

# Natural Hazards

Part 2 includes information about many types of natural hazards. Natural hazards are natural events that threaten lives, property, and other assets. Often, natural hazards can be predicted. They tend to occur repeatedly in the same geographical locations because they are related to weather patterns or physical characteristics of an area.

Natural hazards such as flood, fire, earthquake, tornado, and windstorms affect thousands of people every year. We need to know what our risks are from natural hazards and take sensible precautions to protect ourselves, our families, and our communities.

Use Part 2 to learn about the hazards that pose a risk to you. Include the pertinent information in your family disaster plan. Specific content on each hazard consists of the characteristics of that hazard, terms associated with the hazard, measures that can be taken beforehand to avoid or lessen the impact of these events, and what individuals need to do during and after the event to protect themselves.

When you complete Part 2, you will be able to:

- Know important terms.
- Take protective measures for natural hazards.
- Identify resources for more information about natural hazards.



2.1

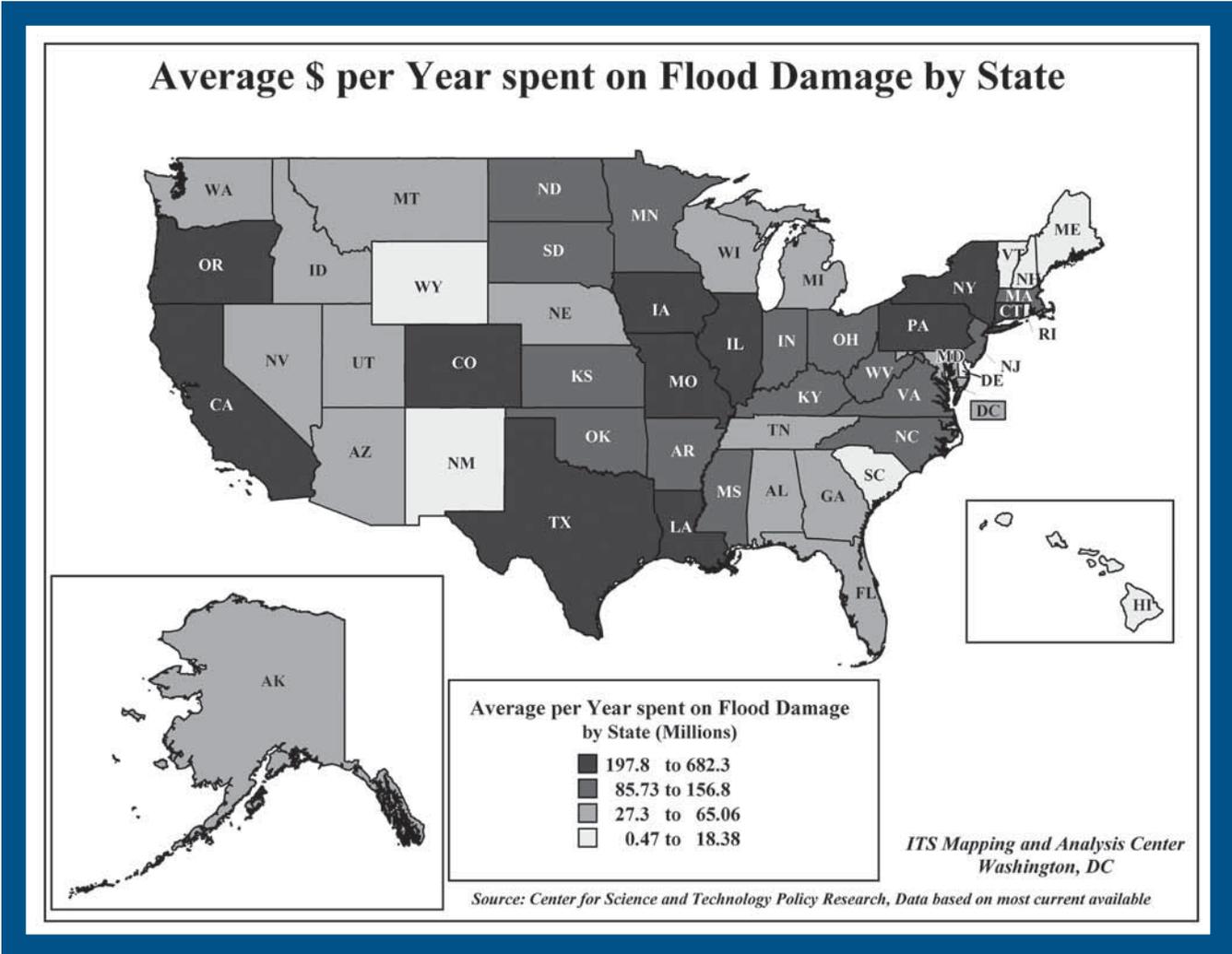
# Floods



Floods are one of the most common hazards in the United States. Flood effects can be local, impacting a neighborhood or community, or very large, affecting entire river basins and multiple states.

However, all floods are not alike. Some floods develop slowly, sometimes over a period of days. But flash floods can develop quickly, sometimes in just a few minutes and without any visible signs of rain. Flash floods often have a dangerous wall of roaring water that carries rocks, mud, and other debris and can sweep away most things in its path. Overland flooding occurs outside a defined river or stream, such as when a levee is breached, but still can be destructive. Flooding can also occur when a dam breaks, producing effects similar to flash floods.

Be aware of flood hazards no matter where you live, but especially if you live in a low-lying area, near water or downstream from a dam. Even very small streams, gullies, creeks, culverts, dry streambeds, or low-lying ground that appear harmless in dry weather can flood. Every state is at risk from this hazard.



## What Would You Do?

You and your family moved from a city neighborhood in San Francisco, CA, to a suburb of Phoenix, AZ. Since earthquakes were a threat in your area, you always kept some extra food, water, and other supplies on hand and maintained an earthquake insurance policy, just in case something happened. You think this kind of preparation is no longer necessary based on what your neighbors have told you. According to them, the biggest threat they face is lack of water caused by the very dry weather. You continue to see public service announcements from the federal government about flood insurance and the need to protect yourself from flood damage. Surely, there would be no need for flood insurance where you live with its bare hills, deep canyons, and dry land.

- Are you at risk for flooding, or is this more of a risk to people who live elsewhere?  
 Yes    No
- Is there a need to have a disaster plan and a disaster supplies kit?  
 Yes    No
- Should you consider purchasing flood insurance?  
 Yes    No

Answer key  
 1. Yes 2. Yes 3. Yes

### Know the Terms

Familiarize yourself with these terms to help identify a flood hazard:

#### Flood Watch

Flooding is possible. Tune in to NOAA Weather Radio, commercial radio, or television for information.

#### Flash Flood Watch

Flash flooding is possible. Be prepared to move to higher ground; listen to NOAA Weather Radio, commercial radio, or television for information.

#### Flood Warning

Flooding is occurring or will occur soon; if advised to evacuate, do so immediately.

#### Flash Flood Warning

A flash flood is occurring; seek higher ground on foot immediately.

## Take Protective Measures

### Before a Flood

To prepare for a flood, you should:

- Avoid building in a floodplain unless you elevate and reinforce your home.
- Elevate the furnace, water heater, and electric panel if susceptible to flooding.
- Install “check valves” in sewer traps to prevent flood water from backing up into the drains of your home.
- Construct barriers (levees, beams, floodwalls) to stop floodwater from entering the building.
- Seal walls in basements with waterproofing compounds to avoid seepage.

### During a Flood

If a flood is likely in your area, you should:

- Listen to the radio or television for information.
- Be aware that flash flooding can occur. If there is any possibility of a flash flood, move immediately to higher ground. Do not wait for instructions to move.
- Be aware of streams, drainage channels, canyons, and other areas known to flood suddenly. Flash floods can occur in these areas with or without such typical warnings as rain clouds or heavy rain.

If you must prepare to evacuate, you should do the following:

- Secure your home. If you have time, bring in outdoor furniture. Move essential items to an upper floor.
- Turn off utilities at the main switches or valves if instructed to do so. Disconnect electrical appliances. Do not touch electrical equipment if you are wet or standing in water.



#### Review

See Section 1.1:  
Getting Informed



If you have to leave your home, remember these evacuation tips:

- **Do not walk through moving water.** Six inches of moving water can make you fall. If you have to walk in water, walk where the water is not moving. Use a stick to check the firmness of the ground in front of you.
- **Do not drive into flooded areas.** If floodwaters rise around your car, abandon the car and move to higher ground if you can do so safely. You and the vehicle can be quickly swept away.

### Driving: Flood Facts

The following are important points to remember when driving in flood conditions:

- Six inches of water will reach the bottom of most passenger cars causing loss of control and possible stalling.
- A foot of water will float many vehicles.
- Two feet of rushing water can carry away most vehicles including sport utility vehicles (SUV's) and pick-ups.



The following are guidelines for the period following a flood:

### After a Flood

- Listen for news reports to learn whether the community's water supply is safe to drink.
- Avoid floodwaters; water may be contaminated by oil, gasoline, or raw sewage. Water may also be electrically charged from underground or downed power lines.
- Avoid moving water.
- Be aware of areas where floodwaters have receded. Roads may have weakened and could collapse under the weight of a car.
- Stay away from downed power lines, and report them to the power company.
- Return home only when authorities indicate it is safe.
- Stay out of any building if it is surrounded by floodwaters.
- Use extreme caution when entering buildings; there may be hidden damage, particularly in foundations.
- Service damaged septic tanks, cesspools, pits, and leaching systems as soon as possible. Damaged sewage systems are serious health hazards.
- Clean and disinfect everything that got wet. Mud left from floodwater can contain sewage and chemicals.

## Additional Information

### Flood Insurance

Consider the following facts:

- Flood losses are **not covered** under homeowners' insurance policies.
- FEMA manages the National Flood Insurance Program, which makes federally-backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage.
- Flood insurance is available in most communities through insurance agents.
- There is a 30-day waiting period before flood insurance goes into effect, so don't delay.
- Flood insurance is available whether the building is in or out of the identified flood-prone area.

### Knowledge Check

Decide whether the following statements are true or false. Check the appropriate column. When you have finished, check your answers using the answer key below.

T	F	Statement
<input type="checkbox"/>	<input type="checkbox"/>	1. Flood emergencies occur in only 12 states.
<input type="checkbox"/>	<input type="checkbox"/>	2. A "flood watch" announcement on the radio indicates that flooding is possible.
<input type="checkbox"/>	<input type="checkbox"/>	3. Flash floods may occur with little warning.
<input type="checkbox"/>	<input type="checkbox"/>	4. Flood risk varies from one region to another.
<input type="checkbox"/>	<input type="checkbox"/>	5. National flood insurance is available only for buildings within an identified flood-prone area.
<input type="checkbox"/>	<input type="checkbox"/>	6. It is safe to walk through floodwater if you can see the ground under it.
<input type="checkbox"/>	<input type="checkbox"/>	7. It takes at least 3 feet of floodwater to make a motorized vehicle float.
<input type="checkbox"/>	<input type="checkbox"/>	8. After flood waters recede from a roadway, the road could still be dangerous.
<input type="checkbox"/>	<input type="checkbox"/>	9. To prepare for a flood emergency, you should have a NOAA Weather Radio as well as a commercial radio.

Answer key  
1. False 2. True 3. True 4. True 5. False 6. False 7. False 8. True 9. True

## For More Information

If you require more information about any of these topics, the following are resources that may be helpful.

- *After a Flood: The First Steps*. L-198. Information for homeowners on preparedness, safety, and recovery from a flood.
- *Homeowner's Guide to Retrofitting: Six Ways to Protect Your House from Flooding*. L-235. A brochure about obtaining information about how to protect your home from flooding.
- *Homeowner's Guide to Retrofitting: Six Ways to Protect Your House from Flooding*. FEMA-312. A detailed manual on how to protect your home from flooding.
- *About the Flood: Elevating Your Floodprone House*. FEMA-347. This publication is intended for builders, code officials and homeowners.
- *Protecting Building Utilities From Flood Damage*. FEMA-348. This publication is intended for developers, architects, engineers, builders, code officials and homeowners.

### FEMA Publications

### American Red Cross

- *Repairing Your Flooded Home*. sixty-page booklet about how to perform simple home repairs after flooding, including cleaning, sanitation, and determining which professionals to involve for various needed services. Local Red Cross chapters can order in packages of 10 as stock number A4477 for a nominal fee. Also available online at [www.redcross.org/services/disaster/0,1082,0\\_570\\_,00.html](http://www.redcross.org/services/disaster/0,1082,0_570_,00.html)

### National Weather Service

- *Hurricane Flooding: A Deadly Inland Danger*. 20052. Brochure describing the impact of hurricane flooding and precautions to take. Available online at [www.nws.noaa.gov/om/brochures/InlandFlooding.pdf](http://www.nws.noaa.gov/om/brochures/InlandFlooding.pdf)
- *The Hidden Danger: Low Water Crossing*. 96074E. Brochure describing the hazards of driving your vehicle in flood conditions. Available online at [www.nws.noaa.gov/om/brochures/TheHiddenDangerEnglish.pdf](http://www.nws.noaa.gov/om/brochures/TheHiddenDangerEnglish.pdf)



### Other Publications

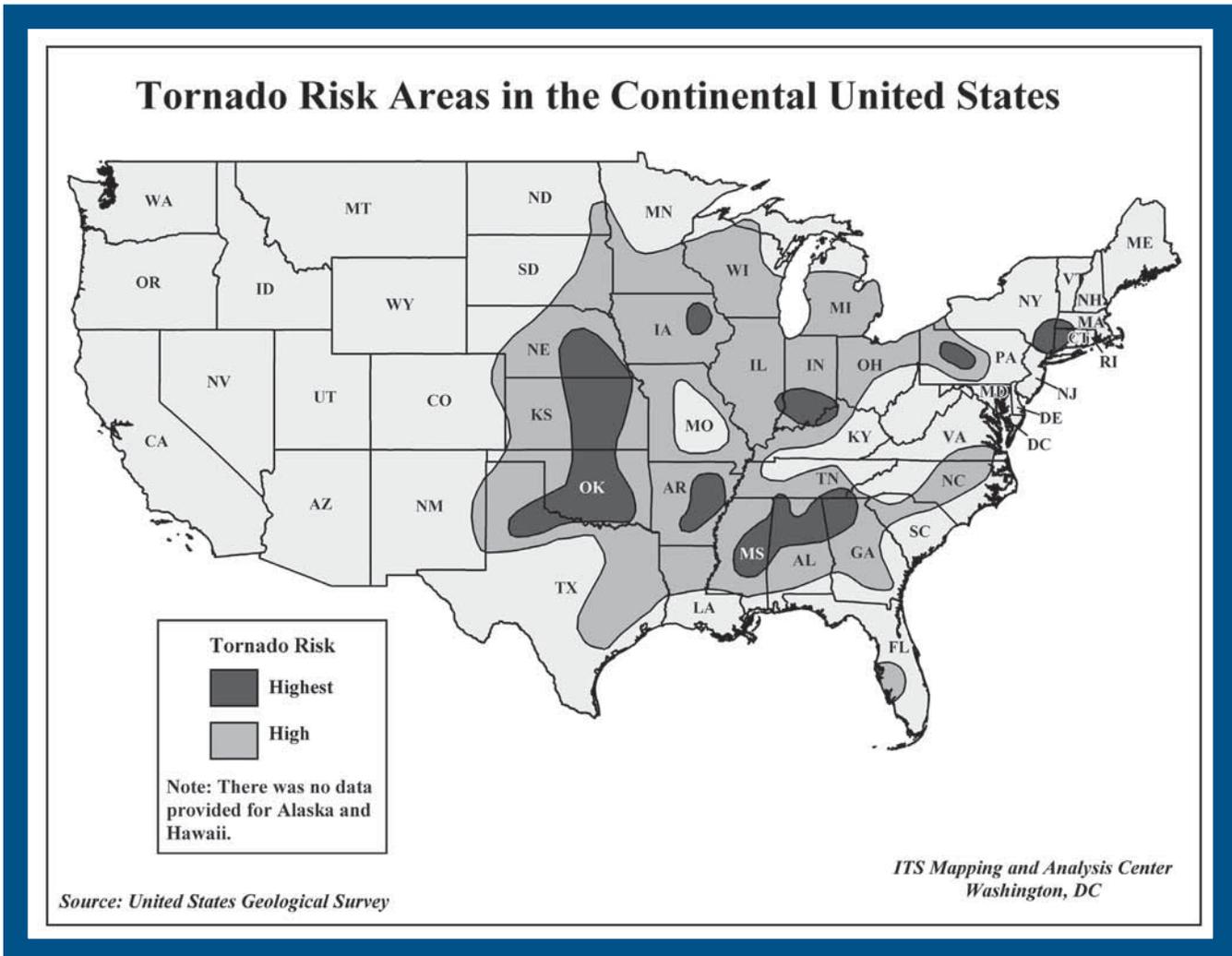


2.2

# Tornadoes



Tornadoes are nature's most violent storms. Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long. Every state is at some risk from this hazard.



