Wind as an Energy Source

WIND TURBINE TECHNICIAN, ELECTRICIAN, POWERLINE TECHNICIAN

GRADES	LEARNING OBJECTIVE	CONCEPTS
Grade 5 Grade 6	This is a project kit. Using the engineering design process, students will design, construct, and test (and, if needed, redesign and retest) turbine blades that are both effective and efficient at generating electrical energy from a wind source. Students will use the Vernier output module to determine how many volts their turbine will produce and a wind meter to determine wind speed.	• Renewable energy (wind) • Generation of electricity (volts) • Aerodynamics • Surface area (of the blade) Angles (of the blades in the hub) • Construction materials

Curriculum connections

GRADE 5 SCIENCE

Guiding question: How are energy resources understood?

Learning outcome: Students investigate and analyze various energy resources

Skills and procedures:

- Compare renewable energy resources with non-renewable energy resources.
- Discuss advantages and disadvantages of using renewable and non-renewable energy resources.

GRADE 6 SCIENCE

Guiding question: How are energy resources used?

Learning outcome: Students investigate energy resources and explain factors that influence their use.

Skills and procedures:

Design a device that uses an energy resource, before or after processing, to solve a problem.

Description

Using the wind turbine kit, students will examine the viability of wind as an energy source in Alberta. Students will construct wind turbines and engage in the engineering design process to design, construct, and test their wind turbine blades. Using concepts such as blade length, shape, material, and angles, students will harness the wind to produce electricity.

Wind turbine technicians work with this renewable energy source daily. Wind turbine technicians construct and maintain turbines as well as repair turbine blades. They focus on everything electrical and mechanical within the wind turbine. Powerline Technicians ensure that the electricity generated from wind turbines is transported from the wind turbine to its destination. Powerline technicians maintain powerlines and transformers. Electricians work with electricity and circuitry and are the professionals who work within a building such as a residence or commercial building.

TIME

60–120 minutes if one is using the wind turbine provided.
To complete this task in a shorter amount of time students can work in groups.

MATERIALS

Vernier wind turbine kit (hub, ¼" dowels, Vernier power output module, generator, protractor)

- Fans
  Blades: cardboard, Balsa wood, lightweight foamboard or polypropylene (display board material)
- Scissors or utility blade
- Measuring tape or ruler
- Hot glue gun
  Phillips screwdriver

Procedure

PREPARATION

If using the provided wind turbines.

- The project kit comes with 3 KidWind turbines. Educators can preassemble each turbine prior to the activity, if desired. This will cut down on the total time required to complete the project.
- Prior to this activity, students should have already learned about renewable and non-renewable energy sources such as fossil fuels, water and hydro, wind, and biomass. If needed, assemble the KidWind wind turbine as outlined in the instructional video. Students can assemble their own wind turbines or educators can have them preassembled.
  ***NOTE: This full assembly is a ONE-TIME process.

STEPS

1. Once the wind turbine is assembled students can engage in blade design which includes the designing and construction phase of the engineering design process.
   - Be sure to show students the black hub, which is used to hold the blades and attaches to the generator on the wind turbine.
   - Students need to consider the following when designing blades:
     - Construction material of the blade (weight, surface)
     - Length of the blade
     - Shape of the blade
     - Orientation of the blades in the hub (angles)
2. Once students have designed and cut out their blades, they will use the hot glue guns to secure their blades to the wood dowels. Once dried, they can insert their blades into the hub and attach the hub to the turbine by tightening the set screw with the Phillips screwdriver.
   **NOTE: Students might need assistance opening the hub. This can be done by loosening the wing nut and using a dowel as a lever to separate the two hub halves. Students may also need assistance when tightening the set screw that holds the hub to the turbine driveshaft.
3. Students will then generate wind by turning on the fan. Students will measure the effectiveness of their wind turbine by examining the volt reading on the Vernier output module.
4. Students are encouraged to track the success of each blade design. Students can record their data in a table or in a logbook. Using the collected data, students should adjust or modify their blade design through the redesign and retest phase of the engineering design process.

Assessment suggestions

PERFORMANCE TASK

Examine the effectiveness of each student's blade. Did the blade design enable the turbine to generate electricity from wind? Did the students engage in the engineering design process in an attempt to make improvements? This can be assessed using a rubric or checklist.

WRITTEN ASSESSMENT

Students can keep a written record of each blade test in a table or chart. Progress can be examined with each iteration. Students can then summarize what they learned from this activity.

COLLABORATION AND GROUP DISCUSSION

Students can take part in a group build where they engage in the engineering design process as a group. Students must collaborate with other group members when making decisions.

Extension

- Examine the effect of adding more blades to the hubs
- Additional blade materials can be examined
- Students can use the anemometer to determine optimal wind speed for their turbine
- Students can install the weights and turn their wind turbines into a windmill and lift weights.

Web resources

- Vernier turbine assembly video: KidWind Wind Turbine Assembly
- Vernier energy sensor software video: Investigate Renewable Energy Systems with Go Direct® Energy
- Link to free software: Vernier Canada Graphical Analysis
- STEM Video Resources: Wind Turbine Kit
- Scientific Method Worksheet: Wind Turbine Activity

Contributors

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