

Tornadoes

What is a Tornado?

Tornadoes combine powerful winds speeds, 300 to 350 miles an hour, with small lifetimes, 10 minutes to a maximum of two hours in a very narrow, sharply defined path. In shape, they resemble either a long thin rope or a fat inverted bell. Tornadoes typically form along the cold front of a fast moving, mid-latitude cyclonic storm system. When a tornado does appear, it usually appears from the storm's rear side where the stream of cool air from a vertical downdraft circulates into the warm, moist lower-level horizontal inflow. The intensity of a tornado's rotation, its complexity (vortex) and its severe effect on atmospheric pressure account for both the destructiveness of tornadoes and their unpredictability. The most promising technology for tornado detection is Doppler radar. Doppler radar is able to indicate the direction of rotation and the speed that the tornado is moving.

Satellites are useful in spotting tornadoes, providing images of cloud

shapes known as signatures of potential tornadoes:

- Bright V-shaped cloud wedge with overshooting towers of convection.
- Mammatus cloud shape, a peculiar pendulous formation that hangs udder-like (the name is derived from the Latin word for having breasts.) below the anvil shaped tops of thunderstorms.
- Rotary circulation in wind-tattered cloud bases.

Risk Assessment

The National Weather Service (NWS) National Severe Storms Forecast Center in Kansas City, MO, provides information on severe thunderstorms and tornadoes to the general public, news media, emergency managers and law enforcement personnel. The center uses Doppler radar, wind profilers and the networks of automated surface ob-

serving systems (ASOS) across the United States to assist in the prediction and identification process for severe thunderstorm and tornado watches and warnings.

A **tornado watch** is issued for a specific location when thunderstorms capable of producing tornadoes are recognized and arrival is expected in a few hours. A **tornado warning** is issued when tornadoes are spotted or Doppler radar identifies a distinctive "hook-shaped" area within a local partition of a thunderstorm line that is likely to form a tornado.

When a tornado watch or warning is issued, local authorities are placed on alert to assist in identifying and locating possible tornadoes. When a tornado is detected, emergency operations personnel and law enforcement agencies are alerted immediately. Warnings are broadcast to the public through radio, television and alarm systems. Emergency managers and local law enforcement officials sound sirens to notify those who have not already received the information by television, radio

Wind Speed and Damage

Tornadoes can range in wind speed from 40 to 350 miles per hour, but ones over 300 miles per hour are rare. When a tornado approaches a house, the atmospheric pressure within the house is greater than the pressure within the tornado. Air can not escape rapidly enough. This causes the windows to explode (break outward) and the walls may explode, causing the roof to collapse. In other instances, the tornado may lift the roof off the house but leave the walls intact.

Tornado Structure Formation

When a moving mass of cold air overtakes and traps an underlying layer of warm moist air, the warm air is drawn up into the core of the storm in a spiraling upward motion. At the same time, the cold air spirals downward, creating a **vortex**, or twisting funnel cloud. The destruc-

tive capabilities of tornadoes come partially from their extremely high wind velocities, and partially from the near-vacuum that exists within the vortex. The air pressure inside the vortex may be as low as 60 percent of normal atmospheric pressure; buildings can explode and disintegrate as a result of the pressure differential between the inside and the outside air. The partial vacuum also causes the tornado to suck up soil and debris, which gives the funnel cloud its typical dark, ominous appearance.

Where Tornadoes Form

Tornadoes occur worldwide; however, they are most common in the United States. About 80% of the US tornadoes ravage three states: Texas, Oklahoma and Kansas. Warm moist air flowing up from the Gulf of Mexico collides with cool dry air from Canada, channeled east by the Rockies. This causes most of the tornadoes in the central part of the country.

What to do if a Tornado Hits

If there is a potential that a tornado may form in your area, the National Weather Service will issue a Tornado Watch. If a Tornado Warning is issued, it means that a tornado or incipient tornado has been sighted. Here are a few tips on what to do if a tornado hits your area:

- If you are not indoors, take cover! Use a battery-powered radio to find out what is happening in your area.
- Go to an inside wall on the lowest floor, kneel on the floor facing the wall and put your hands over your head. Ideally, a room with no windows (often a bathroom, the basement or under a staircase) would be the safest place.
- If in a classroom, stay away from rooms with wide roofs that could collapse easily, such as auditoriums or gymnasiums.
- If you are stuck outside and see a tornado approaching, go to a safe place such as a ditch or underneath a steel bridge. You can crawl up close to the support beams and stand a good chance of riding out the storm. If you are in a car, get out; a tornado can outrun even a very fast car.

