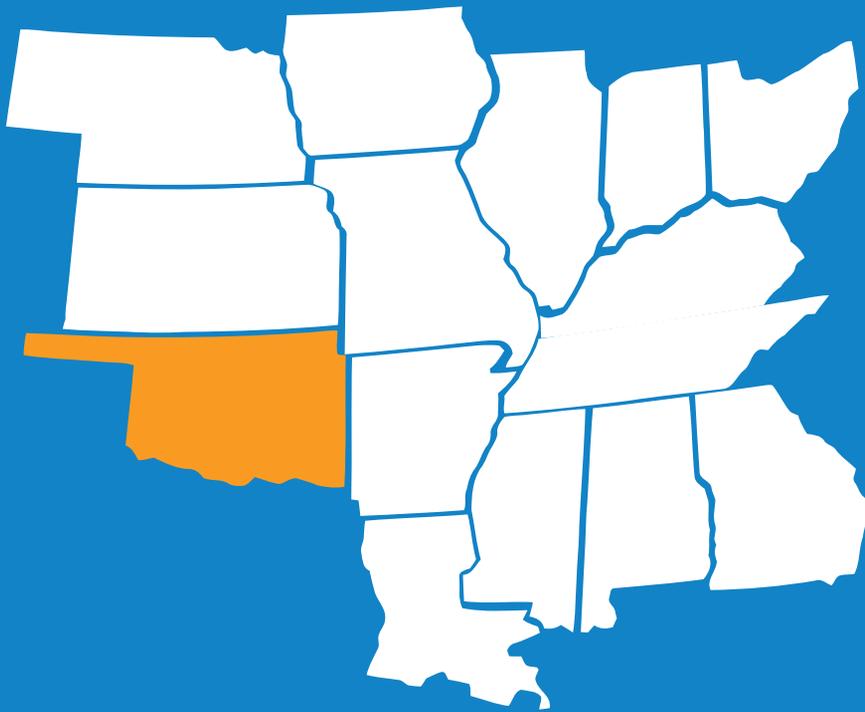


The Great
Central U.S.

Shake Out™

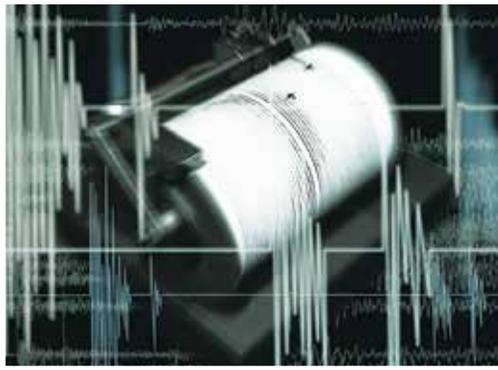


EARTHQUAKES

An overview of how they occur, how
to stay safe, AND how to practice
earthquake drills



The Great
Central U.S.
**Shake
Out**TM



EARTHQUAKES

What is an earthquake? What can you do to prepare for an earthquake? Unlike many other natural disasters, earthquakes occur with little or no warning. That's why it is important to learn about earthquakes and how to protect yourself now. Being prepared for any type of disaster is the best way to stay safe and know what to do when it's most important. This workbook will provide an overview on earthquakes, from how they occur to how to stay safe and practice earthquake drills.

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EARTHQUAKE TERMS TO KNOW

Aftershocks

Aftershocks are earthquakes that follow the largest shock of an earthquake sequence. They are smaller than the main earthquake, but can continue over a period of weeks, months, or years. In general, the larger the main shock, the larger and more numerous the aftershocks, and the longer they will continue.

Epicenter

The point on the Earth's surface above the point at depth in the Earth's crust where an earthquake occurs.

Fault

A fracture or crack, along which two blocks of rock slide past one another.

Fires

Earthquakes can easily cause fires. Ground movements can lead to gas and fuel leaks in pipes or the cutting of electrical cables. The destruction of water pipes makes it harder to fight such fires if they occur. For example, when the 1906 San Francisco earthquake ruptured several water mains, the city fire department had few resources to use to fight the fires, which caused extensive fire damage throughout the city.

Landslides

These occur in hilly or mountainous regions. The damage caused can range from blocked roads to possibly huge property damage and is very dangerous to any person in the area.

Magnitude

Refers to the amount of energy released at the epicenter by the earthquake. Various scales are used, sometimes referred to as the "Richter Scale."

