Wind Turbine Activity

WIND TURBINE TECHNICIAN, ELECTRICIAN, POWERLINE TECHNICIAN

GRADES	LEARNING OBJECTIVE	CONCEPTS
• Grade 9 • Science 30	Students will apply knowledge of blade design and angles to create efficient wind turbine blades. Students will measure and analyze voltage output to evaluate the performance of different blade designs.	• Renewable energy • Energy conversion • Mechanical energy • Measurement • Voltage • Power • Generators

Curriculum Connections

GRADE 9 SCIENCE

- Investigate and interpret the use of devices to convert various forms of energy to electrical energy, and electrical energy to other forms of energy
  - Investigate and describe evidence of energy transfer and transformation
  - Modify the design of an electrical device, and observe and evaluate resulting changes
- Identify and estimate energy inputs and outputs for example devices and systems, and evaluate the efficiency of energy conversions
  - Identify the forms of energy inputs and outputs in a device or system
  - Apply appropriate units, measures, and devices in determining and describing quantities of energy transformed by an electrical device.

SCIENCE 30

- 30–D1.4k Explain the need to develop technologies that use renewable and nonrenewable energy sources to meet the increasing global demand.
- 30–D1.5k Describe the environmental impact of developing and using various energy sources; i.e., conventional oil, oil sands, solar power, wind power, biomass, hydroelectricity, coal burning power, nuclear power, geothermal.

- 30–D2.3k Describe the conversion of solar energy into renewable forms (e.g., wind, hydropower, chemical potential energy by photosynthesis) and nonrenewable forms (e.g., coal, oil and gas) and further conversion into electrical and thermal energy.
- 30–D2.4k Describe the functioning of renewable energy technologies and assess their advantages and disadvantages, including active and passive solar-heating technologies, wind turbines, hydroelectric power, biomass energy, geothermal energy, hydrogen fuel cells.

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. Students can also use the Vernier Go Direct to view the statistical analysis of their blades.

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	MATERIALS
• 60–120 minutes. • To complete this task in a shorter amount of time students can work in groups.	• Vernier wind turbine kit (hub, ¼” dowels, Vernier Power output module, generator, protractor) • Fans • Cardboard, Balsa wood or lightweight foamboard or polypropylene (display board material) • Scissors or utility blade • Measuring tape or ruler • Hot glue gun • Phillips screwdriver

Procedure

PREPARATION

- 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 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 kit 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 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 set. 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.

PRACTICAL SKILLS ASSESSMENT

- Observe students during the design and construction of their wind turbine blades, paying attention to their ability to accurately measure and cut the blade shapes and angles.
- Assess the cleanliness and precision of their blade construction, emphasizing the importance of accuracy and attention to detail.

REFLECTION AND SELF-ASSESSMENT

Ask students to reflect on their experience and assess their own work. Provide guiding questions such as the following:

- How well do you think you measured and cut the angles and blade shapes?
- Did you encounter any challenges during the design and construction process? How did you overcome them?
- How did you use your data to inform your decisions regarding improvements during your series of tests?
- How satisfied are you with the overall quality of your wind turbine blades and their appearance?
- What would you do differently if you were to repeat this project?

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 weight pulley and cup to turn their wind turbines into a windmill and see how much weight they can lift.

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

Contributors

Warren Anderson, Colton Garner, KidWind, Vernier Canada