Generator ↔ Motor

sead : stem

Subjects

Physics | Engineering | Engineering Design Process

Topics

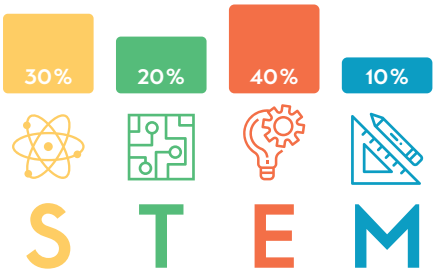
Physics | Engineering | Simple Machines | Energy

Key Words

Generator | Work | Force | Kinetic Energy | Electricity | Simple Machines | Toys from Trash

Connection to SDG

STEM Chart



Time for Activity

2–3 hours

Introduction

Have you ever wondered where electricity comes from? During the past 150 years, electricity has changed our lives dramatically, but most people think it comes from the socket in their wall. Can you imagine living in a world without electricity?

Building simple machines from trash is not that easy, and when it comes to building a small generator it gets more complicated. In this project we will do exactly this.

This project allows students to explore some interesting topics in physics and engineering. It's a great opportunity to learn about simple machines like a motor-generator setup. Here we can also investigate how electricity is produced and what is needed to produce it.

The motor needs kinetic energy, the energy of motion, in order to turn his axle. Where will that energy come from? It could come from human work-force, it could come from students.

Finally, we can use this project to demonstrate the engineering design process. It is unlikely that you will think of an idea for a machine, sit down and build it, and have it work perfectly on the first try. Just encourage students to come up their own designs, test the designs and modify the designs to improve them.

Professional engineers rarely get things right on the first try!

Key Objectives

1. **Building a machine that can generate electricity from human work.**
2. **Understanding the relationship between forces, motion and energy.**
3. **Understanding how kinetic energy can produce magnetic fields that push or pulls electrons in certain objects. It forces them to move.**
4. **Understanding that metals like copper are very good conductors of electrons.**
5. **Understanding that if a magnet is moved quickly through a coil of copper wire, the electrons will move–electricity is generated.**

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Materials

1. 3V LED lamps
2. Old DC motor
3. Rubber band
4. Straw
5. Old CD
6. Nails
7. Some wood
8. Metal strip
9. Hot glue
10. Nut and bolt
11. Some wires
12. Some soldering tin
13. Sewing machine bobbin

Safety

1. Be careful when using scissors, knifes or handsaws for cutting wood or metal strips.
2. Be careful when using hot glue– it's really hot!
3. Be careful when using the soldering iron–it's even hotter than the hot glue.

Guiding Questions

1. How could you build a machine to generate electricity by using these materials?
2. What is the principle of an electric generator?
3. Which materials conduct electricity?

Procedure

(Experimental Procedure or How It Works and How to Design)

The objective of this project is to build a device that produces electricity.

Engage (5 minutes)

Introduce the challenge to the students. Explain that the main goal is to build a machine that can generate electricity using only the given materials.

Design

Before you start building anything, it is a good idea to brainstorm different designs. Try sketching your designs out on paper. Which designs will work best given the rules and materials you are allowed to use? Which design do you think will be the most reliable? Think about these questions and select a design to move forward with.

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Build

Once you have decided on designs, it is time to start building them. You might find out that your designs „on paper“ do not work as planned when you try to build them in the real world. That is OK! You do not have to stick to your original plan. You can make modifications to your design, or even start over with something completely new.

Rules for Building a Machine

1. Only use items listed in the Materials section.
2. Build one machine. The machines within the class can be different from each other.
3. The machine must be freestanding. It cannot be taped to the ground or supported by a person.
4. Your machine has to prove that it generates electricity by lighting up a 3V LED.

Test

Once you have the device, put it on a table and try it out. This is your opportunity to identify weak spots in your designs and things that can be improved. Here are some things to consider:

Rules for Testing a Machine

1. One person at a time can use both hands to operate a machine.
2. The 3V LED has to light up.
3. If you need to make repairs, you must start over counting the number of failed attempts.