Tornado in a Box

Objectives

Participants will:

- Learn about different types of severe weather.
- Be able to define what severe weather is and how it is measured.
- Create a tornado in a box.
- Demonstrate how cyclones work.

Suggested Grade Level

4th-12th

Subject Areas

Science

Timeline

One class period

Standards

Science

NS.5-8.1 Science as Inquiry

- Understandings about scientific inquiry

NS.K-12.4 Earth and Space Science

- Structure of the earth system

NS.K-12.6 Science in Personal and Social Perspectives

- Natural hazards

Background

Severe weather is a term utilized frequently. But what is it that makes weather severe? How does weather become classified as severe? What are the indicators of extreme weather conditions? These questions are important ones and they should be addressed before investigating the outcomes of severe weather.

Meteorologists generally define severe weather as any aspect of the weather that poses risks to life, property or requires the intervention of authorities. A narrower definition of *severe weather* is any weather phenomena relating to severe thunderstorms.

According to the World Meteorological Organization (WMO), severe weather can be categorized into two groups, general severe weather and localized severe weather. Nor'easters, European wind storms, and the phenomena that accompany them form over wide geographic areas. These occurrences are classified as *general severe weather*.

Downbursts and tornadoes are more localized and therefore have a more limited geographic effect. These forms of weather are classified as *localized severe weather*. The term *severe weather* is technically not the same phenomenon as extreme weather. Extreme weather describes unusual weather events that are at the extremes of the historical distribution for a given area.

Although tornadoes occur in many parts of the world, these destructive forces of nature are found most frequently in the United States east of the Rocky Mountains during the spring and summer months. In an average year, 800 tornadoes are reported nationwide, resulting in 80 deaths and over 1,500 injuries. A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long. http://www.nssl.noaa.gov/edu/safety/tornadoguide.html

What causes tornadoes?
Thunderstorms develop in warm, moist air in advance of eastward-moving cold fronts. These thunderstorms often produce large hail, strong winds, and tornadoes. Tornadoes in the winter and early spring are often associated with strong, frontal systems that form in the central states and move east. Occasionally, large outbreaks of tornadoes occur with this type of weather pattern. Several states may be affected by numerous severe thunderstorms and tornadoes.

During the spring in the Central Plains, thunderstorms frequently develop along a "dryline," which separates very warm, moist air to the east from hot, dry air to the west. Tornado-producing thunderstorms may form as the dryline moves east during the afternoon hours.

Along the front range of the Rocky Mountains, in the Texas panhandle, and in the southern High Plains, thunderstorms frequently form as air near the ground flows "upslope" toward higher terrain. If other favorable conditions exist, these thunderstorms can produce tornadoes.

Tornadoes occasionally accompany tropical storms and hurricanes that move over land. Tornadoes are most common to the right and ahead of the path of the storm center as it comes onshore.

Vocabulary

Cyclone, twister, tornado, dryline, hurricane, lightning, atmosphere, joules, Beaufort scale, Saffir-Simpson scale, tropical storm, tropical depression, tropical storm, updraft, downdraft, Fujita scale

Materials

Required for each tornado in a box:
Copy paper box
Utility knife
Ruler
Pencil
Black construction paper

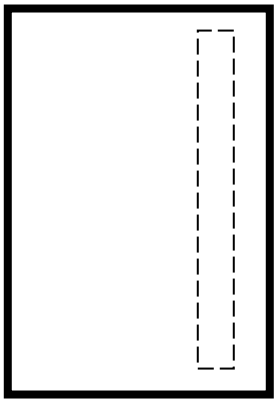
Glue (Elmers or glue stick)
Two transparencies
Clear packing tape
1 lb. Dry ice
Gloves to handle the dry ice
Warm water
Pie tin
6" of a poster packing tube
You will also need:
A vacuum with a hose attachment
A video camera is suggested

Lesson

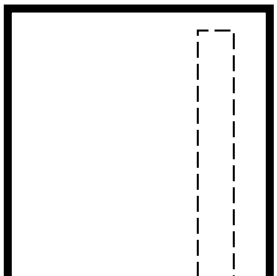
1. Keep the dry ice in the freezer until it is time to begin the demonstration.

Building the Tornado in a Box:

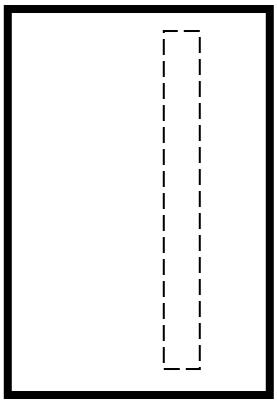
2. Draw a rectangle measuring 1" from each of the edges of the box. Once drawn, use that as the guide and cut the rectangle out using the utility knife
3. Using two transparency sheets, create a window. Attach the sheets (in a landscape position) to the inside of the copy paper box cover, over the rectangle you just cut out. For best results, attach using the shipping tape and connect the two sheets running tape along the line where these two sheets overlap in the middle as well.
4. Line the inside of the box with black construction paper. This will make the tornado easier to see. Simply glue the construction paper to every side of the box (on the inside only).
5. Holding the box in a vertical position, with the inside facing you, turn the box clockwise. Now one side of the box should be facing you. Take the ruler and measure 2" from the right edge, 1" from the top and bottom. You will be making another hole in the box, running the height of the box. This hole only needs to be about 1-1 ½" wide. See the image below for an example



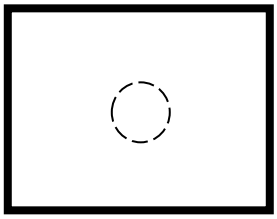
6. Now rotate the box clockwise again. The bottom of the box should be facing you now. Repeat step five.



7. Rotate the box one more time. This time, you will need to move the hole towards the center a bit. This will make sure you do not cover the hole when putting the cover back in place. Measure 4" from the right side and then repeat step five. Your hole should look like the image below.



8. When finished, cut a circular hole in the top of the box by finding the center. The hole should be large enough to fit the poster tube in. When done correctly, this should look like a chimney.



9. Before placing the cover of the box back on, place the pie tin in the center of the bottom. Add the warm water into the tin, filling it halfway.
10. Using gloves, add the dry ice to the water. The result should be a growing cloud!
11. Carefully add the cover of the box.
12. With the vacuum plugged in (and make sure you have the video camera ready if you plan to use it), place the hose connector in through the "chimney" and turn on the vacuum!
13. The result should be a vortex. Make sure to have a discussion with your group about what is happening.
14. Some possible questions are: "Is there a change in pressure within the box?" "Is this exactly how tornadoes work in nature?" "How can I make the vortex swirl faster/slower?" "How can I make a larger vortex?"

Extensions

- Vary the temperature of water.
- Try different liquids to see if the twister is different
- Hold the vacuum hose at different lengths to see a change in twister size and speed
- Use food coloring in the liquid and see if there is a different colored twister
- Turn off the lights in the room and attach a black light to the back of the box. Turn the box on and see the twister "glow".

Evaluation/Assessment

Create a lab sheet and have the students answer the questions given on #14 of the lesson section. If they are videotaping, you can have the students include the video as part of their assessment.

Resources

USA Today Article about Tornadoes
http://www.usatoday.com/weather/resources/2006-04-03-tornado-basics_x.htm

NOAA Site for Tornado Information
http://www.nssl.noaa.gov/edu/safety/tornadoguide.html