

Tornado Alley — a region of high plains in the central U.S., where vast layers of warm, moist air from the Gulf of Mexico come to rest beneath cold air swept in from Canada; more twisters occur here than anywhere else in the world.

twister — Another name for a tornado or cyclone.

updraft — an upward air current.

vortex — See "funnel."

wedge — one shape that a tornado can take; also see "stovepipe."

Things to think about

*If you can't reach a storm shelter during a tornado, where in your home, school or office building might you be safest?

*Would taking shelter under a tree be a good idea? Why or why not?

*Outdoors, from how far away can you see and hear a tornado? 5 miles? 10 miles? 15 miles? 20 miles?

*Because houses can literally "burst apart" from the difference in pressure between the center and the surrounding atmosphere, would it be safer to open all windows, close all windows or make some other arrangement?

*If you were in a plane above the cloud layer of a tornado, would you be able to see the tornado?

"I was convinced there was no way I was going to survive it."

On his way to work on May 3, 1999, Brian Hansen suddenly found himself face to face with The Monster:

What at first looked like a small debris field just became an entire debris wall approaching at just a phenomenal speed. I curled up into the floorboard of the front passenger side of my truck. The windows were breaking. Debris was punching into the vehicle left and right—it almost sounded like I was in the center of shotguns just being fired at the vehicle. I was convinced there was no way I was going to survive it. The wind noise was horrific, and when the eye passed over, the air pressure drop was so intense, I could feel my eyes bulge in my head. It took eight to ten seconds as the eye passed over before the rear wall of the storm came through. By this point, I was covered under 100 to 150 pounds of debris inside my vehicle.

Internet Resources

<http://explorezone.com/news/tornadoes.htm>

Tornadoes in the news, and news on tornadoes.

<http://205.156.54.206/om/brochures/tornado.htm>

Information on tornadoes: how they form, frequently asked questions, and how to make a plan for action in the event of dangerous weather.

<http://www.chaseday.com/tornadoes.htm>

Amazing photographs of deadly tornadoes, complete with brief descriptions of each twister's structure and subsequent path of destruction.

<http://whyfiles.org/013tornado/>

Think you know all there is to know about tornadoes? Learn the facts, and take a quiz!

<http://www.usatoday.com/weather/tg/wtorwhat/wtorwhat.htm>

Illustration of the mechanics of a twister.

<http://www.noaa.gov/tornadoes.html>

Extensive site on tornadoes, with science and news about the mysterious and deadly twisters.

<http://www.tornadoproject.com/recent/recentts.htm>

Frequently updated list of tornadoes for the year with brief descriptions of how they affected the people in their path.

Other Resources

For students:

Heuer, Kenneth. *Thunder, Singing Sands, and Other Wonders: Sound in the Atmosphere*. Dodd, Mead, & Co., 1981.

Simon, Seymour. *Tornadoes*. Morrow Junior Books, 2001.

This Book Really Sucks! The Science Behind Gravity, Flight, Leeches, Black Holes, Tornadoes, Our Friend the Vacuum Cleaner, and Most Everything Else. Planet Dexter, 1999.

Thompson, Luke. *Tornadoes (Natural Disasters)*.

Children's Press, 2000.

Twist, Clint. *Hurricanes and Storms: Repairing the Damage*.

Dillon Press, 1992.

For adults:

Fraidley, Warren. *Storm Chaser: In Pursuit of Untamed Skies*. Independent Publishers Group, 1996.

Verkaik, Jerrine, and Arjen Verkaik. *Under the Whirlwind: Everything You Need to Know About Tornadoes but Didn't Know Who to Ask*. Whirlwind Books, 1998.

Grazulis Thomas P. *The Tornado: Nature's Ultimate Windstorm*. University of Oklahoma Press, 2001.

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EXTREME WEATHER

Although "you can't do anything about the weather," as the old saying goes, people are fascinated with it. Extreme climates, such as the frigid, desolate plains of Antarctica, attract adventurers who pit their stamina against the unrelentingly harsh environment. Armchair weather-watchers are curious about the oddities: the hottest place on Earth, the driest, the rainiest. Episodes of violent weather—tornadoes, hurricanes, blizzards, turbulent thunderstorms—remind us that much in the natural world is still outside of human control. This series explores many types of extreme weather, from inhospitable locations such as the completely arid Atacama Desert in northern Chile to killer storms that can destroy a town in minutes. It also discusses how meteorologists use increasingly sophisticated technology to track approaching storms and issue life-saving warnings before "nature takes its course."