Some tornadoes are clearly visible, while rain or nearby low-hanging clouds obscure others. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible.

Before a tornado hits, the wind may die down and the air may become very still. A cloud of debris can mark the location of a tornado even if a funnel is not visible. Tornadoes generally occur near the trailing edge of a thunderstorm. It is not uncommon to see clear, sunlit skies behind a tornado.

The following are facts about tornadoes:

- They may strike quickly, with little or no warning.
- They may appear nearly transparent until dust and debris are picked up or a cloud forms in the funnel.
- The average tornado moves Southwest to Northeast, but tornadoes have been known to move in any direction.
- The average forward speed of a tornado is 30 MPH, but may vary from stationary to 70 MPH.
- Tornadoes can accompany tropical storms and hurricanes as they move onto land.
- Waterspouts are tornadoes that form over water.
- Tornadoes are most frequently reported east of the Rocky Mountains during spring and summer months.
- Peak tornado season in the southern states is March through May; in the northern states, it is late spring through early summer.
- Tornadoes are most likely to occur between 3 p.m. and 9 p.m., but can occur at any time.

### Know the Terms

Familiarize yourself with these terms to help identify a tornado hazard:

#### Tornado Watch

Tornadoes are possible. Remain alert for approaching storms. Watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information.

#### Tornado Warning

A tornado has been sighted or indicated by weather radar. Take shelter immediately.

## Take Protective Measures

Be alert to changing weather conditions.

Before a Tornado

- Listen to NOAA Weather Radio or to commercial radio or television newscasts for the latest information.
- Look for approaching storms.

- Look for the following danger signs:
  - Dark, often greenish sky
  - Large hail
  - A large, dark, low-lying cloud (particularly if rotating)
  - Loud roar, similar to a freight train.

If you see approaching storms or any of the danger signs, be prepared to take shelter immediately.

### During a Tornado

If you are under a tornado WARNING, seek shelter immediately!

If you are in:	Then:
A structure (e.g. residence, small building, school, nursing home, hospital, factory, shopping center, high-rise building)	<p>Go to a pre-designated shelter area such as a safe room, basement, storm cellar, or the lowest building level.</p> <p>If there is no basement, go to the center of an interior room on the lowest level (closet, interior hallway) away from corners, windows, doors, and outside walls. Put as many walls as possible between you and the outside. Get under a sturdy table and use your arms to protect your head and neck.</p> <p>Do not open windows.</p>
A vehicle, trailer, or mobile home	Get out immediately and go to the lowest floor of a sturdy, nearby building or a storm shelter. Mobile homes, even if tied down, offer little protection from tornadoes.
The outside with no shelter	<ul style="list-style-type: none"> <li>• Lie flat in a nearby ditch or depression and cover your head with your hands. Be aware of the potential for flooding.</li> <li>• Do not get under an overpass or bridge. You are safer in a low, flat location.</li> <li>• Never try to outrun a tornado in urban or congested areas in a car or truck. Instead, leave the vehicle immediately for safe shelter.</li> <li>• Watch out for flying debris. Flying debris from tornadoes causes most fatalities and injuries.</li> </ul>

### Preparing a Safe Room

Extreme windstorms in many parts of the country pose a serious threat to buildings and their occupants. Your residence may be built “to code,” but that does not mean it can withstand winds from extreme events such as tornadoes and major hurricanes. The purpose of a safe room or a wind shelter is to provide a space where you and your family can seek refuge that provides a high level of protection. You can build a safe room in one of several places in your home:

- Your basement.
- Atop a concrete slab-on-grade foundation or garage floor.
- An interior room on the first floor.

Safe rooms built below ground level provide the greatest protection, but a safe room built in a first-floor interior room also can provide the necessary protection. Below-ground safe rooms must be designed to avoid accumulating water during the heavy rains that often accompany severe windstorms.

To protect its occupants, a safe room must be built to withstand high winds and flying debris, even if the rest of the residence is severely damaged or destroyed. Consider the following when building a safe room:

- The safe room must be adequately anchored to resist overturning and uplift.
- The walls, ceiling, and door of the shelter must withstand wind pressure and resist penetration by windborne objects and falling debris.
- The connections between all parts of the safe room must be strong enough to resist the wind.
- Sections of either interior or exterior residence walls that are used as walls of the safe room, must be separated from the structure of the residence so that damage to the residence will not cause damage to the safe room.



### Additional information about Safe Rooms available from FEMA

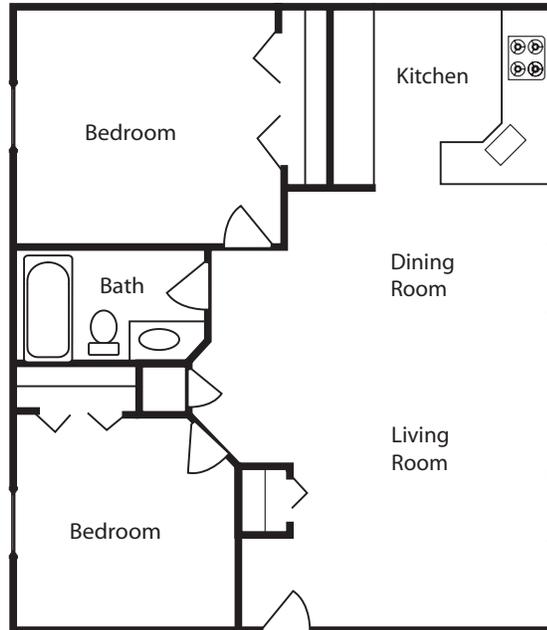
*Taking Shelter from the Storm: Building a Safe Room Inside Your House.* L-233. Brochure providing details about obtaining information about how to build a wind-safe room to withstand tornado, hurricane, and other high winds

*Taking Shelter from the Storm: Building a Safe Room Inside Your House.* FEMA-320. Manual with detailed information about how to build a wind-safe room to withstand tornado, hurricane, and other high winds

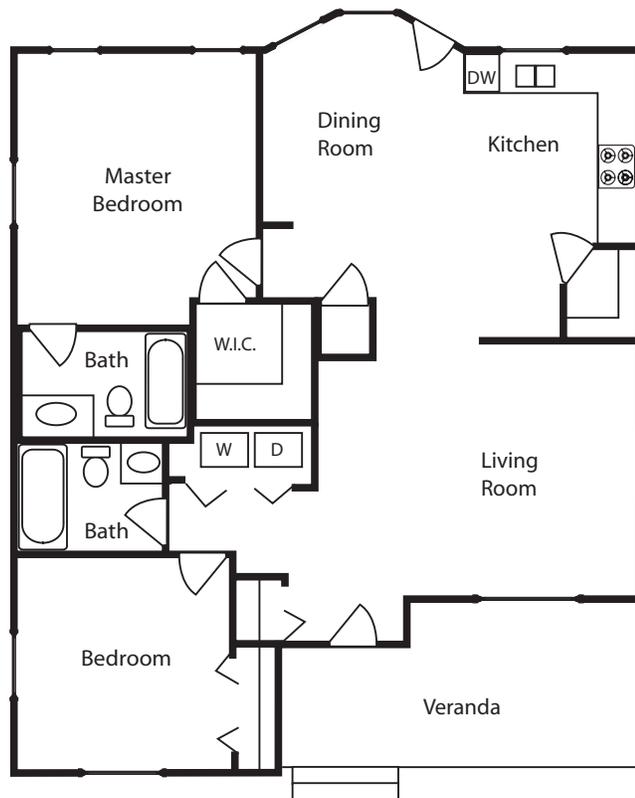
**Locate the Safest Place**

On the following home layout diagrams, locate the safest place to seek shelter should you not be able to evacuate.

Apartment

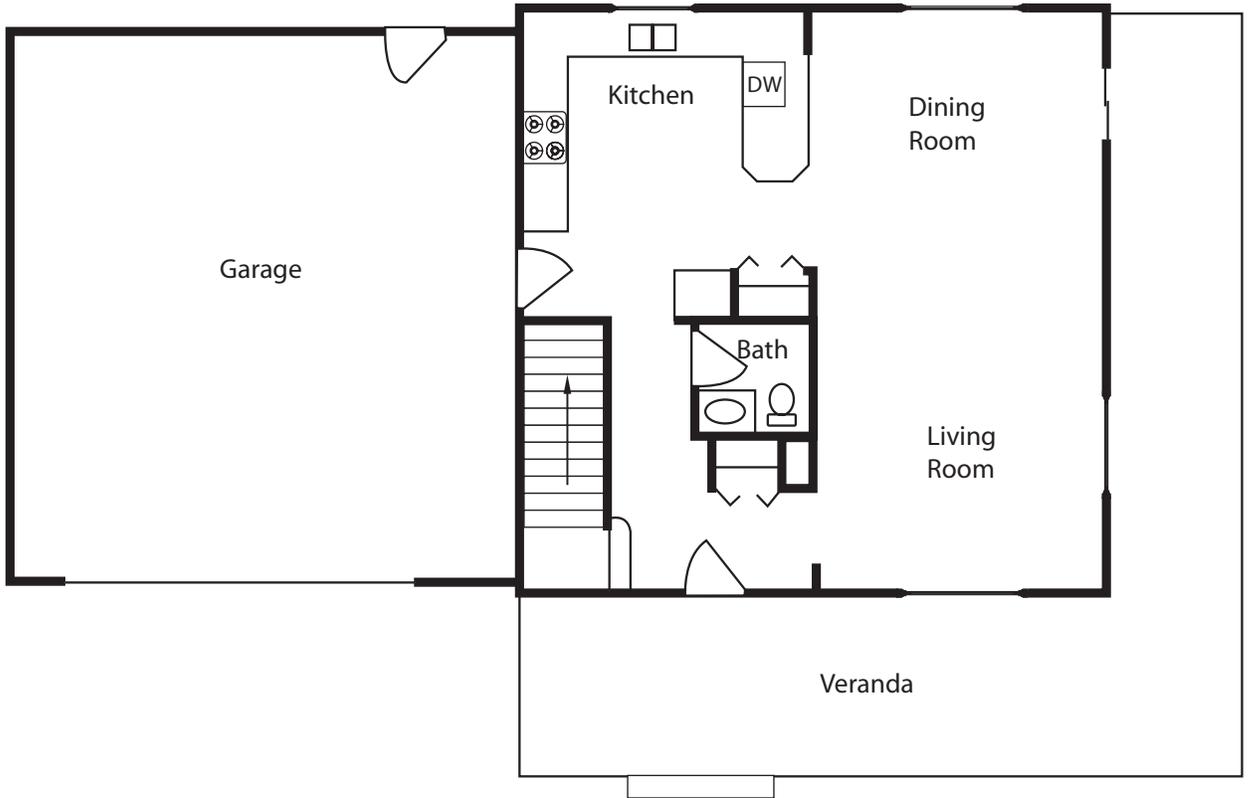


One-Story Home

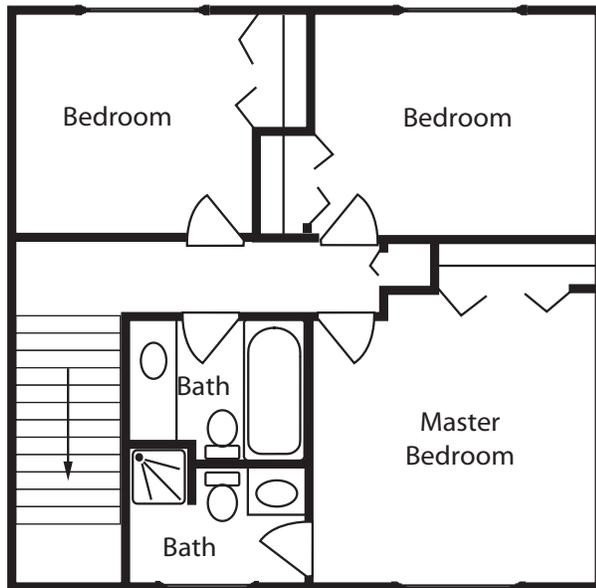


Two-Story Home

**First Floor**



**Second Floor**



Natural Hazards

Apartment: Bathroom, One-story Home: WIC (walk in closet), Two-story Home: First floor bathroom

Answer key

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## After a Tornado

Follow the instructions for recovering from a disaster in Part 5.



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## For More Information

If you require more information about any of these topics, the following are resources that may be helpful.

