Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

THAR SHE BLOWS!

Lesson Overview:

This lesson is designed to build upon students' prior knowledge of seed adaptations for wind dispersal and support students' understanding of weather and the use of tools to document wind speed. Students will be challenged to construct an anemometer and use the anemometer as a tool to gather and record data on wind speed. Fifth grade students will reflect upon wind speed data to identify pattern and explain dispersal of seeds as a result of wind.

Learning Goals for 5th Grade Students:

Through this lesson, students will:

1. Investigate wind and the dispersal of seeds through wind.
2. Learn how to measure wind speed through the construction of an anemometer.

Learning Objectives for 5th Grade Students:

Following this lesson, students will be able to:

1. Explain the role of wind in seed dispersal.
2. Describe and explain the structure and function of an anemometer as a tool for measuring wind speed.
3. Collect weather data over an extended period of time using an anemometer.
4. Reflect upon wind speed data to identify patterns.

National Science Education Standards:

Standard A:

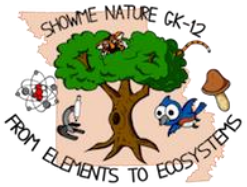
Teachers of science plan an inquiry-based science program for their students. In doing this, teachers

- Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students.

Standard B:

Teachers of science guide and facilitate learning. In doing this, teachers

- Orchestrate discourse among students about scientific ideas.



Office of Science Outreach
University of Missouri

Lesson developed by: Lianne Hibbert Editor: Deanna Lankford, Ph.D.

Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Standard D:

Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this, teachers

- Structure the time available so that students are able to engage in extended investigations.
- Create a setting for student work that is flexible and supportive of science inquiry.

Standard E:

Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive.

- Nurture collaboration among students.
- Structure and facilitate ongoing formal and informal discussion based on a shared understanding of rules of scientific discourse.

Missouri GLEs – 5th Grade:

Strand 2: Properties and principles of force and motion

2.Forces affect motion

F.Work transfers energy into and out of a mechanical system

a. Explain how work can be done on an object (force applied and distance moved.

Strand 5: Process and interactions of the Earth's systems

1. Earth systems (geosphere, hydrosphere, and atmosphere) have common components and unique structures.

C. The atmosphere (air) is composed of a mixture of gases, including water vapor, and minute particles

a. Recognize the atmosphere is composed of a mixture of gases, water, and minute particles

Strand 7: Scientific inquiry

1. Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking.

B. Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations

a. Make qualitative observations using the five senses

b. Determine the appropriate tools and techniques to collect data

Potential Student Misconceptions:

- Air has no mass. The phrase "lighter than air" describes air without mass.
- Because air is invisible, it does not have mass and is not a form of matter.

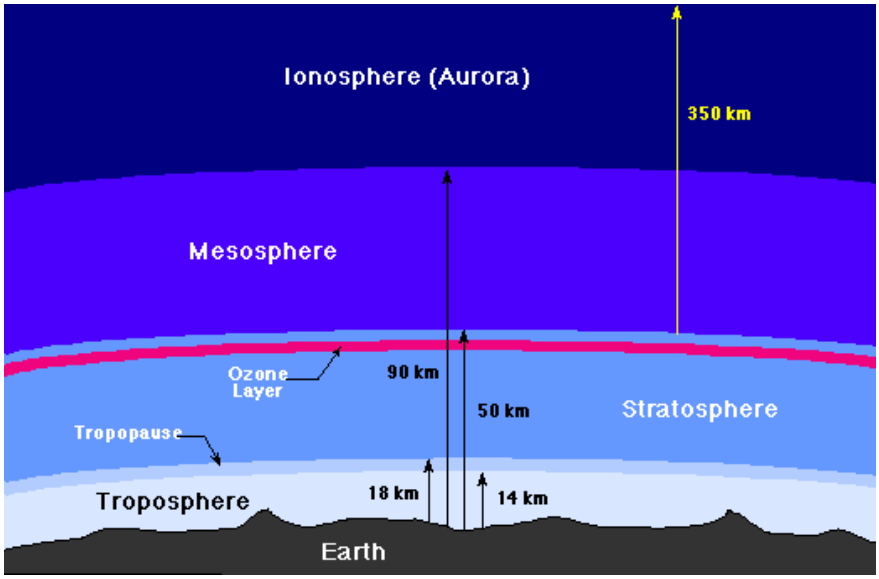
Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Terms to Know:

Barometer: a tool for measuring air pressure
Thermometer: measures temperature
Anemometer: measures wind speed and direction
Rain gauge: measures the amount of rainfall
Hygrometer: measures moisture in the air
Humidity: how moist or warm the air is
Climate: describes patterns of weather over a period of time
Weather: describes the condition of the air at a particular time and place. Weather also tells how the air moves (wind).

