MiSP WEATHER — WIND SPEED AND DIRECTION
Teacher Guide, L1 - L3

Introduction

This MiSP unit can be included in a standard weather and climate unit. Some teachers may like it as part of the introduction. Others may want to study different weather factors before examining this topic. The main idea for the unit is that wind is caused by air pressure differences. The greater the difference, the greater will be the speed. Wind moves from areas of high pressure to areas of low pressure.

The introduction of the unit will focus on the sea/land breeze. This topic is often taught from the point of view of temperature difference (i.e., the sea breeze blows from the cool ocean to the warm land). It is important to underscore that the warm air produces low pressure and the cool air produces high pressure.

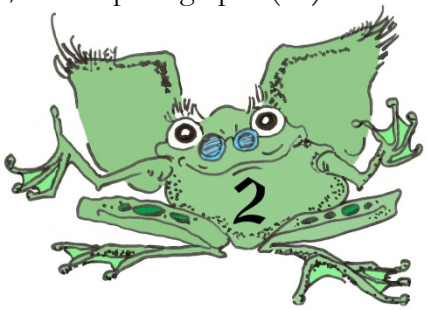
Tornadoes and hurricane data will be used to show the relationship between air pressure and these violent storms' wind speeds.

Standards

ILST Core Curriculum — Major Understandings:
Standard 4 Physical Setting 2.2k, 2.2q
Physical Setting/Earth Science Core Curriculum — Major Understandings:
Standard 4 Physical Setting 2.1b, 2.1c, 2.1e, 2.1f, 2.1h

Lesson Objectives: After completing this unit, students will be able to:

- Interpret a diagram showing land and sea breezes
- State that wind is caused by air pressure differences and that wind moves from areas of high pressure to areas of low pressure
- Interpret data that shows that the greater the difference in air pressure, the greater the wind speed
- Use a simulation to generate tornado pressure difference and wind speed data and to classify tornado strength
- Graph and interpret pressure/wind data (hurricane — central pressure and wind speed; tornado — pressure difference and wind speed)
- Determine and use the unit rate of change of the pressure / wind speed graphs (L2)



- Determine and apply the formulas for the lines on the wind speed graphs (L3).

Day 1 — Land and Sea Breezes

Each teacher must consider her or his overall unit plan to decide how to implement the day 1 activity. Students should have some knowledge of the definition of *weather*, the overall cause of weather ("uneven heating of Earth's surface…"), and the variables of a location's weather (air pressure, air temperature, relative humidity, dew point, precipitation, wind speed and direction, and cloud cover). This and other weather teaching and learning may occur in previous days' lessons or in a brief introduction. A great weather resource is NOAA's National Weather Service "JetStream"; see http://www.srh.noaa.gov/jetstream//.

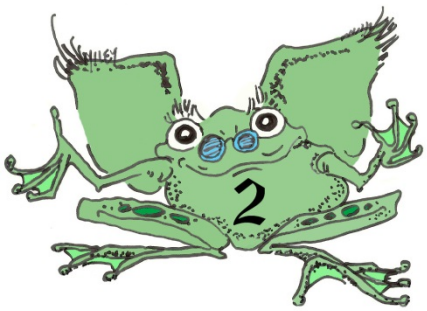
A visual should be used to introduce and explain land and sea breezes. A Google search will produce many images to choose from. A useful simulation may be found at

http://www.classzone.com/books/earth_science/terc/content/visualizations/es1903/es1903page01.cfm.

This site shows an animation of land and sea breezes that examines the changing temperature readings of land and water over a 24-hour period. Teachers must guide the students to the information that the warmer temperatures produce lower pressures and the cooler temperatures produce higher pressures. Thus the air (wind) blows from areas of high pressure to areas of lower pressure. This can be demonstrated with an inflated, untied balloon. When the neck is released, the air rushes from the higher pressure inside to the lower pressure outside. This demonstration provides a good opportunity to tell (or remind) students that winds are named by the direction they come from.

Students may use Worksheet #1 to record notes on this topic. Sample captions for the numbered spots on the sea breeze diagram follow:

1. Hot air rises over land due to heating by the sun.
2. The rising air leaves less air in one spot; low pressure forms.
3. At higher elevations, the air cools; high pressure develops.
4. Meanwhile, over the cooler water, air sinks, leaving less air aloft.
5. More air piles up at the surface of the water, and high pressure forms.
6. Air blows from areas of high pressure to areas of low pressure.
7. The sea breeze occurs as air blows from an area of high pressure over the water to an area of low pressure over the land.



Sample captions for the land breeze diagram are:

1. Warm air rises over the ocean because the water cools more slowly than the land.
2. The rising air leaves less air in one spot; low pressure forms.
3. At higher elevations, the air cools; high pressure develops.
4. Meanwhile, over the cooler land, air sinks, leaving less air aloft.
5. More air piles up over the land, and high pressure forms.
6. Air blows from areas of high pressure to areas of low pressure.
7. The land breeze occurs as air blows from an area of high pressure over the land to an area of low pressure over the water.

Question of the Day:

Why does warm air rise, and why is it less dense than cool air?