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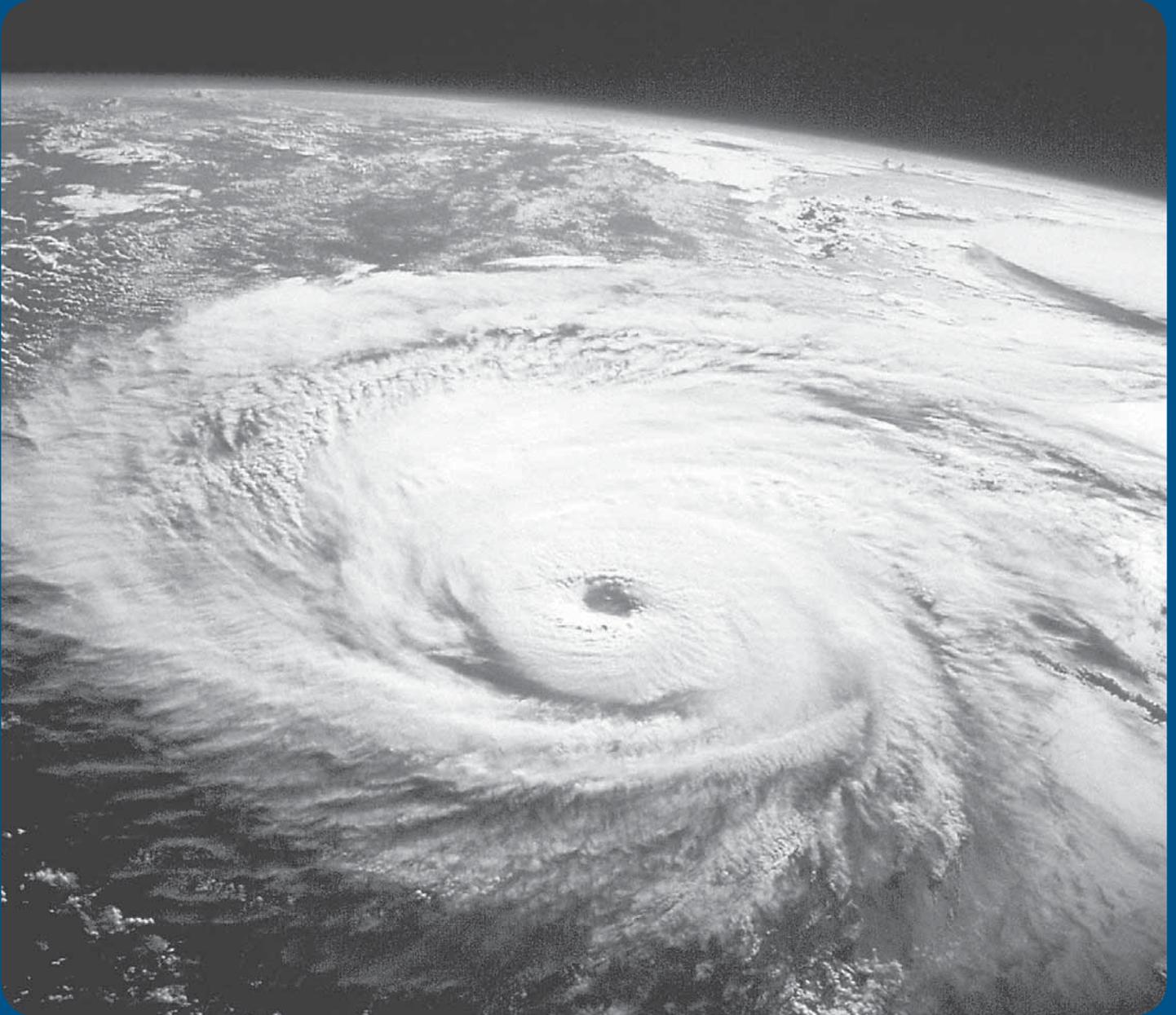
### FEMA Publications

*Tornado Fact Sheet*. L-148. Provides safety tips for before, during, and after a tornado

*Tornado Protection—Selecting Refuge Areas in Buildings*. FEMA 431. Intended primarily to help building administrators, architects, and engineers select the best available refuge areas in existing schools

2.3

# Hurricanes



A hurricane is a type of tropical cyclone, the generic term for a low pressure system that generally forms in the tropics. A typical cyclone is accompanied by thunderstorms, and in the Northern Hemisphere, a counterclockwise circulation of winds near the earth's surface.

All Atlantic and Gulf of Mexico coastal areas are subject to hurricanes or tropical storms. Parts of the Southwest United States and the Pacific Coast experience heavy rains and floods each year from hurricanes spawned off Mexico. The Atlantic hurricane season lasts from June to November, with the peak season from mid-August to late October.

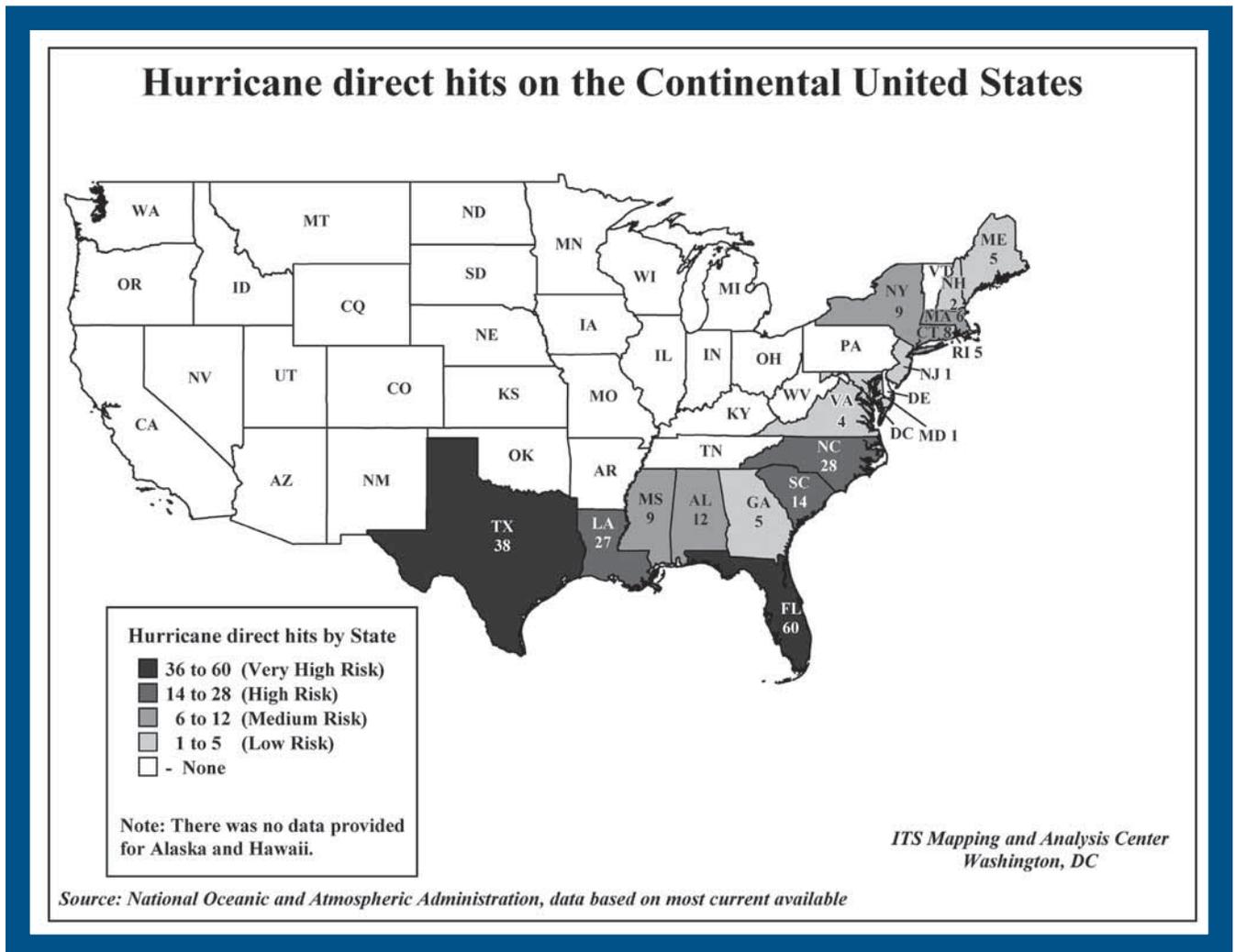
Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Winds can exceed 155 miles per hour. Hurricanes and tropical storms can also spawn tornadoes and microbursts, create storm surges along the coast, and cause extensive damage from heavy rainfall.

Hurricanes are classified into five categories based on their wind speed, central pressure, and damage potential (see chart). Category Three and higher hurricanes are considered major hurricanes, though Categories One and Two are still extremely dangerous and warrant your full attention.

Scale Number (Category)	Sustained Winds (MPH)	Damage	Storm Surge
1	74-95	<b>Minimal:</b> Unanchored mobile homes, vegetation, and signs	4-5 feet
2	96-110	<b>Moderate:</b> All mobile homes, roofs, small craft; flooding	6-8 feet
3	111-130	<b>Extensive:</b> Small buildings; low-lying roads cut off	9-12 feet
4	131-155	<b>Extreme:</b> Roofs destroyed, trees down, roads cut off, mobile homes destroyed, beach homes flooded	13-18 feet
5	More than 155	<b>Catastrophic:</b> Most buildings destroyed, vegetation destroyed, major roads cut off, homes flooded	Greater than 18 feet

Hurricanes can produce widespread torrential rains. Floods are the deadly and destructive result. Slow moving storms and tropical storms moving into mountainous regions tend to produce especially heavy rain. Excessive rain can trigger landslides or mud slides, especially in mountainous regions. Flash flooding can occur due to intense rainfall. Flooding on rivers and streams may persist for several days or more after the storm.

Between 1970 and 1999, more people lost their lives from freshwater inland flooding associated with land falling tropical cyclones than from any other weather hazard related to tropical cyclones.



### Naming the Hurricane

Since 1953, Atlantic tropical storms have been named from lists originated by the National Hurricane Center and now maintained and updated by an international committee of the World Meteorological Organization. The lists featured only women’s names until 1979. After that, men’s and women’s names were alternated. Six lists are used in rotation. Thus, the 2001 lists will be used again in 2007.

The only time there is a change in the list is if a storm is so deadly or costly that the continued use of the name would be inappropriate for reasons of sensitivity. When this occurs, the name is stricken from the list and another name is selected to replace it.

Sometimes names are changed. Lorenzo replaced Luis and Michelle replaced Marilyn. The complete lists can be found at [www.nhc.noaa.gov](http://www.nhc.noaa.gov) under “Storm Names.”

### Know the Terms

Familiarize yourself with these terms to help identify a hurricane hazard:

#### Tropical Depression

An organized system of clouds and thunderstorms with a defined surface circulation and maximum sustained winds of 38 MPH (33 knots) or less. Sustained winds are defined as one-minute average wind measured at about 33 ft (10 meters) above the surface.

#### Tropical Storm

An organized system of strong thunderstorms with a defined surface circulation and maximum sustained winds of 39-73 MPH (34-63 knots).

#### Hurricane

An intense tropical weather system of strong thunderstorms with a well-defined surface circulation and maximum sustained winds of 74 MPH (64 knots) or higher.

#### Storm Surge

A dome of water pushed onshore by hurricane and tropical storm winds. Storm surges can reach 25 feet high and be 50-100 miles wide.

#### Storm Tide

A combination of storm surge and the normal tide (i.e., a 15-foot storm surge combined with a 2-foot normal high tide over the mean sea level creates a 17-foot storm tide).

#### Hurricane/Tropical Storm Watch

Hurricane/tropical storm conditions are possible in the specified area, usually within 36 hours. Tune in to NOAA Weather Radio, commercial radio, or television for information.

#### Hurricane/Tropical Storm Warning

Hurricane/tropical storm conditions are expected in the specified area, usually within 24 hours.

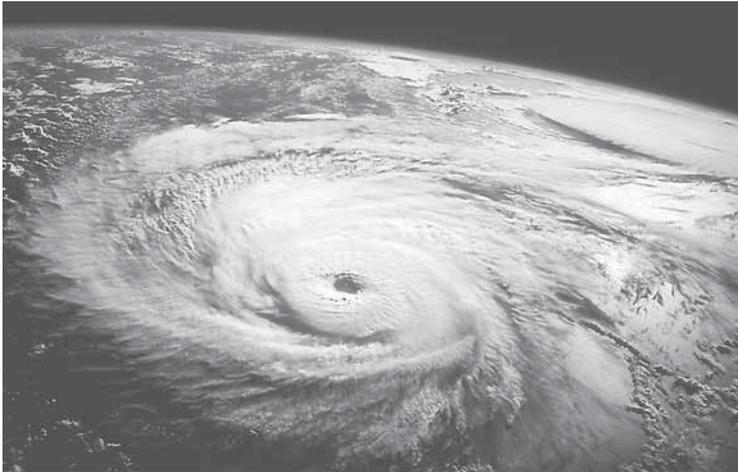
#### Short Term Watches and Warnings

These warnings provide detailed information about specific hurricane threats, such as flash floods and tornadoes.

## Take Protective Measures

To prepare for a hurricane, you should take the following measures:

- Make plans to secure your property. Permanent storm shutters offer the best protection for windows. A second option is to board up windows with 5/8” marine plywood, cut to fit and ready to install. Tape does not prevent windows from breaking.
- Install straps or additional clips to securely fasten your roof to the frame structure. This will reduce roof damage.
- Be sure trees and shrubs around your home are well trimmed.
- Clear loose and clogged rain gutters and downspouts.
- Determine how and where to secure your boat.
- Consider building a safe room.



### Before a Hurricane



#### Review

For more information on safe rooms  
See Section 2.2:  
Tornadoes

If a hurricane is likely in your area, you should:

- Listen to the radio or TV for information.
- Secure your home, close storm shutters, and secure outdoor objects or bring them indoors.
- Turn off utilities if instructed to do so. Otherwise, turn the refrigerator thermostat to its coldest setting and keep its doors closed.
- Turn off propane tanks.
- Avoid using the phone, except for serious emergencies.
- Moor your boat if time permits.
- Ensure a supply of water for sanitary purposes such as cleaning and flushing toilets. Fill the bathtub and other large containers with water.

### During a Hurricane

You should evacuate under the following conditions:

- If you are directed by local authorities to do so. Be sure to follow their instructions.
- If you live in a mobile home or temporary structure—such shelters are particularly hazardous during hurricanes no matter how well fastened to the ground.
- If you live in a high-rise building—hurricane winds are stronger at higher elevations.
- If you live on the coast, on a floodplain, near a river, or on an inland waterway.
- If you feel you are in danger.

If you are unable to evacuate, go to your wind-safe room. If you do not have one, follow these guidelines:

- Stay indoors during the hurricane and away from windows and glass doors.
- Close all interior doors—secure and brace external doors.
- Keep curtains and blinds closed. Do not be fooled if there is a lull; it could be the eye of the storm—winds will pick up again.
- Take refuge in a small interior room, closet, or hallway on the lowest level.
- Lie on the floor under a table or another sturdy object.



### Review

Guidelines for sheltering  
See Section 1.4:  
Shelter

## After a Hurricane

Follow the instructions for recovering from a disaster in Part 5.



## Knowledge Check

### You Make the Call

Read the following and respond to the question below. See the answer key below to check your answer.

Your neighbor said that in the event a hurricane threatens, the household would get ready by closing the windows and doors on the storm side of the house and opening the ones on the side away from the wind. They also will tape the windows to prevent damage to the glass.

Is this a good idea?

**Answer Key**  
No! All of the doors and windows should be closed (and shuttered) throughout the duration of the hurricane. The winds in a hurricane are highly turbulent and any open window or door can be an open target for flying debris. As for the tape, it is a waste of effort, time, and tape. It offers no strength to the glass and no protection against flying debris.

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## For More Information

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If you require more information about any of these topics, the following are resources that may be helpful.

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### FEMA Publications

*Against the Wind: Protecting Your Home from Hurricane and Wind Damage.* FEMA-247. A guide to hurricane preparedness. Available online at [www.fema.gov/txt/hazards/hurricanes/survivingthestormhurricane.txt](http://www.fema.gov/txt/hazards/hurricanes/survivingthestormhurricane.txt)

*Community Hurricane Preparedness.* IS-324. CD-ROM or Web-based training course for federal, state, and local emergency managers. Web-based version available online at <http://meted.ucar.edu/hurricane/chp/index.htm>

*Safety Tips for Hurricanes.* L 105. Publication for teachers and parents for presentation to children. To order, call 1(800)480-2520.

