



UTAH OFFICE OF ENERGY DEVELOPMENT

Speed and Energy

Grade/Subject: Grade 4

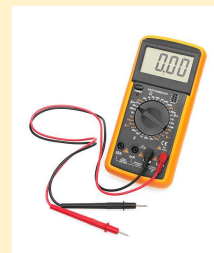
Strand/Standard 4.2.1 Construct an explanation to describe the cause and effect relationship between the speed of an object and the energy of that object. Emphasize using qualitative descriptions of the relationship between speed and energy like fast, slow, strong, or weak. An example could include a ball that is kicked hard has more energy and travels a greater distance than a ball that is kicked softly. (PS3.A)

Lesson Performance Expectations:

- Students will construct a windmill and explore the effect of wind speed on the energy produced.

Materials:

- Windmill kit with various blades, electric motors and leads with alligator clips.
- Voltmeters
- Variable wind source (table fan, blow dryer)
- AA batteries, masking tape
- Cardstock paper



Time: 50 minutes

Teacher Background Information:

- Students will have different shapes of blades provided for their windmills. They can try them all but should test the wind speeds on one style of blade at a time.
- The voltmeters work best with the windmill on the 2000 or 200mv setting. It will also depend on the strength of the fan. Turn the dial to the left to find this reading.
- The electric motor is acting as a generator. The energy coming from the wind spins the motor and creates an electric current. The faster the blade turns, the more energy is produced.

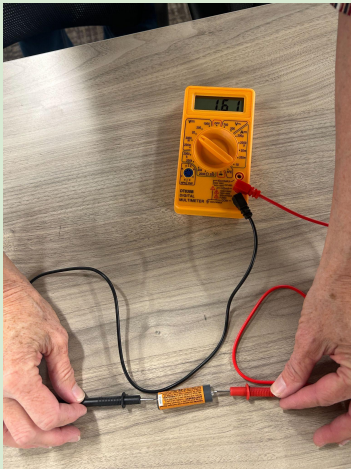
Student Background Knowledge:

Students do not need a detailed understanding of the workings of the motor although some may wish to do further research to find out what is inside the motor. They have most likely never seen a voltmeter before so it is suggested that they use a battery first to give them an idea of how it works. Use this [Link](#) to see a simple setup. Most students will know that the large windmills being built in various parts of the state of Utah are part of the energy network.

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

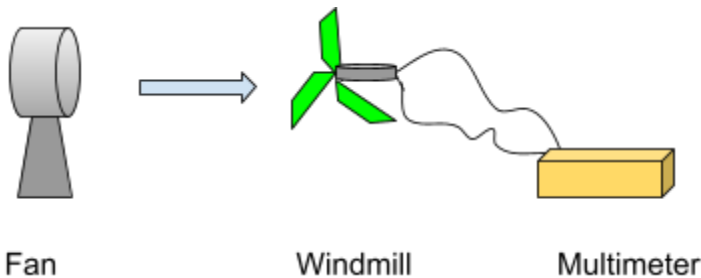
essential. The student sheet provided below provides guidance but is only one example of how students might respond.

- 1. Phenomenon: Show a short part of this video of a moving windmill:
https://www.youtube.com/watch?v=9J6MvP_-5T0 (first 20 seconds most useful)
- 2. Ask for students to write their questions about windmills on the student sheet.
- 3. Read the introduction with students. If the [video](#) is not available, the picture may provide enough information. Local wind farm in Spanish Fork <https://www.youtube.com/shorts/2sMF09eeHyo>
- 4. Provide student groups with a voltmeter and one AA battery. The connection should look like this:



- 5. The size of the batteries matters; larger batteries will heat up and should not be used.
- 6. Introduce the windmill kits and fans to students. If hair dryers are being used, remind students to use “low” or “no heat” settings. If large fans are being used, remind students not to stick fingers or anything else in them.
- 7. Read the directions with students and discuss why different blades or different distances from the fan might give different results. If there are time constraints, only allow students to test one blade type or have different groups test different blades.
- 8. The graph is present if you wish to give students a chance to practice their graphing skills.

Assessment of Student Learning.