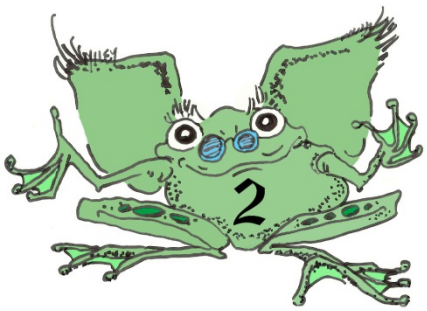
Day 2 — Tornado Pressure Differences and Wind Speed

It is not necessary to teach about the formation of tornadoes or tornado safety as part of this day 2 activity. These topics, if part of a course curriculum, can be taught at another time. But if a teacher chooses to cover the topics now, the MiSP unit can be interrupted for the additional instruction. (For animated guides to tornadoes, see

http://news.bbc.co.uk/2/hi/5328524.stm and
http://www.suu.edu/faculty/colberg/Hazards/Hurricanes_Noreasters/Hurricanes_Anim_1.html.)

The tornado activity uses a simulation (http://whyfiles.org/013tornado/3.html) to produce data for wind speed at different pressure differentials. KEEP THE DIAMETER OF THE FUNNEL CONSTANT. Students may collect the data individually or in groups, or the class can do the work together, depending on computer availability.

Students should use MiSP Worksheet #2. Instruct students to make note of the damage to the items in the simulation. *(The cow seems to survive each tornado, so it is clear that no animals were harmed in the filming of this simulation.)* Students should include in their data the Fujita Tornado Intensity classification.



Question of the Day:

Although tornadoes can occur at any time of year, why do they occur most frequently from April to June?

Days 3 and 4 — Hurricane Pressure and Wind Speed

Ideas for this lab come from a lab posted on www.newyorkscienceteacher.com by James Rice: "Air Pressure and Wind Speeds in a Tropical Storm System" (see http://www.newyorkscienceteacher.com/sci/files/download.php?id=1136&file=Lab_Hurricanes_Storms_Pressure_vs_Winds.doc). MiSP teachers may want to use other components of Mr. Rice's lesson.

MiSP instructors will need to decide how much hurricane introduction/background should be incorporated into the lesson. Hurricane dangers/precautions could be discussed with this lesson or at another time.

The Atlantic Hurricane Tracking Chart (NOAA) is a separate, PDF document. Printing it will produce a clearer image.

For Hurricane Ike data from Weather Underground, see:

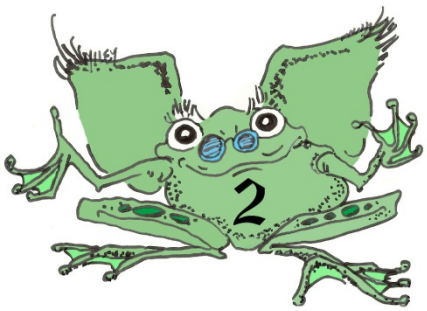
http://www.wunderground.com/hurricane/at20089.asp

For resources on hurricane structure, formation, and movement, see:

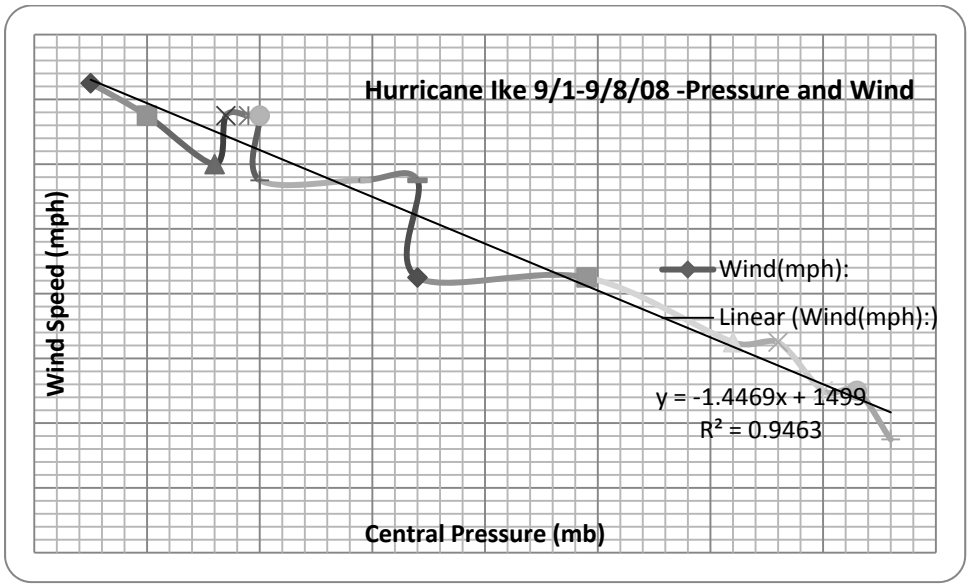
http://scifiles.larc.nasa.gov/kids/Problem_Board/problems/weather/hurricanebasics.swf
http://www.srh.noaa.gov/jetstream/tropics/tc.htm

Students will work on MiSP Worksheet #3. Students, especially at level 1, will probably need help drawing the best-fit line.

The *y*-intercept (levels 2 and 3) may also be a challenge.



The student graph and best-fit line should look like this:



Day 5 — Assessment

Administer the appropriate level assessment.