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### Other Publications

*Protect Your Home against Hurricane Damage,* Institute for Business and Home Safety. 110 William Street, New York, NY 20038

2.4

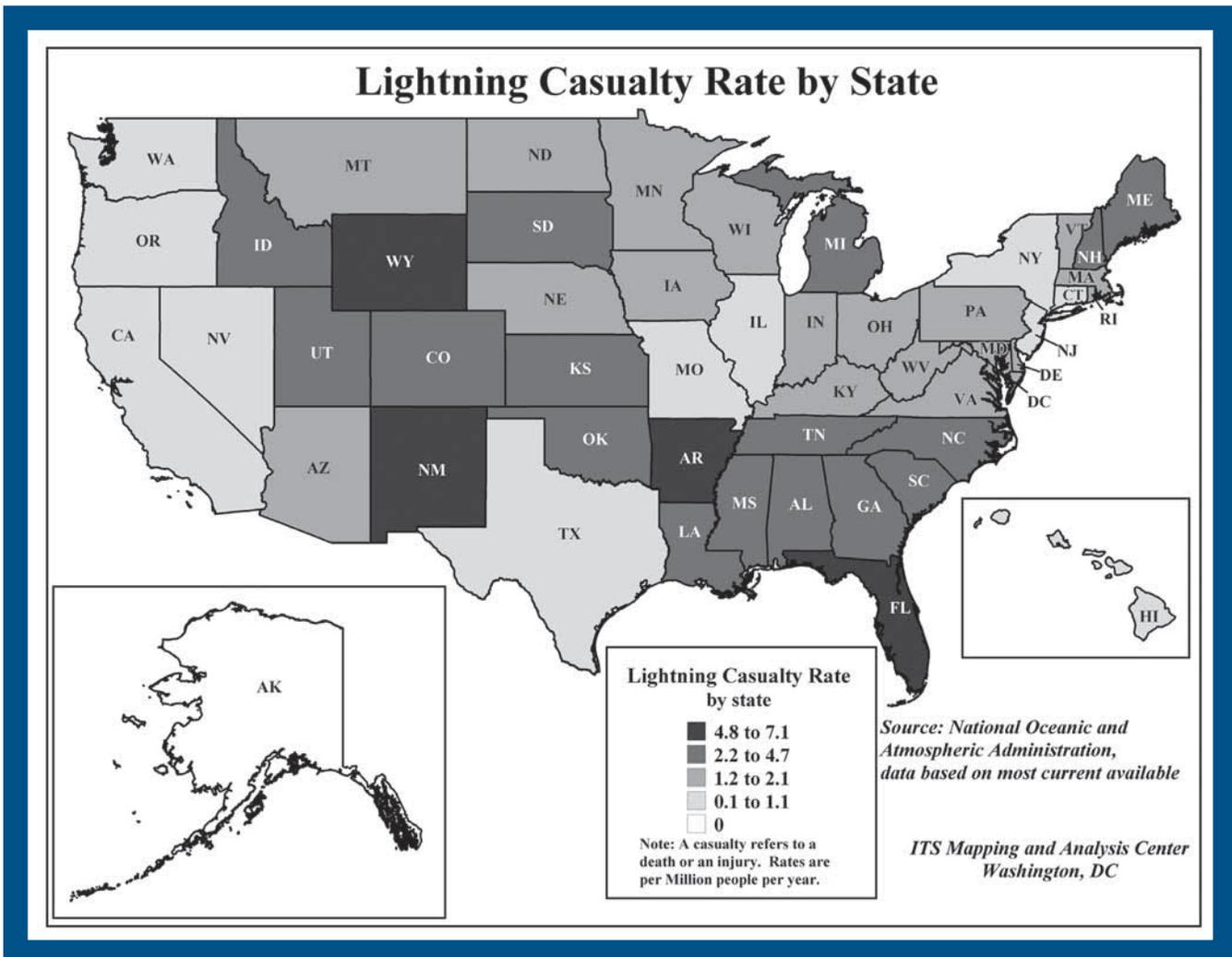
# Thunderstorms and Lightning



All thunderstorms are dangerous. Every thunderstorm produces lightning. In the United States, an average of 300 people are injured and 80 people are killed each year by lightning. Although most lightning victims survive, people struck by lightning often report a variety of long-term, debilitating symptoms.

Other associated dangers of thunderstorms include tornadoes, strong winds, hail, and flash flooding. Flash flooding is responsible for more fatalities—more than 140 annually—than any other thunderstorm-associated hazard.

Dry thunderstorms that do not produce rain that reaches the ground are most prevalent in the western United States. Falling raindrops evaporate, but lightning can still reach the ground and can start wildfires.



The following are facts about thunderstorms:

- They may occur singly, in clusters, or in lines.
- Some of the most severe occur when a single thunderstorm affects one location for an extended time.
- Thunderstorms typically produce heavy rain for a brief period, anywhere from 30 minutes to an hour.
- Warm, humid conditions are highly favorable for thunderstorm development.
- About 10 percent of thunderstorms are classified as severe—one that produces hail at least three-quarters of an inch in diameter, has winds of 58 miles per hour or higher, or produces a tornado.

The following are facts about lightning:

- Lightning's unpredictability increases the risk to individuals and property.
- Lightning often strikes outside of heavy rain and may occur as far as 10 miles away from any rainfall.
- "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!
- Most lightning deaths and injuries occur when people are caught outdoors in the summer months during the afternoon and evening.
- Your chances of being struck by lightning are estimated to be 1 in 600,000, but could be reduced even further by following safety precautions.
- Lightning strike victims carry no electrical charge and should be attended to immediately.

### Know the Terms

Familiarize yourself with these terms to help identify a thunderstorm hazard:

#### Severe Thunderstorm Watch

Tells you when and where severe thunderstorms are likely to occur. Watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information.

#### 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.

## Take Protective Measures

### Before Thunderstorms and Lightning

To prepare for a thunderstorm, you should do the following:

- Remove dead or rotting trees and branches that could fall and cause injury or damage during a severe thunderstorm.
- Remember the 30/30 lightning safety rule: Go indoors if, after seeing lightning, you cannot count to 30 before hearing thunder. Stay indoors for 30 minutes after hearing the last clap of thunder.

### Thunderstorms

The following are guidelines for what you should do if a thunderstorm is likely in your area:

- Postpone outdoor activities.
- Get inside a home, building, or hard top automobile (not a convertible). Although you may be injured if lightning strikes your car, you are much safer inside a vehicle than outside.
- Remember, 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.
- Secure outdoor objects that could blow away or cause damage.
- Shutter windows and secure outside doors. If shutters are not available, close window blinds, shades, or curtains.
- Avoid showering or bathing. Plumbing and bathroom fixtures can conduct electricity.
- Use a corded telephone only for emergencies. Cordless and cellular telephones are safe to use.
- Unplug appliances and other electrical items such as computers and turn off air conditioners. Power surges from lightning can cause serious damage.
- Use your battery-operated NOAA Weather Radio for updates from local officials.



Avoid the following:

- Natural lightning rods such as a tall, isolated tree in an open area
- Hilltops, open fields, the beach, or a boat on the water
- Isolated sheds or other small structures in open areas
- Anything metal—tractors, farm equipment, motorcycles, golf carts, golf clubs, and bicycles

## During a Thunderstorm

If you are:	Then:
In a forest	Seek shelter in a low area under a thick growth of small trees.
In an open area	Go to a low place such as a ravine or valley. Be alert for flash floods.
On open water	Get to land and find shelter immediately.
Anywhere you feel your hair stand on end (which indicates that lightning is about to strike)	Squat low to the ground on the balls of your feet. Place your hands over your ears and your head between your knees. Make yourself the smallest target possible and minimize your contact with the ground. DO NOT lie flat on the ground.



Call 9-1-1 for medical assistance as soon as possible.

## After a Thunderstorm

The following are things you should check when you attempt to give aid to a victim of lightning:

- **Breathing** - if breathing has stopped, begin mouth-to-mouth resuscitation.
- **Heartbeat** - if the heart has stopped, administer CPR.
- **Pulse** - if the victim has a pulse and is breathing, look for other possible injuries. Check for burns where the lightning entered and left the body. Also be alert for nervous system damage, broken bones, and loss of hearing and eyesight.

## Knowledge Check

Decide whether the following statements are true or false. Check the appropriate column. When you have finished, verify your answers using the answer key below.

T	F	Statement
<input type="checkbox"/>	<input type="checkbox"/>	1. Every thunderstorm produces lightning.
<input type="checkbox"/>	<input type="checkbox"/>	2. Never touch a person struck by lightning.
<input type="checkbox"/>	<input type="checkbox"/>	3. Dry, cold conditions favor development of a thunderstorm.
<input type="checkbox"/>	<input type="checkbox"/>	4. If you can count to 25 after seeing lightning and before hearing thunder, it is safe to stay outdoors.
<input type="checkbox"/>	<input type="checkbox"/>	5. It is safe to use a cordless telephone during a thunderstorm.
<input type="checkbox"/>	<input type="checkbox"/>	6. Rubber-soled shoes and rubber tires provide protection from lightning.



## For More Information

If you require more information about any of these topics, the following resource may be helpful.

### Publications

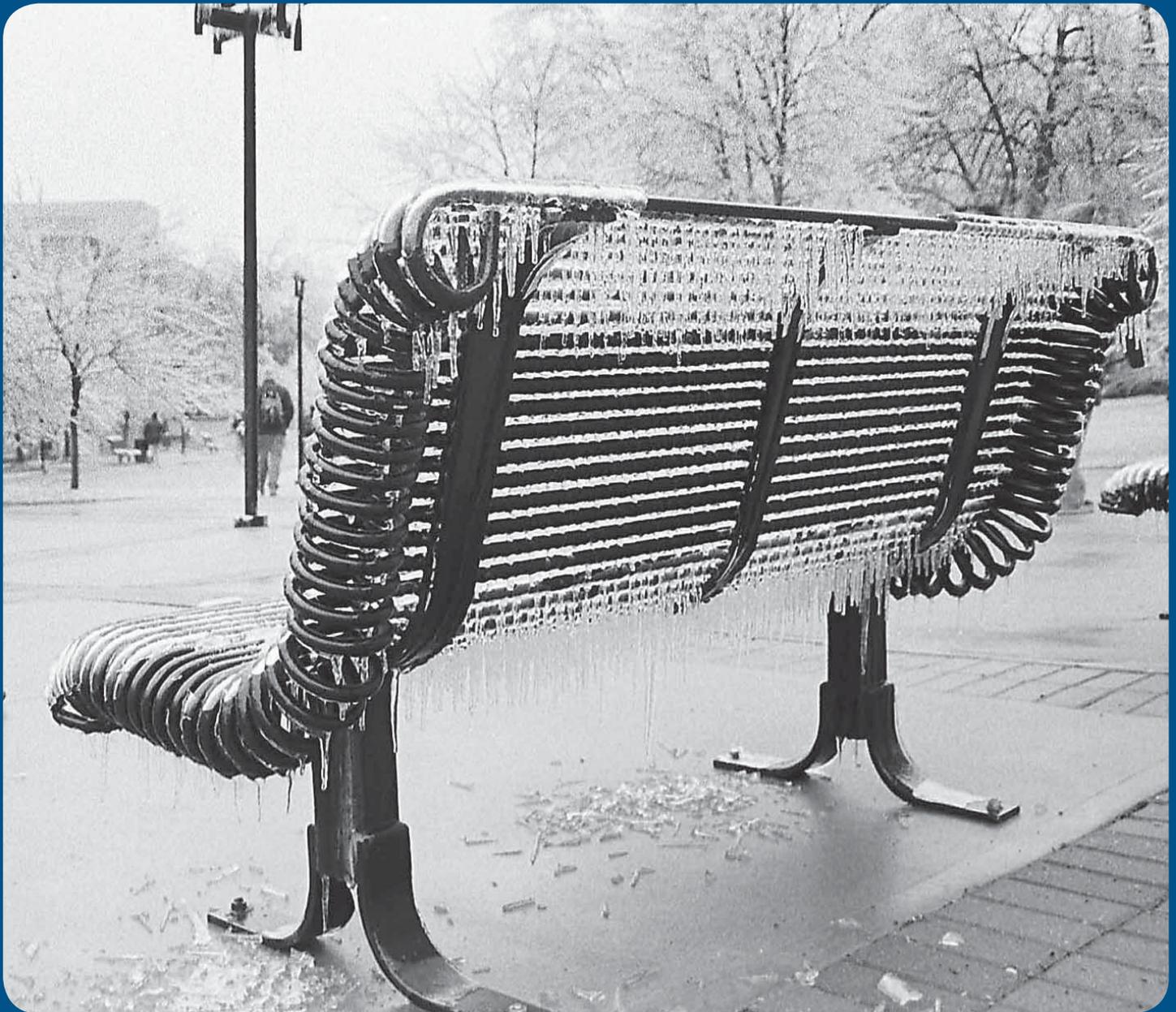
#### National Weather Service

*Facts about Lightning*. 200252. Two-page factsheet for boaters. Available online at [www.nws.noaa.gov/om/wcm/lightning/resources/LightningFactsSheet.pdf](http://www.nws.noaa.gov/om/wcm/lightning/resources/LightningFactsSheet.pdf)

Answer key:  
1. True 2. False 3. False 4. False 5. True 6. False

2.5

# Winter Storms and Extreme Cold



Heavy snowfall and extreme cold can immobilize an entire region. Even areas that normally experience mild winters can be hit with a major snowstorm or extreme cold. Winter storms can result in flooding, storm surge, closed highways, blocked roads, downed power lines and hypothermia.

### Know the Terms

Familiarize yourself with these terms to help identify a winter storm hazard:

#### Freezing Rain

Rain that freezes when it hits the ground, creating a coating of ice on roads, walkways, trees, and power lines.

#### Sleet

Rain that turns to ice pellets before reaching the ground. Sleet also causes moisture on roads to freeze and become slippery.

#### Winter Storm Watch

A winter storm is possible in your area. Tune in to NOAA Weather Radio, commercial radio, or television for more information.

#### Winter Storm Warning

A winter storm is occurring or will soon occur in your area.

#### Blizzard Warning

Sustained winds or frequent gusts to 35 miles per hour or greater and considerable amounts of falling or blowing snow (reducing visibility to less than a quarter mile) are expected to prevail for a period of three hours or longer.

#### Frost/Freeze Warning

Below freezing temperatures are expected.