Background Information for Teachers:

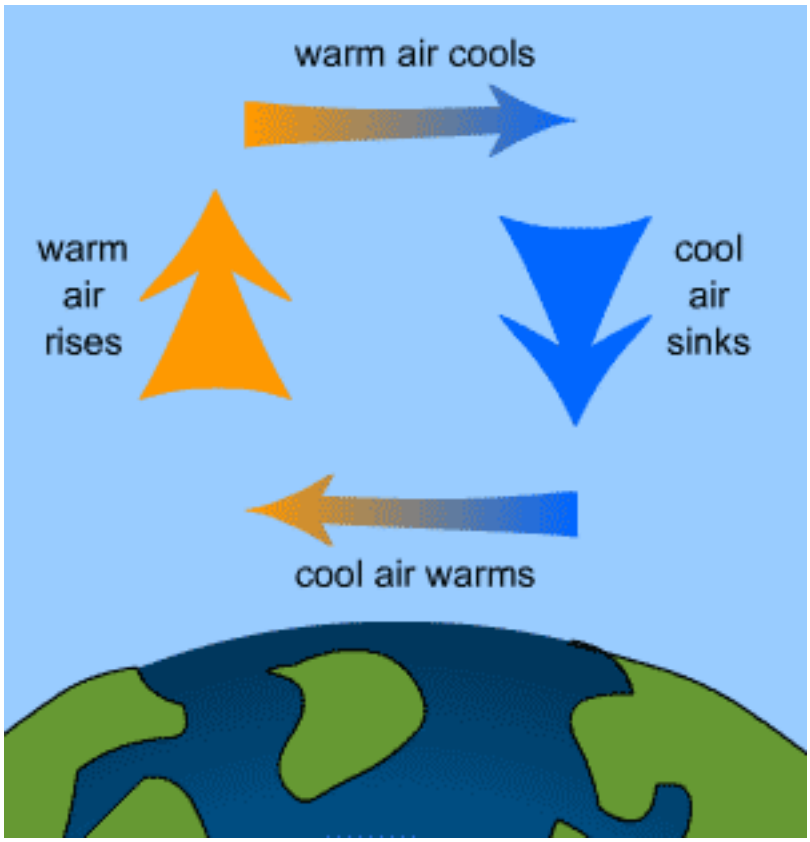
What is weather? Weather describes the condition of the air at a particular place and time. Rain, sunshine, snow, thunder, lightning, rainbows, haze, fog and storms are all part of weather. It helps us decide what clothes we wear, what food we eat, and what kind of life we lead. We are not the only ones affected by weather conditions. Weather also affects how animals and plants survive. Different types of weather are caused by what is happening in the atmosphere. Climate and weather are two different concepts. Weather changes everyday, but climate changes only over hundreds or thousands of years. Climate is the word used to describe the average weather conditions in a certain place or during a certain season. Our planet is wrapped in a blanket of air called the atmosphere. It stretches hundreds of kilometers above our heads. It keeps in heat and without it there would be no weather. Most of the weather occurs in the troposphere, the layer of atmosphere that stretches from the ground to around 10 kilometers up.



http://csep10.phys.utk.edu/astr161/lect/earth/atmosphere.html

Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Weather also tells how air moves and describes anything it might be carrying (rain, snow, clouds). Wind is air that is moving. The air is in motion because of the uneven heating of the earth's surface by the sun. How does the wind blow? What causes the wind to blow? As the sun warms the Earth's surface, the atmosphere warms also. Warm air which weighs less than cold air, rises. Then cool air moves in and replaces the rising warm air. This movement pattern of the air is what makes the wind blow. Wind blows because air is constantly moving from areas of high pressure to areas of low pressure. The bigger the difference in temperature between the two areas, the faster the wind blows.



http://dwinterscience.wikispaces.com/Wind+Patterns+2-7

Meteorologists are scientists who study and predict weather patterns. As meteorologists, we can measure wind by speed and direction. Wind speed ranges from light breezes to hurricanes. Its strength is measured on the Beaufort Scale. The scale ranges from Force 0 (total calm) to Force 12 (hurricane). Meteorologists are scientists who study and predict weather using sophisticated equipment. Weather measuring instruments include thermometers, barometers, anemometers, rain gauge, hygrometer. By looking at changes in the atmosphere, and comparing them to weather patterns of

the past, forecasters can make an accurate guess at what the weather will be tomorrow, the next day, or even further ahead than that.

