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Build Your Own Simple Electric Motor

15-210 / 15-212

Build Your Own Simple Electric Motor

Kemtec Kits #15-210/15-212

Quick Contents

LESSON PLANS

GRADE LEVELS:	
Grade 5-8	
UNIT NAME:	
Build Your Own Simple Electric Motor	
LESSON PLAN TITLE: **The Main Essential Question**	**DAY WITHIN UNIT:**
How can students "explicitly learn how to engage in engineering design practices to solve problems"?	1-7

NATIONAL STANDARD(S) ADDRESSED

MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electrical and magnetic forces

MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even through the objects are not in contact.

MS-PS2.B: Types of interactions

HS-PS2-5. Plan and conduct and investigation to provide evidence that an electrical current can produce a magnetic field and that a changing magnetic field can produce an electrical current.

HS-PS2.B: Types of interactions

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-5. Develop and use a model of two objects interacting through electrical or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS3.A: Definitions of energy

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1.B: Developing possible solutions

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1.C: Optimizing the design solution.

The Engineering Design Process

The Engineering Design Process is a stepwise process of development and evaluation which engineers use to analyze problems they are working on. It is something like the Scientific Method which scientists use in their experimental process. Both the Engineering Design Process and the Scientific Method help guide the logical process of evaluating problems and developing solutions.

While different engineers may use slightly different processes and terminology, the general design process is basically the same. The Engineering Design Process is generally broken down into five to eight steps, sometimes categorized as Ask, Imagine, Plan, Create, Improve or Define Problem, Research Problem, Brainstorm Solutions, Build Model or Prototype, Test Your Solution, Share Your Results, and Modify and Re-Design. Basically, the steps of the process follow this general scenario:

- Define the problem to be solved and the standards to be used to determine optimal performance.
- Research the problem, limitations, and what others have already done.
- Brainstorm possible solutions with other engineers.
- Select the best possible solution for the problem as a team.
- Design the model or prototype solution.
- Test the planned solution.
- Publish or communicate the results of the test.
- Re-evaluate your results and improve the prototype based on the test data and communication feedback.
- Test the improved prototype and continue the evaluation and improvement process until the standard performance has been achieved.

Since the process is repetitive, the process is often diagrammed as a continuous cycle (Figure 1).

Figure 1
Steps of the Engineering Design Process

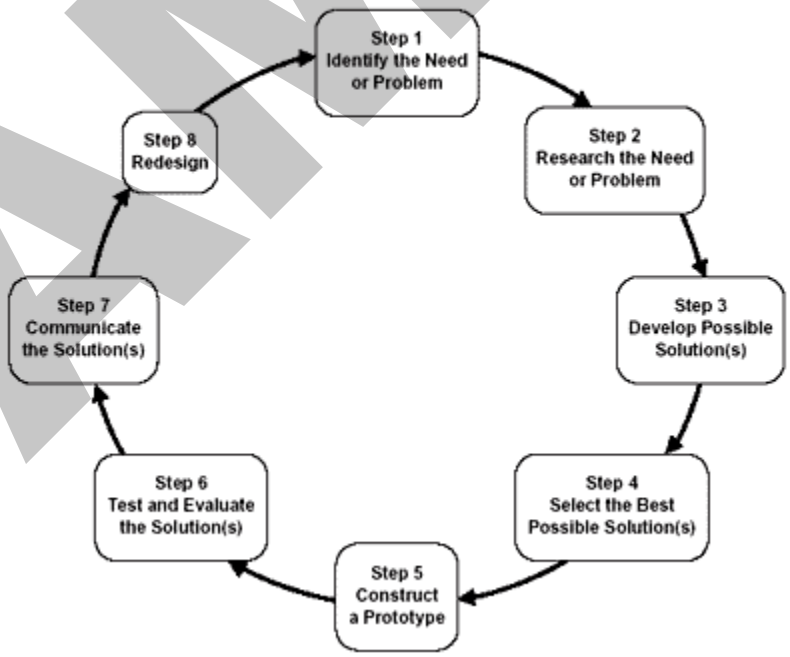


Figure 1. Steps of the Engineering Design Process.
http://www.doe.mass.edu/frameworks/scitech/2001/standards/strand4.html

