA/Reading: Read a picture book about trains or vehicles, then have students write or dictate simple sentences about what they learned (e.g., "Trains are big and move on tracks. Cars are small and move on roads."). Create a class book titled "Vehicles That Move" with student-drawn pictures and labels.

3. Social Studies: Discuss how trains and cars help people and communities. Show pictures of trains delivering goods to stores and cars helping people get to work, school, and places they want to go. Connect to the phrase "Building America"—trains and trucks deliver materials to build homes and roads!

4. Art: Have students draw or paint their own vehicle design. Before drawing, ask them to think about: "What materials would you use? What would it look like? How would it move?" Students can color, decorate, and label their vehicle, then explain their design choices to a partner or the class.

STEM Career Connection

1. Locomotive Engineer (Train Driver): A locomotive engineer drives a train along railroad tracks to move cargo (goods) and passengers from place to place. They make sure the train runs safely and on time. They understand how the train's engine works and how to control the train's speed and brakes. Average Salary: $65,000–$75,000 per year.

2. Mechanical Engineer: A mechanical engineer designs and builds machines like trains, cars, and engines. They figure out how to make vehicles work better, move faster, use less fuel, and be safer for people. They test materials and designs to solve problems. Average Salary: $88,000–$95,000 per year.

3. Automotive Technician (Car Mechanic): An automotive technician repairs and maintains cars, trucks, and other vehicles. They diagnose problems with engines, brakes, and other parts; fix broken pieces; and make sure vehicles run safely. They need to understand how engines work and how to test vehicles. Average Salary: $38,000–$50,000 per year.

NGSS Connections

2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- Rationale: The train and car are made of different materials (metal, rubber, glass, plastic) chosen specifically for their properties. Metal is used for strength, rubber for gripping wheels, glass for windows. Students can observe and discuss why certain materials were chosen for different parts of these vehicles.

2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- Rationale: Students can examine pictures or examples of materials used in vehicles and describe their observable properties (hard, shiny, flexible, smooth, rough) and classify them by these properties. This connects to understanding what the train and car are made of.

Key Disciplinary Core Ideas and Crosscutting Concepts:
- 2-PS1.A: Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- 2-ETS1.B: Before building a solution, it is important to clearly understand the problem. One way to better understand a problem is to examine in detail objects, systems, and processes similar to the one you want to design.
- Energy and Matter: Energy can be transferred in various ways and between objects.
- Structure and Function: The way an object is shaped or structured affects how it functions.
- Cause and Effect: Simple events have causes and effects; events that occur together with regularity might be a cause and effect.

Science Vocabulary

* Energy: The power that makes things move and change; energy comes from sources like fuel, sunlight, and food.
* Force: A push or pull that makes something move, stop, or change direction.
* Motion: When something moves or changes position from one place to another.
* Fuel: A material (like diesel or gasoline) that is burned to create energy that makes engines run.
* Mass: How much "stuff" or material an object has; heavier objects have more mass.
* Friction: A force that happens when two things rub together and makes it harder for things to move smoothly.

External Resources

Children's Books:

* "How Do Trains Work?" by Geoff Barker – A beginner-friendly book that explains train engines, tracks, and how trains move goods and people.

* "Cars" by DK Findout (DK Publishing) – A photo-rich book showing different types of cars, how engines work, and the history of automobiles.

* "The Little Engine That Could" by Watty Piper – A classic story about a small train engine that builds character through determination and shows the power of perseverance and energy.