Beaufort Scale

Beaufort number	Wind speed (MPH)	Wind Speed (Knots)	Description	Sea conditions	Land conditions
0	<1	<1	Calm	Flat	Calm
1	1-3	1-3	Light air	Ripples without crests	Wind motion visible in smoke
2	4-7	4-6	Light breeze	Small wavelets	Leaves rustle
3	8-12	7-10	Gentle breeze	Large wavelets	Smaller twigs in constant motion
4	13-18	11-16	Moderate breeze	Small waves	Small branches begin to move
5	19-24	17-21	Fresh breeze	Moderate longer waves	Smaller trees sway
6	25-31	22-27	Strong breeze	Large waves with foam crests	Large branches in motion
7	32-38	28-33	Near gale	Sea heaps up and foam begins to streak	Whole trees in motion
8	39-46	34-40	Gale	Moderately high waves with breaking crests	Twigs broken from trees
9	47-54	41-47	Severe gale	High waves with dense foam	Light structure damage
10	55-63	48-55	Storm	Very high waves. The sea surface is white	Trees uprooted. Considerable structural damage
11	64-72	56-63	Violent storm	Exceptionally high waves	Widespread structural damage
12	73-82	64-71	Hurricane	Sea completely white with driving spray.	Massive and widespread damage to structure

Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Duration of Thar She Blows Unit: 2-4 days

Lesson Materials:

- 4 small paper cups (Dixie cups)
- 4 plastic drinking straws
- Tape
- Scissors
- Straight pin
- Pencil with a new eraser
- Stapler
- Stopwatch

Engage – Day 1:

Activity #1

- Ask students to first collaborate with their peers to make a list of choices activities linked to weather conditions.

- Next, have students circle the things likely to be postponed if the weather were not favorable.

- Ask several questions related to weather:
  - How do you keep informed about the weather when making your plans?
  - Are animals in the wild also alert to the weather?
  - How do animals in the wild use weather cues?
  - Are plants affected by weather conditions?
  - Can plants take advantage of weather conditions? For example, can plants make use of wind or rain?

- Show students a video clip or images of a pinwheel spinning, a weather vane turning, leaves blowing, and a tornado.
  - Ask students what do all these things have in common?
  - Write their answers on the board for all to see.
  - Have students try to see if there is one thing amongst their answers that is common. The correct answer is that wind is used to make them move!

- Ask students to think about the following questions and try to answer them:
  - How do we know how fast the wind is moving?
  - How do weather forecasters know the speed of the wind when reporting the weather?
  - Why is it important to know how fast the wind is moving? If they were going to build a weather instrument that would measure the speed the wind is moving, what would it look like?
  - Ask students to draw a picture of this instrument in their science notebooks. (NOTE: give them 5-10 minutes to create a drawing.)

Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Activity #2 (Day 2 of Engage)

- Plan to take students to the media center. Instruct students to visit the following websites to learn about weather instruments used by meteorologists in weather forecasting.
    - Helpful Weather websites
        - Weather Wiz kids – http://www.weatherwizkids.com/weather-wind.htm
        - Dan's Wild Wild Weather Page – http://www.wildwildweather.com/
        - Scholastic Interactive Weather Maker – http://www.scholastic.com/kids/weather/
        - Weather Channel kids – http://www.weatherchannelkids.com
        - NOAA's National Weather Service Kidspage – http://www.nws.noaa.gov/om/reachout/kidspage.shtml
        - US Search and Rescue Task Force - http://www.ussartf.org/predicting_weather.htm

- Identify key books in the library arrange to have the books in the media center as alternative sources of information on weather for students.

- Time required for the Engage may vary with students (approximately 30 to 45 minutes would be appropriate). Plan for additional time if necessary.

- Allow students to work in teams to collect information on the weather.

- Questions to guide student research:
    - What instrument measures temperature?
    - What instrument measures wind speed?
    - What instrument measures wind direction?
    - What instrument measures air pressure?
    - What instrument measures rainfall or precipitation?
    - What instrument measures air moisture?

