



Earthquake

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Why talk about earthquakes?

Earthquakes strike suddenly, without warning. Earthquakes can occur at any time of the year and at any time of the day or night. On a yearly basis, 70 to 75 damaging earthquakes occur throughout the world. Estimates of losses from a future earthquake in the United States approach \$200 billion.

There are 41 states and territories in the United States at moderate to high risk from earthquakes, and they are located in every region of the country. California experiences the most frequent damaging earthquakes; however, Alaska experiences the greatest number of large earthquakes — most located in uninhabited areas. The largest earthquakes felt in the United States were along the New Madrid Fault in Missouri, where a three-

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month long series of quakes from 1811 to 1812 included three quakes larger than a magnitude of 8 on the Richter Scale. These earthquakes were felt over the entire Eastern United States, with Missouri, Tennessee, Kentucky, Indiana, Illinois, Ohio, Alabama, Arkansas, and

Mississippi experiencing the strongest ground shaking.

What are earthquakes, and what causes them?

An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. 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 move slowly 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 causing the ground to shake. Most earthquakes occur at the boundaries where the plates meet; however, some earthquakes occur in the middle of plates.

Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge, destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers and homes not tied to their foundations are at risk because they can be shaken off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths and injuries and extensive property damage.

The Northridge, California, earthquake of January 17, 1994, struck a modern urban environment generally designed to withstand the forces of earthquakes. Its economic cost, nevertheless, has been estimated at \$20 billion. Fortunately, relatively few lives were lost. Exactly one year later, Kobe, Japan, a densely populated community less prepared for earthquakes than Northridge, was devastated by the most costly earthquake ever to occur. Property losses were projected at \$96 billion, and at least 5,378 people were killed. These two earthquakes tested building codes and construction practices, as well as emergency preparedness and response procedures.

Where earthquakes have occurred in the past, they will happen again. Learn whether earthquakes are a risk in your area by contacting your local emergency management office, American Red Cross chapter, state geological survey, or department of natural resources.

Awareness Information

Expect aftershocks. Aftershocks are smaller earthquakes that follow the main shock and can cause further damage to weakened buildings. Aftershocks can occur in the first hours, days, weeks, or even months after the quake. Be aware that some earthquakes are actually foreshocks, and a larger earthquake might occur.

Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related injuries result from collapsing walls, flying glass, and falling objects as a result of the ground shaking, or people trying to move more than a few feet during the shaking. Much of the damage in earthquakes is predictable and preventable. We must all work together in our communities to apply our knowledge to building codes, retrofitting programs, hazard hunts, and neighborhood and family emergency plans.

Plan for an Earthquake

Develop a Family Disaster Plan. Please see the “Family Disaster Plan” section for general family planning information. Develop earthquake-specific planning. **Learn about earthquake risk in your area.** Contact your local emergency management office, American Red Cross chapter, state geological survey, or department of natural resources for historical information and earthquake preparedness for your area. Although there are

41 states or territories at moderate to high risk, many people do not realize the potential for earthquakes in their area.

If you are at risk from earthquakes:

- **Pick “safe places” in each room of your home.** A safe place could be under a sturdy table or desk or against an interior wall away from windows, bookcases, or tall furniture that could fall on you. The shorter the distance to move to safety, the less likely you will be injured. Injury statistics show that persons moving more than 10 feet during an earthquake’s shaking are most likely to experience injury.
- **Practice drop, cover, and hold-on in each safe place.** Drop under a sturdy desk or table, hold on, and protect your eyes by pressing your face against your arm. Practicing will make these actions an automatic response. When an earthquake or other disaster occurs, many people hesitate, trying to remember what they are supposed to do. Responding quickly and automatically may help protect you from injury.
- **Practice drop, cover, and hold-on at least twice a year.** Frequent practice will help reinforce safe behavior.
- **Talk with your insurance agent.** Different areas have different requirements for earthquake protection. Study locations of active faults, and if you are at risk, consider purchasing earthquake insurance.
- **Inform guests, babysitters, and caregivers of your plan.** Everyone in your home should know what to do if an earthquake occurs. Assure yourself that others will respond properly even if you are not at home during the earthquake.
- **Get training.** Take a first aid class from your local Red Cross chapter. Get training on how to use a fire extinguisher from your local fire department. Keep your training current. Training will help you to keep calm and know what to do when an earthquake occurs.
- **Discuss earthquakes with your family.** Everyone should know what to do in case all family members are not together. Discussing earthquakes ahead of time helps reduce fear and anxiety and lets everyone know how to respond.

