WeatherREADY plan for it. Tornadoes

Age Range: *This unit has been designed specifically for students in grades 5-8. It can easily be adapted for younger or older students.*
Teaching Note: *Depending on your time frame and student abilities and interests, have student groups complete each of the activities below or assign groups to work on specific activities and share their information.*

Vocabulary

Tornado	Tornado Watch	hail	cyclone	downdraft
troposphere	vortex	low pressure	Fujita-Pearson Scale	Doppler radar
Tornado Alley	downburst	wind shear	Tornado Warning	waterspout
satellites	updraft	funnel cloud	twister	

Check The Weather Channel Education online glossary (http://www.weatherclassroom.com) for the meanings of these weather terms.

Resources

For information on the science and safety of tornadoes, check out The Weather Classroom program on The Weather Channel. Check online at http://www.weatherclassroom.com for program schedules and accompanying lesson plans and hands-on activities.

Weather Note:

Tornado formation is still a mystery. It is believed that winds blowing from different directions — wind shear — in the lowest 3 kilometers of the atmosphere can cause horizontal spinning. In the presence of a thunderstorm updraft, this spinning can be tilted into a vertically spinning column. Continued interaction with the updraft causes the column to spin faster and faster.

Science

Purpose: To have students investigate and demonstrate the science behind the development of tornadoes

1. Distribute "The Science of Tornadoes" Student Handout to small groups of students. Have them follow the steps to demonstrate the science behind tornadoes. Encourage them to consider:
   a. How do tornadoes develop?
   b. What are the characteristics of a tornado?
   c. Why are tornadoes dangerous?

2. Have groups research to find and develop other ways to demonstrate the science behind, and the power of, tornadoes. Have them turn these demonstrations into lesson plans, complete with handouts for others in the class. www

Language Arts Extension:
Have students transform their final scientific report into an eyewitness account of a tornado for a local television report. Have them consider ways they must change their writing to fit the medium. What additions might they include: personal interviews, local background information, visuals?

Research

Purpose: To guide students to understand and demonstrate forecasting, frequency, location, and deadly effects of tornadoes across the U.S.

1. Have student teams follow the steps on the "Mapping and Graphing" Tornadoes Student Handout to begin to determine frequency, location of, and deaths related to tornadoes in the U.S. www
2. Have teams analyze their data and develop the best plans for illustrating the information about their own area and comparing it with other areas.

Weather Note:
The unique geography of Tornado Alley produces favorable conditions for the development of thunderstorms and tornadoes. The Gulf of Mexico provides moisture and the Rocky Mountains bring dry air to the mid and upper levels of the troposphere.

Language Arts Extension:
Have students become "Storm Chasers" who observed tornado outbreaks during some of the most powerful U.S. tornadoes.

a. Have students research to discover information about a deadly tornado: Palm Sunday, 1965; the Super Outbreak of 1974; Alabama, April 1998; or one in their own area. www
b. Based on the information they discover, have students:
   - Document their day in half-hour intervals, inserting specific times of important events (spotting the tornado, tornado's ground life, path width, etc.)
   - Emphasize creativity based on sound meteorological information to ensure accuracy and capture the excitement and difficulty of a storm chaser's work.
   - Add sketches and diagrams for clarity and emphasis. www

Weather Note:
During the Palm Sunday Outbreak of April 11-12, 1965, 48 tornadoes ripped paths of devastation through Iowa, Wisconsin, Illinois, Minnesota, Indiana and Ohio...killing more than 250 people and causing over $200 million in damages.

Tornadoes that move over lakes have been known to lift fish out of the water, and then "rain" them down on land farther away.

Safety

Purpose: To guide students to research, devise and distribute guidelines for staying safe during a tornado

1. Have student teams use the "Safety…Tornadoes" Student Handout and other resources listed to find and illustrate the best way to stay safe during tornadoes. www

   - The Weather Channel WeatherREADY information at http://www.weatherclassroom.com
   - The American Red Cross: Safety: http://www.redcross.org/services/disaster/0,1082,0_501_,00.html
   - American Red Cross: Local Red Cross Chapters: http://www.redcross.org/where/where.html
   - FEMA Preparedness: Tornadoes http://www.fema.gov/hazard/tornado/index.shtm

2. Teams should review the guidelines they discover in their research and create customized tornado safety guidelines for school and home. Have them consider safety preparations for their community before, during and after the storm.

