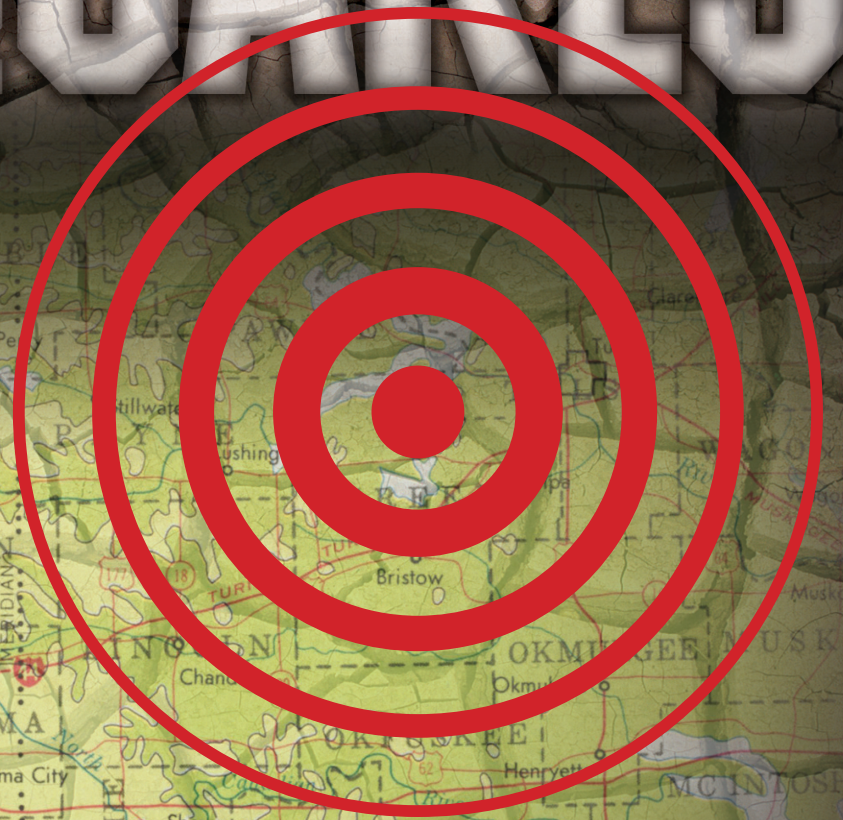


EARTHQUAKES

IN OKLAHOMA



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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 book will provide an overview on earthquakes, from how they occur to how to stay safe and practice earthquake drills.

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Photo provided by FEMA



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 deep 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.

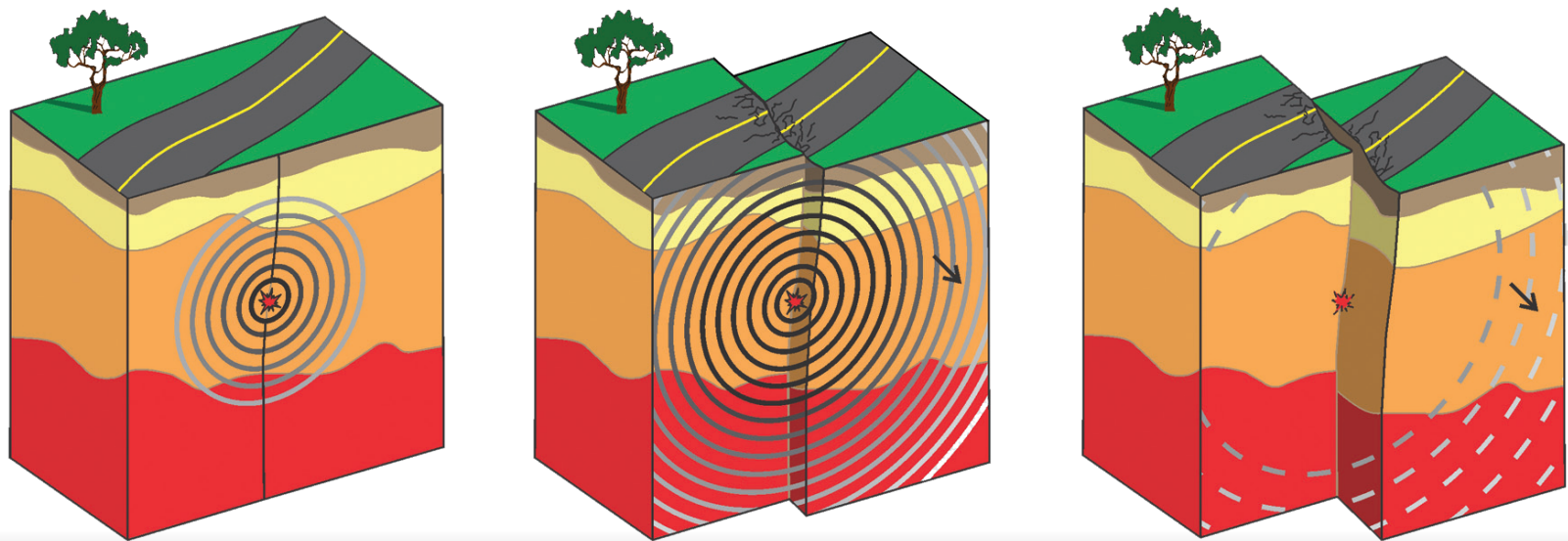
SOIL LIQUEFACTION - This happens when the movement caused by an earthquake forces water to seep into the material beneath a building, thereby causing saturated granular material to lose its strength and briefly change into a liquid from a solid. This can force the foundations of homes or other buildings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