Modified Mercalli Intensity (MMI) Scale

The Modified Mercalli Intensity Scale is commonly used in the United States by seismologists seeking information on the severity of earthquake effects.

Seismologists

Scientists who study earthquakes and their causes and effects.

Seismographs

Instruments that make an automatic record of the time, duration, direction, and intensity of earthquakes.

Soil Liquefaction

This happens when the movement caused by an earthquake forces water to seep into the material beneath a building, thereby causing saturated granular material to lose its strength and briefly change into a liquid from a solid. This can force the foundations of homes or other buildings to become unstable and sink into the ground.



San Andreas Fault in California



Broken asphalt road by Chuetsu Earthquake, 2004, Ojiya, Niigata, Japan. Soil liquefaction took place on this road. commons.wikimedia.org/wiki/File:Chuetsu_earthquake-earthquake_liquefaction1.jpg

WHAT IS AN EARTHQUAKE AND HOW DO THEY DO DAMAGE?

Earthquakes occur when two blocks of rock within the Earth's crust slide past each other. The contact zone between these two blocks is called a fault. Faults come in nearly all shapes and sizes. Faults can be thousands of miles long on the tectonic plate boundaries, like the San Andreas fault running most of the length of California, or smaller than a football field, and everything in between. The epicenter of an earthquake is the location on the surface of the Earth above the point where the earthquake first originated along that fault.

Earthquakes do damage in a few different ways. When an earthquake occurs, the ground can move significantly compared to the other side of the fault. Buildings and roads that are built on a fault can be torn apart during an earthquake. When an earthquake occurs, seismic waves are generated. Seismic waves are similar to sound. A good analogy is the sound you get by sliding two bricks past each other. The seismic waves generated in an earthquake travel very fast through the Earth and cause shaking or a rolling motion. If this shaking is strong enough, buildings can be damaged or collapse. The shaking or intensity lessens as the seismic waves move away from the epicenter. This is similar to the ripples when you throw a rock in a still pond. As the ripples move away from the spot where the rock hit the water, they become smaller and harder to see until they are no longer visible.

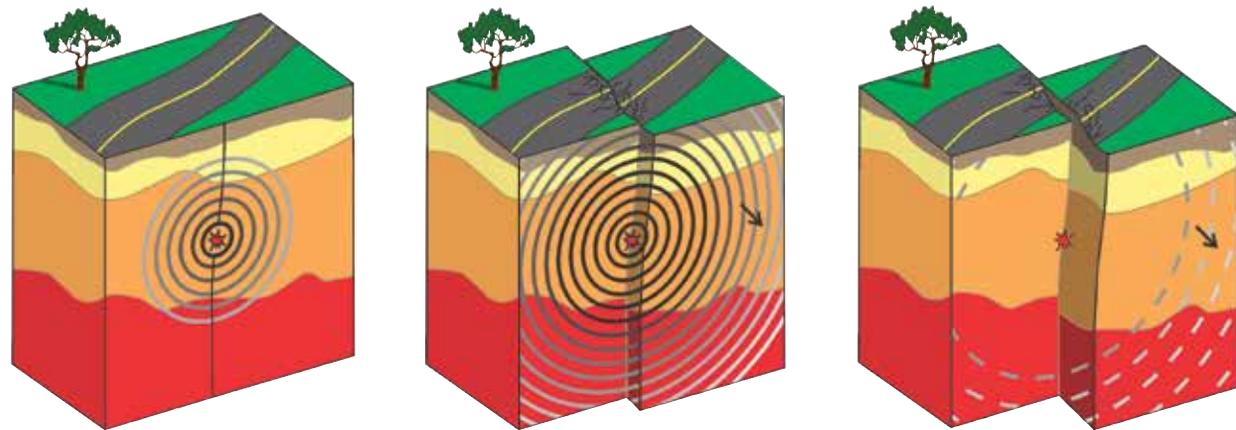


Figure 1 Figure illustrates how a fault might look and how buildings and roads on the fault are damaged when a fault slips and an earthquake occurs. The black rings represent the seismic energy as it radiates away from the epicenter. As the amplitude of the wave decreases it goes to gray. Modified from the USGS.

WHAT IS AN EARTHQUAKE AND HOW DO THEY DO DAMAGE?

In addition, the seismic waves can cause the ground to lose its strength, especially soils that contain large amounts of water. This is called liquefaction, and can cause buildings to collapse because the soils underneath cannot support the weight of the building. Mountains can have landslides if large amounts of material on a steep-slope collapse quickly and come down the side of the mountain. A landslide occurred near Cavanal Hill in eastern Oklahoma directly after the 1952 M 5.4 El Reno earthquake. Landslides have been associated with many earthquakes around the world and can be a leading cause of casualties and damage associated with earthquakes.