3. Have students share their guidelines with others in the school community in various forms: skits, brochures, posters, interviews or presentations to a younger grade.

Safe Room:

In some areas of the U.S., the risk of high winds from tornadoes, hurricanes and extreme windstorms is great. Each year extreme winds cause injuries and deaths and damage millions of dollars worth of property. The Federal Emergency Management Agency (FEMA) recommends that people who live in high-risk areas make sure they have a safe place to go during these storms.

A basement in a tornado-prone area is considered a good, safe place. But, what if your house doesn't have a basement? The Wind Engineering Research Center of Texas Tech University in Lubbock, Texas, developed plans for a safe room that can provide protection against winds of up to 250 miles per hour and against flying objects traveling as fast as 100 miles per hour. These rooms are built inside a house, but separate from the house, with walls and ceilings so thick and strong that its occupants stay safe even if the rest of the house is destroyed by high winds and flying objects.

Have students use the "Assessing the Risk" Student Handout to discuss their area 's risks from high winds and the safe places they can go.

Check online for FEMA's Safe Room Construction Plans. Or, order a copy of their construction handbook with plans and specifications by calling 1-888-565-3896. www

Mathematics Extension:

Sometimes the need for knowing and taking safety precautions can best be explained through statistics that emphasize the dangers of tornadoes. Have students research data and then determine the best mathematical means of illustrating these statistics to have the greatest impact on community safety. www

the Science of...

Tornadoes

Tornado in a Bottle

Purpose:
To create your own small tornado

Materials for each group of students:
- large plastic soda bottle with cap
- water
- dishwashing liquid
- marbles or other similar objects

Procedure:
1. Fill the bottle with water.
2. Put three drops of dishwashing liquid into the bottle.
3. Place a few marbles into the bottle.
4. Shake the bottle in a circular motion so that the marbles spin around the walls of the bottle. Put the bottle down. What do you see?

Analysis:
1. How does this represent a tornado?

2. Why is each part of the "tornado" necessary to create this effect?

3. Use the vocabulary below to describe what happened when you created your "tornado."

tornado	twister	downburst
updraft	downdraft	vortex

Mapping & Graphing

Tornadoes

Procedure:

Use this map to chart the date and location of tornadoes over the past year or several years. Check the Internet. WWW

Use graph paper to:

1. Prepare a graph showing the number of tornadoes, by month, for several years past.

2. For each year, prepare a graph showing the number of tornadoes and the number of deaths caused by tornadoes per month.

Analysis:

Based on the graph prepared in Step 1, during which months were tornadoes most frequent?

Based on the graphs prepared in Step 2, during which months do most deadly tornadoes typically occur?

Compare the number of tornadoes for each month to the number of deaths due to tornadoes. What conclusions can you draw?

Safety
Tornadoes

Weather forecasting technology has improved warning times for large thunderstorms that might produce tornadoes. NOAA Weather Radio, with a tone-alert feature, keeps you informed of WATCHES and WARNINGS issued in your area. You can also use a battery-powered radio or television to listen to local weather information.

Watch for Tornado Danger Signs

- Dark, often greenish sky
- Wall cloud, an isolated lowering of the base of a thunderstorm
- Calm before the storm
- Cloud of debris
- Funnel cloud
- Roaring noise

If Indoors

- Go to a safe place to protect yourself from glass and other flying objects. The safest place to take shelter during a tornado is in a basement that does not have windows.
- If there is no basement, go to the lowest floor and take shelter in a hallway, bathroom, closet or small room toward the inside of the building and away from windows.
- Get under a piece of sturdy furniture and hold on to it. Heavy furniture can help protect you from falling debris. If tornado wind enters the room and the object moves, holding on with one hand will help you move with it, keeping you protected. Use your other arm and hand to protect your head and neck from falling or flying objects.
- If you're not at home, go to a basement or low-level hallway or room, and avoid places with wide-span roofs such as auditoriums, cafeterias, large hallways, or shopping malls.

