Electricity's Attraction: Teacher's Guide

Grade Level: 6-8	**Curriculum Focus:** Physical Science	**Lesson Duration:** Three class periods

Program Description

Magnetic Earth—Examines our discovery of magnetism and how it works. ***Electric Earth***—Examines the science of electricity and how electric currents work. ***Ultimate Thrill: Electromagnetism at Play***—Examines how we use electricity and magnetism on theme park rides. ***Electronics at Work***—Looks at how electronics have many uses, including powering an artificial arm.

Onscreen Questions

Segments 1 & 2, Magnetic Earth and Electric Earth (13 min.)

- How are electricity and magnetism related?
- How has understanding electricity and magnetism led to advancements in medicine, transportation, power production, and space science?

Segments 3 & 4, Electromagnetism at Play and Electronics at Work (33 min.)

- How has the way we use electricity and magnetism changed since they were first discovered?
- How have advances in electronics changed the way we live and work?

Lesson Plan

Student Objectives

- Share words, phrases, and images that describe the latest thrill rides.
- Explore Web sites about roller coasters.
- Write a creative piece about a roller coaster or another thrill ride.

Materials

- *Electricity's Attraction* video and VCR, or DVD and DVD player
- Computer with Internet access

Procedures

1. As students are watching the video, ask them to jot down words, phrases, images, or sounds that reflect the experience of riding a roller coaster or thrill ride. (For example, my stomach dropped, sky-ground-sky-ground, like a rocket, intense, weightlessness, a blur, adrenaline rush, boom, flying, thrust, shoot out like a volcano, suspended, screams, zero g, loops, 360-degree view of the park, twists, double barrel.)
2. Give students a class period to explore the roller coaster features at the Web sites below. They can learn about roller coasters through history, build their own, and watch videos of rides. Encourage students to explore and address the physical-science features of the rides, such as forces and motion, thrust, weightlessness, and zero g. As students explore these sites, encourage them to add more words or phrases to their list:
   - Travel Channel: Speed Vision Videos Gallery

     http://travel.discovery.com/guides/video/coasters/speedvision.html
   - Discovery: Ride Through Time

     http://dsc.discovery.com/convergence/coasters/timeline/timeline.html
   - Travel Channel: Build Your Own Coaster

     http://travel.discovery.com/ideas/themeparks/rollercoasters/buildacoaster.html
3. Finally, have students use their notes to make up a poem, short story, song, rap, or other creative piece describing the experience of a roller coaster or other thrill ride, or related physical scientific issues. They might describe a specific ride, the experience of riding a roller coaster, or an imaginary ride of the future?

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students were highly engaged in class discussions; recorded many words, phrases, and images from the video; gathered several details from the suggested Web sites; wrote an engaging, thoughtful piece about the experience of riding a roller coaster.
- **2 points:** Students participated in class discussions; recorded some words, phrases, and images from the video; gathered a few details from the suggested Web sites; wrote a satisfactory piece about the experience of riding a roller coaster.
- **1 point:** Students did not participate in class discussions; recorded few or no words, phrases, or images from the video; gathered few or unrelated details from the suggested Web sites; created a simplistic or undeveloped piece about the experience of riding a roller coaster.

Vocabulary

electromagnet

Definition: An electrically produced magnet that can be turned on and off

Context: The roller coaster was launched by electromagnets.

Linear Induction Motors (LIMs)

Definition: Large, flat magnets arranged along a track; used to generate thrust

Context: LIMs were first developed to launch spacecraft into orbit

zero g

Definition: Short for "zero gravity"; a state of apparent weightlessness

Context: The roller coaster ride made it feel like zero g because the centrifugal force offset the gravitational force.

Academic Standards

National Academy of Sciences

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K-12. To view the standards, visit http://books.nap.edu.

This lesson plan addresses the following science standards:

- Physical Science: Motions and forces; Transfer of energy

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit http://www.mcrel.org/.

This lesson plan addresses the following national standards:

- Science—Physical Sciences: Understands the sources and properties of energy, Understands forces and motion
- Language Arts—Viewing: Uses viewing skills and strategies to understand and interpret visual media; Writing: Uses the stylistic and rhetorical aspects of writing

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- http://school.discovery.com/teachingtools/teachingtools.html

DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video—This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index—Here the video is divided into four parts (see below), indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Curriculum Units—These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link—Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources—This screen gives the technical support number and Web site address.

Video Index

I. Magnetic Earth (7 min.)

The discovery of electromagnetism led to most of our technology and modern conveniences. This traces back to humankind's first interactions with the naturally magnetic lodestone.

II. Electric Earth (6 min.)

In 1752, Benjamin Franklin launched a kite into a thunderstorm, revolutionizing the way we see electricity. Take a closer look at electricity and the uses we have for this energy.

III. Ultimate Thrill: Electromagnetism at Play (27 min.)

Roller coaster manufacturers are constantly experimenting with faster and more intense ride designs. Learn how electromagnetism is employed at amusement parks to entertain the thrill seeker in all of us.

IV. Electronics at Work (6 min.)

Electronics are a crucial part of everyday living, but for some people they mean even more. Bob Goodman's electronic Utah Arm has changed his grip on life.