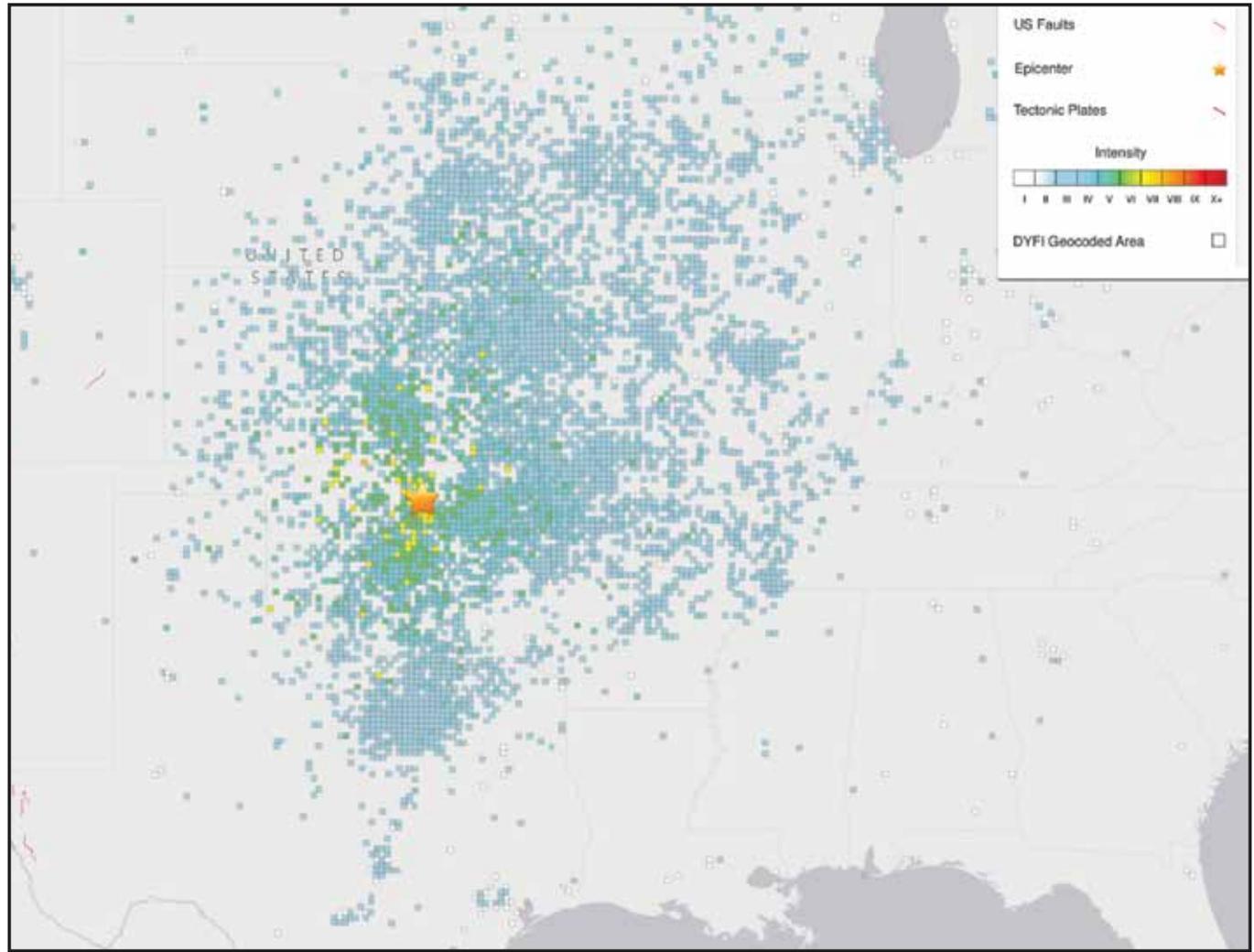


Figure 2 Map showing how the intensity of seismic waves decrease with distance from the 2016 M 5.8 Pawnee earthquake. Intense shaking was observed near the epicenter and it was slightly felt by several people as far away as Denver, Colorado; Chicago, Illinois; and Austin, Texas. These are reported as Modified Mercalli Intensities through the USGS Did You Feel It (DYFI) program, which gathers citizen reports of earthquake shaking with a simple form on the USGS website. You can help scientists understand how shaking effects are felt widely by reporting your own observations after an earthquake you feel!



