



Drexel-SDP GK-12 ACTIVITY

Activity Template

Subject Area(s) Physical Science, Problem Solving

Associated Unit Wind Turbine

Associated Lesson

Activity Title Magnetic Induction

Grade Level 11 (10-12)

Activity Dependency

Time Required 30 minutes

Group Size 3

Expendable Cost per Group \$0

Summary

In this activity, the students learn about magnetic induction, specifically how it applies to electric generators. First, the students are given some background information on magnetic fields and the magnetic fields pattern of a bar magnet. Next, the students are introduced to magnetic flux and are asked to calculate the magnetic flux of some simple geometries. Finally the electric generator is discussed and the students are asked to design their own generator for their wind turbine.

Engineering Connection

The conversion of kinetic energy to electrical energy is an important engineering problem, even more so now with regards to the worldwide energy crisis. Wind energy is a renewable energy source that is being used in order to reduce the amount of fossil fuels we need to use. However, a spinning turbine is only half of the energy production mechanism. Engineers are always looking for efficient methods of transferring the energy of motion into electrical energy that can be transmitted long distances. This lesson focuses on electrical energy generation through magnetic induction.

Keywords

energy, flux, generator, induction, magnet, wind

Educational Standards

- Science: 3.2.P.B4, 3.2.B7, 3.4.E3
- Math: 2.8, 2.9

Learning Objectives

After this lesson, students should be able to:

- Explain the concepts of magnetic fields, magnetic flux, and magnetic induction.
- Explain how a electric generator functions
- Design their own electric generator

Materials List

Each group needs:

- Pencil
- Paper

To share with the entire class:

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Introduction / Motivation

The energy crisis is a great challenge facing our world right now. Fossil fuels are limited in supply and no one can deny that we will eventually run out. However, alternative energies such as solar and wind offer an alternative to our reliance on fossil fuels. In order to extract usable electrical energy from wind and hydro powers, it is necessary to have a generator that transforms kinetic energy to electrical energy. Today we will investigate magnetic induction to learn how magnets can be used to convert kinetic energy to electrical energy. First we must learn about magnetic fields. Magnetic fields lines give us information on the strength and direction of the magnetic force that results from a magnet. They are also a convenient way of visualizing the force. Once we learn about magnetic fields, we will apply that knowledge to design a simple generator.

Vocabulary / Definitions

Word	Definition
Magnetic Field	A field that surrounds magnetic materials and electrical currents. The field shows the direction and strength of the magnetic force at different points.
Magnetic Flux	A measure of the strength of magnetic field going through a surface.
Electric Generator	A device which converts kinetic energy to electric energy.
Magnetic Induction	The process in which current is generated in a wire due to a changing magnetic field.

Procedure

Background

Review the background presentation.

With the Students

1. Start the lesson by introducing the energy crisis and the different ways energy can be generated.
2. Begin the presentation by explaining magnetic fields to the students. Explain that we can draw the magnetic field lines to visualize the magnetic field. The density of the lines represents the strength of the field and the arrows show the direction of the field. After showing the students a picture of field lines around a bar magnet, ask where the field is strongest.
3. Define magnetic flux. Explain that while the total field going through and area is important, the angle at which the field points in relation to the normal of the surface is also important, as shown by the equation. Show the students the example slide and ask if magnetic flux is positive or negative.
4. Explain magnetic induction as the process in which current is generated by a changing magnetic flux. Stress that the change in flux is important, not necessarily the magnitude of the flux. Show some examples of how the flux can be changed by rotating a bar magnet. Then show the two examples of the magnet spinning and ask if the flux has changed.
5. Split the students into groups of 3-4 and ask them to design a system that will generate electricity that can be attached to their wind turbine. Have the students draw their design and submit it. The students should use bar magnets in their design.

Attachments

magnetic_induction.ppt

Safety Issues

- None

Troubleshooting Tips

Investigating Questions

How does the distance between the coil and magnet affect the flux?

Assessment

Pre-Activity Assessment

Class Discussion: Ask the students what they know about energy conversion and the different processes involved.

Activity Embedded Assessment

Class Questioning: During the presentation ask the students questions listed in the procedure as well as any other questions you feel are beneficial. You can split the students in groups and ask for group answers as well.

Post-Activity Assessment

Generator Design: The generator design will allow you to see if the students understand the concepts of magnetic induction as applied to electric generators.

Activity Extensions

If materials are available, the students can build and test their generator.

Owner

Drexel University GK-12 Program

Contributors

Ben Pelleg, Electrical and Computer Engineering Department, Drexel University

Manuel Figueroa, Biomedical Engineering Department, Drexel University

Matthew VanKouwenberg, Science Leadership Academy, School District of Philadelphia

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