thunderstorms and lightning...

the underrated killers!

A PREPAREDNESS GUIDE

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration National Weather Service

January 1994

NOAA, FEMA, The American Red Cross

---

thunderstorms...and their offspring

Thunderstorms affect relatively small areas when compared with hurricanes and winter storms. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Nearly 1,800 thunderstorms are occurring at any moment around the world. That's 16 million a year!

Despite their small size, all thunderstorms are dangerous. Every thunderstorm produces lightning, which kills more people each year than tornadoes. Heavy rain from thunderstorms can lead to flash flooding. Strong winds, hail, and tornadoes are also dangers associated with some thunderstorms.

Of the estimated 100,000 thunderstorms that occur each year in the United States, only about 10 percent are classified as severe.

Your National Weather Service considers a thunderstorm severe if it produces hail at least 3/4-inch in diameter, wind 58 mph or higher, or tornadoes.

Take the time *NOW* to understand these dangers and learn basic safety rules!

Flash Floods/Floods

- The number ONE thunderstorm killer...nearly 140 fatalities each year.
- Most flash flood deaths occur at night and when people become trapped in

automobiles.

Lightning

- Occurs with ALL thunderstorms.
- Averages 93 deaths and 300 injuries each year.
- Causes several hundred million dollars in damage to property and forests annually.

Straight-line Winds

- Responsible for most thunderstorm wind damage.
- Winds can exceed 100 mph!
- One type of straight-line wind, the downburst, can cause damage equivalent to a strong tornado and can be extremely dangerous to aviation.
- During the summer in the western states, thunderstorms often produce little rain but very strong wind gusts and dust storms.

Large Hail

- Causes nearly $1 billion in damage to property and crops annually.
- Costliest United States hailstorm: Denver, Colorado, July 11, 1990. Total damage was $625 million.

Tornadoes

- Nature's most violent storms.
- Winds can exceed 200 mph.
- Result in an average of 80 deaths and 1,500 injuries each year.
- Most fatalities occur when people do not leave mobile homes and automobiles.

Contact your local National Weather Service office, American Red Cross chapter, or local emergency management office for a copy of "Flash Floods and Floods...The Awesome Power" (NOAA PA 92050/ARC 4493) and "Tornadoes...Nature's Most Violent Storms" (NOAA PA 92052/ARC 5002).

---

what makes a thunderstorm?

Every Thunderstorm Needs:

- **Moisture** - to form clouds and rain.
- **Unstable Air** - relatively warm air that can rise rapidly.
- **Lift** - fronts, sea breezes, and mountains are capable of lifting air to help form

thunderstorms.

Life Cycle of a Thunderstorm

Developing Stage

- Towering cumulus cloud indicates rising air.
- Usually little if any rain during this stage.
- Lasts about 10 minutes.
- Occasional lightning during this stage.

Mature Stage

- Most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes.
- Storm occasionally has a black or dark green appearance.
- Lasts an average of 10 to 20 minutes but may last much longer in some storms.

Dissipating Stage

- Rainfall decreases in intensity.
- Some thunderstorms produce a burst of strong winds during this stage.
- Lightning remains a danger during this stage.

---

when are thunderstorms most likely?

Thunderstorms are most likely to happen in the spring and summer months and during the afternoon and evening hours but can occur year-round and at all hours.

Along the Gulf Coast and across the southeastern and western states, most thunderstorms occur during the afternoon.
Thunderstorms frequently occur in the late afternoon and at night in the Plains states.
Thunder and lightning occasionally accompany snow or freezing rain. During the blizzard of March 1993, lightning resulted in power outages near Washington, D.C.!

Who's Most At Risk From Thunderstorms?

 **From Lightning:**

People who are: outdoors, especially under or near tall trees; in or on water; or on or near hilltops.

 **From Flooding:**

People who are in automobiles when flash flooding occurs near them.

 **From Tornadoes:**

People who are in mobile homes and automobiles.

thunderstorm winds and hail

Downbursts

- A small area of rapidly descending air beneath a thunderstorm
- Can cause damaging winds in excess of 100 mph.
- The strong winds usually approach from one direction and may be known as "straight-line" winds.
- In extreme cases, straight-line winds can reach speeds equal to a strong tornado, causing significant damage to some buildings.
- Strong winds may or may not be accompanied by rain.

Large Hail

- The strong rising currents of air within a storm, called updrafts, carry water droplets to a height where freezing occurs.
- Ice particles grow in size, finally becoming too heavy to be supported by the updraft and fall to the ground.
- Large hailstones fall at speeds faster than 100 mph.

---

lightning... nature's fireworks

What is Lightning?