Debunk the Myths

- Leave the windows alone. It's a myth that tornadoes cause houses to explode due to changes in air pressure. Opening windows allows damaging winds to enter the structure.
- Tornadoes do not "suck" houses, cars, cows or people up into the funnel. Their strong winds, however, can blow large objects hundreds of feet away.
- Don't worry about the southwest corner of your basement. Any part of the basement, or lowest level of your home, that is away from windows is just as safe as any other corner or even the middle of the room.

If Outdoors

- If possible, get inside a building.
- If shelter is not available, or if there is no time to get indoors, lie in a ditch or low-lying area or crouch near a strong building. Be aware of potential flooding.
- Do not go under bridges and overpasses — dangerous flying debris can be blown under the overpass and weakened overpasses or bridges can be destroyed.

If in a Car

- Never try to outdrive tornadoes, they can change direction quickly and their winds can lift and toss a car or truck.
- Get out of the car immediately and take shelter in a nearby building. If there is no time to get indoors, lie in a ditch or low-lying area. Be aware of potential flooding.

After a Tornado

- Listen to authorities for updated information and instructions. Access may be limited to some parts of the community.
- Help neighbors who may require assistance.
- Watch out for fallen power lines or broken gas lines and report them immediately to the utility company.
- Avoid disaster areas. You could hamper rescue and emergency operations.
- Stay out of damaged buildings. Return home only when safe.
- When you're able to re-enter damaged buildings, use extreme caution:
  - Wear sturdy shoes.
  - Use flashlights to examine the building.
  - Look for fire hazards.

Assessing the Risk of...
Tornadoes

The Federal Emergency Management Agency (FEMA) has developed guidelines for assessing risk from high winds — tornadoes, hurricanes, and extreme windstorms. Use the maps and charts from FEMA's "Taking Shelter from a Storm" (Publication #320, available from FEMA) to determine your community's risk factors.

Step 1: Find your community on the map. According to the key, how many tornadoes are recorded per 1,000 square miles each year?

Step 2: In what wind zone is your community located?

Step 3: Use the chart below to assess your community's risk.

Wind Zone

# of Recorded Tornadoes per 1000 square miles	I	II	III	IV
<1	LOW RISK	LOW RISK	LOW RISK	MODERATE RISK
1-5	LOW RISK	MODERATE RISK	HIGH RISK	HIGH RISK
6-10	LOW RISK	MODERATE RISK	HIGH RISK	HIGH RISK
11-15	HIGH RISK	HIGH RISK	HIGH RISK	HIGH RISK
>15	HIGH RISK	HIGH RISK	HIGH RISK	HIGH RISK

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Analysis:

1. How does this represent a tornado?
   According to the Glossary of Meteorology (AMS 2000), a tornado is "a violently rotating column of air, pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud." http://www.spc.noaa.gov/faq/tornado/#The%20Basics

   In our demonstration, instead of a rotating column of air, we have a rotating column of water. The dishwashing liquid represents the cloud that gave birth to the tornado and the shape of the rotating column of water is that of a funnel.

2. Why is each part of the "tornado" necessary to create this effect?
   If you try the demonstration with just water, it is difficult to "see" the rotating funnel of water. Also, adding dishwashing liquid helps create the "cloud" effect. The marbles make it easier to spin the bottle to produce a rotating column of water. For the best effect, it is helpful to hold the bottle upside down when spinning.

3. Use the vocabulary below to describe what happened when you created your "tornado."

tornado	twister	downburst
updraft	downdraft	vortex

   *As you begin to spin the bottle so that the marbles rotate around the walls, an **updraft** is created that carries water towards the top of the bottle. This water, mixing with the dishwashing liquid, produces the "cloud' effect at the top of the bottle. As the water continues to spin, it is moving faster near the outside of the bottle than in the center. This creates a **vortex** where there is less water near the center of the bottle than along the outside. The spinning water produces a **downdraft**, or downward force that results in water at the top spiraling down towards the bottom of the bottle. This process is known as a **downburst**. The end result is the spinning column of water with the funnel shape that is known as a **twister** or as a **tornado**.*