**Additional
Materials:**

<http://earthquake.usgs.gov/learn/animations/>
<http://earthquake.usgs.gov/learn/kids/>

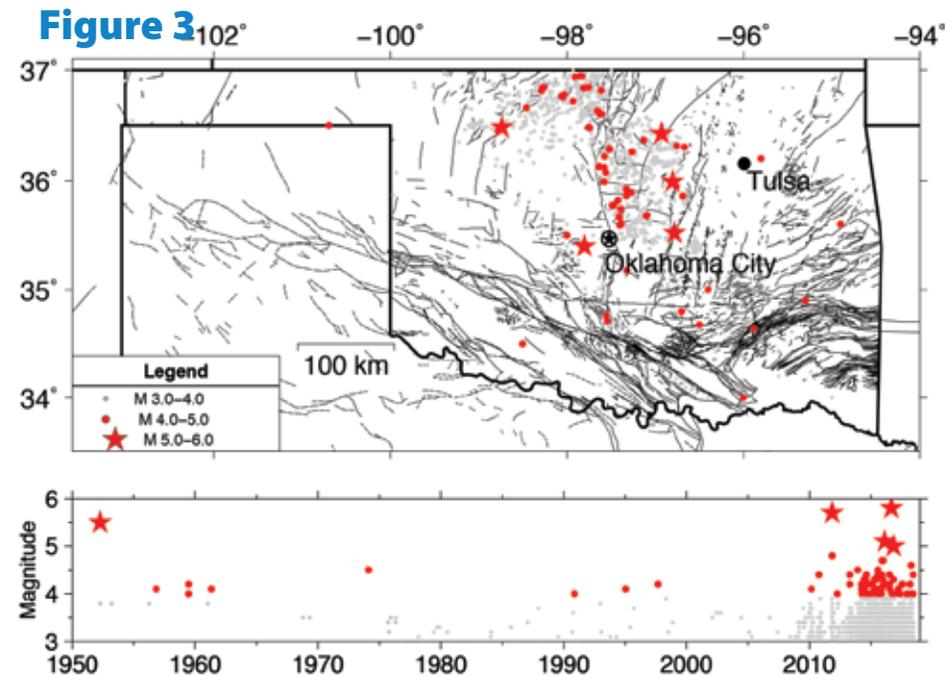
EARTHQUAKE MYTHS: EARTHQUAKES DON'T HAPPEN IN OKLAHOMA!

Until a decade ago, people probably didn't think about earthquakes when they thought about Oklahoma's natural disasters. Oklahoma is well-known to most folks across the country for weather-related hazards such as tornadoes and hail. Large earthquakes occur more often on plate tectonic boundaries such as the San Andreas fault in Southern California, but this does not mean that Oklahoma cannot have damaging earthquakes.

On November 6, 2011, a magnitude 5.7 earthquake occurred about 40 miles east of Oklahoma City near Prague, Oklahoma, and was the largest earthquake to occur in recent times in Oklahoma until a magnitude 5.8 earthquake occurred on September 3, 2016 near Pawnee, Oklahoma. Hundreds of buildings and homes were damaged. These earthquakes were not the only earthquakes to cause damage within Oklahoma. On April 9, 1952, a magnitude 5.4 earthquake occurred about 25 miles west of Oklahoma City and did damage to buildings in Oklahoma City. All these earthquakes were felt over very large regions of the central U.S. and are considered moderate earthquakes. Thankfully there have been no deaths associated with earthquakes in Oklahoma. These earthquakes occurred in the midst of a 200-fold increase in the frequency of smaller earthquakes with magnitudes large enough to be felt but not do major damage (M 4.0 and lower).

What led to the sudden increase in Oklahoma earthquakes? In the early 2010s, oil companies began horizontal drilling and hydraulic fracturing layers of rock. These formations contained substantial amounts of ancient saltwater locked up in those rocks, in addition to valuable hydrocarbons. This mostly occurred throughout

Central Oklahoma. To dispose of this saltwater, those companies utilized a decades-old method of pumping the wastewater deep underground into the Arbuckle Group, which lies directly above crystalline basement in Oklahoma. These rocks can be seen when driving along I-35 just north of Ardmore, they are visible due to mountain-building processes (large-scale movements of the Earth's crust).



Map of Oklahoma showing major population centers and some of the largest historical earthquakes as red stars (greater than Magnitude 5.0).

