LESSON 2 How Can We Predict Weather with Technology?

Lesson at a Glance

Students collect data about the weather, including temperature and rainfall. They compare their data with National Weather Service (NWS) daily weather reports, and see how the information compares and contrasts to it. They research tools that NOAA and NWS use to measure and predict weather, and make a prediction of their own.

Lesson Duration

Three 60-minute periods

Essential Question(s)

How does technology help humans to observe and predict weather and climate?

How do models and simulations teach us about features of objects, events and processes in the real world?

Key Concepts

- The weather consists of a number of variables, including temperature and rainfall.
- Scientists measure weather with tools that include buoys, automated surface observing systems, radiosondes, satellites, and radar.
- Models and simulations are used to represent and investigate features of objects, events, and processes in the real world.

Instructional Objectives

- I can describe and measure weather.
- I can describe tools for measuring weather.
- I can use a variety of print and online resources to research a topic.
- I can use models and simulations to represent and investigate features of objects, events, and processes in the real world.

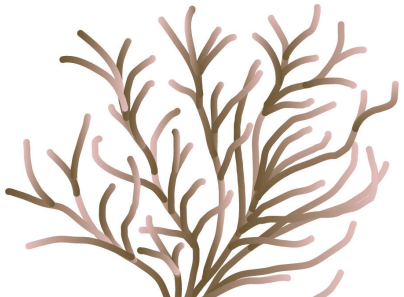
Related HCPSIII Benchmark(s):

Science SC 5.2.1
Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.

Math MA 5.10.2
Model problem situations with objects or manipulatives and use representations (e.g., graphs, tables, equations) to draw conclusions

Language Arts LA 5.1.2
Use a variety of grade–appropriate print and online resources to research a topic.

Language Arts LA 5.4.1
Write in a variety of grade-appropriate formats for a variety of purposes and audiences, such as note summarizing what they have read or heard.



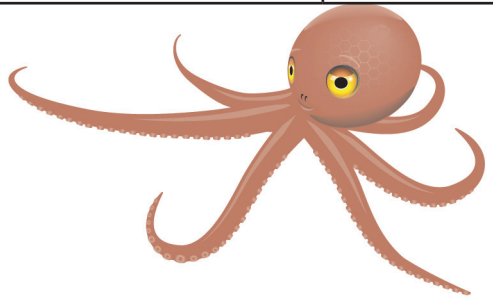
Assessment Tools

Benchmark Rubric:

Topic		Unifying Concepts and Themes	
Benchmark SC.5.2.1		Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Consistently select and use models and simulations to effectively represent and investigate features of objects, events, and processes in the real world	Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world	With assistance, use models or simulations to represent features of objects, events, or processes in the real world	Recognize examples of models or simulations that can be used to represent features of objects, events, or processes

Topic		Numeric and Algebraic Representations	
Benchmark MA.5.10.2		Model problem situations with objects or manipulatives and use representations (e.g., graphs, tables, equations) to draw conclusions	
Sample Performance Assessment (SPA)		The student: Makes a table or graph to model a problem situation and interprets the trend in the data.	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Model problem situations with objects or manipulatives and use representations to draw conclusions, with accuracy	Model problem situations with objects or manipulatives and use representations to draw conclusions, with no significant errors	Model problem situations with objects or manipulatives and use representations to draw conclusions, with a few significant errors	Model problem situations with objects or manipulatives and use representations to draw conclusions, with many significant errors

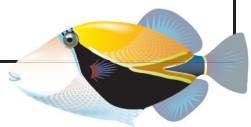
Topic		Locating Sources/ Gathering Information	
Benchmark LA.5.1.2		Use a variety of grade-appropriate print and online resources to research a topic	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Use substantive information from an extensive variety of grade-appropriate print and online resources to thoroughly research a topic	Use relevant information from a variety of grade-appropriate print and online resources to research a topic	Use some relevant information from a few grade-appropriate print and online resources to research a topic	Use very little relevant information from grade-appropriate print and online resources to research a topic



Topic		Range of Writing	
Benchmark LA.5.4.1		Write in a variety of grade-appropriate formats for a variety of purposes and audiences.	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Insightfully adapt writing to grade-appropriate formats for a variety of purposes and audiences	Adapt writing to grade-appropriate formats for a variety of purposes and audiences	Write with some adaptation to grade- appropriate formats for a variety of purposes and audiences	Write with little adaptation to grade-appropriate formats for a variety of purposes and audiences

