**Lesson Topic: Grade Level: Time:**

Wind Energy 3-5 30-45 minutes

 Can be 2 days depending on the

 depth of the lesson

**Objective:**

Students will identify the cause of wind and examine its effects in order to classify wind as an energy source.

**Teacher Background Information and Instructional Alternatives**

* <http://www.kids.esdb.bg/wind.html> This site could be used during the explanation. It provides information on wind and wind turbines and also includes photographs.
* <http://www.kidcyber.com.au/topics/windenerg.htm> This site includes an explanation of wind energy that the teacher could read to the students during the explanation. It includes photos as well.
* <http://www.greenmountain.com/resources/enviro-kids/renewable-energy-101/wind-energy> This site shows a diagram of a turbine.
* <http://www.kids.esdb.bg/wind.html> Gives a more detailed explanation of what wind is and how we use turbines to create energy.
* <http://www.energyquest.ca.gov/story/chapter16.html> Give a more detailed explanation of wind energy and the parts of a turbine.
* <http://www.alliantenergykids.com/FunandGames/OnlineGames/007011> This is an interactive game where students learn more about wind farms.

**Materials Needed:**

-model of a wind turbine

-picture of a kite and sailboat

-For each small group:

* 5, 3-ounce paper cups
* Hole punch or sharpened pencil
* Ruler
* 2 plastic straws
* 1 pin
* timer
* 1 stapler (teachers usually have one or two of these in their class)
* Pencil with an eraser on one end (are you supplying these)

-Fan with different speeds (take this off of the materials list if you will not include it and change to “a windy day”

**Engagement:**

-Show students the picture of a kite and sail boat. (Gabe large pic where they identify) What do we know about each of these objects? Discuss each of these objects and gather information about what children know about them.

-Now ask students how these two objects are connected. Once students come to the conclusion that it takes wind to move both of these things reiterate that the wind gives these objects the energy to move. But how does wind do that? What are ways that something needs to be constructed to gather that energy from wind? Why does a kite fly when there is wind? Why does a sailboat move when wind hits the sail?

**Exploration:**

- What are the ways you know that wind is present? Display this question and have students talk to a partner or group.

-Discuss the different effects that wind has to display its presence.

**Explanation:**

- What is wind anyway? We know when it is there but what causes it?

-At this point show the “wind cycle” handout as it is being explained. While papers are being passed out discuss the word “cycle” and students’ prior knowledge of other types of cycles.

- Explain to students that it is similar to the water cycle and is a process that is constantly happening. It starts with the uneven heating of parts of the earth’s surface. Certain areas and specific parts of the day influence this. Wind is formed when one area of the earth’s surface heats more than the surface next to it. Warm air rises and the cool air comes in to replace where that warm air was. This movement is the wind. It is a cycle because that process is constantly happening. During the day the area over the land warms faster than over the water. So the warm air rises and cool air from the water comes in to take its place. During the night this process is reversed because the area over the land cools faster than over the water.

-Consider using one of the following websites to illustrate the above discussion.

* <http://kids.discovery.com/tell-me/curiosity-corner/weather/how-is-wind-created>

This site explains the wind cycle in child-friendly format.

* <http://www.kidsgeo.com/geography-for-kids/0081-atmospheric-pressure.php>

This site illustrates the cycle and uses a quick video to display the warm and cold air.

-Now that we have covered what wind is, we are going to explore how we can catch this energy from the wind. What have you seen before that catches the energy from the wind? Students may respond with windmills or wind turbines. Explain that people have used wind for energy for a long time. Windmills were used to grind stones and grains or pump water from wells. What we use in the present is wind turbines.

-These turbines catch the wind’s energy and use this to power a generator. When many wind turbines are placed near one another, this is called a wind farm. Why would they call it that? Discuss what might be seen on a wind farm.

-Explain that in order for wind turbines to be effective they must be placed where wind is frequent. Wind turbines are usually high off the ground because wind moves faster the higher it is.

- Display the diagram of a wind turbine. The wind turbine has blades that move when the wind hits them. These blades are attached to a shaft that rotates. The shaft goes through a gear transmission box where the speed of the wind is modified and is attached to a generator that creates electricity from the wind’s energy.

- Some people think that there are pros and cons to using wind turbines. What do you think the pros would be? Discuss how it a renewable resource (something we can you over and over) and that it is clean for our environment. Consider providing a visual to students by creating a T-chart labeled “pros (+)” and “cons (-)”.

-Now discuss what some of the negatives could be. People who live in the areas do not like how large they are, they do make noise when they rotate.

-Ask students what their opinion is and if the benefits outweigh the negatives.

-The speed of wind is measured using at anemometer. Why would people need to use an anemometer?

-We are going to become engineers for the day and create an anemometer and measure the speed of wind from speeds of a fan. An anemometer is one of the tools used to measure the speed of wind. They use revolutions per minute or RPM.

**Extension:**

Procedure: It may be beneficial for you to display the directions or complete a model as the students follow your steps.

1. Use the paper hole punch or sharpened pencil to punch one hole in the side of each cup, about ½ inch below the rim. (For each demo or small group, prepare four cups this way)
2. Use the paper hole punch or sharpened pencil to punch four equally spaced holes in the sides of another cup, about ¼ inch below the rim. Then, with the pencil, punch one hole in the center of the bottom of the cup. (For each demo or small group, prepare one cup this way)
3. Have students take one of the one-hole cups and push a straw through the hole about an inch. Tell students to fold the end of the straw on the inside of the cup and staple it securely to the side of the cup. Repeat this using another one-hole cup and the other straw.
4. Have students take each of their straw-cup assemblies and push the empty end of each straw straight through two facing holes on the side of the five-hole cup, to form an "X" in the middle of the five-hole cup. Make sure that the cups face the same direction, with the rims all facing either clockwise or counterclockwise.
5. On the empty end of each straw, tell students to insert a new one-hole cup about an inch into the cup, then fold the straw on the inside and staple it securely in place, as they did in step 2 above. Make sure that cups on the same straw face opposite directions.
6. Have students position all cups an equal distance from the center of the five-hole cup and then carefully push the pin through the two straws where they intersect, roughly in the middle of the open end of the five-hole cup. You can help students push the pin in if it is safer for you to do so.
7. Instruct the students to push the pencil through the hole in the bottom of the five-hole cup, eraser-end first, until it reaches the straws. Then ask the students to carefully push the pin securely into the eraser; help them push in the pin if necessary. The completely assembled anemometer should now be ready to measure wind speeds.

-To have the students see how the anemometer detects wind, have them hold the meter upright on a desk or table and blow straight into an open cup. Tell them to blow gently for a few seconds, and then blow harder. How did blowing harder change how the anemometer turns?

-Students can now calculate the velocity (speed) of wind! Using the fans have students hold their anemometer. In order to measure the velocity they have to calculate the RPM first (revolutions per minute). Gabe- what are they supposed to do after the RPM, is it something with circumference?

**Evaluation:**

-Many mathematical activities can be implemented at this point (this will need to be edited if you are not supplying fans) I can add a hand out if there are fans once I know the settings

* Calculate the velocity at different fan speeds.
* Go outside on a windy day and calculate the velocity of wind
* Create different math situations using students’ actual numbers for a real-life connection. For example, if the anemometer went around 24 times in one minute how many times would it revolve in 12 minutes?

-Draw a detailed diagram about the parts of the turbine.

-Do further research using the suggested sites to explain what wind energy is.

-Create a debate with students taking a stance either for or against wind energy. Do further research using the sites to support your argument.

-Create an instructional article about how to make an anemometer.

-Explain the cycle of wind and how a turbine uses wind to make energy.