Locations of earthquakes with magnitudes between 4.0 and 5.0 are shown as red circles and faults mapped by OGS are shown throughout Oklahoma.

EARTHQUAKE MYTHS: EARTHQUAKES DON'T HAPPEN IN OKLAHOMA!

It is widely recognized by the scientific community and state agencies that wastewater injection into the Arbuckle Group led to the state's most recent large earthquakes. As a result, the Oklahoma Corporation Commission has taken measures to reduce the water volumes that can be injected. They continue to monitor this activity, with technical guidance from the Oklahoma Geological Survey.

Luckily these earthquakes did not lead to any fatalities, but those events and others, including the 2016 M 5.0 Cushing earthquake, have led to significant damage to buildings and homes. In developing countries, earthquakes of this size can do considerable amounts of damage, destroying thousands of buildings and injuring or killing many people. One such example would be a magnitude 5.7 earthquake that struck San Salvador in 1986 resulting in 1,500 fatalities and 10,000 injuries. Modern building codes and methods within the U.S. help protect people during moderate to large earthquakes. Because frequent, smaller earthquakes still occur, the seismic hazard in Oklahoma remains very high. Therefore, it is important for Oklahomans to know what to do in an earthquake in case a large one occurs in the near future.



https://upload.wikimedia.org/wikipedia/commons/c/c0/2011_Oklahoma_earthquake_damage.jpg
By Brian Sherrod, United States Geological Survey (United States Geological Survey
Multimedia Gallery) [Public domain], via Wikimedia Commons



<https://commons.wikimedia.org/wiki/File:HotelSanSalvador.jpg>
By Guasinay50 [Public domain], from Wikimedia Commons



HOW TO PREPARE BEFORE AN EARTHQUAKE



Before an Earthquake

- Talk to family or caregivers about how to protect your home and belongings from earthquake damage. Check for hazards in your home.
- Make sure that you have your supply kit and that it is maintained. Some of the supplies that you should have in your kit include batteries, flashlights, emergency food and water, and an emergency supply of your medications.
- In case family members are separated from one another during an earthquake, develop an emergency communications plan. Ask an out-of-state relative or friend to serve as the "family contact."
- Expect aftershocks. These secondary shockwaves are usually less intense than the main earthquake but can be strong enough to do additional damage to weakened structures.
- Tune into local media to stay informed about what is happening and what public officials are asking residents to do. Be prepared to follow their instructions.
- Talk to your friends and relatives about being prepared for an earthquake or other disaster and share your emergency plan with them.
- Don't be afraid to ask for help if you think you will need it. Having a plan and being ready are the keys to safety.

Create an Emergency Plan

- Schedule a family meeting to discuss the dangers of possible emergency events including earthquakes, fire, severe weather, hazardous spills and terrorism.
- Discuss how you and your family will respond to each possible emergency.
- Discuss what to do in case of power outages or personal injuries.
- Draw a floor plan of your home and mark two escape routes from each room.
- Ask an out-of-state relative or friend to serve as the "family contact." After a disaster, it may be easier to contact someone outside of the affected area. Try texting if phone calls won't work. Make sure everyone in the family knows the name, address, and phone number of the contact person.
- Pick two meeting places – one near your home and one outside your neighborhood in case you cannot return home after an emergency.
- Keep family records in a safe place.



Recommended Items to Include in a Basic Emergency Supply Kit:

- Flashlight and extra batteries
- A three-day supply of water, nonperishable food and snacks
- Portable battery-powered or hand crank radio AM/FM radio
- NOAA All Hazards Weather Radio with tone alert and extra batteries
- First aid kit and manual
- Manual can opener
- Essential medicines
- Cash and credit card
- Pet food and other pet supplies
- Whistle to signal for help
- Matches in a waterproof container
- Masks to guard against dust
- Moist towelettes, garbage bags and plastic ties for personal sanitation
- Wrench or pliers to turn off utilities
- Local maps
- Cell phone with charger
- Sturdy shoes
- Complete change of clothing including a long-sleeve shirt and long pants
- Baby supplies
- Fire extinguisher
- Mess kits (utensils), paper cups, plates, utensils, and paper towels
- Important family documents
- Paper and pencil
- Toiletries
- Comfort items such as books, games or toys

During an Earthquake, When the Ground Moves:

DROP

Drop down to the floor.

COVER

Take cover by getting under a sturdy desk, table, or other piece of furniture. If there isn't a table or desk near you, cover your head and neck with your arms and crouch in an inside corner of the building or against an interior wall.