## Take Protective Measures

### Before Winter Storms and Extreme Cold



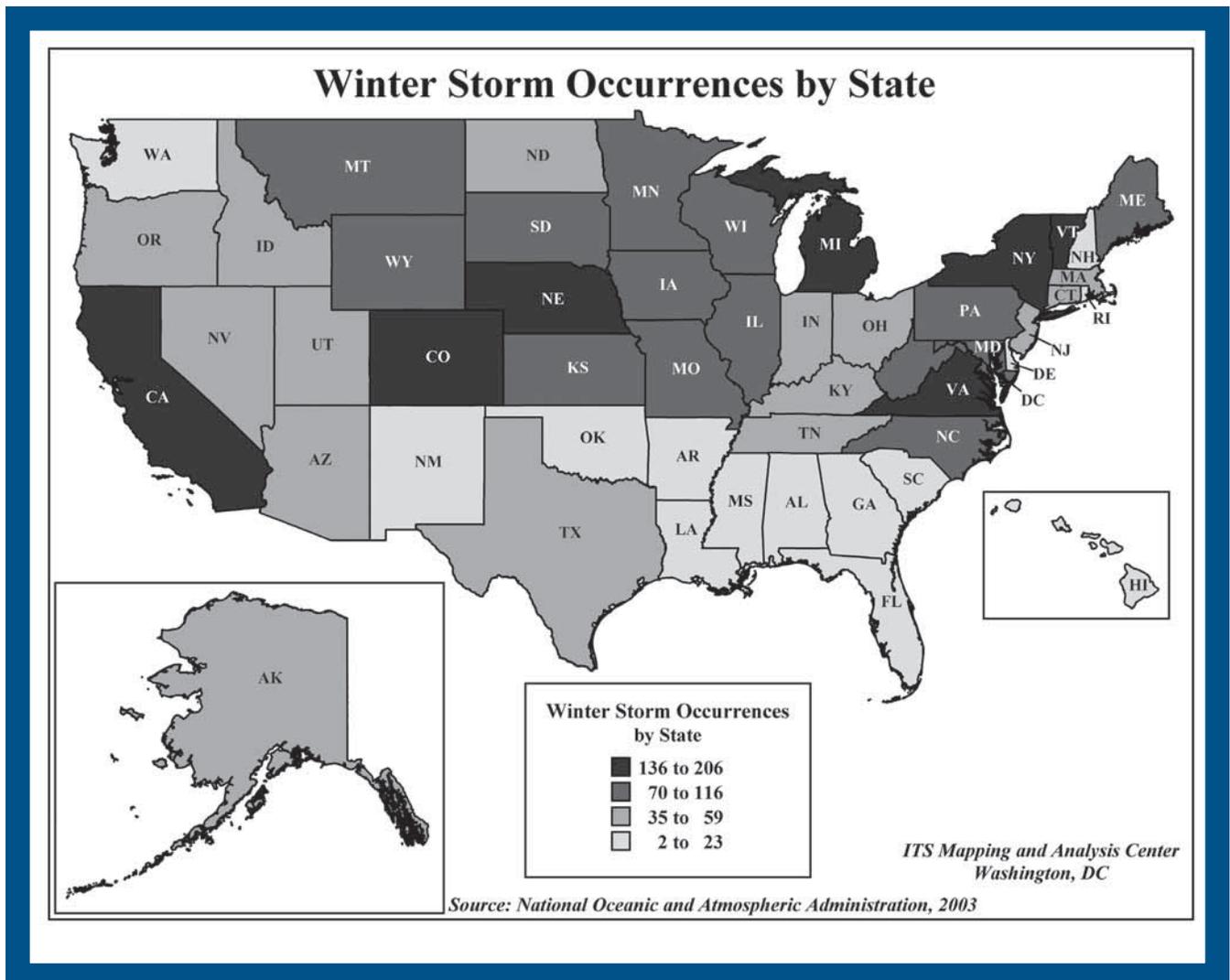
#### Review

See Section 1.3:  
Assemble a Disaster  
Supplies Kit

Include the following in your disaster supplies kit:

- Rock salt to melt ice on walkways
- Sand to improve traction
- Snow shovels and other snow removal equipment.

Prepare for possible isolation in your home by having sufficient heating fuel; regular fuel sources may be cut off. For example, store a good supply of dry, seasoned wood for your fireplace or wood-burning stove.



Winterize your home to extend the life of your fuel supply by insulating walls and attics, caulking and weather-stripping doors and windows, and installing storm windows or covering windows with plastic.

To winterize your car, attend to the following:

- Battery and ignition system should be in top condition and battery terminals clean.
- Ensure antifreeze levels are sufficient to avoid freezing.
- Ensure the heater and defroster work properly.
- Check and repair windshield wiper equipment; ensure proper washer fluid level.
- Ensure the thermostat works properly.
- Check lights and flashing hazard lights for serviceability.
- Check for leaks and crimped pipes in the exhaust system; repair or replace as necessary. Carbon monoxide is deadly and usually gives no warning.

- Check breaks for wear and fluid levels.
- Check oil for level and weight. Heavier oils congeal more at low temperatures and do not lubricate as well.
- Consider snow tires, snow tires with studs, or chains.
- Replace fuel and air filters. Keep water out of the system by using additives and maintaining a full tank of gas.

### Dress for the Weather



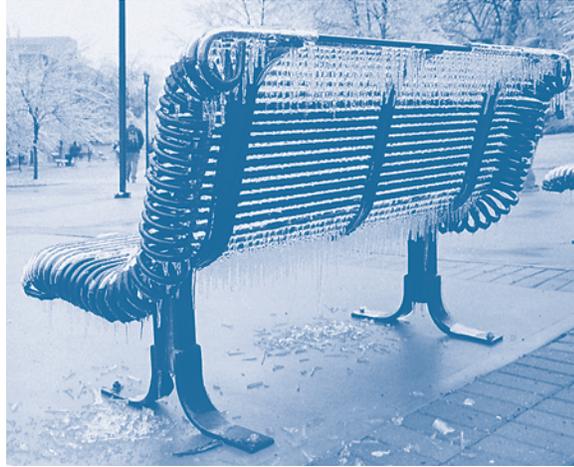
- Wear several layers of loose fitting, lightweight, warm clothing rather than one layer of heavy clothing. The outer garments should be tightly woven and water repellent.
- Wear mittens, which are warmer than gloves.
- Wear a hat.
- Cover your mouth with a scarf to protect your lungs.

### During a Winter Storm

The following are guidelines for what you should do during a winter storm or under conditions of extreme cold:

- Listen to your radio, television, or NOAA Weather Radio for weather reports and emergency information.
- Eat regularly and drink ample fluids, but avoid caffeine and alcohol.
- Avoid overexertion when shoveling snow. Overexertion can bring on a heart attack—a major cause of death in the winter. If you must shovel snow, stretch before going outside.
- Watch for signs of frostbite. These include loss of feeling and white or pale appearance in extremities such as fingers, toes, ear lobes, and the tip of the nose. If symptoms are detected, get medical help immediately.
- Watch for signs of hypothermia. These include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and apparent exhaustion. If symptoms of hypothermia are detected, get the victim to a warm location, remove wet clothing, warm the center of the body first, and give warm, non-alcoholic beverages if the victim is conscious. Get medical help as soon as possible.
- Conserve fuel, if necessary, by keeping your residence cooler than normal. Temporarily close off heat to some rooms.
- Maintain ventilation when using kerosene heaters to avoid build-up of toxic fumes. Refuel kerosene heaters outside and keep them at least three feet from flammable objects.

- Drive only if it is absolutely necessary. If you must drive, consider the following:
  - Travel in the day, don't travel alone, and keep others informed of your schedule
  - Stay on main roads; avoid back road shortcuts



If a blizzard traps you in the car, keep these guidelines in mind:

- Pull off the highway. Turn on hazard lights and hang a distress flag from the radio antenna or window.
- Remain in your vehicle where rescuers are most likely to find you. Do not set out on foot unless you can see a building close by where you know you can take shelter. Be careful; distances are distorted by blowing snow. A building may seem close, but be too far to walk to in deep snow.
- Run the engine and heater about 10 minutes each hour to keep warm. When the engine is running, open an upwind window slightly for ventilation. This will protect you from possible carbon monoxide poisoning. Periodically clear snow from the exhaust pipe.
- Exercise to maintain body heat, but avoid overexertion. In extreme cold, use road maps, seat covers, and floor mats for insulation. Huddle with passengers and use your coat for a blanket.
- Take turns sleeping. One person should be awake at all times to look for rescue crews.
- Drink fluids to avoid dehydration.
- Be careful not to waste battery power. Balance electrical energy needs—the use of lights, heat, and radio—with supply.
- Turn on the inside light at night so work crews or rescuers can see you.
- If stranded in a remote area, stomp large block letters in an open area spelling out HELP or SOS and line with rocks or tree limbs to attract the attention of rescue personnel who may be surveying the area by airplane.
- Leave the car and proceed on foot—if necessary—once the blizzard passes.

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## After a Winter Storm

Follow the instructions for recovering from a disaster in Part 5.

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## For More Information

If you require more information about any of these topics, the following are resources that may be helpful.

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### Publications

#### National Weather Service

*Winter Storms... The Deceptive Killers.* Brochure packed with useful information including winter storm facts, how to detect frostbite and hypothermia, what to do in a winter storm, and how to be prepared. Available online at: [www.nws.noaa.gov/om/brochures/wntrstm.htm](http://www.nws.noaa.gov/om/brochures/wntrstm.htm)

#### Centers for Disease Control and Prevention

*Extreme Cold: A Prevention Guide to Promote Your Personal Health and Safety.* An extensive document providing information about planning ahead for cold weather, safety both indoors and outdoors in cold weather, and cold weather health conditions. Available online at: [www.phppo.cdc.gov](http://www.phppo.cdc.gov)

2.6

# Extreme Heat





### Know the Terms

Familiarize yourself with these terms to help identify an extreme heat hazard:

#### Heat Wave

Prolonged period of excessive heat, often combined with excessive humidity.

#### Heat Index

A number in degrees Fahrenheit (F) that tells how hot it feels when relative humidity is added to the air temperature. Exposure to full sunshine can increase the heat index by 15 degrees.

#### Heat Cramps

Muscular pains and spasms due to heavy exertion. Although heat cramps are the least severe, they are often the first signal that the body is having trouble with the heat.

#### Heat Exhaustion

Typically occurs when people exercise heavily or work in a hot, humid place where body fluids are lost through heavy sweating. Blood flow to the skin increases, causing blood flow to decrease to the vital organs. This results in a form of mild shock. If not treated, the victim's condition will worsen. Body temperature will keep rising and the victim may suffer heat stroke.

#### Heat Stroke

A life-threatening condition. The victim's temperature control system, which produces sweating to cool the body, stops working. The body temperature can rise so high that brain damage and death may result if the body is not cooled quickly.

#### Sun Stroke

Another term for heat stroke.

## Take Protective Measures

To prepare for extreme heat, you should:

- Install window air conditioners snugly; insulate if necessary.
- Check air-conditioning ducts for proper insulation.
- Install temporary window reflectors (for use between windows and drapes), such as aluminum foil-covered cardboard, to reflect heat back outside.
- Weather-strip doors and sills to keep cool air in.

**Before Extreme Heat**

- Cover windows that receive morning or afternoon sun with drapes, shades, awnings, or louvers. (Outdoor awnings or louvers can reduce the heat that enters a home by up to 80 percent.)
- Keep storm windows up all year.

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### During a Heat Emergency

The following are guidelines for what you should do if the weather is extremely hot:

- Stay indoors as much as possible and limit exposure to the sun.
- Stay on the lowest floor out of the sunshine if air conditioning is not available.
- Consider spending the warmest part of the day in public buildings such as libraries, schools, movie theaters, shopping malls, and other community facilities. Circulating air can cool the body by increasing the perspiration rate of evaporation.
- Eat well-balanced, light, and regular meals. Avoid using salt tablets unless directed to do so by a physician.
- Drink plenty of water. Persons who have epilepsy or heart, kidney, or liver disease; are on fluid-restricted diets; or have a problem with fluid retention should consult a doctor before increasing liquid intake.
- Limit intake of alcoholic beverages.
- Dress in loose-fitting, lightweight, and light-colored clothes that cover as much skin as possible.
- Protect face and head by wearing a wide-brimmed hat.
- Check on family, friends, and neighbors who do not have air conditioning and who spend much of their time alone.
- Never leave children or pets alone in closed vehicles.
- Avoid strenuous work during the warmest part of the day. Use a buddy system when working in extreme heat, and take frequent breaks.



### First Aid for Heat-Induced Illnesses

Extreme heat brings with it the possibility of heat-induced illnesses. The following table lists these illnesses, their symptoms, and the first aid treatment.

Condition	Symptoms	First Aid
Sunburn	Skin redness and pain, possible swelling, blisters, fever, headaches	<ul style="list-style-type: none"> <li>Take a shower using soap to remove oils that may block pores, preventing the body from cooling naturally.</li> <li>Apply dry, sterile dressings to any blisters, and get medical attention.</li> </ul>
Heat Cramps	Painful spasms, usually in leg and abdominal muscles; heavy sweating	<ul style="list-style-type: none"> <li>Get the victim to a cooler location.</li> <li>Lightly stretch and gently massage affected muscles to relieve spasms.</li> <li>Give sips of up to a half glass of cool water every 15 minutes. (Do not give liquids with caffeine or alcohol.)</li> <li>Discontinue liquids, if victim is nauseated.</li> </ul>
Heat Exhaustion	Heavy sweating but skin may be cool, pale, or flushed. Weak pulse. Normal body temperature is possible, but temperature will likely rise. Fainting or dizziness, nausea, vomiting, exhaustion, and headaches are possible.	<ul style="list-style-type: none"> <li>Get victim to lie down in a cool place.</li> <li>Loosen or remove clothing.</li> <li>Apply cool, wet cloths.</li> <li>Fan or move victim to air-conditioned place.</li> <li>Give sips of water if victim is conscious.</li> <li>Be sure water is consumed slowly.</li> <li>Give half glass of cool water every 15 minutes.</li> <li>Discontinue water if victim is nauseated.</li> <li>Seek immediate medical attention if vomiting occurs.</li> </ul>
Heat Stroke (a severe medical emergency)	High body temperature (105+); hot, red, dry skin; rapid, weak pulse; and rapid, shallow breathing. Victim will probably not sweat unless victim was sweating from recent strenuous activity. Possible unconsciousness.	<ul style="list-style-type: none"> <li>Call 9-1-1 or emergency medical services, or get the victim to a hospital immediately. <b>Delay can be fatal.</b></li> <li>Move victim to a cooler environment.</li> <li>Remove clothing.</li> <li>Try a cool bath, sponging, or wet sheet to reduce body temperature.</li> <li>Watch for breathing problems.</li> <li>Use extreme caution.</li> <li>Use fans and air conditioners.</li> </ul>

### Additional Information

An emergency water shortage can be caused by prolonged drought, poor water supply management, or contamination of a surface water supply source or aquifer.

Drought can affect vast territorial regions and large population numbers. Drought also creates environmental conditions that increase the risk of other hazards such as fire, flash flood, and possible landslides and debris flow.

Conserving water means more water available for critical needs for everyone. Appendix A contains detailed suggestions for conserving water both indoors and outdoors. Make these practices a part of your daily life and help preserve this essential resource.

### After Extreme Heat

Follow the instructions for recovering from a disaster in Part 5.



## Knowledge Check

You and a friend have been outdoors in the sun for some time. Shortly after coming inside, your friend complains of nausea and headache but tells you not to worry as it is probably a food allergy.

What would you advise him or her to do?

Answer: Seek immediate medical attention and discontinue intake of water.

## For More Information

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If you require more information about any of these topics, the following resource may be helpful.