Assessment/Evidence Pieces

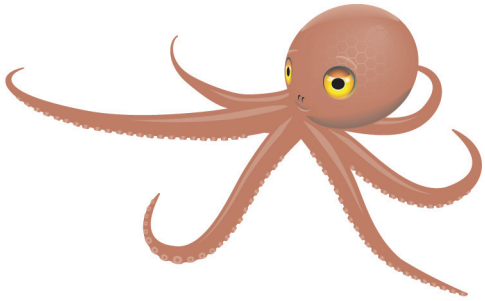
Lesson
- Weather Data Table
- Student Worksheets *Tools to Predict Weather*
- Note-taking in science notebook
- Discussion of weather forecasting models



Materials Needed

Teacher	Class	Group	Student
• Method to project PowerPoint • Chart paper, marking pens to record weather data from students • Thermometer hung outside (in shade) • Rain gauge or rain collecting device such as a cup placed outside (in open area)	• None	• None	• Duplicate the table in Activity I.C. to use as a worksheet for data collection • Daily National Weather Service weather report • Student Worksheet: *Tools to Predict Weather*

Instructional Resources



Teacher Reading: *Predicting Weather with Technology*
Student Worksheet: *Tools to Predict Weather -Buoys*
Student Worksheet: *Tools to Predict Weather -Radar*
Student Worksheet: *Tools to Predict Weather -Satellites*
Student Worksheet: *Tools to Predict Weather -ASOC*
Student Worksheet: *Tools to Predict Weather -Radiosonde*
PowerPoint Presentation: *Buoys*
Optional: The Asian Pacific Digital Library- Traditions of Oahu has a list of Native Hawaiian names of winds http://apdl.kcc.hawaii.edu

Student Vocabulary Words

climate: the long-term average of conditions in the atmosphere (weather), ocean, ice sheets on land and sea ice.

climate model: computer-based programs that use data compiled from weather instruments and others over many years to project climate patterns into the future; predictions are based on varying certain parameters of the data.

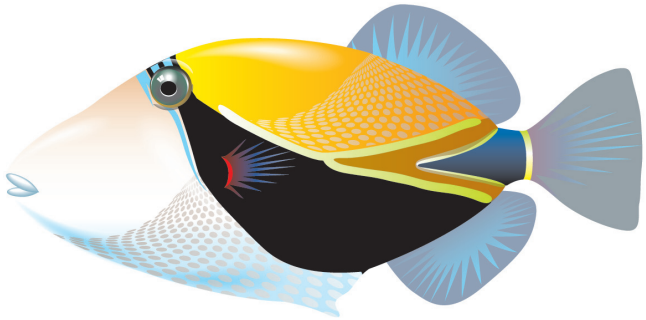
meteorology: the scientific study of weather.

radiosonde: an instrument that measures temperature, pressure and humidity while floating in the atmosphere for short time periods.

weather satellite: an instrument that orbits the Earth and often used in meteorology to follow weather patterns across large areas of the Earth.

weather: the daily atmospheric conditions at a given location.

weather balloon: a latex balloon that is used with radiosondes to travel into the atmosphere for short time periods.



Lesson Plan

Lesson Preparation

- Review the Science Background provided in the Unit Overview and the Teacher Reading *Predicting Weather with Technology.*
- Preview PowerPoint *Buoys* and make arrangements to project it.
- Set up a standard rain gauge and standard outdoor thermometer outside in a place that is accessible to students, and at a height that can easily be read by them. If possible, the thermometer should not be hung in direct sun, and the rain gauge should be in an open area, not under an overhang. A nail, a hammer, and (possibly) permission from your school, may be needed before you install the rain gauge and thermometer. Thermometers are available at gardens, nurseries, and major retailers. Rain gauges can often be purchased inexpensively at a local hardware store or you can make your own weather station (including rain gauge) by following the instructions here: http://oceanservice.noaa.gov/education/for_fun/BuildyourownWeatherStation.pdf.
- Prepare student copies of a daily weather report from the National Weather Service (NWS).

  The NWS report can be obtained from http://www.weather.gov/.

  The Hawaii-specific report can be obtained from www.prh.noaa.gov/hnl/.

- Arrange for Internet access, so that students can address Part IV Research the Weather Data.

I. Measuring and Describing the Weather

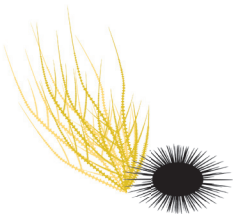
A. Introduce the lesson by reviewing the difference between weather and climate *(weather is short-term conditions; climate is long-term conditions)*. Also, review any other important concepts from their Word Wall. Ask students how they can measure and describe the weather. Gather their ideas for the sorts of measurements they could take, including rainfall, temperature, wind speed and direction, and cloud cover.