Fan Speed	Multimeter Reading
High	.15 mv

Medium	?
Low	.2 mv

- Which of the following is a reasonable estimate for the multimeter reading for a medium fan speed?
 - .1 mv
 - .9 mv*
 - .25 mv
- If the speed of the fan is the cause, what are the effects in this experiment? Choose all that apply.
 - The movement of the blades on the windmill*
 - The amount of energy measured on the multimeter*
 - The movement of the fan blades.
- Which statement best sums up the results of the experiment?
 - The faster the air moves out of the fan, the greater the amount of energy is produced.*
 - The faster the air moves out of the fan, the smaller the amount of energy is produced.
 - The slower the air moves out of the fan, the greater the amount of energy is produced.

Extension of lesson and Career Connections:

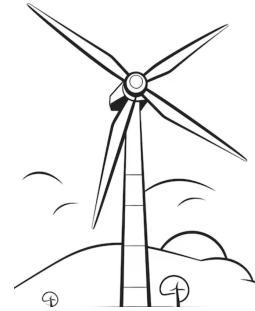
- Students could use this map of wind energy in Utah to predict where new windmills should be placed:
<https://storymaps.arcgis.com/stories/1cffb552442b4446e81ec4546e6da6a16>
- Students could redesign the blades of the fans and test them for change in energy produced.

Title: Speed and Energy

Name _____

Phenomenon: Watch the video of the windmills or look at the picture:
What questions do you have?

- 1.
- 2.



Introduction:

Windmills can be seen in many places today in Utah. They are part of the energy production in Utah that powers our home, school, hospitals and businesses. Windmills are located in areas with the most wind. In this activity, you will test how the speed of the wind affects the energy a windmill can produce. You will finish this lesson by constructing an explanation to describe the cause-and-effect relationship between the speed of an object and the energy of that object.

Materials: Windmill motors with blades, “leads” with clamps, AA batteries, fans or blow dryers

Procedures:

1. Start by placing the leads by taping them in place one on each end of the AA battery. Set the voltage on the voltmeters to 20 by turning the dial to the left. Place one end of each lead in the black and red areas on the voltmeter. The dial will show how much energy the battery is producing:



2. Your windmill will transfer the speed of the moving air into a form of energy (electricity). Find the small openings on the sides of the motor to clip the leads to.

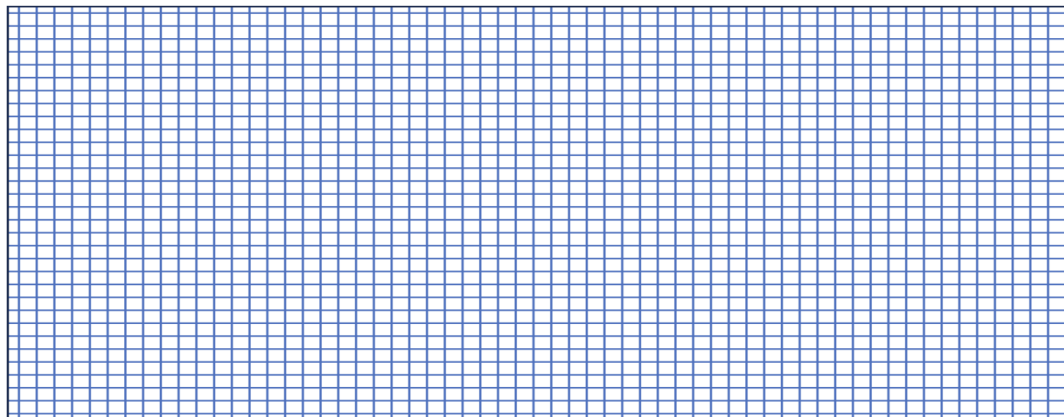
3. Place a blade on the battery and set the voltmeter to 200. Have one team member blow on the blade and see if the dial on the voltmeter moves.
4. Use a fan as a “wind” source to test the amount of electricity created by different speeds of wind. Each fan has speed adjustments: low, medium and high.
5. Hold your windmill the same distance from the fan for each test.
6. Test your windmill on all three speeds and write down the voltage for each. Do not change the blade until all three speeds are finished. If you have time, change the blade for a new set of tests.

Data:

Blade Type (draw)	Energy from Low-speed fan	Energy from Medium-speed fan	Energy from High-speed fan

Bar Graph of Data

Energy
in mv



Low speed

Medium speed

High speed

Claim - Evidence - Reasoning

Summarize your experiments.

State your **claim** by telling what happens to the amount of energy produced when the wind speed is increased. Use the words: speed, energy

List your **evidence** of why this happened.

Explain your **reasoning**. Use cause and effect in your sentence.