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### National Weather Service

*Heat Wave: A Major Summer Killer.* An online brochure describing the heat index, heat disorders, and heat wave safety tips. Available online at: [www.nws.noaa.gov/om/brochures/heat\\_wave.htm](http://www.nws.noaa.gov/om/brochures/heat_wave.htm)

### Publications

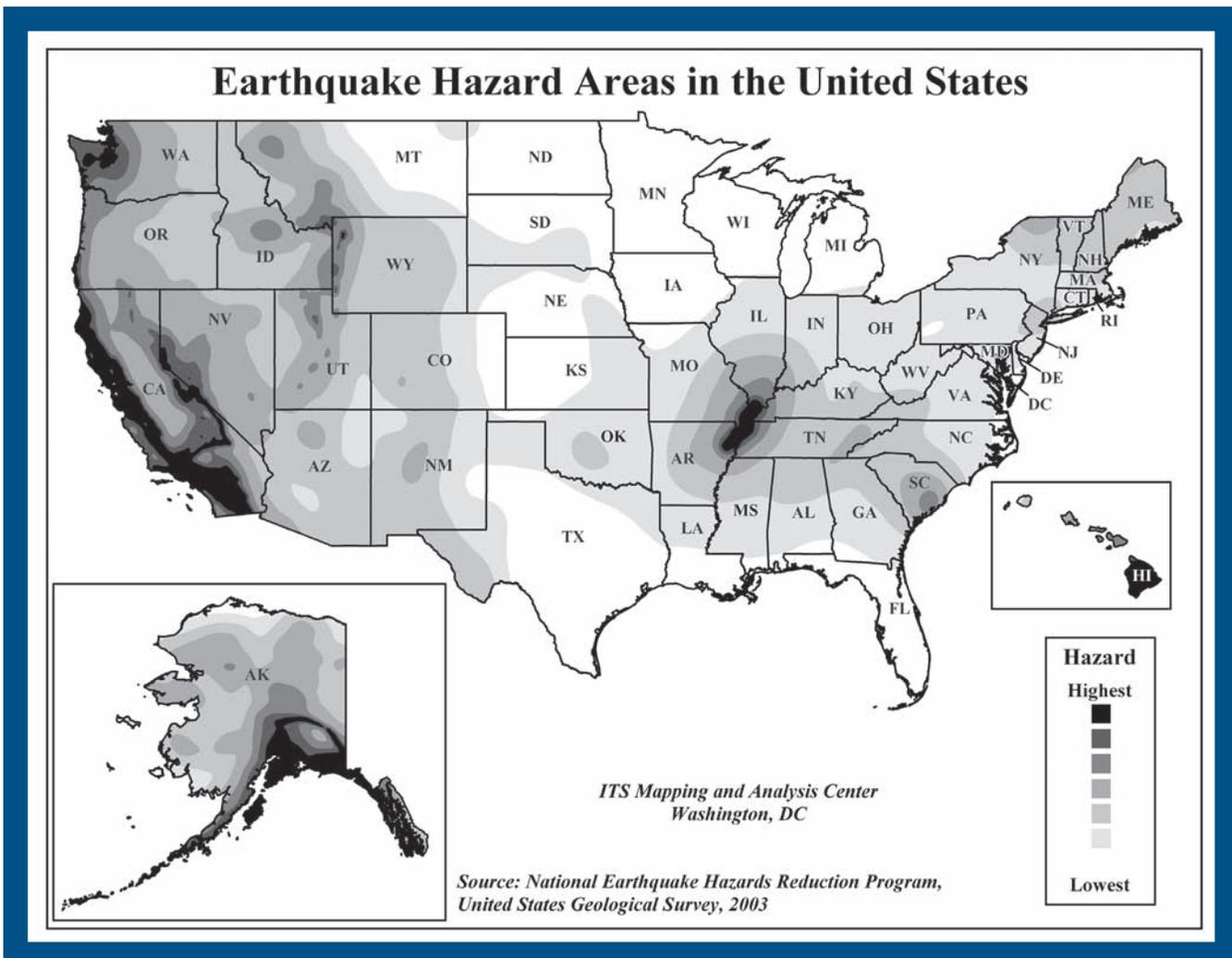


2.7

# Earthquakes



One of the most frightening and destructive phenomena of nature is a severe earthquake and its terrible aftereffects. An earthquake is a sudden movement of the earth, caused by the abrupt release of strain that has accumulated over a long time. For hundreds of millions of years, the forces of plate tectonics have shaped the earth, as the huge plates that form the earth's surface slowly move over, under, and past each other. Sometimes, the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free. If the earthquake occurs in a populated area, it may cause many deaths and injuries and extensive property damage.



### Know the Terms

Familiarize yourself with these terms to help identify an earthquake hazard:

#### Earthquake

A sudden slipping or movement of a portion of the earth's crust, accompanied and followed by a series of vibrations.

#### Aftershock

An earthquake of similar or lesser intensity that follows the main earthquake.

#### Fault

The fracture across which displacement has occurred during an earthquake. The slippage may range from less than an inch to more than 10 yards in a severe earthquake.

#### Epicenter

The place on the earth's surface directly above the point on the fault where the earthquake rupture began. Once fault slippage begins, it expands along the fault during the earthquake and can extend hundreds of miles before stopping.

#### Seismic Waves

Vibrations that travel outward from the earthquake fault at speeds of several miles per second. Although fault slippage directly under a structure can cause considerable damage, the vibrations of seismic waves cause most of the destruction during earthquakes.

#### Magnitude

The amount of energy released during an earthquake, which is computed from the amplitude of the seismic waves. A magnitude of 7.0 on the Richter Scale indicates an extremely strong earthquake. Each whole number on the scale represents an increase of about 30 times more energy released than the previous whole number represents. Therefore, an earthquake measuring 6.0 is about 30 times more powerful than one measuring 5.0.

## Take Protective Measures

The following are things you can do to protect yourself, your family, and your property in the event of an earthquake:

### Before an Earthquake

- Repair defective electrical wiring, leaky gas lines, and inflexible utility connections. Get appropriate professional help. Do not work with gas or electrical lines yourself.

- Bolt down and secure to the wall studs your water heater, refrigerator, furnace, and gas appliances. If recommended by your gas company, have an automatic gas shut-off valve installed that is triggered by strong vibrations.
- Place large or heavy objects on lower shelves. Fasten shelves, mirrors, and large picture frames to walls. Brace high and top-heavy objects.
- Store bottled foods, glass, china, and other breakables on low shelves or in cabinets that fasten shut.
- Anchor overhead lighting fixtures.
- Be sure the residence is firmly anchored to its foundation.
- Install flexible pipe fittings to avoid gas or water leaks. Flexible fittings are more resistant to breakage.
- Locate safe spots in each room under a sturdy table or against an inside wall. Reinforce this information by moving to these places during each drill.
- Hold earthquake drills with your family members: Drop, cover, and hold on!

### During an Earthquake

Minimize your movements during an earthquake to a few steps to a nearby safe place. Stay indoors until the shaking has stopped and you are sure exiting is safe.

If you are:	Then:
Indoors	<ul style="list-style-type: none"> <li>• Take cover under a sturdy desk, table, or bench or against an inside wall, and hold on. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.</li> <li>• Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or furniture.</li> <li>• Stay in bed—if you are there when the earthquake strikes—hold on and protect your head with a pillow, unless you are under a heavy light fixture that could fall. In that case, move to the nearest safe place.</li> <li>• Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported, load-bearing doorway.</li> <li>• Stay inside until the shaking stops and it is safe to go outside. Most injuries during earthquakes occur when people are hit by falling objects when entering into or exiting from buildings.</li> <li>• Be aware that the electricity may go out or the sprinkler systems or fire alarms may turn on.</li> <li>• DO NOT use the elevators.</li> </ul>
Outdoors	<ul style="list-style-type: none"> <li>• Stay there.</li> <li>• Move away from buildings, streetlights, and utility wires.</li> </ul>

If you are:	Then:
In a moving vehicle	<ul style="list-style-type: none"> <li>• Stop as quickly as safety permits and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and utility wires.</li> <li>• Proceed cautiously once the earthquake has stopped, watching for road and bridge damage.</li> </ul>
Trapped under debris	<ul style="list-style-type: none"> <li>• Do not light a match.</li> <li>• Do not move about or kick up dust.</li> <li>• Cover your mouth with a handkerchief or clothing.</li> <li>• Tap on a pipe or wall so rescuers can locate you. Use a whistle if one is available. Shout only as a last resort—shouting can cause you to inhale dangerous amounts of dust.</li> </ul>

- Be prepared for aftershocks. These secondary shockwaves are usually less violent than the main quake but can be strong enough to do additional damage to weakened structures.
- Open cabinets cautiously. Beware of objects that can fall off shelves.
- Stay away from damaged areas unless your assistance has been specifically requested by police, fire, or relief organizations.
- Be aware of possible tsunamis if you live in coastal areas. These are also known as seismic sea waves (mistakenly called “tidal waves”). When local authorities issue a tsunami warning, assume that a series of dangerous waves is on the way. Stay away from the beach.

### After an Earthquake



## Knowledge Check

Check your knowledge about what to do during an earthquake. For each question, choose answer A or B and circle the correct response. When you have finished, check your responses using the answer key below.

What action should you take during an earthquake? The answer varies by where you are when an earthquake strikes. For each situation, pick the best course of action from the choices given.

1. At home	A. Stay inside B. Go out to the street
2. In bed	A. Stand by a window to see what is happening B. Stay in bed and protect your head with a pillow
3. In any building	A. Stand in a doorway B. Crouch in an inside corner away from the exterior wall
4. On the upper floor of an apartment building	A. Take the elevator to the ground floor as quickly as possible B. Stay in an interior room under a desk or table
5. Outdoors	A. Run into the nearest building B. Stay outside away from buildings
6. Driving a car	A. Stop the car in an open area B. Stop the car under an overpass

Answer key  
1. A 2. B 3. B 4. B 5. B 6. A

## For More Information

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If you require more information about any of these topics, the following are resources that may be helpful.

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*Avoiding Earthquake Damage: A Checklist for Homeowners.* Safety tips for before, during, and after an earthquake

FEMA Publications

*Preparedness in High-Rise Buildings.* FEMA-76. Earthquake safety tips for high-rise dwellers

*Learning to Live in Earthquake Country: Preparedness in Apartments and Mobile Homes.* L-143. Safety tips on earthquake preparation for residents of apartments and mobile homes

*Family Earthquake Safety Home Hazard Hunt and Drill.* FEMA-113. How to identify home hazards; how to conduct earthquake drills

*Earthquake Preparedness: What Every Childcare Provider Should Know.* FEMA 240. Publication for teachers and for presentation to children. Available online at [www.fema.gov/kids/tch\\_eq.htm](http://www.fema.gov/kids/tch_eq.htm)





2.8

# Volcanoes

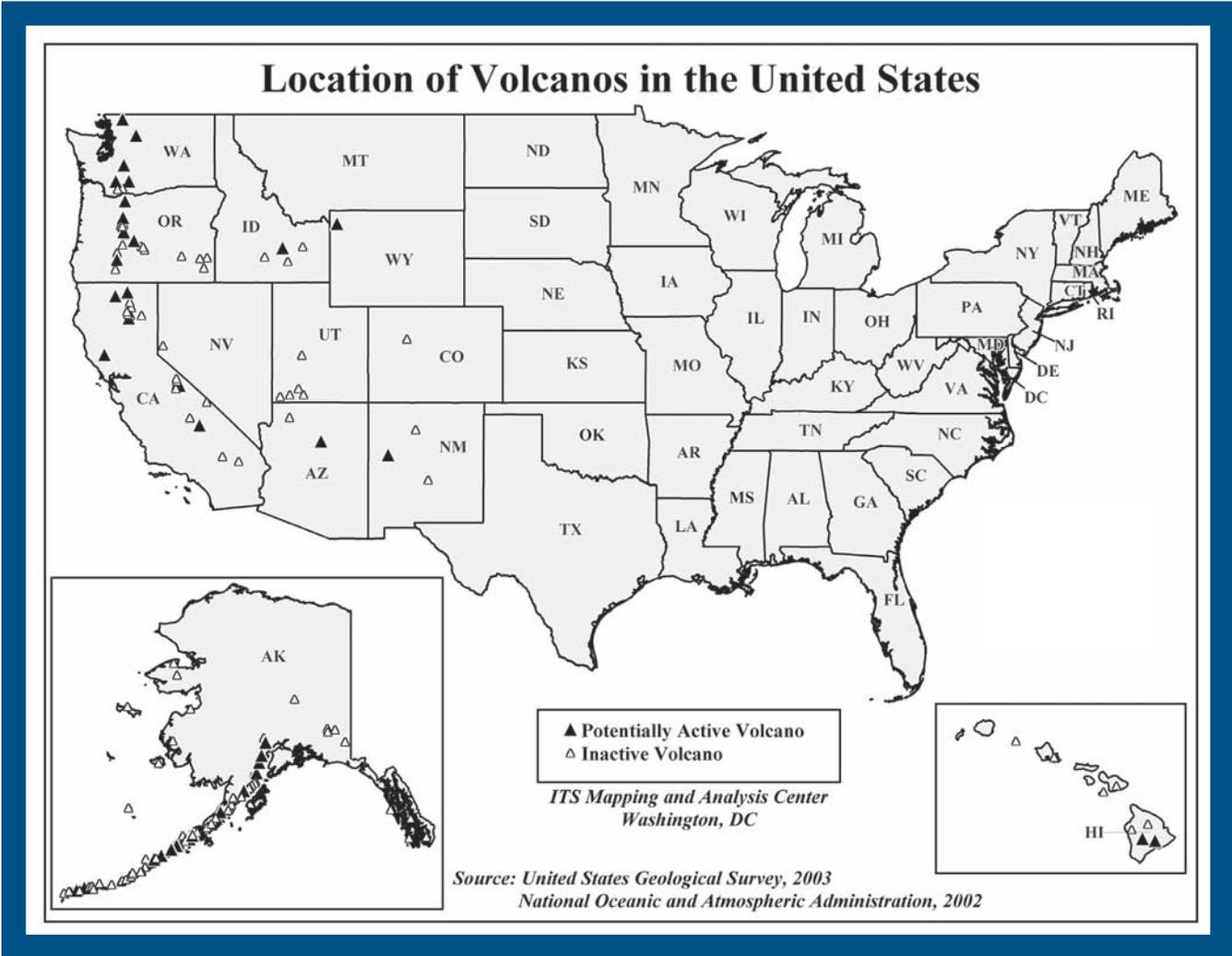


A volcano is a vent through which molten rock escapes to the earth's surface. When pressure from gases within the molten rock becomes too great, an eruption occurs. Eruptions can be quiet or explosive. There may be lava flows, flattened landscapes, poisonous gases, and flying rock and ash.

Because of their intense heat, lava flows are great fire hazards. Lava flows destroy everything in their path, but most move slowly enough that people can move out of the way.

Fresh volcanic ash, made of pulverized rock, can be abrasive, acidic, gritty, gassy, and odorous. While not immediately dangerous to most adults, the acidic gas and ash can cause lung damage to small infants, to older adults, and to those suffering from severe respiratory illnesses. Volcanic ash also can damage machinery, including engines and electrical equipment. Ash accumulations mixed with water become heavy and can collapse roofs.

Volcanic eruptions can be accompanied by other natural hazards, including earthquakes, mudflows and flash floods, rock falls and landslides, acid rain, fire, and (under special conditions) tsunamis. Active volcanoes in the U.S. are found mainly in Hawaii, Alaska, and the Pacific Northwest.



## Take Protective Measures

- Add a pair of goggles and a disposable breathing mask for each member of the family to your disaster supplies kit.
- Stay away from active volcano sites.

### Before a Volcanic Eruption

The following are guidelines for what to do if a volcano erupts in your area:

- Evacuate immediately from the volcano area to avoid flying debris, hot gases, lateral blast, and lava flow.
- Be aware of mudflows. The danger from a mudflow increases near stream channels and with prolonged heavy rains. Mudflows can move faster than you can walk or run. Look upstream before crossing a bridge, and do not cross the bridge if mudflow is approaching.
- Avoid river valleys and low-lying areas.

### During a Volcanic Eruption

#### Protection from Falling Ash

- Wear long-sleeved shirts and long pants.
- Use goggles and wear eyeglasses instead of contact lenses.
- Use a dust mask or hold a damp cloth over your face to help with breathing.
- Stay away from areas downwind from the volcano to avoid volcanic ash.
- Stay indoors until the ash has settled unless there is danger of the roof collapsing.
- Close doors, windows, and all ventilation in the house (chimney vents, furnaces, air conditioners, fans, and other vents).
- Clear heavy ash from flat or low-pitched roofs and rain gutters.
- Avoid running car or truck engines. Driving can stir up volcanic ash that can clog engines, damage moving parts, and stall vehicles.
- Avoid driving in heavy ash fall unless absolutely required. If you have to drive, keep speed down to 35 MPH or slower.



**After a Volcanic Eruption**

Follow the instructions for recovering from a disaster in Part 5.

**Knowledge Check**

Read the scenario and answer the question. Check your responses with the answer key below.

