Teaching About Severe Weather

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K-12 and the UCAR Center for Science Education:

- We develop innovative K-12 educational resources for teaching about climate, weather, and earth science.
- We provide informal learning experiences at the NCAR Mesa Lab in Boulder, CO including field trip programs and exhibits.
- We offer teacher professional development from short workshops to year-long courses.
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ABOUT US

The UCAR Center for Science Education engages people in the wonder and relevance
Severe weather affects everyone.

- Weather impacts daily life.
- It’s relevant to national security and global politics.
- Crosscutting between social studies, science, and geography.
Storms are in the standards.

Next Generation Science Standards

- **MS ESS3B** Natural Hazards; Earth and Human Activity
  - **PE MS ESS3-2** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

- **HS ESS3B** Natural Hazards; Earth and Human Activity
  - **PE HS ESS3-1** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity

**Science and Engineering Practices:** Analyzing and interpreting data, defining an engineering problem, considering solutions

**Crosscutting Concepts:** Cause and Effect, Stability and Change, Influence of Science Engineering and Technology on Society and the Natural World
Severe weather du jour:

- Tornadoes
- Flash floods
- Winter storms
- Hurricanes
tornadoes
Get the Picture

An activity in which students explore and interpret graphics that describe weather data.

1. Take a look at the graph or diagram that conveys information about severe weather events
2. Discuss and decide whether statements are true or false.
Tornadoes, also called twisters, are rare and powerful weather events in which columns of air rotate dangerously fast. In this teaching box are resources to help students learn why and where tornadoes happen and how these weather events impact people’s lives.

Teaching Boxes are collections of classroom-ready and standards-aligned activities, content, and multimedia that build student understanding of science, technology, engineering, and math.

Overview  How do they happen?  Where do they happen?  How do tornadoes affect people?  Resources

UCAR Center for Science Education Teaching Boxes are themed collections of classroom-ready educational resources to build student understanding of science, technology, engineering, and math (STEM). Resources highlighted within teaching boxes are from various science education programs and all have been vetted by the UCAR Center for Science Education team.

- Topic: Tornadoes
- Level: Middle and high school
- How to use this resource: Each tab correlates with a part of the scope and sequence for this topic and includes links to hands-on activities, background content, and multimedia resources. Select resources within each tab that are best suited for your students to meet the learning goals. (There are often more resources linked within each section than you will need.)

How do they happen?
What is a teaching box?

- Themed collections of classroom-ready educational resources to build student understanding of science, technology, engineering, and math (STEM).
- Resources highlighted within teaching boxes are from various science education programs and all have been vetted by the our educators.
Return from Catastrophe: Moore, Oklahoma a Year After the Tornado

Satellite imagery from Airbus Defense and Space reveals that dramatic progress has been made in recovering from the devastating twister that struck on May 20, 2013.

A Tale of Two Streets

Left image: 2013, after tornado
Right image: 2014, during recovery

In the middle of the afternoon on May 20, 2013, a killer tornado swept through Moore, Oklahoma, a suburb of Oklahoma City. In its path were Southwest 147th Street and South Harvey Avenue, the cul-de-sac that branches off from it (area within red outline). The streets had been lined with 40 low-slung ranch houses, every one of which was reduced to rubble (left image).

Although the storm debris had long since been carted off, by spring 2014 (right...
flash floods
The Flash Flood Teaching Box

Flash floods happen when quick and heavy rainfall causes placid waterways to turn into raging torrents. This teaching box is filled with explorations and readings that help secondary students learn the science of flash flooding. Students will learn that storms with unusually heavy rainfall can cause a flood, that the shape of the land and the ability of the ground to hold water influences whether a flood is likely, and they will learn how flash flood risk and probability is assessed. Get your feet wet by bringing the science of flash floods to your classroom.

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- Topic: Flash Flooding
- Level: Secondary grades (6-12)
- How to use this resource: Each tab correlates with a part of the scope and sequence for this topic and includes links to hands-on activities, background content, and multimedia resources. Select the resources within each tab that are best suited for your students to meet the learning goals. (There are often more resources linked within each section than you will need.)
- Printable version of this overview (PDF)

Rainfall and Flash Flooding

Goal: Students learn that storms with unusual amounts of rainfall can cause a flash flood.

Activity: Students learn how rainfall is measured and how it can lead to flooding.

Performance Expectation: Students learn that storms with unusual amounts of rainfall can cause a flash flood by studying how rainfall is measured, analyzing and interpreting rainfall data, and using mathematics.

Standards:
Goal: Students learn that storms with unusual amounts of rainfall can cause a flash flood.

Engage students with a map showing data about rainfall that caused flooding.

- Map of Precipitation Totals from the September 2013 Colorado Rainstorm: Heavy rainfall in Colorado during September 2013 caused widespread flash flooding. Instruct students to look at a map of rainfall totals in the area to learn how much water the storm dropped. Which areas got the most rain? Where would you predict the most flooding to occur? The rainfall totals on this map are provided by volunteer weather observers with the CoCoRaHS project.
- Watch the 3 minute CNN Colorado Flood Explanier video for a quick introduction to how such a large storm happened in Colorado during September 2013.

Explore how rainfall leads to flooding through one of the following investigations.