- The action of rising and descending air within a thunderstorm separates positive and negative charges. Water and ice particles also affect the distribution of electrical charge.
- Lightning results from the buildup and discharge of electrical energy between positively and negatively charged areas.
- The average flash could light a 100-watt light bulb for more than 3 months.
- Most lightning occurs within the cloud or between the cloud and ground.
- Your chances of being struck by lightning are estimated to be 1 in 600,000 but could be reduced by following safety rules.
- Most lightning deaths and injuries occur when people are caught outdoors.
- Most lightning casualties occur in the summer months and during the afternoon and early evening.
- The air near a lightning strike is heated to 50,000øF hotter than the surface of the

sun! The rapid heating and cooling of air near the lightning channel causes a shock wave that results in thunder.
- Many fires in the western United States and Alaska are started by lightning. In the past decade, over 15,000 lightning-induced fires nationwide have resulted in several hundred million dollars a year in damage and the loss of 2 million acres of forest.

In recent years, people have been killed by lightning while:

- boating
- standing under a tree
- playing soccer
- swimming
- riding on a lawnmower
- fishing in a boat
- golfing
- talking on the telephone
- mountain climbing
- bike riding
- loading a truck

---

lightning can strike anywhere!

In recent years, sophisticated lightning detection equipment has monitored cloud-to-ground lightning strikes. The map at right shows which areas were **MOST** prone to lightning during one year.

Which way does lightning travel?

A cloud-to-ground lightning strike begins as an invisible channel of electrically charged air moving from the cloud toward the ground. When one channel nears an object on the ground, a powerful surge of electricity from the ground moves upward to the cloud and produces the visible lightning strike!

Lightning Myths and Facts

MYTH: If it is not raining, then there is no danger from lightning.
FACT: Lightning often strikes outside of heavy rain and may occur as far as 10 miles

away from any rainfall.

MYTH: The rubber soles of shoes or rubber tires on a car will protect you from being struck by lightning.
FACT: Rubber-soled shoes and rubber tires provide NO protection from lightning. However, the steel frame of a hard-topped vehicle provides increased protection if you are not touching metal. Although you may be injured if lightning strikes your car, you are much safer inside a vehicle than outside.

MYTH: People struck by lightning carry an electrical charge and should not be touched.
FACT: Lightning-strike victims carry no electrical charge and should be attended to immediately. Contact your local American Red Cross chapter for information on CPR and first aid classes.

MYTH: "Heat lightning" occurs after very hot summer days and poses no threat.
FACT: What is referred to as "heat lightning" is actually lightning from a thunderstorm too far away for thunder to be heard. However, the storm may be moving in your direction!

---

environmental clues

When skies darken or thunderstorms are forecast, look AND listen for

- Increasing wind.
- Flashes of lightning.
- Sound of thunder.
- Static on your AM radio.

To estimate the distance in miles between you and the lightning flash, count the seconds between the lightning and the thunder and divide by five.

Advanced Weather Radar Sees "Inside" the Storm

Doppler Radars, which are being strategically deployed around the country, are capable of seeing "inside" a thunderstorm to detect hazardous weather conditions. New storms often form along leading edge of the storm's cool-air outflow; this feature is able to be detected on Doppler Radar.

---

thunderstorms and lightning safety

What *YOU* Can Do!

Before the Storm...

- Know the county or parish in which you live and the names of nearby major cities. Severe weather warnings are issued on a county or parish basis.
- Check the weather forecast before leaving for extended periods outdoors.
- Watch for signs of approaching storms.
- If a storm is approaching, keep a NOAA Weather Radio or AM/FM radio with you.
- Postpone outdoor activities if thunderstorms are imminent. This is your best way to avoid being caught in a dangerous situation.
- Check on those who have trouble taking shelter if severe weather threatens.

When Thunderstorms Approach...

- Remember: if you can hear thunder, you are close enough to the storm to be struck by lightning. Go to safe shelter immediately!
- Move to a sturdy building or car. Do not take shelter in small sheds, under isolated trees, or in convertible automobiles.
- If lightning is occurring and a sturdy shelter is not available, get inside a hard top automobile and keep windows up.
- Get out of boats and away from water.
- Telephone lines and metal pipes can conduct electricity. Unplug appliances not necessary for obtaining weather information. Avoid using the telephone or any electrical appliances. Use phones ONLY in an emergency.
- Do not take a bath or shower.
- Turn off air conditioners. Power surges from lightning can overload the compressors.
- Get to higher ground if flash flooding or flooding is possible. Once flooding begins, abandon cars and climb to higher ground. Do not attempt to drive to safety. Note: Most flash flood deaths occur in automobiles.

If Caught Outdoors and No Shelter Is Nearby...