**Scenario**

About an hour after the eruption of Mount St. Helens, ash began to fall in Yakima, a city in eastern Washington. The ash fall was so extensive and it became so dark that lights were turned on all day. It took 10 weeks to haul away the ash from Yakima's streets, sidewalks, and roofs.

Assume you were a resident of Yakima during this time. What would you need to protect yourself when going outside?

**For More Information**

If you require more information about any of these topics, the following are resources that may be helpful.

**Publications****National Weather Service**

*Heat Wave: A Major Summer Killer.* An online brochure describing the heat index, heat disorders, and heat wave safety tips. Available online at: [www.nws.noaa.gov/om/brochures/heat\\_wave.htm](http://www.nws.noaa.gov/om/brochures/heat_wave.htm)

**U.S. Geological Survey**

*Volcano Hazards Program.* Website with volcano activity updates, feature stories, information about volcano hazards, and resources. Available online at: <http://volcanoes.usgs.gov>

Answer key  
possible

1. Face masks 2. Goggles 3. Eyeglasses instead of contact lenses 4. Clothing to cover as much of the body as possible

2.9

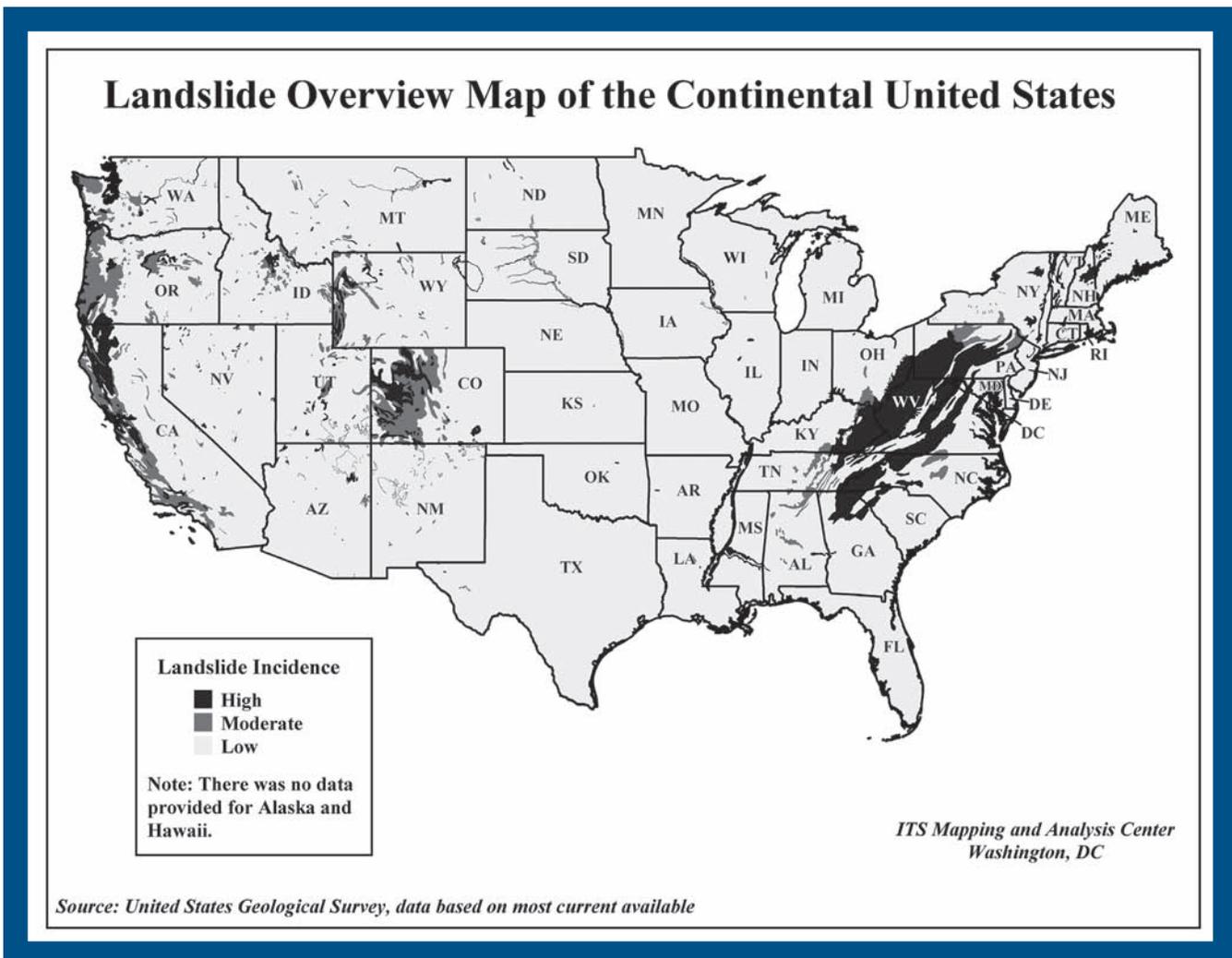
# Landslides and Debris Flow (Mudslide)



Landslides occur in all U.S. states and territories. In a landslide, masses of rock, earth, or debris move down a slope. Landslides may be small or large, slow or rapid. They are activated by storms, earthquakes, volcanic eruptions, fires, and human modification of land.

Debris and mud flows are rivers of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, during heavy rainfall or rapid snowmelt, changing the earth into a flowing river of mud or “slurry.” They flow can rapidly, striking with little or no warning at avalanche speeds. They also can travel several miles from their source, growing in size as they pick up trees, boulders, cars, and other materials.

Landslide problems can be caused by land mismanagement, particularly in mountain, canyon, and coastal regions. Land-use zoning, professional inspections, and proper design can minimize many landslide, mudflow, and debris flow problems.



## Take Protective Measures

### Before a Landslide or Debris Flow

The following are steps you can take to protect yourself from the effects of a landslide or debris flow:

- Do not build near steep slopes, close to mountain edges, near drainage ways, or natural erosion valleys.
- Get a ground assessment of your property.
- Consult an appropriate professional expert for advice on corrective measures.
- Minimize home hazards by having flexible pipe fittings installed to avoid gas or water leaks, as flexible fittings are more resistant to breakage (only the gas company or professionals should install gas fittings).

### Recognize Landslide Warning Signs

- Changes occur in your landscape such as patterns of storm-water drainage on slopes (especially the places where runoff water converges) land movement, small slides, flows, or progressively leaning trees.
- Doors or windows stick or jam for the first time.
- New cracks appear in plaster, tile, brick, or foundations.
- Outside walls, walks, or stairs begin pulling away from the building.
- Slowly developing, widening cracks appear on the ground or on paved areas such as streets or driveways.
- Underground utility lines break.
- Bulging ground appears at the base of a slope.
- Water breaks through the ground surface in new locations.
- Fences, retaining walls, utility poles, or trees tilt or move.
- A faint rumbling sound that increases in volume is noticeable as the landslide nears.
- The ground slopes downward in one direction and may begin shifting in that direction under your feet.
- Unusual sounds, such as trees cracking or boulders knocking together, might indicate moving debris.
- Collapsed pavement, mud, fallen rocks, and other indications of possible debris flow can be seen when driving (embankments along roadsides are particularly susceptible to landslides).

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### During a Landslide or Debris Flow

The following are guidelines for what you should do if a landslide or debris flow occurs:

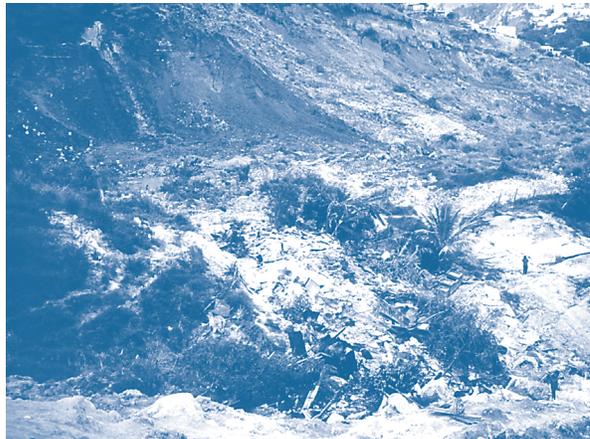
- Move away from the path of a landslide or debris flow as quickly as possible.
- Curl into a tight ball and protect your head if escape is not possible.

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### After a Landslide or Debris Flow

The following are guidelines for the period following a landslide:

- Stay away from the slide area. There may be danger of additional slides.
- Check for injured and trapped persons near the slide, without entering the direct slide area. Direct rescuers to their locations.
- Watch for associated dangers such as broken electrical, water, gas, and sewage lines and damaged roadways and railways.
- Replant damaged ground as soon as possible since erosion caused by loss of ground cover can lead to flash flooding and additional landslides in the near future.
- Seek advice from a geotechnical expert for evaluating landslide hazards or designing corrective techniques to reduce landslide risk.
- Follow the instructions for returning home in Part 5.



## Knowledge Check

Review the following information and answer the questions. Check your responses with the answer key below.

Landslides occur in all 50 states—it is estimated that they cause between 25 and 50 deaths each year in the U.S. and thousands more in vulnerable areas around the globe. The number of landslides in the United States is expected to increase.

1. What might account for the projected increase in landslides?
2. What can you do to help reverse the upward trend?

1. Mounting pressure for approving the development of lands subject to landslides and earth failures has increased development in these unsafe areas.

2. Work with others in the community to enact and enforce regulations that prohibit building near areas subject to landslides and mudslides. In areas where the hazard exists and development has already occurred, work to promote protective measures such as encouraging homeowners to get a professional ground assessment of their property and educating residents about the warning signs.

Answer Key



2.10

# Tsunamis



Tsunamis (pronounced soo-ná-mees), also known as seismic sea waves (mistakenly called “tidal waves”), are a series of enormous waves created by an underwater disturbance such as an earthquake, landslide, volcanic eruption, or meteorite. A tsunami can move hundreds of miles per hour in the open ocean and smash into land with waves as high as 100 feet or more.

From the area where the tsunami originates, waves travel outward in all directions. Once the wave approaches the shore, it builds in height. The topography of the coastline and the ocean floor will influence the size of the wave. There may be more than one wave and the succeeding one may be larger than the one before. That is why a small tsunami at one beach can be a giant wave a few miles away.

All tsunamis are potentially dangerous, even though they may not damage every coastline they strike. A tsunami can strike anywhere along most of the U.S. coastline. The most destructive tsunamis have occurred along the coasts of California, Oregon, Washington, Alaska, and Hawaii.

Earthquake-induced movement of the ocean floor most often generates tsunamis. If a major earthquake or landslide occurs close to shore, the first wave in a series could reach the beach in a few minutes, even before a warning is issued. Areas are at greater risk if they are less than 25 feet above sea level and within a mile of the shoreline. Drowning is the most common cause of death associated with a tsunami. Tsunami waves and the receding water are very destructive to structures in the run-up zone. Other hazards include flooding, contamination of drinking water, and fires from gas lines or ruptured tanks.

### Know the Terms

Familiarize yourself with these terms to help identify a tsunami hazard:

#### Advisory

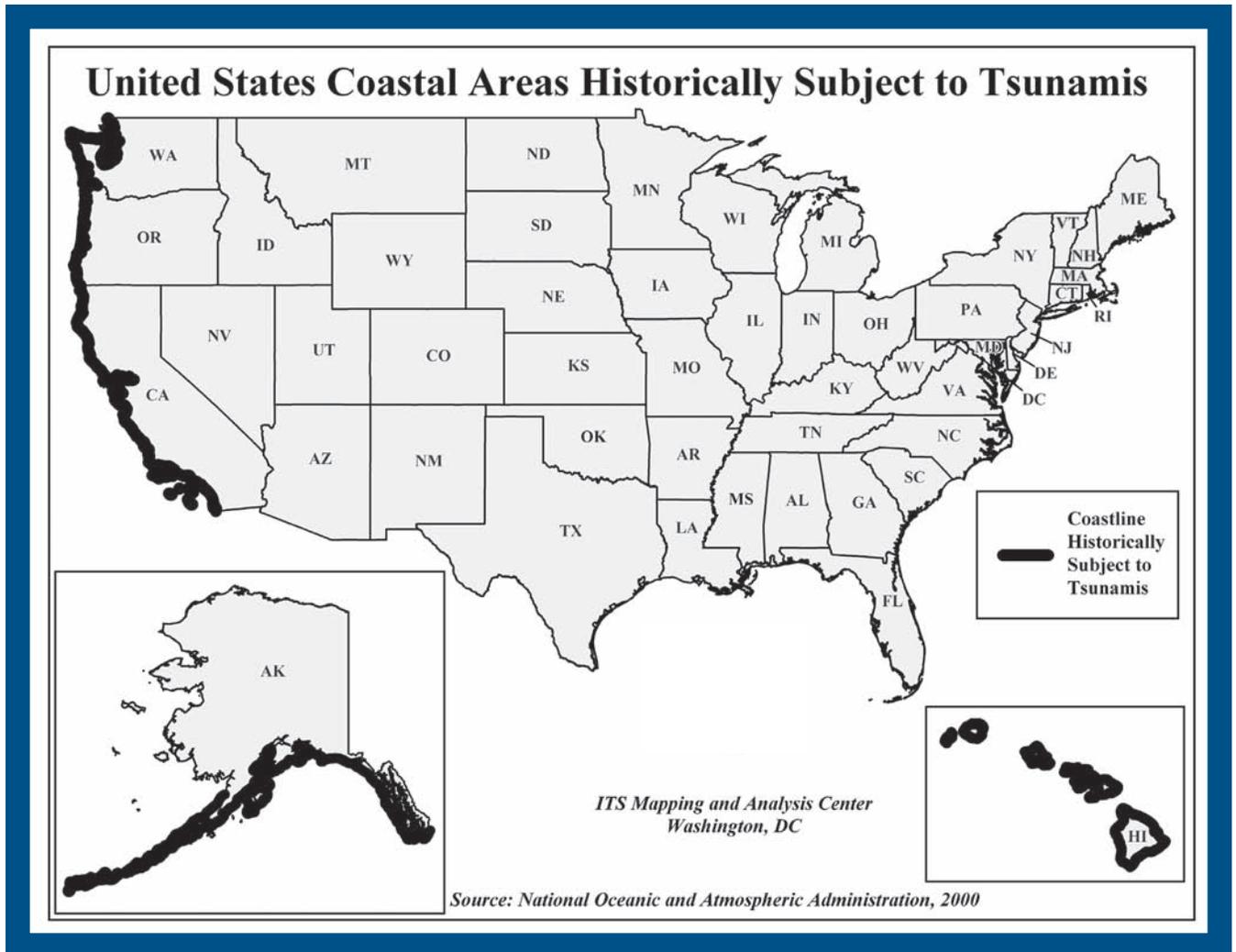
An earthquake has occurred in the Pacific basin, which might generate a tsunami.

#### Watch

A tsunami was or may have been generated, but is at least two hours travel time to the area in Watch status.

#### Warning

A tsunami was, or may have been generated, which could cause damage; therefore, people in the warned area are strongly advised to evacuate.



## Take Protective Measures

The following are guidelines for what you should do if a tsunami is likely in your area:

- Turn on your radio to learn if there is a tsunami warning if an earthquake occurs and you are in a coastal area.
- Move inland to higher ground immediately and stay there.

### During a Tsunami



If there is noticeable recession in water away from the shoreline this is nature's tsunami warning and it should be heeded. You should move away immediately.

## After a Tsunami

The following are guidelines for the period following a tsunami:

- Stay away from flooded and damaged areas until officials say it is safe to return.
- Stay away from debris in the water; it may pose a safety hazard to boats and people.



