NATIONAL GEOGRAPHIC

RESOURCE LIBRARY I ACTIVITY : 1 HR 15 MINS

Meteorological Models

Students read encyclopedia entries to define key variables associated with weather. Next, they use a weather station or online source to collect and graph current local data for these variables. Finally, they incorporate these variables to revise their extreme weather models from the *Weather Interconnections*activity, and discuss factors common and unique to extreme weather events.

GRADES

6, 7, 8

SUBJECTS

Earth Science, Climatology, Meteorology

CONTENTS

3 Videos, 6 Resources, 1 Link

OVERVIEW

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For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/meteorological-models/

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DIRECTIONS

This activity is part of the Climate Change Challenge unit.

1. Support students as they read to define key meteorological terms.

- Go outside briefly, or open classroom windows and ask students to quickly brainstorm everything they can see, hear, smell, or feel to describe the weather at this moment in time.
- Next, challenge students to identify the six variables used by professionals to describe weather conditions. List ways that weather channels or apps describe current weather conditions in a Think-Pair-Share. Celebrate student identification of any of the six weather variables from prior knowledge:
    - *Temperature*
    - *Precipitation*
    - *Humidity*
    - *Atmospheric Pressure*
    - *Wind*
    - *Cloud-cover*
- Organize students into small groups associated with each weather variable listed above, aside from temperature (which will be used as a model variable at the end of this step). Assign each group to read and annotate the encyclopedic entry associated with their variable.
- Prompt students in their groups to begin Part C of the *Extreme Weather Model Builder* handout by defining their weather variables using knowledge from the article.
- Use temperature to model the collaborative definition process: request volunteers to share and record definitions on the board to evaluate and edit as a class. Assign all students to record accurate consensus definitions for each term to complete the table in Part C of the *Extreme Weather Model Builder*.

2. Introduce the class weather station, and gather and graph initial weather data with students.

- Introduce the class weather station (the *Setup* section contains guidance on creating this very simple station). This will be used to gather data on temperature and precipitation (and other variables, if desired) throughout the *Extreme Weather* lesson.
- Model how to collect initial temperature data using a thermometer. Incorporate this data point onto a class temperature point/line graph that will last for the next three days (this

and the following two activities, *Weather, Meet Climate*, and *Now and Then*).

    - Prompt students to check the temperature graph for critical elements discussed in the *Global Trends* activity: title, axis labels, and key.

- Have students continue to work in the same *Weather Data Collection* groups from Step 1. Assign groups to collect data for additional variables. Depending on the complexity of your class weather station, you may wish to direct students on how to collect this data directly or use the *National Weather Service 3-Day Weather Observation History* to collect the data digitally. Project the National Weather Service site as you enter your zip code in the upper left corner of the page, then click on the '3 Day History' link at right-center. The graphs and chart that appear give hourly data, of which students only need the most recent (first) entry. In the table, the key weather variables appear as follows:

    - Temperature, with units in degrees Fahrenheit (F)
    - Humidity, with units in percent (%)
    - Wind; read only the first number, which refers to the constant wind speed, with units in miles per hour (mph)
    - Atmospheric Pressure, with units in inches (in)
    - Precipitation, with units in inches per 24 hours (in)
    - Cloud-cover (not measured here); looking at the sky through a window, students can make a rough estimate of cloud cover, in bins of 0–25%, 25–50%, 50–75%, and 75–100%.

- Orient students to this chart, and help the groups identify the most recent (first) entry for their variable.
- Assign students to incorporate this data onto the first day of a point/line graph, mirroring the one that you created for temperature.

3. Prompt students to revise their extreme weather event models with additional research.

- Reconvene students in their extreme weather groups from the *Weather Interconnections* activity. Prompt groups to revisit their initial weather models (Part B) and key meteorological terms (Part C) from their *Extreme Weather Model Builder*.
- Have students re-watch the appropriate extreme weather video (Extreme *Weather: Drought* (3:01), *Hurricanes 101* (2:42), or *Tornadoes 101* (3:01)) to practice identifying how these weather variables influence extreme weather. Complete Part D of the *Extreme Weather Model Builder* for at least four weather variables.

- Using this information, have students create a revised model of their extreme weather event in Part E of the *Extreme Weather Model Builder*. This new model should contain:

    - A visual representation of the extreme weather event.
    - Labels to identify at least four weather variables.
    - Arrows to show interactions between the variables.
    - Plus and minus signs to show relationships between the variables.

4. Lead a discussion of the factors that are common or unique to extreme weather events.

- Ask groups to choose one member's revised weather model (Part E) to post in a visible location in the classroom.
- Organize a gallery walk, in which students visit other groups' revised weather models sequentially, preparing through small group discussion to answer two questions:

    - *What do these extreme weather events have in common?* (Listen for responses such as, 'all weather events involve temperature and moving air' or 'hurricanes and tornadoes both involve high winds and they spin.')
    - *What is unique to each extreme weather event?* (Listen for responses such as, 'each kind of event has different variables that are more important' or 'drought comes with very low precipitation, which is different from tornadoes and hurricanes.')

- Reconvene the class, soliciting volunteer contributions. Direct students to record what they think are the most meaningful similarities and differences between the different extreme weather events in Part F of the *Extreme Weather Model Builder*.

Modification

Step 2: You may choose to have students create their graphs using a digital spreadsheet program.