HOLD ON

Hold on and stay in that position until the shaking stops and it is safe to move.



STAYING SAFE DURING AN **EARTHQUAKE**

Identify Your Safe Places

Before an emergency strikes, take time to identify your safest place at home, at school, or other places such as church, stores, office buildings, or friends' houses.

During an earthquake, always remember the phrase "**Drop, Cover, and Hold On.**" The safest place in most indoor rooms is under a sturdy desk, table, or other piece of furniture.

If you are in an empty room or a room without furniture large enough to crawl under, crouch against an interior wall or in a corner while covering your head and neck with your arms. Stay away from glass, windows, outside doors, and anything that could fall, such as light fixtures or other hanging objects. Avoid tall furniture like bookcases that could fall over.

Look for a safe place in each room you might be in when an earthquake occurs.

Discussion:

What would you do if an earthquake occurred while you were at school? Or at a shopping mall? Or at a sports stadium? Think about each place and make a plan.

Quake Tips:

- In **BED**, stay there and cover your head and neck with a pillow.
- When **OUTDOORS**, move to a clear area away from trees, signs, buildings, or downed electrical wires and poles.
- In a **CLASSROOM**, *Drop, Cover and Hold On* under your desk or table.
- When **DRIVING**, pull over to the side of the road and stop. Avoid overpasses and power lines. Stay inside your vehicle until the shaking stops.
- When in a **CROWDED STORE OR OTHER PUBLIC PLACE**, *Drop, Cover and Hold On* where you are. A shopping cart will provide some protection from falling objects.
- When in a **STADIUM OR THEATER**, *Drop* to the ground in front of your seat or lean over as much as possible, then *Cover* your head with your arms, and *Hold On* to your neck with both hands.
- When in a **TALL BUILDING**, *Drop, Cover and Hold On* under a sturdy desk or table. Avoid windows or other hazards. Do not use the elevators.

Earthquakes can strike suddenly, so it is important to be prepared. There are many things in our homes, schools, and communities that could cause us harm during an earthquake. We refer to these things as “hazards.” Potential hazards include objects that might fall, break, or catch fire during an earthquake.

There may be many hazards that we cannot correct. But identifying these hazards will help us to anticipate them and avoid danger and injury.

Hazards inside a building may include:

- falling ceiling plaster and light fixtures
- overturned bookcases and other tall furniture or appliances
- falling objects from shelves and walls such as lamps or mirrors

Hazards outside a building may include:

- toppling chimneys
- falling brick from walls
- collapsing walls
- falling glass from broken windows

Learn how to recognize and avoid the following additional hazards that can be caused by an earthquake:

- downed power lines
- damage to bridges and roads
- fires from spilled gasoline and other chemicals
- landslides