### *Save Yourself—Not Your Possessions*

Like everyone else in Maullin, Chile, Ramon Atala survived the 1960 Chile earthquake. However, he lost his life trying to save something from the tsunami that followed.

Mr. Atala was Maullin's most prosperous merchant. Outside of town, he owned a barn and a plantation of Monterey pine. In town, he owned a pier and at least one large building and also had private quarters in a waterfront warehouse.

Mr. Atala entered this warehouse between the first and second wave of the tsunami that struck Maullin. The warehouse was washed away and his body was never found.

It is unclear what he was trying to save. What is clear is that no possession is worth your life and that it is important to get to higher ground away from the coast and stay there until it is safe to return.

2.11

# Fires



Each year, more than 4,000 Americans die and more than 25,000 are injured in fires, many of which could be prevented. Direct property loss due to fires is estimated at \$8.6 billion annually.

To protect yourself, it is important to understand the basic characteristics of fire. Fire spreads quickly; there is no time to gather valuables or make a phone call. In just two minutes, a fire can become life-threatening. In five minutes, a residence can be engulfed in flames.

Heat and smoke from fire can be more dangerous than the flames. Inhaling the super-hot air can sear your lungs. Fire produces poisonous gases that make you disoriented and drowsy. Instead of being awakened by a fire, you may fall into a deeper sleep. Asphyxiation is the leading cause of fire deaths, exceeding burns by a three-to-one ratio.



## Take Protective Measures

### Before a Fire

#### Smoke Alarms

- Install smoke alarms. Properly working smoke alarms decrease your chances of dying in a fire by half.
- Place smoke alarms on every level of your residence. Place them outside bedrooms on the ceiling or high on the wall (4 to 12 inches from ceiling), at the top of open stairways, or at the bottom of enclosed stairs and near (but not in) the kitchen.
- Test and clean smoke alarms once a month and replace batteries at least once a year. Replace smoke alarms once every 10 years.

#### Escaping the Fire

- Review escape routes with your family. Practice escaping from each room.
- Make sure windows are not nailed or painted shut. Make sure security gratings on windows have a fire safety opening feature so they can be easily opened from the inside.

- Consider escape ladders if your residence has more than one level, and ensure that burglar bars and other antitheft mechanisms that block outside window entry are easily opened from the inside.
- Teach family members to stay low to the floor (where the air is safer in a fire) when escaping from a fire.
- Clean out storage areas. Do not let trash, such as old newspapers and magazines, accumulate.

### Flammable Items

- Never use gasoline, benzine, naphtha, or similar flammable liquids indoors.
- Store flammable liquids in approved containers in well-ventilated storage areas.
- Never smoke near flammable liquids.
- Discard all rags or materials that have been soaked in flammable liquids after you have used them. Safely discard them outdoors in a metal container.
- Insulate chimneys and place spark arresters on top. The chimney should be at least three feet higher than the roof. Remove branches hanging above and around the chimney.

### Heating Sources

- Be careful when using alternative heating sources.
- Check with your local fire department on the legality of using kerosene heaters in your community. Be sure to fill kerosene heaters outside, and be sure they have cooled.
- Place heaters at least three feet away from flammable materials. Make sure the floor and nearby walls are properly insulated.
- Use only the type of fuel designated for your unit and follow manufacturer's instructions.
- Store ashes in a metal container outside and away from your residence.
- Keep open flames away from walls, furniture, drapery, and flammable items.
- Keep a screen in front of the fireplace.
- Have heating units inspected and cleaned annually by a certified specialist.

### Matches and Smoking

- Keep matches and lighters up high, away from children, and, if possible, in a locked cabinet.
- Never smoke in bed or when drowsy or medicated. Provide smokers with deep, sturdy ashtrays. Douse cigarette and cigar butts with water before disposal.

### Electrical Wiring

- Have the electrical wiring in your residence checked by an electrician.
- Inspect extension cords for frayed or exposed wires or loose plugs.
- Make sure outlets have cover plates and no exposed wiring.
- Make sure wiring does not run under rugs, over nails, or across high-traffic areas.
- Do not overload extension cords or outlets. If you need to plug in two or three appliances, get a UL-approved unit with built-in circuit breakers to prevent sparks and short circuits.
- Make sure insulation does not touch bare electrical wiring.

### Other

- Sleep with your door closed.
- Install A-B-C-type fire extinguishers in your residence and teach family members how to use them.
- Consider installing an automatic fire sprinkler system in your residence.
- Ask your local fire department to inspect your residence for fire safety and prevention.

### During a Fire

If your clothes catch on fire, you should:

- **Stop, drop, and roll**—until the fire is extinguished. Running only makes the fire burn **faster**.

To escape a fire, you should:

- **Check closed doors for heat before you open them.** If you are escaping through a closed door, use the back of your hand to feel the top of the door, the doorknob, and the crack between the door and door frame before you open it. Never use the palm of your hand or fingers to test for heat—burning those areas could impair your ability to escape a fire (i.e., ladders and crawling).

Hot Door	Cool Door
Do not open. Escape through a window. If you cannot escape, hang a white or light-colored sheet outside the window, alerting fire fighters to your presence.	Open slowly and ensure fire and/or smoke is not blocking your escape route. If your escape route is blocked, shut the door immediately and use an alternate escape route, such as a window. If clear, leave immediately through the door and close it behind you. Be prepared to crawl. Smoke and heat rise. The air is clearer and cooler near the floor.

- Crawl low under any smoke to your exit—heavy smoke and poisonous gases collect first along the ceiling.
- Close doors behind you as you escape to delay the spread of the fire.
- Stay out once you are safely out. Do not reenter. Call 9-1-1.



The following are guidelines for different circumstances in the period following a fire:

#### After a Fire

- If you are with burn victims, or are a burn victim yourself, call 9-1-1; cool and cover burns to reduce chance of further injury or infection.
- If you detect heat or smoke when entering a damaged building, evacuate immediately.
- If you are a tenant, contact the landlord.
- If you have a safe or strong box, do not try to open it. It can hold intense heat for several hours. If the door is opened before the box has cooled, the contents could burst into flames.
- If you must leave your home because a building inspector says the building is unsafe, ask someone you trust to watch the property during your absence.
- Follow the instructions for recovering from a disaster in Part 5.

## Knowledge Check

Answer each question and check your responses using the answer key below.

1. You need to escape a fire through a closed door. What, if anything, should you do before opening the door?
2. What should you do if your clothes are on fire?
3. What actions should be taken for burn victims?
4. To reduce heating costs, you installed a wood-burning stove. What can you do to reduce the risk of fire from this heating source?
5. To escape in thick smoke, what should you do?

- Answer key
1. Check the door for heat with the back of your hand
  2. Stop, drop, and roll
  3. Call 9-1-1 and cool and cover burns
  4. Have the stove cleaned and inspected by a certified specialist
  5. Crawl close to the floor

## For More Information

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If you require more information about any of these topics, the following are resources that may be helpful.

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*After the Fire: Returning to Normal.* FA 046. This 16-page booklet provides information about recovering from a fire, including what to do during the first 24 hours, insurance considerations, valuing your property, replacement of valuable documents, salvage hints, fire department operations, and more. Available online at [www.usfa.fema.gov/public/hfs/pubs/atf/after.shtm](http://www.usfa.fema.gov/public/hfs/pubs/atf/after.shtm)

*Protecting Your Family From Fire.* FA 130. This pamphlet was written to provide the information you need to decide what you must do to protect your family from fire. Topics include children, sleepwear, older adults, smoke detectors, escape plans, and residential sprinklers. Available online at [www.usfa.fema.gov/public/hfs/pubs/hfs\\_pubs2.shtm](http://www.usfa.fema.gov/public/hfs/pubs/hfs_pubs2.shtm)

*Fire Risks for the Hard of Hearing.* FA 202; *Fire Risks for the Older Adult.* FA 203; *Fire Risks for the Mobility Impaired.* FA 204; *Fire Risks for the Blind or Visually Impaired.* FA 205  
These reports address preparation for fire risks for populations with special challenges. All are available online at [www.usfa.fema.gov/fire-service/education/education-pubs.shtm](http://www.usfa.fema.gov/fire-service/education/education-pubs.shtm)

FEMA Publications

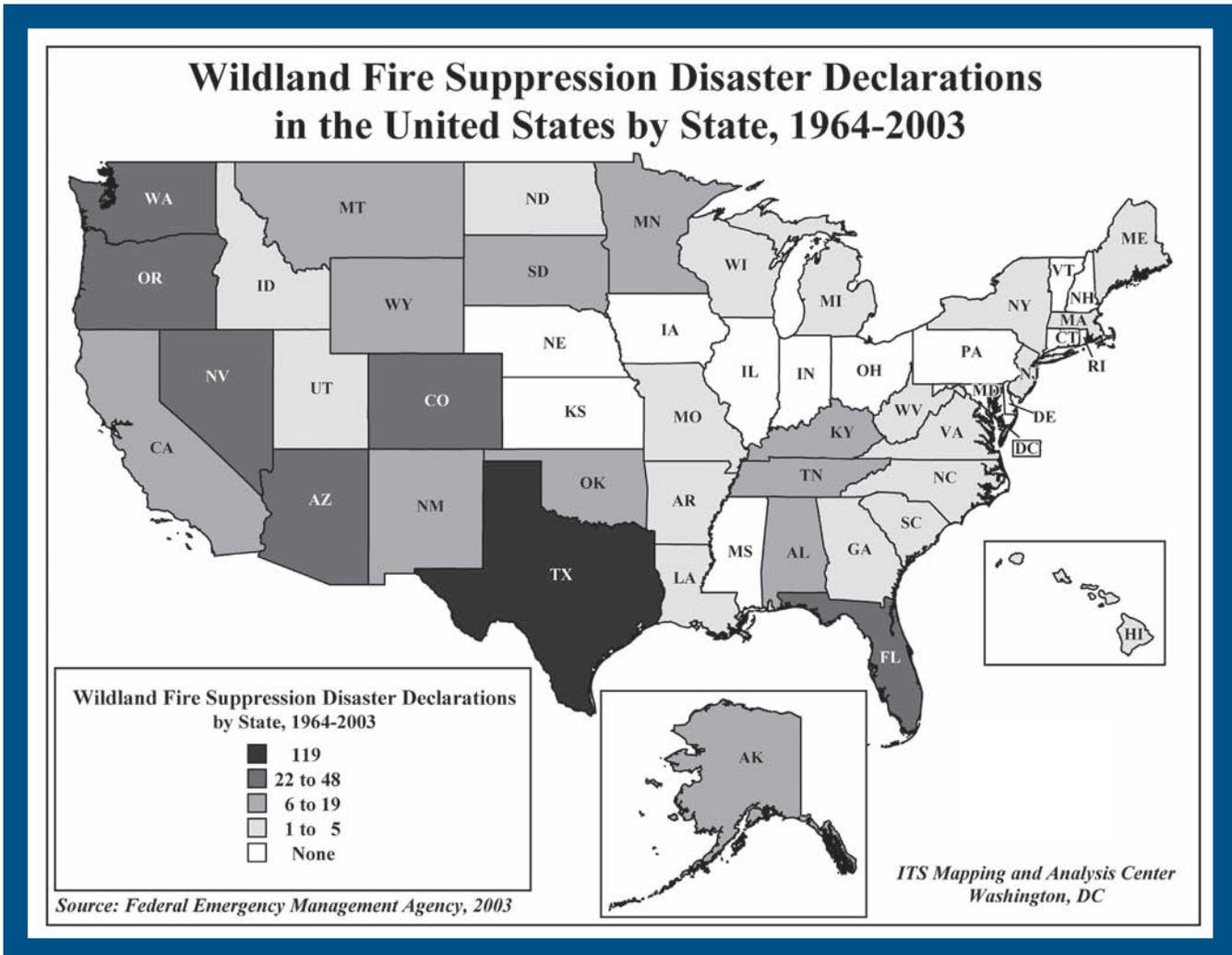


2.12

# Wildfires



If you live on a remote hillside or in a valley, prairie, or forest where flammable vegetation is abundant, your residence could be vulnerable to wildfires. These fires are usually triggered by lightning or accidents. Wildfires spread quickly, igniting brush, trees, and homes.



## Take Protective Measures

### Before a Wildfire

To prepare for wildfires, you should:

- Mark the entrance to your property with address signs that are clearly visible from the road.
- Keep lawns trimmed, leaves raked, and the roof and rain gutters free from debris such as dead limbs and leaves.
- Stack firewood at least 30 feet away from your residence.

- Store flammable materials, liquids, and solvents in metal containers outside your residence at least 30 feet away from structures and wooden fences.
- Create defensible space by thinning trees and brush within 30 feet around your residence. Beyond 30 feet, remove dead wood, debris, and low tree branches.
- Landscape your property with fire resistant plants and vegetation to prevent fire from spreading quickly. For example, hardwood trees are more fire-resistant than pine, evergreen, eucalyptus, or fir trees.
- Make sure water sources, such as hydrants, ponds, swimming pools, and wells, are accessible to the fire department.
- Use fire resistant, protective roofing and materials like stone, brick, and metal to protect your residence. Avoid using wood materials. They offer the least fire protection.
- Cover all exterior vents, attics, and eaves with metal mesh screens no larger than 6 millimeters or 1/4 inch to prevent debris from collecting and to help keep sparks out.
- Install multi-pane windows, tempered safety glass, or fireproof shutters to protect large windows from radiant heat.
- Use fire-resistant draperies for added window protection.
- Have chimneys, wood stoves, and all home heating systems inspected and cleaned annually by a certified specialist.
- Insulate chimneys and place spark arresters on top. The chimney should be at least 3 feet above the roof.
- Remove branches hanging above and around the chimney.

### Follow Local Burning Laws

Before burning debris in a wooded area, make sure you notify local authorities, obtain a burning permit, and follow these guidelines:

- Use an approved incinerator with a safety lid or covering with holes no larger than 3/4 inch.
- Create at least a 10-foot clearing around the incinerator before burning debris.
- Have a fire extinguisher or garden hose on hand when burning debris.



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## During a Wildfire

If a wildfire threatens your home and time permits, take the following precautions:

- Shut off gas at the meter. Only a qualified professional can safely turn the gas back on.
- Seal attic and ground vents with pre-cut plywood or commercial seals.
- Turn off propane tanks.
- Place combustible patio furniture inside.
- Connect garden hose to outside taps. Place lawn sprinklers on the roof and near above-ground fuel tanks. Wet the roof.
- Wet or remove shrubs within 15 feet of your residence.
- Gather fire tools such as a rake, axe, handsaw or chainsaw, bucket, and shovel.
- Back your car into the garage or park it in an open space facing the direction of escape. Shut doors and roll up windows. Leave the key in the ignition and the car doors unlocked. Close garage windows and doors, but leave them unlocked. Disconnect automatic garage door openers.
- Open fireplace damper. Close fireplace screens.
- Close windows, vents, doors, blinds or noncombustible window coverings, and heavy drapes. Remove flammable drapes and curtains.
- Move flammable furniture into the center of the residence away from windows and sliding-glass doors.
- Close all interior doors and windows to prevent drafts.
- Place valuables that will not be damaged by water in a pool or pond.

If advised to evacuate, do so immediately. Choose a route away from the fire hazard. Watch for changes in the speed and direction of the fire and smoke.

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## After a Wildfire

Follow the instructions for recovering from a disaster in Part 5.

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## For More Information

If you require more information about any of these topics, the following resource may be helpful.

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### FEMA Publications

*Wildfire: Are You Prepared?* L-203. Wildfire safety tips, preparedness, and mitigation techniques.