- At the close of the Engage, bring students together to discuss their progress.
    - Record responses on the board.
    - Ask students to share the nature of the devises found to measure wind speed.
    - Share student ideas and diagrams of anemometers.
    - What type of anemometers were found?

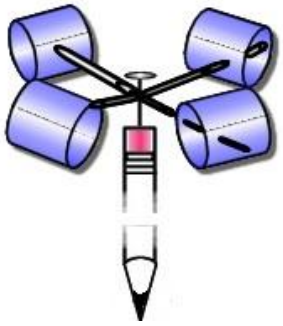
Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Explore – Day 2

Procedure 1:

- Build upon students' research into tools to measure wind by designing and constructing anemometers.
    - After completing the engage activities, instruct students that we will need to build an anemometer to investigate how to measure wind speed.
    - Focus students on the design of the anemometer to be constructed in class. Use student input to complete the design.
    - The experiment question will be what is the average wind speed for their school grounds?

- Organize students into groups of 3-4 with materials to build the anemometer.



- The anemometer shown above is one of the simplest, yet effective designs. Students should be able to construct the anemometer without much difficulty
    - This anemometer has four cups which catch the wind and cause the anemometer to spin. The inward curve of the cups receives most of the force of the wind. That's what makes the cups move. The more spins per minute, the greater the wind velocity.
    - Anemometer building directions for students:
        1. Arrange four (4) plastic drinking straws to form a cross and tape them together at the center.
        2. Staple the top-side of one Dixie cup to the end of each straw, so the open ends of the cups all face the same direction.
        3. Push a straight pin through the center of the straws into an eraser on the end of a pencil. This provides the axle.
        4. Mark (or color) one of the cups; this will be the one they use for counting when the anemometer spins. (**NOTE**: When using this anemometer, 10 turns per minute means the wind speed is about one mile per hour.)
        5. Blow on the anemometer or turn an electric fan on low to make sure that it spins easily.

Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Procedure 2:

- Once the anemometer has been constructed, students will have the following roles in their small groups (optional):
    a. Time-keeper who will be responsible for timing one minute for each trial.
    b. Official "counter" for the day. The others may count on their own; but the official counter's readings will be the ones recorded.
    c. One holder who will hold the anemometer while the spins are counted. The holder should make sure that they hold the anemometer so that the wind is unobstructed.

- Groups will choose a location on the school ground that has full access to the wind from all directions to take measurements.
    a. When the time keeper says "Go", the counter in each group will count how many times the marked cup passes them in one minute and write it down in the data table. Repeat three (3) times and calculate the average number of spins for that location.
    b. If there is enough time, have students select a second location and repeat the exercise.

- Students are to collect additional information that may affect how the wind might move at their sampling location (trees, rocks, playground equipment, cars, buildings, etc.). Use the included data sheet.

- Have students calculate the average wind speed for their locations. Have the students discuss possible explanations about factors affecting wind speed for their chosen location. Were their trees present or absent? Was it a narrow passage between two buildings? Was it an open playground with no other structures? Was it a high or low area?

- As a class create a data table of wind speed measurements for the various locations sampled. Then calculate the average (mean) wind speed for the school grounds?
    a. Students can use the Anemometer Data Sheet (found at the end of the lesson) to record their data from the experiment.

Explain

- An anemometer is useful in measuring wind speed because it rotates with the wind. As the wind pushes against the inside of a cup, it causes the cups rotate. Anemometers measure the velocity of the wind as it pushes against the cups.
    - The number of revolutions per minute roughly approximates the velocity of the wind.

Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

- A commercial anemometer can be used for accuracy and to compare against your homemade device. (*Note*: Some forces are being ignored including drag and friction for this elementary illustration.)
    - Ask students if they can name some of these forces.

- A good video to watch on measuring wind strength can be found on the PBS Kids webpage for the show CyberChase, episode 704 'Blowin in the Wind' - http://pbskids.org/cyberchase/videos/blowin-in-the-wind-ep-704/. It could also be used for the introduction to this experiment.

- Meteorologists use weather instruments to make predictions about weather conditions at the local level by sampling a wide network of weather stations and using satellite images to map out the positions of the large air masses circling the Earth.
    - Ask students to explain how their anemometer could be used to predict weather and measure changes in the weather.

