

## Photo Description



A long white train with big windows moves along metal tracks. The train gets power from wires above it using a special arm called a pantograph. This electric train can carry many people from place to place without making pollution.

## Scientific Phenomena

The anchoring phenomenon is electric transportation systems. This light rail train demonstrates how electrical energy is converted to mechanical energy to create motion. The train receives electrical power through overhead wires via a pantograph (the diamond-shaped collector on top), which then powers electric motors that turn the wheels. This represents a clean energy transportation system that reduces air pollution compared to gasoline-powered vehicles.

## Core Science Concepts

1. Energy Transfer and Conversion: Electrical energy from power lines is converted to mechanical energy that moves the train
2. Forces and Motion: The train's electric motors create forces that push and pull the train along the tracks
3. Simple Machines: Wheels and axles help the train move efficiently with less friction
4. Environmental Science: Electric trains produce less air pollution than cars and buses that burn gasoline

### Pedagogical Tip:

Use toy trains or simple circuits with batteries and motors to help students visualize how electricity can create motion. Let them experiment with connecting wires to see cause and effect relationships.

### UDL Suggestions:

Provide multiple ways for students to explore this concept: kinesthetic learners can build simple circuits, visual learners can watch the train video, and auditory learners can discuss the sounds different transportation makes.

## Zoom In / Zoom Out

**Zoom In:** Inside the electric motor, electricity flows through copper wires wrapped around magnets. When electricity moves through these wires, it creates magnetic forces that spin the motor, which turns the train's wheels.

**Zoom Out:** This train is part of a larger transportation network that connects neighborhoods and cities. The electricity powering it might come from solar panels, wind turbines, or other power sources, making it part of a cleaner energy system for our communities.

### Discussion Questions

1. What do you think makes this train move forward? (Bloom's: Analyze | DOK: 2)
2. How is this train different from a car or bus? (Bloom's: Compare | DOK: 2)
3. Why might people choose to ride this train instead of driving a car? (Bloom's: Evaluate | DOK: 3)
4. What would happen if the wires above the train were broken? (Bloom's: Predict | DOK: 2)

### Potential Student Misconceptions

1. Misconception: "Trains need gasoline like cars do."  
Clarification: Many modern trains use electricity instead of gasoline, which creates less pollution and can come from clean energy sources.
2. Misconception: "The wires above the train are just for decoration."  
Clarification: Those wires carry electricity that powers the train, just like the cord that plugs into your tablet to charge it.
3. Misconception: "Electric trains are slower than regular trains."  
Clarification: Electric trains can actually go very fast and are often quicker than cars in cities because they don't get stuck in traffic.

### Cross-Curricular Ideas

1. Math - Counting and Measurement: Students can count the windows on the train or measure how long the train is using string and a ruler. They can also practice addition by figuring out how many passengers might fit if each train car holds a certain number of people.
2. ELA - Descriptive Writing: Have students write or dictate sentences describing what they see in the photo using adjectives (long, white, fast, shiny). Students can create a simple story about a day riding on the electric train, describing where they go and what they see.
3. Social Studies - Community Helpers and Transportation: Discuss how trains help communities by moving people to work, school, and fun places. Students can learn about train operators and conductors as community helpers who keep people safe and get them where they need to go.
4. Art - Design and Color: Students can draw their own electric train using white, gray, and black markers or paint. They can also create a collage showing different types of transportation (cars, buses, trains) and compare them visually.

### STEM Career Connection

1. Train Engineer/Operator: A train engineer is the person who drives the train and makes sure it runs safely on the tracks. They check the train before it starts, control how fast it goes, and make sure all the passengers are safe. Average Annual Salary: \$67,000 USD
2. Electrical Engineer: An electrical engineer designs and builds the systems that make trains run using electricity. They figure out how to get power from the wires to the train and make sure everything works properly. Average Annual Salary: \$105,000 USD
3. Mechanical Engineer: A mechanical engineer designs the parts of the train that move, like the wheels, brakes, and doors. They test these parts to make sure the train works well and carries people safely and comfortably. Average Annual Salary: \$95,000 USD

### NGSS Connections

- Performance Expectation: K-2-ETS1-1 - Ask questions, make observations, and gather information about a situation 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 - A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Crosscutting Concepts: Cause and Effect - Events have causes that generate observable patterns.

### Science Vocabulary

- \* Electricity: Energy that flows through wires and can power machines and lights
- \* Pantograph: The special arm on top of trains that collects electricity from overhead wires
- \* Motor: A machine that uses electricity to create motion and make things move
- \* Transportation: Ways that people and things move from one place to another
- \* Energy: The power needed to make things work or move
- \* Pollution: Harmful things in the air, water, or land that can hurt people and animals

### External Resources

Children's Books:

- Trains by Gail Gibbons
- The Little Engine That Could by Watty Piper
- Freight Train by Donald Crews