What to Tell Children

- **Find safe places in every room of your home and your classroom. Look for safe places inside and outside of other buildings where you spend time.** The shorter the distance you have to travel when the ground shakes, the safer you will be. Earthquakes can happen anytime and anywhere, so be prepared wherever you go.
- **If you’re indoors during an earthquake, drop, cover, and hold on.** Get under a desk, table or bench. Hold on to one of the legs and

cover your eyes. If there's no table or desk nearby, sit down against an interior wall. An interior wall is less likely to collapse than a wall on the outside shell of the building. Pick a safe place where things will not fall on you, away from windows, bookcases, or tall, heavy furniture. It is dangerous to run outside when an earthquake happens because bricks, roofing, and other materials may fall from buildings during and immediately following earthquakes, injuring persons near the buildings.

- **Wait in your safe place until the shaking stops, then check to see if you are hurt.** You will be better able to help others if you take care of yourself first, then check the people around you. Move carefully and watch out for things that have fallen or broken, creating hazards. Be ready for additional earthquakes called “aftershocks.”
- **Be on the lookout for fires.** Fire is the most common earthquake-related hazard, due to broken gas lines, damaged electrical lines or appliances, and previously contained fires or sparks being released.
- **If you must leave a building after the shaking stops, use the**

Assemble a Disaster Supplies Kit

Please see the section “Disaster Supplies Kit” for general supplies kit information. Earthquake-specific supplies should include the following:

- A flashlight and sturdy shoes by each person's bedside.
- Disaster Supplies Kit basics.
- Evacuation Supplies Kit.

stairs, not the elevator. Earthquakes can cause fire alarms and fire sprinklers to go off. You will not be certain whether there is a real threat of fire. As a precaution, use the stairs.

- **If you're outside in an earthquake, stay outside. Move away from buildings, trees, streetlights, and power lines. Crouch down and cover your head.** Many injuries occur within 10 feet of the entrance to buildings. Bricks, roofing, and other materials can fall from buildings, injuring persons nearby. Trees, streetlights, and power lines may also fall, causing damage or injury.

How to Protect Your Property

- **Bolt bookcases, china cabinets, and other tall furniture to wall studs. Brace or anchor high or top-heavy objects.** During an earthquake, these items can fall over, causing damage or injury.
- **Secure items that might fall (televisions, books, computers, etc.).** Falling items can cause damage or injury.
- **Install strong latches or bolts on cabinets.** The contents of cabinets can shift during the shaking of an earthquake. Latches will prevent cabinets from flying open and contents from falling out.
- **Move large or heavy objects and fragile items (glass or china) to lower shelves.** There will be less damage and less chance of injury if these items are on lower shelves.