- Weather forecasts are useful in a number of ways. We use weather warnings to protect our life and property in the case of severe weather conditions.
    - Engage students in a discussion of weather and how plants and animals are affected by the weather.
    - It is important to ask students to reflect upon their understanding of plants and think of ways in which plants may benefit from weather. At this point encourage students to think of seeds and seed transport.
        - Use a video or pictures of plant seeds adapted for wind dispersal and ask students to explain the most likely means of dispersal of these seeds.
        - Build connections between seed dispersal and weather condition (wind speed).

Evaluate

Evaluation is ongoing throughout the unit. There are critical ways to implement formative assessments to gauge learning as the unit proceeds.

- Consider the following formative assessments to gain insight into students' learning during the unit:
    - Note students' questions, the questions posed by students are indicative of their perception of unit content and may indicate deficits in conceptual knowledge which could be addressed during instruction.
    - As students collaborate, move through the classroom to listen to students' discussions. Students' conversations with each other about lesson content may provide important insights into their understanding.

- Question students about their decisions, plans, etc. to gain greater insight into their thinking and comprehension of lesson content.
- Ask students to explain their ideas and support explanations with evidence. Student explanations provide important insight into their thinking.

Extend

- You may want to use one or more of the activities listed below.
  1. Read a poem about the wind, such as "The Wind" by Robert Louis Stephenson (see below). Then have students write a poem about the wind using what they have learned through their investigation.

"The Wind"
by Robert Louis Stephenson

I saw you toss the kites on high
And blow the birds about the sky;
And all around I heard you pass,
Like ladies' skirts across the grass--
O wind, a-blowing all day long,
O wind, that sings so loud a song!

I saw the different things you did,
But always you yourself you hid.
I felt you push, I heard you call,
I could not see yourself at all--
O wind, a-blowing all day long,
O wind, that sings so loud a song!

O you that are so strong and cold,
O blower, are you young or old?
Are you a beast of field and tree,
Or just a stronger child than me?
O wind, a-blowing all day long,
O wind, that sings so loud a song!

  2. Have students conduct investigations exploring the following questions.
     a. How do landforms affect wind speed and direction?
     b. How can trees be used to affect wind speed? Students can explore wind speed across various simulated terrains (tall grass prairie, mountain, forest, valley, etc.).

c. Would the top of a mountain or the bottom of a canyon be a better place for a wind turbine? Why? How do they affect wind speed?

- Discuss with students the following scenario from the Journey North website. This scenario is helpful in connecting how an understanding of weather patterns is useful to both humans and animals survival needs.
    - The Journey North program engages students in a global study of wildlife migration and seasonal change; and offers many tools and resources for teachers and students.

    - Before discussing you may want to share information on butterflies and their migration. This will help them as they review the data.

    - Focus the discussion of the data on how butterflies use the wind's speed and direction to aid in their migration efforts. The focus of the data review is to highlight that the number of butterflies present at Mr. Viger's home is dependent on the direction of the wind and its speed. When the wind is blowing in a direction favorable to migration, there are low numbers present at his home. When wind conditions are not favorable, there are high numbers of butterflies present. They may be waiting for more favorable conditions and are using his yard as shelter.

    - As you review the data with students, point out the relevant information; such as butterfly numbers and wind speed/direction. Have students write in their science notebooks possible explanations for these patterns in the data. Instruct students to develop explanations based on what they know from their investigation about wind.

        - Guiding questions include:
            - What relationship do you see between wind and migration?
            - What direction should the wind blow to help monarch butterflies cross the Gulf of Mexico or to get over the Rocky Mountains?

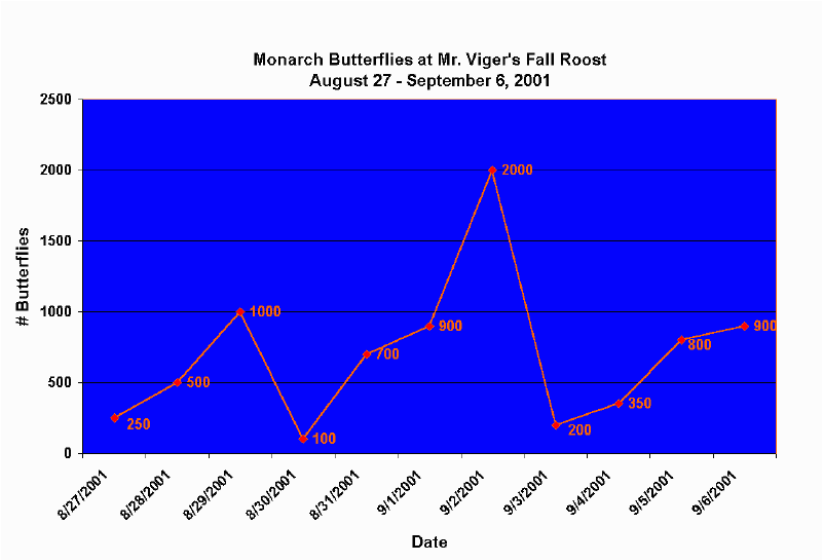
<u>BACKGROUND INFORMATION – Monarch Butterflies</u>
A monarch is a butterfly that is approximately 10cm wide (including wings) weighing on average a half a gram. Monarchs are found in many places throughout the world, but they probably originated in the Americas, and were spread either with the help of