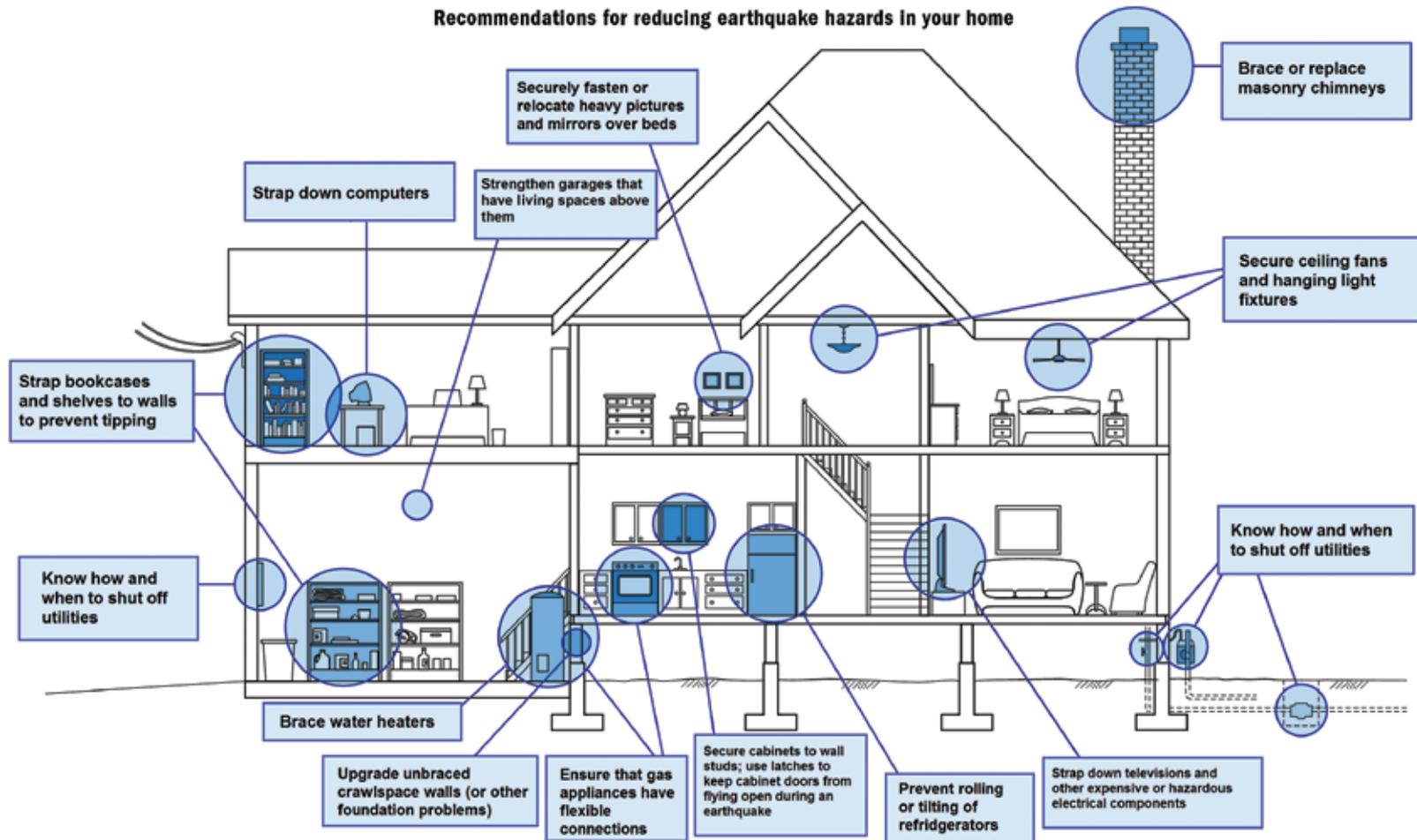
Quake-Safe Home Checklist

Before an earthquake occurs you should look around your house and identify hazards that could be harmful if an earthquake should occur. Correcting or identifying these hazards will help you to anticipate them and avoid danger and injury. Below is a list of some easy things you and your family can do to protect your home from an earthquake or other natural disaster such as tornado or wind storm.

- Place beds so that they are not next to large windows.
- Place beds so that they are not right below hanging lights, heavy mirrors, framed pictures, or shelves.
- Replace heavy lamps on bed tables with light, non-breakable lamps.
- Change hanging plants from heavy pots into lighter pots.
- Remove all heavy objects from high shelves.
- Remove all breakable things from high shelves.
- Remove glass containers that are around the bathtub.
- Move materials that can easily catch fire so they are not close to heat sources.
- Make sure heavy mirrors or picture frames are well fastened to walls.

Earthquake Home Hazard Hunt

Recommendations for reducing earthquake hazards in your home



More Hazard Hunt Ideas:

1. Conduct a hazard hunt in the classroom or throughout the school building.
2. Identify potential hazards in the classroom that may cause injury during an earthquake.
3. How do you avoid these hazards and stay safe during an earthquake?

Discussion:

1. What types of earthquake hazards would you find inside your home?
2. What can you do to make those hazards safer?
3. How can you stay safe from these hazards by practicing "Drop, Cover, and Hold On?"

The amount of damage caused by an earthquake depends on the magnitude and location of the quake. It can vary from minor cracks or items knocked off shelves to major damage to buildings, roads or bridges.

Earthquakes can be very scary for people of all ages. Involving children and teenagers in the preparedness steps previously discussed in this workbook, such as developing an earthquake plan, preparing an earthquake emergency kit and practicing “Drop, Cover, and Hold on,” can help minimize stress when an actual earthquake occurs.

What to do after an earthquake

After an earthquake, there are things you can do to stay safe, make sure others are safe, and cope with what you have just experienced. Here are some general guidelines on what to do after an earthquake.