The Fujita-Pearson Tornado Intensity Scale

Professor Fujita and Dr. Allen Pearson, Director of NSSFC (National Severe Storm Forecast Center) brought the scale into widespread use in the early 1970's. The **Fujita Scale** is based on **damage**, not the appearance of the funnel. The funnel size does not necessarily indicate speed or intensity. This scale measures both the path **length** and **width**.

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F-0	Gale Tornado	40-70 mph	Some roof damage; breaks branches off trees, knocks down shallow rooted trees.
F-1	Moderate Tornado	73-112 mph	Removes shingles from roofs; mobile homes moved from foundation or overturned ; moving automobiles are pushed off the roads; attached garages may be destroyed.
F-2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; large trees snapped/uprooted; small flying debris becomes hazardous.
F-3	Severe Tornado	158-206 mph	Roof and walls torn from houses; trains overturned, most trees in tornado's path are uprooted.
F-4	Devastating Tornado	207-260 mph	Houses are leveled, cars are thrown, large debris becomes dangerous
F-5	Incredible Tornado	261-318 mph	Strong frame house lifted off foundations and carried considerable distances to disintegrate; automobiles and other debris fly at high rates of speed
F-6	Inconceivable Tornado	319-379 mph	These winds are highly unlikely.

**Wind Speed Needed
to Lift an Object**

<u>Object</u>	<u>Weight (in lbs.)</u>	<u>Wind Speed (mph)</u>
3/4" sheet of plywood	95	31
light mobile home 8' x 40'	4800	54
brick	3	56
heavy mobile home	39,200	88
concrete block	40	99
compact car	2000	105
standard car	4000	114
fertilizer tank	26,000	202
brick chimney	390	197

Deadliest Recorded Tornadoes:1870-1979

<u>Date</u>	<u>Name or Location</u>	<u># of Tornadoes</u>	<u>Deaths</u>	<u>Number of States Affected</u>	<u>Estimated Damage (in millions)</u>
3/18/1925	Tri-state	7	740	6	\$18
4/5-6/1936	Tupelo-Gainesville	17	446	5	\$18
2/19/1884	Enigma	60	420	8	\$3
3/21-22/1932	North Alabama	33	334	7	\$5
4/3-4/1974	Super	148	315	13	N/A
4/24-25/1908	Louisiana-Georgia	18	310	5	\$1
5/27/1896	St. Louis, MO	18	306	3	\$15
4/11/12/1965	Palm Sunday	51	256	6	\$200

Storm Chasers

The best method of tracking a tornado is Doppler radar. Government agencies and university researchers use this method to track weather data. They use vehicles such as trucks and vans equipped with the Doppler radar on the roof of the vehicle. They will chase a storm in order to gain information on the weather patterns. This is not safe and should not be attempted without expert chasers.

Water Spouts

Water spouts are tornadoes that form over water. They pick up the water and carry it in its cyclone. Water spouts are capable of siphoning millions of tons of water from water bodies. They are dangerous to boaters. When they make landfall, they can also cause severe coastal damage.

Activities

Tornado Bottles

Materials:

- large, clear plastic bottle with cap
- water
- crayon shavings
- glitter
- metal or plastic confetti
- bits of Easter grass

Fill the bottle with water. Add crayon shavings, glitter or other small floating materials such as Easter grass or plastic confetti. Replace the cap and tighten. Shake the bottle and watch the objects move. Try to make a tornado movement by swirling in one direction. Experiment with designs and patterns in movement by tipping and shaking the bottle different ways.

For a different look:

Materials:

- 2-empty two liter bottles
- water
- tornado cap (purchased at most educational supply stores)

Fill one bottle half-full and place the cap on that bottle. Attach the other bottle to the opposite end of the cap. Turn bottle over see the swirling pattern of the water, similar to a tornado.

Words to know:

Vortex

Cyclone

Fujita-Pearson Scale

Tornado Watch

Tornado Warning

Doppler Radar

Discussion Questions:

1. *A tornado with what wind speeds can overturn a train?*
2. *What should you do if you are at school and a tornado warning is issued?*