Tip

Step 2: Although the weather station need not be complex, it may be helpful to construct it prior to class (see instructions in the *Setup*).

Modification

Step 2: At the end of this step, you may choose to lead students through a quick peer evaluation process of their graphs.

Tip

Step 2: Students' graph construction may require more or less scaffolding, depending on prior experience. As you model creating a graph of the temperature data, explicitly designate space for two following data collection events. Label these days clearly on your x-axis, and instruct students to do the same in their graphs—additionally, note for students how you chose your range of values for the y-axis. Particular values will depend on the variable and time of year, but students can use the other days in the *National Weather Service 3-Day Weather Observation History* to get a sense of the variation in their variable over time.

Modification

Step 2: The sixth weather variable, cloud-cover, is more challenging than the others to measure and find in datasets. You may consider omitting this variable from student weather data collection and/or from consideration in Lesson 2 as a whole.

Informal Assessment

Informally assess students' understanding of the weather variables contributing to extreme weather events, as well as similarities between these events, by examining Parts B–F of their *Extreme Weather Model Builder*.

Extending the Learning

Step 2: Students may wish to explore additional elements of the *National Weather Service* website, including the 'Active Alerts' and 'Rivers, Lakes, and Rainfall' tabs. Both tabs are relevant to extreme weather events occurring currently. You may wish to consider having students gather and graph additional information. This can be done either daily if data collection during this and the following two activities span a weekend, or by incorporating more hourly information from the 3-day forecast.

OBJECTIVES

Subjects & Disciplines

Earth Science

- Climatology
- Meteorology

Learning Objectives

Students will:

- Read to define key weather variables.
- Collect and graph current, local data on these key weather variables.
- Revise a model of an extreme weather event to incorporate the roles of, and interactions between, key weather variables.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Lab procedures
- Reading

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information, Communications, and Technology Literacy
    - Media Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
  - Life and Career Skills

    - Productivity and Accountability
    - Social and Cross-Cultural Skills
- 21st Century Themes
    - Environmental Literacy
    - Global Awareness
- Critical Thinking Skills
    - Applying
    - Remembering
    - Understanding
- Science and Engineering Practices
    - Developing and using models
    - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.RST.6-8.4:**
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2: Cause and Effect:**
Cause and effect relationships may be used to predict phenomena in natural or designed systems.
• **MS-ESS2-5:**
Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
• **Science and Engineering Practice 2:**
Developing and using models

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Anemometer (optional)
- Barometer (optional)
- Clear-walled, straight-sided vessel, such as a glass beaker
- Hygrometer (optional)
- Rulers
- Thermometers

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per pair, Monitor/screen, Projector

PHYSICAL SPACE

- Classroom
- Computer lab

GROUPING

- Large-group instruction
- Large-group learning
- Small-group learning
- Small-group work

RESOURCES PROVIDED: WEBSITES

- National Weather Service

RESOURCES PROVIDED: UNDEFINED

- Extreme Weather: Droughts
- Hurricanes 101
- Tornadoes 101

RESOURCES PROVIDED: REFERENCE

- temperature

- Precipitation
- humidity
- atmospheric pressure
- wind

RESOURCES PROVIDED: AUDIO & VIDEO

- Upturning Tornadoes

BACKGROUND & VOCABULARY

Background Information

Weather describes the state of the atmosphere at a specific place and a short span of time. Six key variables contribute to weather: temperature, precipitation, pressure, wind, humidity, and cloudiness. Scientists and forecasters precisely measure these variables with tools such as a thermometer, barometer, and anemometer. These variables combine to influence what we feel when we walk outside, but also determine other important aspects of our lives, such as the ability of our food to grow in a given season.

Extreme weather events include hurricanes, tornadoes, and droughts. Each of these extreme weather events has the capacity to powerfully influence the lives of humans, and can sometimes even be deadly. Extreme weather events involve the same set of variables as other types of weather. For example, hurricanes depend on temperature and humidity—they thrive on warm, moist air. Droughts occur when precipitation is very low. Although the conditions leading to the formation of tornadoes is slightly less clear, these storms seem related to differing temperatures in colliding air masses.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
atmospheric pressure	*noun*	force per unit area exerted by the mass of the atmosphere as gravity pulls it to Earth.
climate	*noun*	all weather conditions for a given location over a period of time.
cloud cover	*noun*	amount of sky covered with clouds.
drought	*noun*	period of greatly reduced precipitation.
humidity	*noun*	amount of water vapor in the air.
hurricane	*noun*	tropical storm with wind speeds of at least 119 kilometers (74 miles) per hour. Hurricanes are the same thing as typhoons, but usually located in the Atlantic Ocean region.
precipitation	*noun*	all forms in which water falls to Earth from the atmosphere.
temperature	*noun*	degree of hotness or coldness measured by a thermometer with a numerical scale.
tornado	*noun*	a violently rotating column of air that forms at the bottom of a cloud and touches the ground.
weather	*noun*	state of the atmosphere, including temperature, atmospheric pressure, wind, humidity, precipitation, and cloudiness.
wind	*noun*	movement of air (from a high pressure zone to a low pressure zone) caused by the uneven heating of the Earth by the sun.

For Further Exploration

Instructional Content

- National Geographic: Resource Library: Collection: Weather
- National Geographic: Resource Library: Collection: Catastrophic Weather Events
- National Geographic: Resource Library: Collection: Climate
- National Geographic: Resource Library: Collection: Climate Change