UTAH OFFICE OF
ENERGY DEVELOPMENT

Building a Motor

Grade/Subject: Physics

Strand/Standard Phys 2.4 Design a solution by constructing a device that converts one form of energy into another form of energy to solve a complex real-life problem. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Examples of energy transformation could include electrical energy to mechanical energy, mechanical energy to electrical energy, or electromagnetic radiation to thermal energy. (PS3.A, PS3.B, ETS1.A, ETS1.B, ETS1.C)

Lesson Performance Expectations:

- Students will build a motor and design changes to improve it.

Materials: Each group will need

- **Video** https://www.youtube.com/watch?v=WI0pGk0MMhg
  - 2 mm nichrome wire 75 ft (32 gauge) 30 cm per group
  - 2 mm copper wire (30 gauge) 1.5 meter
  - 2 mm of any other wire
  - Wire cutters
  - Multimeter
  - Battery (size D)
  - Solar panels with different voltages
  - Paper Clips
  - Electrical tape
  - Small magnets of different strengths
  - Alligator clips.
  - Styrofoam brick (big enough to span the copper wire coil.

Time: 180 minutes

Teacher Background Information:

There are many ways to build a motor. The video below describes one way.. The standard suggests that the students will build and design a device and test it. If possible and time permits, students should have time to build and improve the motor as measured by its output.

https://www.youtube.com/watch?v=WI0pGk0MMhg

Student Background Knowledge:

- Students should be aware that solar energy can be transformed into electrical energy through the use of a solar panel.
- Students may be aware of mathematical concepts related to magnetism and electricity but that is not the focus of this activity.

Teacher Directions: A standards-based lesson engages students' curiosity, interest and motivation to learn more. Time and space for the students to experience the phenomenon and ask questions is essential. The student sheet provided below provides guidance but is only one example of how students might respond.

1. Collect the materials.
2. Introduce *Question: How do motors work and what are the best designs for simple motors?*
3. Ask students to write questions about motors on their student sheet. Insist that they must have some. Discuss their questions but avoid answering them.
4. Show the video describing the building of a motor and introduce the materials. Student groups of 2-3 are preferable. Allow at least 50 minutes for building and have a light source available for testing the solar panel. The batteries can help them test the motor at first but at some point they will use the solar panel to create the energy needed to run the motor.
5. Ask student groups to report on the progress of their initial design. The motor will be "rated" on how quickly it turns, which will be somewhat qualitative. Students with slow motion features on their phones may be able to count revolutions more accurately.
6. Allow another 50 minutes for a rebuild and testing. Students should document the changes they make to the device.

Assessment of Student Learning.

1. Which form of energy does the light energy striking a solar cell become?
   A. Electrical*
   B. Chemical
   C. Mechanical
   D. Thermal

2. What form of the energy does the motor produce?
   A. kinetic energy*
   B. heat energy
   C. chemical energy
   D. electrical energy

3. Which motors created in your class work best?

4. Why do you think this was?

5. What changes improved the performance of the motors?

Extension of lesson and Career Connections:
Research and report on the use of solar energy in Utah. Where are solar panels being used, how much energy do they produce?

Title: Building a Motor **Name**_____