- **Store breakable items such as bottled foods, glass, and china in low, closed cabinets with latches.** Latches will help keep contents of cabinets inside.
- **Store weed killers, pesticides, and flammable products securely in closed cabinets with latches, on bottom shelves.** Chemical products will be less likely to create hazardous situations from lower, confined locations.
- **Hang heavy items, such as pictures and mirrors, away from beds, couches, and anywhere people sit.** Earthquakes can knock things off walls, causing damage or injury.
- **Brace overhead light fixtures.** During earthquakes, overhead light fixtures are the most common items to fall, causing damage or injury.
- **Strap the water heater to wall studs.** The water heater may be your best source of drinkable water following an earthquake. Protect it from damage and leaks.
- **Bolt down any gas appliances.** After an earthquake, broken gas lines frequently create fire hazards.
- **Install flexible pipe fittings to avoid gas or water leaks.** Flexible fittings will be less likely to break.
- **Repair any deep cracks in ceilings or foundations. Get expert advice if there are signs of structural defects.** Earthquakes can turn cracks into ruptures and make smaller problems bigger.
- **Check to see if your house is bolted to its foundation.** Homes bolted to their foundations are less likely to be severely damaged during earthquakes. Homes that are not bolted have been known to slide off their foundations, and many have been destroyed because they are uninhabitable.
- **Consider having your building evaluated by a professional structural design engineer.** Ask about home repair and strengthening tips for exterior features, such as porches, front and back decks, sliding glass doors, canopies, carports, and garage doors. Learn about additional ways you can protect your home. A professional can give you advice on how to reduce potential damage.
- Follow local seismic building standards and safe land use codes that regulate land use along fault lines. Some municipalities, counties, and states have enacted codes and standards to protect property and occupants. Learn about your area's codes before construction.

Media and Community Education Ideas

- Ask your community to develop stronger building codes. Building codes are the public's first line of defense against earthquakes. The codes

specify the levels of earthquake forces that structures must be designed to withstand. As ground motions of greater intensity have been recorded, the minimum earthquake requirements specified in building codes have been raised.

- Publish a special section in your local newspaper with emergency information on earthquakes. Localize the information by printing the phone numbers of local emergency services offices, the American Red Cross, and hospitals.
- Conduct a week-long newspaper series on locating hazards in the home.
- Work with local emergency services and American Red Cross officials to prepare special reports for people with mobility impairments about what to do during an earthquake.
- Provide tips on conducting earthquake drills in the home.
- Interview representatives of the gas, electric, and water companies about shutting off utilities.

What to Do During an Earthquake

- **Drop, cover, and hold on!** Move only a few steps to a nearby safe place. Most injured persons in earthquakes move more than five feet during the shaking. It is very dangerous to try to leave a building during an earthquake because objects can fall on you. Many fatalities occur when people run outside of buildings, only to be killed by falling debris from collapsing walls. In U.S. buildings, you are safer to stay where you are.
- **If you are in bed, hold on and stay there, protecting your head with a pillow.** You are less likely to be injured staying where you are. Broken glass on the floor has caused injury to those who have rolled to the floor or tried to get to doorways.
- **If you are outdoors, find a clear spot away from buildings, trees, streetlights, and power lines. Drop to the ground and stay there until the shaking stops.** Injuries can occur from falling trees, streetlights and power lines, or building debris.
- **If you are in a vehicle, pull over to a clear location, stop and stay there with your seatbelt fastened until the shaking has stopped.** Trees, power lines, poles, street signs, and other overhead items may fall during earthquakes. Stopping will help reduce your risk, and a hard-topped vehicle will help protect you from flying or falling objects. Once the shaking has stopped, proceed with caution. Avoid bridges or ramps that might have been damaged by the quake.

- **Stay indoors until the shaking stops and you're sure it's safe to exit.** More injuries happen when people move during the shaking of an earthquake. After the shaking has stopped, if you go outside, move quickly away from the building to prevent injury from falling debris.
- **Stay away from windows.** Windows can shatter with such force that you can be injured several feet away.
- **In a high-rise building, expect the fire alarms and sprinklers to go off during a quake.** Earthquakes frequently cause fire alarm and fire sprinkler systems to go off even if there is no fire. Check for and extinguish small fires, and, if exiting, use the stairs.
- **If you are in a coastal area, move to higher ground.** Tsunamis are often created by earthquakes. (See the "Tsunami" section for more information).
- **If you are in a mountainous area or near unstable slopes or cliffs, be alert for falling rocks and other debris that could be loosened by the earthquake.** Landslides commonly happen after earthquakes. (See the "Landslide" section for more information.)

