Design and Build your Own Wind Turbine

Overview: Wind can be found in nature. Wind is a part of weather and can bring in various types of storms. Wind is **renewable** and can power things. Students will need to design a wind turbine that creates the highest number (voltage) on the multi-meter. Students will decide on the number of blades, the length of the blades, the material for your blades, and the distance from the hub to the blades.

Procedure:
Day 1: Read the Story of *Engineering Elephants*. Talk about what engineers do; especially pay attention to the page that describes how engineers create artificial limbs. Make connections to the devices used to assist students in Challenger Baseball (switches are used to power a bat).

Day 2: Read *The Boy Who Harnessed the Wind*. Discuss what materials the boy collected to use to try and harness the wind. Stress the PROCESS and trial and error.

Students work with a partner to work with the vocabulary on the communication devices.

Communication device (16 choice) programmed with the following words: wind, blow, moves, slow, fast, turn on, fan, pitch/turn, close, far away, multi-meter, measures, aluminum pie pan, paper plate, plastic water bottle, predict. Students will touch the items on the table or show examples of fast, slow, etc. Certain terms can be acted out.

Day 3: Show the eere doe wind animation of turbine parts for the SmartBoard.

- Show the FLIP video of assembling our Wind Turbine Kit.
  http://www.vernier.com/products/kidwind/wind-energy/kits/kw-bwx/
- Provide Tinkertoys to build different parts of the turbine. Watch that students who like to put things in their mouth do not insert small Tinkertoys in their mouths.
- Replaying the FLIP video, students will work in pairs to assemble the wind turbine tower.
- Hand out the *Testing Sheet Packet for Wind Turbines*. Explain what you will test on each page.

Using the available materials and tools, build your wind turbine. For students who do not have use of their hands or for those who cannot cut, there will be multiple sizes, shapes, and lengths of blades in aluminum, plastic, cardstock, or cardboard to use. They could verbally give instructions for how to make their blades. Other students could cut and construct on their own. Peer Pals (general education students who tutor in our room) who come during science could also assist once they learned to guide and not DO for our students.

ASOL Covered in this Activity:

3S-ESS 1 The student will investigate and understand basic types, changes, and patterns of weather. Key concepts include:

a) identification of common storms and other weather phenomena

Extension Ideas: *Sesame Street: Listen to the Wind Blow* (although performed on Sesame St. in the 1980s, this is not a preschool song. On this version it is sung by Buffy St. Marie, a folksinger).
http://www.youtube.com/watch?v=dyEE7EQx5Z0

Weather Songs: Why does the Wind Blow? Weather Songs, sung by Tom Glazer, is part of *Singing Science* set of recordings. This set came out in the late 50s/early 60s and exposed children to different science topics through fun and catchy little songs.
http://www.youtube.com/watch?v=p-cq6W1XeHI

3S-ESS 7 The student will investigate and understand different sources of energy. Key concepts include:

b) sources of renewable energy

Extension Idea: Read *Wind Energy* by Jack Dunn from the Tarheel Reader Web site. http://tarheelreader.org/2009/11/04/wind-energy/. Ask students questions as they read or as you read to them.

Read *Energy* by Mrs. J. from the Tarheel Reader Web site:
http://tarheelreader.org/2010/02/10/the-sun-4/

Discuss both renewable and nonrenewable energy sources.

5S-ESS 1 The student will investigate and understand how weather conditions and phenomena occur and can be predicted. Key concepts include

a) Weather phenomena.
b) Weather instruments and meteorological tools.

8S-ESS 1 The student will investigate and understand basic sources of energy, their origins, transformations, and uses. Key concepts include

d) Renewable energy sources.

8S-ESS 6 The student will investigate and understand public policy decisions relating to the environment. Key concepts include

a) Management of renewable resources.

HSS-ESS 3 The student will investigate and understand that energy transfer between the sun and

Earth and its atmosphere drive weather and climate on Earth. Key concepts include

a) Observation and collection of weather data.

Additional ASOLs

4M-NSCE 1 The student will

b) compare whole numbers (<,>,=);

As students get readings on their multi-meter, they can compare the numbers.

Extension Idea: Graph the readings from the multi-meter. Large graph paper can be used. In addition, it is possible to use the computer program Max Count to graph on the computer. Your assistive technology staff can assist you in knowing what programs are available in your school.