- Find a low spot away from trees, fences, and poles. Make sure the place you pick is not subject to flooding.
- If you are in the woods, take shelter under the shorter trees.
- If you feel your skin tingle or your hair stand on end, squat low to the ground on the balls of your feet. Place your hands on your knees with your head between them. Make yourself the smallest target possible, and minimize your contact with the ground.
- If you are boating or swimming, get to land and find shelter immediately!

STAY INFORMED ABOUT THE STORM

by listening to NOAA Weather Radio, commercial radio, and television for the latest severe thunderstorm WATCHES and WARNINGS.

When conditions are favorable for severe weather to develop, a severe thunderstorm **WATCH** is issued.

Weather Service personnel use information from weather radar, satellite, lightning detection, spotters, and other sources to issue severe thunderstorm **WARNINGS** for areas where severe weather is imminent.

Severe thunderstorm warnings are passed to local radio and television stations and are broadcast over local NOAA Weather Radio stations serving the warned areas. These warnings are also relayed to local emergency management and public safety officials who can activate local warning systems to alert communities.

NOAA WEATHER RADIO IS THE BEST MEANS TO RECEIVE WARNINGS FROM THE NATIONAL WEATHER SERVICE

The National Weather Service continuously broadcasts updated weather warnings and forecasts that can be received by NOAA Weather Radios, which are sold in many stores. The average range is 40 miles, depending on topography. Your National Weather Service recommends purchasing a radio that has both a battery backup and a tone-alert feature that automatically alerts you when a watch or warning is issued.

What to Listen For...

- **SEVERE THUNDERSTORM WATCH:** tells you when and where severe thunderstorms are more likely to occur. Watch the sky and stay tuned to know when warnings are issued. Watches are intended to heighten public awareness and should not be confused with warnings.
- **SEVERE THUNDERSTORM WARNING:** issued when severe weather has been reported by spotters or indicated by radar. Warnings indicate imminent danger to life and property to those in the path of the storm. Also listen for Tornado Watch or Warning and Flash Flood Watch or Warning.
- Also...listen for Tornado Watch or Warning and Flash Flood Watch or Warning.

FAMILY DISASTER PLAN

Families should be prepared for all hazards that could affect their area. NOAA's National Weather Service, the Federal Emergency Management Agency, and the American Red Cross urge every family to develop a family disaster plan.

Where will your family be when disaster strikes? They could be anywhere_at work, at school, or in the car. How will you find each other? Will you know if your children are safe? Disaster may force you to evacuate your neighborhood or confine you to your home. What would you do if basic services_water, gas, electricity or telephones_were cut off?

Follow these basic steps to develop a family disaster plan...

I. Gather information about hazards. Contact your local National Weather Service office, emergency management office, and American Red Cross chapter. Find out what type of disasters could occur and how you should respond. Learn your community's warning signals and evacuation plans.

II. Meet with your family to create a plan. Discuss the information you have gathered. Pick two places to meet: a spot outside your home for an emergency, such as fire, and a place away from your neighborhood in case you can't return home. Choose an out-of-state friend as your "family check-in contact" for everyone to call if the family gets separated. Discuss what you would do if advised to evacuate.

III. Implement your plan.

(1) Post emergency telephone numbers by phones;
(2) Install safety features in your house, such as smoke detectors and fire extinguishers;
(3) Inspect your home for potential hazards (such as items that can move, fall, break, or catch fire) and correct them;
(4) Have your family learn basic safety measures, such as CPR and first aid; how to use a fire extinguisher; and how and when to turn off water, gas, and electricity in your home;
(5) Teach children how and when to call 911 or your local Emergency Medical Services number;
(6) Keep enough supplies in your home to meet your needs for at least three days. Assemble a disaster supplies kit with items you may need in case of an evacuation. Store these supplies in sturdy, easy-to-carry containers, such as backpacks or duffle bags. Keep important family documents in a waterproof container. Keep a smaller disaster supplies kit in the trunk of your car.

A DISASTER SUPPLIES KIT SHOULD INCLUDE:

- A 3-day supply of water (one gallon per person per day) and food that won't spoil
- one change of clothing and footwear per person
- one blanket or sleeping bag per person
- a first aid kit, including prescription medicines
- emergency tools, including a battery-powered NOAA Weather Radio and a portable radio, flashlight, and plenty of extra batteries
- an extra set of car keys and a credit card or cash
- special items for infant, elderly, or disabled family members.

IV. Practice and maintain your plan. Ask questions to make sure your family remembers meeting places, phone numbers, and safety rules. Conduct drills. Test your smoke detectors monthly and change the batteries two times each year. Test and recharge your fire extinguisher(s) according to manufacturer's instructions. Replace stored water and food every 6 months. Contact your local National Weather Service office, American Red Cross chapter, or local office of emergency management for a copy of "Your Family Disaster Plan" (L-191/ARC4466).

LOCAL SPONSORSHIP: NOAA/PA 92053 ARC 5001