What to Do After an Earthquake

- **Check yourself for injuries.** Often people tend to others without checking their own injuries. You will be better able to care for others if you are not injured or if you have received first aid for your injuries.
- **Protect yourself from further danger by putting on long pants, a long-sleeved shirt, sturdy shoes, and work gloves.** This will protect you from further injury by broken objects.
- **After you have taken care of yourself, help injured or trapped persons.** If you have it in your area, call 9-1-1, then give first aid when appropriate. Don't try to move seriously injured people unless they are in immediate danger of further injury.
- **Look for and extinguish small fires. Eliminate fire hazards.** Putting out small fires quickly, using available resources, will prevent them from spreading. Fire is the most common hazard following earthquakes. Fires followed the San Francisco earthquake of 1906 for three days, creating more damage than the earthquake.
- **Leave the gas on at the main valve, unless you smell gas or think it's leaking.** It may be weeks or months before professionals can turn gas back on using the correct procedures. Explosions have caused injury and death when homeowners have improperly turned their gas back on by themselves.

- **Clean up spilled medicines, bleaches, gasoline, or other flammable liquids immediately.** Avoid the hazard of a chemical emergency.
- **Open closet and cabinet doors cautiously.** Contents may have shifted during the shaking of an earthquake and could fall, creating further damage or injury.
- **Inspect your home for damage. Get everyone out if your home is unsafe.** Aftershocks following earthquakes can cause further damage to unstable buildings. If your home has experienced damage, get out before aftershocks happen.
- **Help neighbors who may require special assistance.** Elderly people and people with disabilities may require additional assistance. People who care for them or who have large families may need additional assistance in emergency situations.
- **Listen to a portable, battery-operated radio (or television) for updated emergency information and instructions.** If the electricity is out, this may be your main source of information. Local radio and local officials provide the most appropriate advice for your particular situation.
- **Expect aftershocks.** Each time you feel one, drop, cover, and hold on! Aftershocks frequently occur minutes, days, weeks, and even months following an earthquake.
- **Watch out for fallen power lines or broken gas lines, and stay out of damaged areas.** Hazards caused by earthquakes are often difficult to see, and you could be easily injured.
- **Stay out of damaged buildings.** If you are away from home, return only when authorities say it is safe. Damaged buildings may be destroyed by aftershocks following the main quake.
- **Use battery-powered lanterns or flashlights to inspect your home.** Kerosene lanterns, torches, candles, and matches may tip over or ignite flammables inside.
- **Inspect the entire length of chimneys carefully for damage.** Unnoticed damage could lead to fire or injury from falling debris during an aftershock. Cracks in chimneys can be the cause of a fire years later.
- **Take pictures of the damage, both to the house and its contents, for insurance claims.**
- **Avoid smoking inside buildings.** Smoking in confined areas can cause fires.
- **When entering buildings, use extreme caution.** Building damage may have occurred where you least expect it. Carefully watch every step you take.

- **Examine walls, floor, doors, staircases, and windows to make sure that the building is not in danger of collapsing.**
- **Check for gas leaks.** If you smell gas or hear a blowing or hissing noise, open a window and quickly leave the building. Turn off the gas, using the outside main valve if you can, and call the gas company from a neighbor's home. If you turn off the gas for any reason, it must be turned back on by a professional.
- **Look for electrical system damage.** If you see sparks or broken or frayed wires, or if you smell burning insulation, turn off the electricity at the main fuse box or circuit breaker. If you have to step in water to get to the fuse box or circuit breaker, call an electrician first for advice.
- **Check for sewage and water line damage.** If you suspect sewage lines are damaged, avoid using the toilets and call a plumber. If water pipes are damaged, contact the water company and avoid using water from the tap. You can obtain safe water from undamaged water heaters or by melting ice cubes.
- **Watch for loose plaster, drywall, and ceilings that could fall.**
- **Use the telephone only to report life-threatening emergencies.** Telephone lines are frequently overwhelmed in disaster situations. They need to be clear for emergency calls to get through.
- **Watch animals closely. Leash dogs and place them in a fenced yard.** The behavior of pets may change dramatically after an earthquake. Normally quiet and friendly cats and dogs may become aggressive or defensive.