Materials Needed: aluminum pie pans, card stock, plastic water bottles, glue, glue sticks, dowel rods, cardboard; KidWind Basic Wind Energy Kit; photos of actual parts from the KidWind Kit, FLIP movie for how to assemble the tower, Tinkertoys

Tools: hub, generator, FLIP camera, scissors, glue gun, fan, rubber stamps and stamp pad

Communication Devices (16 choice) programmed with the following words: wind, blow, moves, slow, fast, turn on, fan, pitch/turn, close, far away, multi-meter, measures, aluminum pie pan, paper plate, plastic pater bottle, predict

Handouts: *Testing Sheet Packet for Wind Turbines*, *Wind Blade Turbine Design Specification* sheet

Literacy Connections: *Engineering Elephants* by Emily M. Hyunt, Ph.D. and Michelle L. Pantoya, Ph.D., *The Boy Who Harnessed the Wind: Creating Currents of Electricity and Hope* by William Kamkwamba and Bryan Mealer

Instructional Setting: Special education, Inclusive general education science class

Community Connections and/or Peer Interaction: Trips can be taken to see local wind turbines or other houses or businesses that use renewable resources. James Madison University and Thomas Harrison Middle School in Harrisonburg have their own wind turbines. Local universities, landscaping businesses, and the Chamber of Commerce can provide you with trip ideas.

Functional Activity/Routine: The task of actually building the turbine involves fine motor

skills; mathematics skills and following sequenced directions are also involved.

Strategies to Collect Evidence: Observation, as well as the *Testing Sheet Packet* and the *Wind Blade Turbine Design Specification* sheet, may be used.

Specific Options for Differentiating this Activity: For students who do not have use of their hands or for those who cannot cut, there will be multiple sizes, shapes, and lengths of blades in aluminum, plastic, cardstock, or cardboard. They could verbally give instructions for how to make their blades. Other students could cut and construct on their own. Peer Pals (general education students who tutor in our room) who come during science could also assist once they learned to guide and not DO for our students. Worksheets can be completed with rubber stamp letters and numbers for the student who cannot write. AlphaSmart or Forte devices can be used to type answers as well.

Design Brief: Build Your Own Wind Turbine!


Background: We have been learning how wind moves things. We have explored using pinwheels  on a windy day.

Challenge: <u>Design</u> and create a wind turbine that creates the highest number (voltage) on the multi-meter. Decide on your number of blades, the length of the blades, the material for your blades, and the distance from the hub to the blade.

Criteria: Complete the *Wind Turbine Blade Testing Sheet* as well as the *Design Specification Sheet* (on another page)

Do you have a certain number of blades?

_____

Did you decide on a length for the blades? _____

Did you decide on a material for the blades? _____

Did you decide on the pitch for the blades? _____

Did you decide on the distance from the hub to the blade? _____

Materials:

* Photos of each part of the turbine so students can match to the same.

* FLIP movie of how to assemble the wind turbine. It can be stopped at specific points so students can follow along. (The movie will only show how to build the tower. Students will decide on the number of blades, materials, etc.)

* Pie Plates  * Glue 
* Card Stock * Glue sticks 
* Plastic  * Dowel Rods
* Cardboard 
* KidWind: Basic Wind Energy Kit
* Blades in various lengths of different materials for the students who are unable to cut.

Tools:

* Hub  * Communication Devices
* Generator  *Fan 
* Scissors  * Glue Gun 
* Rubber Stamps and Stamp Pad 
* Communication device (16 choice) programmed with the following words: wind, blow, moves, slow, fast, turn on, fan,

pitch/turn, close, far away, multi-meter, measures, aluminum pie pan, paper plate, plastic water bottle, predict

Adapted by Jennifer Wright, Special Education Teacher, Harrisonburg City Public Schools, from *The K-5 Children's Engineering* Notebook (JMU Content Teaching Academy).

Testing Sheet Packet for Wind Turbines

Blade Length

Predict and make a hypothesis for which design will work best. Why?

_____

_____

Design	Voltage (V)

Did it work the way you thought? Why or why not?

_____

_____

Blade Material

Predict and make a hypothesis for which design will work best. Why?

_____

_____

Design	Voltage (V)

Did it work the way you thought? Why or why not?

_____

_____

Blade Number Station

Predict and make a hypothesis for which design will work best. Why?

_____

_____

Design	Voltage (V)

Did it work the way you thought? Why or why not?

_____

_____

Blade Pitch Station

Predict and make a hypothesis for which design will work best. Why?

_____

_____

Design	Voltage (V)

Did it work the way you thought? Why or why not?

_____

_____

Wind Blade Turbine Design Specifications

Name:_____

Date: _____

Number of blades: _____

Pitch of blades: _____

Length of blades: _____

Material: _____

Distance from hub to blade: _____

Maximum Voltage Output with fan on HIGH _____