

**2008
Winning Lesson Plan
from Boulder, Colorado**

*Wind Over the Landscape
Inquiry Lab*

by Grace Ellen DeBacker
Nevin Platt Middle School

Subject: Earth Science,
Meteorology, Energy
Grade Level: 8
Duration: 1 Week

Overview and Purpose

This inquiry lab is designed to allow students to investigate how wind patterns change at differing heights above a landscape when the landscape varies in shape and vegetation amounts. The data collected will allow the students to determine the best placement for a wind turbine that will convert wind energy to electrical energy. The purposes of this inquiry lab are to learn how wind patterns vary over the landscape, to set up and run a series of related inquiry labs, to work together as a team in solving a problem, and to understand the wind turbine placement will determine the amount of energy collected.

Innovations

This instructional plan is innovative because it involves students in a series of inquiry labs that will give the students information to solve a real world problem, where to place a wind turbine for creating electrical energy. It uses a 4 foot long cardboard box with Plexiglas viewing ports as a wind tunnel that allows the students to collect the data.

Unit Description

This inquiry lab has been used as part of a unit on weather. The unit is set up with a focus on wind. The students learn about how weather measurements are made, the changes in weather conditions as fronts move through, the different types of extreme weather, and how all of these affect the amount and type of wind that is received by certain locations.

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Colorado Educational Standards Addressed

Standard 1

Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.

Standard 4

Earth and Space Science: Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space. (Focus: Geology, Meteorology, Astronomy, Oceanography)

Standard 5

Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.

Objectives

The objectives are to learn how differences in the landscape affect the wind speed, to successfully work as a team, to develop and carry out a series of related inquiry labs, and to analyze the data to determine the best location for a wind turbine.

Materials

- wind tunnels (4 foot cardboard box with Plexiglas viewing ports glued on)
- box fans
- foam landscapes of varying contours (smooth, mountain, valley, rough)
- model pine trees (from hobby shop)
- sticks with flags attached at 3 centimeter intervals
- meter sticks

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Procedures

1. Build or obtain wind tunnels and other supplies, copy student papers.
2. Set up groups of students. Discuss the problem and how the lab will work.
3. Give students planning time. Structure this as needed for the group.
4. Allow students work time for doing the labs. Support as needed.
5. Give students work time as needed for writing up the lab reports.
6. Have a discussion of the findings for each group.

Activities Outside Classroom

1. Have students research wind turbines (how they work, different types, etc.)
2. Have students collect research on the amount of wind that occurs daily at the school site. This can be collected daily using an anemometer, off a web site, or from the weather page of the newspaper.
3. Have students find out the amount of energy their home uses, then find the size of wind turbine and speed of wind needed to provide that energy.
4. Have students find out how wind energy is collected by the local energy supplier.
5. Have students research how wind breaks of trees are used on farms to prevent erosion and along highways to prevent snow drifts.

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Purpose: To learn as much as possible about how wind travels across a landscape.

Problem: Use your knowledge about how the wind travels across the landscape to determine where to place a wind turbine for maximum electrical generation.

Procedure:

1. As a lab group, determine what variables to test during this week of labs. Test only one variable at a time.
2. Write up each variable tested in detail, including procedure (step by step with location of flags and trees), data (horizontal and vertical), conclusion of how the variable tested affects wind speed, and your conclusion of the best location for a wind turbine with each test. Do one write up per lab group for each variable tested using a standard format. One lab partner is responsible for each write up, with their name on top of the paper.
3. After testing each variable, test a combination of variables to see if there is any change of results when combined. Write up these labs in the above manner.
4. Each individual needs to write up their own final conclusion. This needs to include the following items:
 - a. What have you learned about how wind travels across the landscape? Include a discussion of how different variables affect how the wind travels. Also be sure to include the vertical and horizontal wind patterns change. This should be at least a page in length.
 - b. Where in a landscape would you recommend placing a wind turbine? Include what items need to be avoided in the placement and specifics on the topography of the landscape as well as the recommended height of the turbine. Include a diagram to clarify the description.
5. Put all the write-ups together in a folder. Put in a cover, a table of contents listing each lab included and the conclusions (with the name of the responsible partner by each item), the labs write-ups, and each individuals conclusions. Make sure the cover sheet has the names of all the partners in the lab group. Separate each item with a divider that is labeled to correspond with the table of contents. There will be one folder including all the information for each lab group.

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6. Notes:

- a. Neatness counts in the final product.
- b. Each partner is responsible for writing up at least one of the variable labs. The name of the partner doing the write-up needs to be recorded on the top of the lab.
- c. All write-ups need to be in a standard format for labs.
 - Purpose/Problem
 - Hypothesis
 - Procedure including diagrams of placement
 - Data in chart format and with diagrams
 - Conclusions drawn from data
(affect on wind speed, turbine placement, and accuracy of hypothesis)
- d. Each partner is responsible for their own individual conclusions. Be sure the name of the person is recorded on top of the conclusion paper.
- e. All write-ups and conclusions need to be typed in 12-point font.
- f. The final product is due on _____ at the beginning of class.
- g. You will have five 45 minute classes for testing. You will need to coordinate with other lab groups for supplies so plan ahead.
- h. I expect a minimum of 4 individual variables to be tested and 1 combination trial.
- i. This project is worth 100 points for the group grade, and an additional 100 for the individual grade (a total of 200 points per student).
 - The group grade will be based on:
 1. Neatness of the folder of lab information (15 pts)
 2. Completeness of requirements (25 pts)
 3. Methods used for the labs including only 1 variable tested per trial (50 pts)
 4. Participation of all lab members in the process (evaluated by me and by your lab group) (10 pts)
 - The individual grade will be based on:
 1. Quality and completeness of your write-up of the lab you were responsible for (30 pts)
 2. Your conclusion of what you have learned about how wind travels across a landscape (30 pts)
 3. Your conclusion of the best placement for a wind turbine (30 pts)
 4. Your participation in the process (10 pts)

NAME:

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Variables:

Plan for Testing and Responsibility:

Day 1

Day 2

Day 3

Day 4

Day 5

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