TORNADOES

Most tornadoes are short-lived, but May 3, 1999, brought a rare and deadly exception. One of the most destructive tornadoes in U.S. history swept through Oklahoma City, in an area of Southwest Oklahoma known as "Tornado Alley." By the time the terrifying mass of wind, rain, hail and debris—swirling at speeds of over 300 miles an hour—had subsided 90 minutes later, 38 people were dead and 8,000 buildings destroyed. This killer tornado was eventually classified as an F5, the most powerful class of tornadoes on Earth. Follow the monster ravaging the landscape. Race with forecasters as they rush to predict its course. Scramble with researchers as they probe its power. And see the eyewitness account of a survivor who was buried under 150 pounds of debris in his truck.



Tornado Alley

It's springtime in Tornado Alley, and storms are always expected. Each year this 320-mile strip of high plains land, stretching from Texas to Missouri, is hit with more tornadoes than anywhere else in the world. Some of them last only 15 minutes, others roar and shriek for hours. They sweep across the land for sometimes hundreds of miles, tossing people, buildings and cars high into the air, then smashing them to the ground.

In recent years, forecasters had become fairly accurate at forecasting supercell thunderstorms, but they could not predict what would make a tornado emerge from a supercell. This was because their meteorological instruments would be destroyed by the tornado itself as they were trying to describe the conditions inside it.

As the May 3, 1999, tornado moved toward Tornado Alley, researchers in mobile Doppler RADARs got into position near the supercell to gather wind, temperature and pressure data from around the storm. They measured the fastest wind speeds ever recorded in a tornado—318 miles per hour—and collected the most complete view of the internal structure of a long-lived tornado.

Meanwhile, the destruction raged. In one neighborhood, minivans and boats landed in people's yards. Everything was covered in mud and insulation. The roads were impassable, cut off by trees and wood. Blocks and blocks of homes were destroyed.

Relying on the laws of physics, the forecasters were able to predict which communities might be hit next, and to warn them. And perhaps most important, they captured on radar the first-ever image of the birth of a tornado. This data may lead to an understanding of how tornadoes are formed and to systems that can better pinpoint when and where one might strike. And although May 3, 1999, will go down in history as a disaster, it was also a triumph, because forecasting saved hundreds of lives. Hundreds could have died but, remarkably, only 38 were killed.

The F- Scale

Tornadoes are ranked according to their wind speed and the kind of damage they can cause. The scale used to measure them is the Fujita-Pearson Tornado Intensity Scale, or F-Scale. Here are the rankings:

* **F0**—winds range from 40 to 72 miles per hour; they do light damage to roof shingles, chimneys, television antennas and small tree branches. Nearly three out of 10 tornadoes are classed as F0.

* **F1**—winds range from 73 to 112 miles per hour; they overturn automobiles and trucks, push trailers around on the ground and uproot some trees. About four out of 10 tornadoes are classed as F1.

* **F2** — winds range from 113 and 157 miles per hour; they may rip off roofs, demolish small outbuildings, overturn mobile homes and collapse the walls of wooden buildings. Two to three out of 10 tornadoes are classed as F2.

Timeline

The Life and Death of "The Monster" Oklahoma City, Oklahoma, May 3, 1999

10:00 a.m. Meteorologists with the National Weather Service watch an expansive area of cirrus clouds spreading toward them from the southwest. They are looking for the first signs of severe weather, particularly the thunderstorms that produce tornadoes.
3:30 p.m. Weather instruments find the ingredients for supercell thunderstorms: strong winds, cold upper air above, and warm, moist air below.

4:00 p.m. The eruption starts south of a town called Lawton. A sun-warmed patch of moist air rises into the cold, starting an updraft that skyrockets over 50,000 feet. Rain begins to fall as more moist air is drawn in from below. The circulation grows regular and strong. A thunderstorm is born.