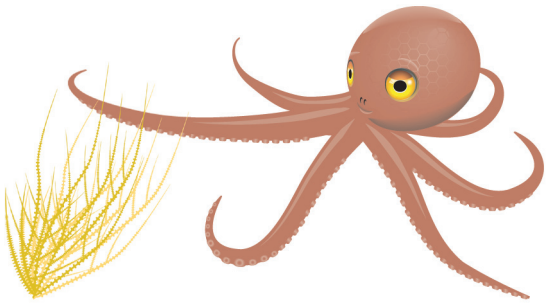
B. Divide students into pairs, and distribute student worksheet, *Weather Data*, to each person. Tell students that they will be making measurements and descriptions of the weather with partners. Lead students to the idea that a table might be one way of recording many measurements in a fashion that is easy to read. A sample table is provided below. Depending on the ability of your students, you may want to select only temperature, rainfall and cloud cover. Length of data collections can vary.

C. **Weather Data:**

Date	Time	Temperature (°F)	Rainfall (inches)	Wind Speed (mi/h)	Wind Direction	Cloud Cover	Humidity (%)

- Date: Record the date.
- Time: Record the time.
- Temperature: If a weather station is not available on campus, students can take a thermometer outdoors, not in a shady area, and record the temperature. This information can also be found online at the National Weather Service site or in the daily newspapers. It is also given during the evening newscast.
- Rainfall: If you do not have a rain gauge on campus, then this information can be found online or in the newspapers.
- Wind speed: The instrument to measure wind speed is an anemometer. If you do not have one, go online and download a Beaufort Scale. There are several to choose from. The Beaufort Scale looks at the conditions on land or at sea to determine wind speed, i.e. if you feel wind on your face, then there's a light breeze of about 5-7 miles/hour or if the flag is extended and leaves are moving around, then there's a gentle breeze of about 8-11 miles/hour. NOTE: The Beaufort Scale can be obtained from http://www.spc.noaa.gov/faq/tornado/beaufort.html .
- Wind direction: If you have a compass, take it outside and point it in the direction that the wind is coming from and record the direction (N, NE, E, SE, S, SW, W, NW).
- Cloud Coverage: Students go outside and make observations and record a description of the cloud cover; i.e., clear, scattered, broken, or overcast.
- Humidity: There are student digital hand held instruments to measure humidity (the amount of moisture in the atmosphere); however, if you do not have one available, this information can be found online at the National Weather Service site or in the newspaper.
- You may also want to add UV Index or other observations to the table.





II. Analyzing the Weather Data

A. Bring the pairs into a whole group setting. Ask pairs of students to tell you the outdoor temperature. Record their measurements in the table you created on the board.

B. Discuss with students variations in temperature measurements. Did everyone record the same measurement? What would account for any differences? As a class, list the possible reasons that may have caused the different temperature readings. Emphasize the need to use consistent data collecting techniques throughout the lesson whenever possible. Tell students that to read the thermometer, it is best to do so directly, at eye level. If they read the thermometer by looking down at the measurement, the resulting measurement may appear to be a lower temperature. Likewise, if students look up, the measurement may appear to be at a higher temperature.

C. Ask pairs of students to tell you the amount of rainfall that they measured. Record their measurements in the table.

D. Discuss with students any differences in rainfall measurements. Did everyone record the same measurement? What would account for any differences? Tell students that, like with the thermometer, any measurements of rainfall need to be read at eye level, or the measurements will appear higher or lower than they truly are.

E. Distribute an up-to-date daily weather forecast for today's date from the National Weather Service (NWS) from www.weather.gov. Ask students to identify what information is included in the weather report. What information did students record that is similar? What information is different? Students may note that NWS provides a word or two of description (e.g., Cloudy or Sunny) to describe the weather in addition to temperature, wind direction, and a prediction of rain (rather than rainfall in the past 24 hours).

F. Emphasize that NWS is making a prediction, an educated guess based on evidence, as to what the weather will be like in the future. Contrast this with what students did, which was to measure the weather at the present moment. Students should understand that measuring the current weather is what allows scientists to make predictions of weather in the future.

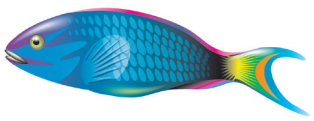
III. Tools that Collect Weather Data

A. Break students into four groups and assign each group one of the Student Worksheets, *Tools to Predict Weather*. Ask each group to take the assigned research tool NOAA uses to predict weather in order to complete the drawing and summary.