- Measuring Precipitation: Equipment and Measurements (CoCoRaHS Lesson 1): Students explore how rainfall is measured by taking readings from a rain gauge and reading about how one scientist struggled to measure rainfall during the Colorado rainstorm that produced floods.
- Reading: Measuring rainfall - it's easy and difficult at the same time, by Dr. Peggy LeMone

Elaborate by building student understanding of what is a normal or typical amount of precipitation for this region.

- Have students look for average precipitation in climate data from cities and towns they identify on the Google map of rainfall data. You can find weather data on the Weather Channel website by:
  o entering a town and state into the search tool
  o clicking “Monthly” on the left
  o then clicking “Averages” below the calendar
- Explain that the averages tell us what is expected. They are an average of 30 years of data. Have each student group search for a different town and then report the difference they find between the storm totals and the average rainfall.

Evaluate student learning by comparing storm totals to averages.

- Have students compare the Google Map of CoCoRaHS rainfall totals with a histogram of average precipitation for Boulder, Colorado.

Performance Expectation and Standards:

- Science and Engineering Practices: Analyzing and Interpreting Data
- Science and Engineering Practices: Using Mathematics and Computational Thinking
- MS-ESS2-C: The Role of Water in Earth’s Surface Processes
Goal: Students learn that water flows downhill on land and that the shape of the land and the ability of water to soak into the ground influences whether a rainstorm causes a flash flood.

Engage students with a video of flash flooding occurring in a natural environment.

- Flash Flood: This 5-minute video shows how a creek can fill to flood level in seconds. After having students watch the video ask whether any of them have visited an area where this could happen. Have they seen it happen? Survey student knowledge about where the water could be coming from to fill this creek so quickly. Students should recognize that a storm upstream could have added water to this creek, or that a dam upstream was opened.

Explore by having students build models to learn how topography and the permeability of the land affect flash flooding.

- Topography models
  - Crumple a Watershed: This activity gives students a quick and easy way to model a watershed and can be adapted for various grades. While a map that shows topographic relief is a part of this activity, you can substitute online relief maps or videos that show birds-eye views of topographic relief.
  - Build Your Own Watershed: In this activity, students develop a more elaborate model of a watershed. You may wish to monitor student use of spray bottles during this activity.
- Porosity and permeability models
  - Just Passing Through: Have students set up the demonstration if time allows, or set it up beforehand and focus on student observations of the model.
  - Experiment Porosity: For a quick and easy model of porosity, this can be implemented in a short amount of class time.
  - Porosity and Water Flow in Soils: An advanced activity for high school students.

Evaluate by having students apply what they have learned about the shape of the land and porosity to another context.

Tell students that flash flooding is also common in urban settings. Ask students why that might be. Ask students to write a paragraph to describe, based on what they have learned about flash flooding in mountain environments, why flash floods might happen in urban settings. Student answers should include (1) the impermeability of urban surfaces such as concrete, asphalt, and buildings, which prevent water from soaking into the ground and (2) that a flash flood would depend on the topography of the city.

Performance Expectation and Standards:

- Science and Engineering Practices: Developing and Using Models
- Science and Engineering Practices: Planning and Carrying Out Investigations
- MS-ESS2.C: The Role of Water in Earth's Surface Processes
Students learn how flash flood risk and probability is assessed.

Risk = probability x consequences
100 year flood zone
Flood Chances

Students test the hypothesis that in the 100-year floodplain, a flood happens once in every hundred years.

1. One person pulls a bead/marble from the bag
2. Another person records its color. (The one different bead is a flood.)
3. Repeat 100 times. Did you get 1 flood?
About the term 100-year flood:

“We’re getting away from that terminology, because people tend to think that’s the storm that happens every 100 years. But, really, it’s the change of it happening in any given year is one in 100.”

- Robert Kimbrough, associate director, USGS Colorado Water Science Center
winter storms
Winter Weather in the News
Weather isn’t covered the same way in different news sources.

- What’s the perspective?
  - Local news versus national news
- What’s the point of view?
  - Reporting versus opinion/editorial
- What’s the focus?
  - People focus versus science focus
Weather in the News

Students explore the different ways that media covers a weather event.

1. Read an article about snow in Boston. Take notes on the worksheet.
2. Jigsaw: Share your article with your group. How are the articles different? How are they the same?
There are more heavy snowstorms in the Northeast.
Winter Weather in Cartoons
The polar vortex is lurking in her North Pole lair.

It’s not a SECRET LAIR! I’m here every winter.

Meanwhile, somewhere near the equator, a storm named Nori grows into the STRONGEST TYPHOON OF THE YEAR.

In the Atlantic they’d call me a HURRICANE!
Super typhoon Nori moves north, crashing into Polar Vortex territory.

This sends a piece of the chilly vortex south into North America.

Oopsy daisy!
Investigate:
Slippery Ice
Why is ice slippery?
Tracking Hurricane News

1. Each student reads a news story about Hurricane Irene.
2. Students present information from their articles to the rest of the class.
3. Each student constructs a timeline to describe the hurricane’s story over time and across geographic area based on all the news stories.
Hurricane Irene

- Strengthened to a Category 3 storm.
Irene made landfall many times along its path

(Puerto Rico, Bahamas, North Carolina, New York and New Jersey)
Get the workshop handouts at: SciEd.ucar.edu/workshops

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