

BASIS Lesson Plan

Lesson Name: Paper Clip Motor

Grade Level Connection(s)

NGSS Standards:

- 4-PS3-2: "Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents."
- 4-PS3-4: "Apply scientific ideas to design, test, and refine a device that converts energy from one form to another."

**Note to teachers: Detailed standards connections can be found at the end of this lesson plan.*

Teaser/Overview

In this activity, students will learn how electric motors work. Students will be introduced to the concepts of energy transfer by assembling a motor that converts electric energy to rotational energy.

Lesson Objectives

Students will:

- Explore how magnets have poles
- Learn about magnetic fields
- Build an electric motor

Vocabulary Words

- Magnet
- Magnetic field
- Motor

Materials

Scientist Volunteers will bring:

- Magnet wire (green or red coat work best since students can see contrast after sanding)
- D cell batteries
- C cell batteries
- Magnet
- Paperclips
- Popsicle sticks

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- Sandpaper
- Rubber bands
- Pennies

Classroom Set-Up

Before class:

- Print instruction pages
- Cut wire to length (~35in), 1 per student

During class:

- Students should be arranged into groups of 4
- One kit goes to each group.

Classroom Visit

1. Introduction (10 minutes)

Role Model Introduction:

Who we are as a group? *American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)*

Why did we become engineers?

- How did we get to where we are now?
- What do we do with our jobs?
- What hobbies do we have?

Topic Introduction:

What do you know about magnets?

What is a motor? What are some examples?

What is electricity?

2. Learning Experience (35 minutes)

How does a motor work? (PowerPoint slides)

http://www.crscience.org/lessonplans/NGSS/4_PaperClipMotor_1718_ElectricMotorsIntro.pptx

Have the students sketch out how they would create a motor. What components will they need?

Assemble the electric motor (PowerPoint slides)

http://www.crscience.org/lessonplans/NGSS/4_PaperClipMotor_1718_preparationnotes.pptx

3. Wrap Up: Review and Discuss the Learning Experience (10 minutes)

Questions to ask the whole class:

- What do you need to create a motor?
- What does each component do?
 - Each group can say one component

4. Connections & Close (5 minutes)

Connections to the real world around students:

- How can you make the motor go faster?
- What could you use the motor for?

Close:

Wrap up as a role model by leaving a few minutes for students to ask questions about science, about being a scientist, and about becoming a scientist. Then, thanks and goodbye!

Follow Up: After the Presentation

Teachers who wish to extend the impact of this lesson may find the following CRS web pages useful:

- <http://www.crscience.org/educators/helpfulreports>
- <http://www.crscience.org/educators/treasuretrove>

Standards Connections

NGSS Science and Engineering Practices

- 4-PS3-2: “Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.”
- 4-PS3-4: “Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.”

Disciplinary Core Ideas

- PS3.B: Conservation of Energy and Energy Transfer– “Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.”

Crosscutting Concepts

- 4-PS3-2/4: Energy and Matter– Energy can be transferred in various ways and between objects.
- 4-PS3-4: Most scientists and engineers work in teams.