Curriculum Units

1. Discovering Magnetism

Pre-viewing question
Q: What are magnets used for?
A: Answers will vary.

Post-viewing question
Q: What is lodestone?
A: First found in deposits in the Greek province of Magnesia, lodestone is an iron ore that is a natural magnet.

2. The Earth's Magnetic Pull

Pre-viewing question
Q: What is a magnetic field?
A: A magnetic field is the area of space around or near a magnetized object where magnetic forces can be detected. Such a field is generated when electric charges move through space or within an electrical conductor.

Post-viewing question
Q: Where do modern researchers believe that magnetism comes from?
A: Researchers today believe that magnetism comes from the liquid metals in the Earth's core.

3. Electromagnetism

Pre-viewing question
Q: How does an electric circuit work?
A: An electric circuit is comprised of a power source, such as a battery, connecting wires or conductors, and a device that uses electrical energy, such as a light bulb. In a closed electric circuit, a current flows uninterrupted from the negatively charged part of the power source through the conductors and the device, back to the positively charged part of the power source.

Post-viewing question
Q: What is induction?
A: Induction is the process by which electric currents induce magnetic fields, and vice versa. The discovery of induction allowed mechanical energy to be converted into electrical energy and electrical energy to be converted to mechanical energy.

4. Experimenting with Electricity

Pre-viewing question
Q: What is electricity?
A: Electricity is the phenomenon caused by electric charge, whether static or in motion; electric charge is the force of the electrons.

Post-viewing question
Q: What is the relationship between positive and negative electrical charges?
A: When there is an oversupply of moving electrons, an object develops a negative electrical charge. Nature balances this charge by producing an equal positive charge somewhere else. The potential difference between these two charges is measured in volts of electricity.

5. Currents and Volts

Pre-viewing question
Q: What are some of the dangers of electricity?
A: Dangers associated with electricity are electrical fires and shocks. Although people fear electrical volts, it is really the electrical current that can be deadly: One amp of electrical current can stop the human heart.

Post-viewing question
Q: What are electrical measurements based on?
A: Electrical measurements are based on the number of electrons. If you multiply volts, the measurement of the potential between positive and negative charges, by amps, the measurement of electrical current, you get watts. It takes 100 watts to light a common light bulb.

6. The Flying Coaster

Pre-viewing question
Q: What do you like about roller coasters?
A: Answers will vary.

Post-viewing question
Q: How is electricity employed in the X-Flight roller coaster?
A: An electric current on the X-Flight activates advanced hydraulic motors to lift and drop the carriage after riders are seated. The carriage drops backwards, so riders lie on their backs, which feels like flying.

7. The Slingshot

Pre-viewing question
Q: What kinds of rides would exist at amusement parks without magnetism and electricity?
A: Answers will vary.

Post-viewing question
Q: How does the Slingshot work?
A: Hydraulic pressure raises hundreds of feet of steel cables in the spring machine. The springs stretch, and 40 metric tons of force pull the cable taut. A giant electromagnet anchors the ride globe to the ground while the cables are stretched. But when the magnet releases, the ride globe shoots up like a bungee cord.

8. Volcano: The Ride

Pre-viewing question
Q: What rides or events have given you an adrenaline rush?
A: Answers will vary.

Post-viewing question
Q: What makes the Volcano so fast?
A: The Volcano—the first suspended, electromagnetically launched roller coaster—picks up speed within the first seconds of the ride. The coaster cars get their launch speed from cutting-edge linear induction motors, large flat magnets along a track. When a coaster car travels between the magnets, their magnetic field induces an electrical current in the car. This electricity creates an opposite magnetic field in the car, resulting in great thrust.

9. In the Drop Zone

Pre-viewing question
Q: Do you think the newer roller coasters are safer or more dangerous than older versions?
A: Answers will vary.

Post-viewing question
Q: What do you think would be the most thrilling aspect of Drop Zone?
A: Answers will vary.

10. Soaring with Superman

Pre-viewing question
Q: What do you think roller coasters of the future will be like?
A: Answers will vary.

Post-viewing question
Q: How does Superman: Ultimate Escape incorporate technology to go faster than other coasters?
A: Linear induction motors power the Superman: Ultimate Escape ride. A long chain of electromagnets along the track fire energy in rapid succession, pulling and pushing the coaster down the rails. The coaster builds speed with every push-pull combination.

11. Advanced Electronics: The Utah Arm

Pre-viewing question
Q: What are electronics?
A: Electronics are machines that use electricity to control, communicate, or process information.

Post-viewing question
Q: How does the Utah Arm work?
A: The Utah Arm is a mechanical arm that is operated through the electrical impulses in the wearer's body. In the arm are several electrical motors; all the information sent through the motors is processed through a microcomputer mounted in the lower arm.

12.. A Functioning Arm

Pre-viewing question
Q: Do you think electronic limbs can function as well as natural human limbs?
A: Answers will vary.

Post-viewing question
Q: How does a person move the Utah Arm?
A: The brain sends a signal to flex the arm, which is intercepted at the muscle site by electrodes, or skin sensors. A microcomputer amplifies and uses this electric impulse to control the motors in the Utah Arm.