- Be prepared for possible aftershocks
- Take care of yourself first. Make sure you are okay before you try to check on family members or friends.
- Be cautious of falling objects when opening cabinets or closet doors.
- Be cautious of bricks or other building materials that could fall off of the outside of buildings.
- Wear sturdy shoes to avoid injury from broken glass and debris.
- Turn on the TV or radio or check online for instructions on safety or recovery actions. Emergency officials will provide safety information through the news media.
- Use the telephone for emergencies only.
- When safe, follow your family emergency plan.
- Use your emergency communications plan to make contact with any family members that you have been separated from.
- Help check for injuries. If a person is bleeding or appears to be injured, call an adult to help them. Do not attempt to move a seriously injured person. Call 9-1-1 for medical help for serious injuries.
- If you begin to feel sick, call for help right away.
- Keep an eye out for damage to your house from a distance by looking for cracks, leaning walls or fallen bricks. If any part of the building looks unsafe, leave the building and alert an adult immediately. Buildings could receive additional damage from aftershocks.
- Avoid hazards. Stay away from damaged areas and other hazards such as downed power lines, broken glass and damaged electrical wiring. If you smell gas, alert an adult immediately.
- Be careful of fires or fire hazards. Call 9-1-1 immediately if you see fire or smell smoke.
- Be aware that the first 72 hours after an earthquake, or any disaster, are the most critical. Electricity, gas, water and telephones may not be working and may take time to be restored.
- Avoid areas of town that have been damaged by an earthquake. Keep the area and streets clear for emergency vehicles.
- Know that it is okay to be scared or stressed. Talk to an adult about what you experienced.

After you've recovered:

- Restock your Supply Kit.
- Review and update your family emergency plan.
- Learn more about how to help your community during future earthquakes or other emergencies.

Classroom Activity:

- 1.) Pretend an earthquake has occurred. Which areas should you avoid while evacuating the building? Which areas would not be safe?
- 2.) Research a recent earthquake and discuss with your class what the community has done to recover from the damaging effects of the earthquake.

Helpful Websites:

Oklahoma Geological Survey
www.ogs.ou.edu

Oklahoma Department of Emergency Management
www.oem.ok.gov

Central U.S. Earthquake Consortium (CUSEC)
www.cusec.org

Center for Earthquake Research & Information (CERI)
www.ceri.memphis.edu

National Earthquake Hazards Reduction Program (NEHRP)
www.nehrp.gov

Federal Emergency Management Agency (FEMA)
www.fema.gov

U.S. Geological Survey (USGS)
www.earthquake.usgs.gov

Ready America
www.ready.gov/america

American Red Cross
www.redcross.org

American Veterinary Medical Association
www.avma.org

At 10:18 a.m. on October 18, 2018, millions of people will “Drop, Cover, and Hold On” in The Great ShakeOut, the world’s largest earthquake drill. All schools are encouraged to participate on that day or schedule a drill for another day during the school year.

Major earthquakes may happen anywhere you live or travel and the ShakeOut is an opportunity to practice how to be safe during an earthquake and to learn how to be better prepared.

Why is a “Drop, Cover, and Hold On” drill important? As with anything, to act quickly you must practice often. You may only have seconds to protect yourself in an earthquake before strong shaking knocks you down, or something falls on you. **Everyone can participate!** Individuals, families, businesses, schools, colleges, government agencies and organizations are all invited to sign up for the ShakeOut.

Here are a few suggestions for what schools can do to participate in the ShakeOut. More ideas, materials, and other resources can be found at www.ShakeOut.org/centralus/schools.

Plan Your Drill:

- Register at www.ShakeOut.org/centralus/register to be counted in the ShakeOut Drill, get email updates, and more.
- Download a Drill Broadcast recording from www.ShakeOut.org/drill/broadcast.
- Have a “Drop, Cover, and Hold On” drill at 10:18 a.m. on October 18 or another date. You can also exercise other aspects of your emergency plan.
- Discuss what you learned and make improvements.

Get Prepared for Earthquakes:

- Check your emergency supplies and equipment; make sure they are accessible and functional.
- Download and review school preparedness materials from www.ShakeOut.org/centralus/schools.
- Encourage staff and students to prepare at home.
- Distribute ShakeOut take-home materials.

Share the ShakeOut:

- Encourage students and staff to ask their friends, families and neighbors to register.
- Ask colleagues at other schools to participate.
- Posters, flyers, and other materials for promoting the ShakeOut are available at www.ShakeOut.org/centralus/resources.
- Share your experience at www.ShakeOut.org/centralus/share.



On October 18, 2018 at 10:18 a.m.,



Get Ready to Shake Out

Join Us

for the Largest Earthquake Drill in Central U.S. History



Register at www.ShakeOut.org/centralus