humans or on their own to other places. They are found in such places as the US, Mexico, Australia and New Zealand, and many islands east of these countries (most islands between Australia and Tahiti have monarchs). They are also found in Hawaii, South America, several Pacific Islands, most islands in the Caribbean, and even sometimes in western Europe.

In the US and Canada, monarch butterflies migrate every Fall to wintering grounds in Mexico; arriving around November. They leave Mexico in March and migrate back. Very little is known about what prompts the butterflies to migrate south. It could be that in the spring they journey north to take advantage of food sources, so once the weather conditions are no longer favorable they return south. Scientists are still studying this. But a visit to the Journey North website is a great resource on Monarch migration.

Monarchs are efficient flyers. They take advantage of air currents and soar versus flapping their wings constantly. They choose altitudes that allow them to take advantage of the wind to help them in their migration. However, they do not fly when there is a strong wind blowing in the wrong direction.

SCENARIO: (from Journey North)
During fall migration, some lucky people have thousands of monarchs pause in their yards at overnight roosts. Mr. Viger of Campbell, Minnesota, is one such person. Each day he counts the monarchs and tags them. He also records information about the wind and weather. The data below were collected during the fall 2001 season. The monarchs were present for almost 3 weeks and Mr. Viger noticed an interesting pattern. You can see it too if you look carefully at his data between August 27 and September 6. What relationship do you see between wind and migration? Explain why you think monarchs might behave this way.



Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Data From Mr. Viger's Monarch Roost
Fall 2001

Date	# Butterflies at the Viger's	Wind Direction	Wind Speed (MPH)
8/27/2001	250	-	-
8/28/2001	500	SE	5-10
8/29/2001	1000	SE then NW	10
8/30/2001	100	NW all day	10-20
8/31/2001	700	SE	5
9/01/2001	900	SE	5-10
9/02/2001	2000	SE	2-5
9/03/2001	200	NW	0-2
9/04/2001	350	SE	10-15
9/05/2001	800	SE	10-20
9/06/2001	900	SE	10-20

Resources:

Books

1. Oliver, Clare. 2002. 100 Things you should know about weather. Miles Kelly Publishing. 48pp.
2. Kahl, Jonathan D.W. 1998. First Field Guide: Weather. National Audubon Society. Scholastic Publishing. 160pp.
3. Scholastic Atlas of Weather. 2004. Scholastic Inc. 80pp.

Websites

1. Journey North – http://www.learner.org/jnorth/
2. Journey North, Mr. Viger's Fall 2001 class data on roosting monarch butterflies – http://www.learner.org/jnorth/tm/monarch/FallRoostViger2001.html
3. Weather Wiz Kids – http://www.weatherwizkids.com
4. Center for Innovation in Engineering and Science Education (CIESE) -- Weather Scope page – http://ciese.org/curriculum/weatherproj2/en/docs/anemometer.shtml
5. Natural Inquirer – www.naturalinquirer.org
6. New Scientist – www.newscientist.com
7. US Search and Rescue Task Force - http://www.ussartf.org/predicting_weather.htm

Thar She Blows!
5th Grade Lesson Focused on Seed Dispersal
Using Tools to Measure Wind Speed

Anemometer Data Sheet

	Wind Speed (MPH)				
	Time Trial 1	Time Trial 2	Time Trial 3	Total (MPH)	Mean (MPH)
Location #1					
Location #2					

What is the weather like (sunny, cloudy, rainy, snowy, windy)?

_____

_____

_____

What is the temperature?

_____

Draw a picture of your first location. Note any possible obstacles to the wind blowing.	**Draw a picture of your second location. Note any possible obstacles to the wind blowing.**