Experiment 3: Varying the Magnets in a Motor

Your group will need:

[redacted]

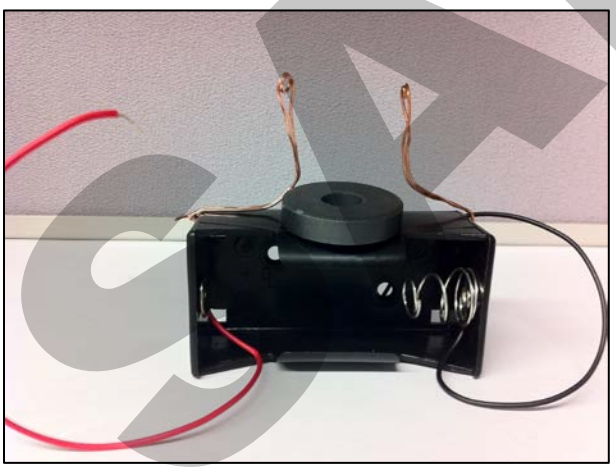
Impact goggles must be worn by all students to protect the eyes.

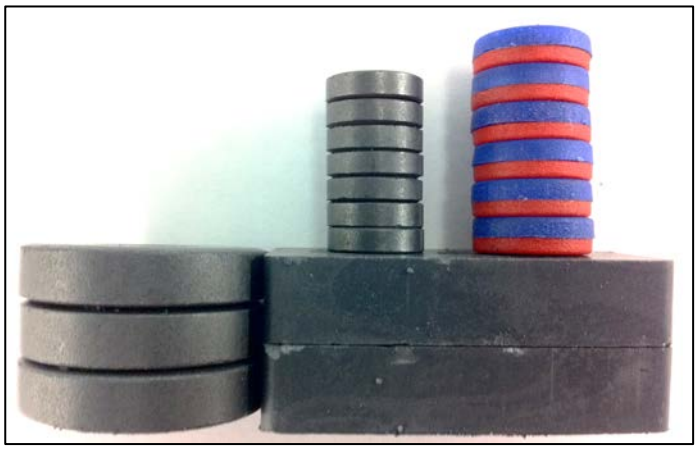
Getting familiar with the magnet components.

One way to change the function of your motor is to alter the magnets you use. There are a number of ways to modify the magnets, which range from changing the shape, size, or strength, to changing the number or type of magnets you use. You may also choose to arrange the magnets in another position or another orientation, or in multiple positions.

Hold a second magnet over the top of the motor while it is running. Does moving the top magnet closer make the coil run faster or slower? Switch the orientation of the top magnet. What happens? Why does this happen? If the north and south poles are facing one another, holding the additional magnet over the top should speed up the turning of the motor.
What happens to your motor when you reverse the polarity of the single magnet? (Turn the magnet over and see. The coil should start turning in the opposite direction.)

What happens when you reverse the direction the electrons are going through the motor? (Switch the black and red leads so that they are connecting to the opposite support wires. The motor should turn in the opposite direction. Why would this happen?) What happens if you change the placement of the magnet or add an additional magnet to the motor? Do some research and discover what type of motor this simulates? After you have taken some time to play with the magnets in your motor, design a simple experiment to test a hypothesis about how changing the magnet in some way will affect the speed of your motor. We have a sample experiment for you below. You may design your experiment after you try the sample below. Your group will need to write up the experiment and have it approved by your teacher before your proceed with the experiment you design.





Build a Motor

Student Data Sheet

Experiment 1: Building Your Motor

1. What was the hardest part of building your motor?

2. What part did you have to modify or change to get the motor to work better? Describe what you did to make the motor run more smoothly.

Experiment 2: Varying the number of coils in a motor

1. List the specifications of your motors including what magnets you used, the number of coils you used, the gauge of the wire you made your coils from, the battery size, and all of the details you would need to repeat the experiment in exactly the same manner at another time.

2. Describe what happened when you ran your motors with the different numbers of coils.