B. Ask groups to share their summaries of tools NOAA uses to predict weather with the class. Students will record their own tool information in their science notebooks as well as information about the other three tools used to predict weather (NOTE: After the students who are presenting about "buoys" come up show short PowerPoint presentation *Buoys*.).

C. Tell students that combined information provided by all the tools they researched is used to make predictions about weather using computer models. Discuss how the tools are used in the creation of these forecast models.

D. Teacher should conclude with the following questions:



- Is a forecast definitely going to occur? Why or why not?
- Why is weather forecasting such an imperfect science (Models are just representations)?

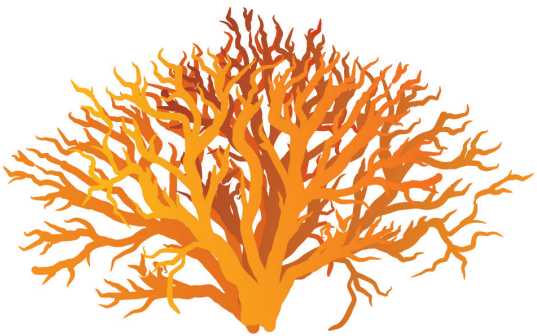
IV. Lesson Review

A. Review lesson concepts with the class.

B. Add new vocabulary to the Word Wall.

Extended Activities

Ask students to create a bulletin board on which they can keep records of daily weather measurements. Students can also make tomorrow's weather prediction, based on today's measurements.



LESSON 2 - Teacher Reading

Predicting Weather with Technology

The National Oceanic and Atmospheric Administration (NOAA) uses a variety of ways to measure and predict weather. The most basic methods include the following tools:

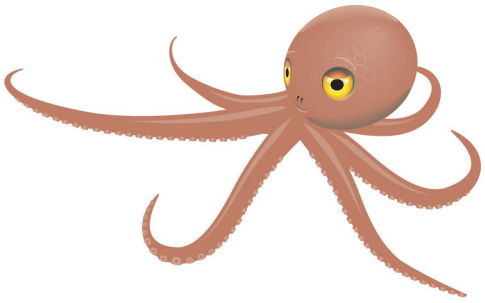
Buoys are weather stations in the ocean, and can measure wind speed, wind direction, wave height, atmospheric pressure, and air and sea temperatures.

Automated Surface Observing Systems are weather stations on land, which measure and report data, including air temperature and pressure, 12 times an hour to the National Weather Service (NWS).

Radiosondes are instruments on weather balloons, which track their position in relation to temperature, pressure, and relative humidity as they rise in the atmosphere.

Weather Satellites orbit the Earth and take visual and infrared photographs that tell scientists the temperature of the Earth's surface, type of cloud cover, presence of circulation, and height of moisture in the atmosphere. Satellites let scientists look at a much bigger picture than buoys, automated surface observing systems, and radiosondes.

Radar is an instrument that transmits and receives radio waves, transmitted from stations on land. When the radio wave hits a raindrop, part of the wave bounces back to the station. Scientists measure how long it takes for the wave to bounce off the raindrops and return to the station. The percent of the radar wave that bounces back tells scientists how much rain is falling. Radar also lets scientists look at a much bigger picture than buoys, automated surface observing stations, or radiosondes.



LESSON 2

Name: _____ Date: _____

Tools to Predict Weather - Buoys

Directions

Use the following Internet link to draw and write a summary about each tool that scientists use to measure and predict weather.

Buoys: www.ndbc.noaa.gov/mooredbuoys.html

LESSON 2

Name: _____ Date: _____

Tools to Predict Weather - Radar

Directions

Use the following Internet link to draw and write a summary about each tool that scientists use to measure and predict weather.

Radar: http://www.ncdc.noaa.gov/oa/radar/radarresources.html

LESSON 2

Name: _____ Date: _____

Tools to Predict Weather - Satellites

Directions

Use the following Internet link to draw and write a summary about each tool that scientists use to measure and predict weather.

Weather Satellites: www.weather.gov/sat_tab.php?image=ir

LESSON 2

Name: _____ Date: _____

Tools to Predict Weather - ASOC

Directions

Use the following Internet link to draw and write a summary about each tool that scientists use to measure and predict weather.

Automated Surface Observing Centers: www.srh.noaa.gov/jetstream/remote/asos.htm

LESSON 2

Name: _____ Date: _____

Tools to Predict Weather - Radiosonde

Directions

Use the following Internet link to draw and write a summary about each tool that scientists use to measure and predict weather.

Radiosondes: www.srh.noaa.gov/jetstream/remote/ua.htm