*Meteorologists watch closely to see if the storm will grow into a supercell. While most thunderstorms that become supercells take over an hour to start rotating, this one rotates in minutes.

4:30 p.m. With a twister possible at any moment, forecasters rush to issue a tornado watch for southwest Oklahoma.

4:48 p.m. The supercell continues to grow. It is now 6 miles wide.

4:59 p.m. 11 minutes after the warning, a funnel begins to appear beneath the cloud.

6:11 p.m. Beneath the cloud, The Monster is born. It begins as an invisible whirlwind, extending down to the ground. Its rotation quickly tightens and accelerates to over 200 mph.

*Vacuuming the earth, the tornado takes on the color of all it consumes. First, it is the white of fresh rainwater; then it darkens as it sucks up dirt and debris. The Monster begins as a stovepipe, then expands into a giant wedge. It fluctuates back and forth between these two shapes.

*In most tornadoes, the eye is mere inches wide, sometimes feet. This one measures the length of a football field.

*Debris flies through the air. Power lines flash as they snap. The vortex is clocked at 318 miles per hour, the fastest tornado wind speed ever recorded.

6:45 p.m. The Monster closes in on the small town of Bridge Creek, wiping homes off their foundations and killing 11 people.

7:09 p.m. After nearly 25 miles and 62 minutes on the ground, The Monster is still thriving. As it approaches the interstate, police block traffic to play "crossing guard" for the funnel.

*The tornado then heads for the one million residents of Oklahoma City. For the first time in 10 years, the Weather Service issues a tornado emergency. No F5 tornado has ever hit such a densely populated area.

7:22 p.m. The leading edge of the tornado cuts into the Oklahoma City suburb of Moore. Tons of debris whirl around.

7:31 p.m. The Monster moves beyond the city border, leaving behind a swath of ruin a half-mile wide and three-and-a-half miles long.

7:44 p.m. The Monster turns to the left, and finally dies down.

* **F3** — winds range from 158 to 206 miles per hour; they can collapse metal buildings and concrete walls and can flatten all the trees in a forest. Six out of every 100 tornadoes are classed as F3.

* **F4** — winds range from 207 to 260 miles per hour; they flatten buildings, break uprooted tree trunks in half and hurl building materials long distances. Two out of every 100 tornadoes are classed as F4.

* **F5** — the "monster" tornadoes, with winds more than 261 miles per hour. After an F5, all structures are leveled. Fewer than one out of 100 tornadoes is classed as F5.

Warning signs

Just before a tornado arrives:

* The sky turns black or green.

* A sound, which at first sounds like a waterfall or rushing air, becomes a roar as the tornado approaches.

* A spinning, funnel-shaped cloud appears, with other clouds moving quickly toward it.

* Hail begins to fall (after a tornado watch or warning has been issued).

Vocabulary

cirrus cloud — a type of wispy, white cloud consisting of ice crystals and found at high altitudes.

cumulonimbus cloud— the type of dense cloud that develops vertically through all cloud levels; consisting of water droplets, ice crystals and sometimes hail, it is associated with thunder, lightning and heavy showers.

cyclone — a windstorm with a violent, whirling movement; another name for a tornado.

eye — the calm, low-pressure area in the center of a tornado; the tornado's high-velocity winds move around it.

F-scale — (for Fujita-Pearson Tornado Intensity Scale) a scale for ranking the kind of damage a tornado can cause.

funnel — the center of the tornado that acts like a giant vacuum cleaner, sucking objects into the air; also called the vortex.

mezzo cyclone — circulation in a storm that could turn into a tornado but has not yet become one.

mini-tornadoes — less powerful tornadoes that spin along the wall of the tornado's eye

stovepipe — a highly organized, powerful tornado, shaped like a round chimney flue; see also "wedge."

supercell — created when a large thunderstorm begins to rotate because circulation is strong and outside winds are intense; tornadoes are born from supercells.

thunderstorm — created when a lower layer of warm air rises into a layer of cold air, resulting in a powerful updraft of warm, moist air and violent downdraft of rain and hail.

tornado — a violently whirling column of air that extends downward from a cumulonimbus cloud; another name for a cyclone. From the Spanish word *tronada*, meaning "thunderstorm."