WHAT ARE EARTHQUAKES AND HOW DO THEY DO DAMAGE?

Earthquakes occur when two blocks of rock within the Earth's crust slide past each other within the Earth. 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 or smaller than a football field, and everything in between. The epicenter is the location on the surface of the Earth above the point where the earthquake first originated.

The figure below 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.

Earthquakes do damage in a few different ways. When an earthquake occurs, the ground can be moved significantly compared to the other side of the fault. Buildings and roads 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, and 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.



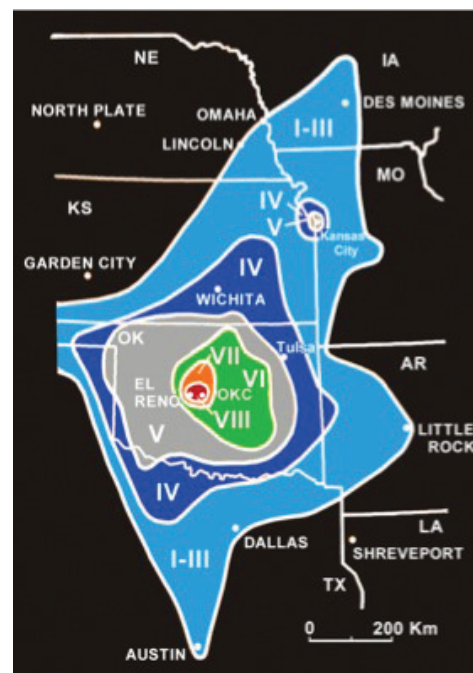
In addition, the seismic waves can cause the ground to lose its strength. Soils that contain large amounts of water can lose their strength when they are shaken. This is called liquefaction, and can cause buildings to collapse because the soils underneath cannot support the weight of the building. Mountains can have landslides if large amounts of material on a steep-slope collapse quickly and come down the side of the mountain. Landslides have been associated with many earthquakes around the world. In 1959, an earthquake near Yellowstone National Park caused a landslide that blocked the flow of a river and created a new lake called Quake Lake.

ADDITIONAL MATERIAL:

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

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

http://en.wikipedia.org/wiki/1959_Yellowstone_earthquake



This map shows how the intensity of seismic waves decreases with distance from an earthquake. The areas of greatest shaking are shown in red, and blue regions indicate where the earthquake was barely noticed. These are the Modified Mercalli Intensities for the April 9, 1952, El Reno, Oklahoma, earthquake.

ACTIVITY:

Ingredients you will need:

two rectangular pieces of cardboard
hole puncher
tape

string

cookie sheet

dirt (enough to cover the two cardboard pieces)

Use the hole puncher to punch out two holes on one side of each piece of cardboard. Then put the string through the holes. Tie a knot using the ends of the string for both pieces of cardboard. Tape the cardboard pieces together but lay them so that the ends are not touching. Place the cardboard pieces on the cookie sheet. Put some dirt over the top of the cardboard pieces. Make sure the dirt is covering both pieces completely. Pull on the strings outward and watch the dirt as it simulates an earthquake. (Activity is best done outdoors)

EARTHQUAKE MYTHS: EARTHQUAKES DON'T HAPPEN IN OKLAHOMA!

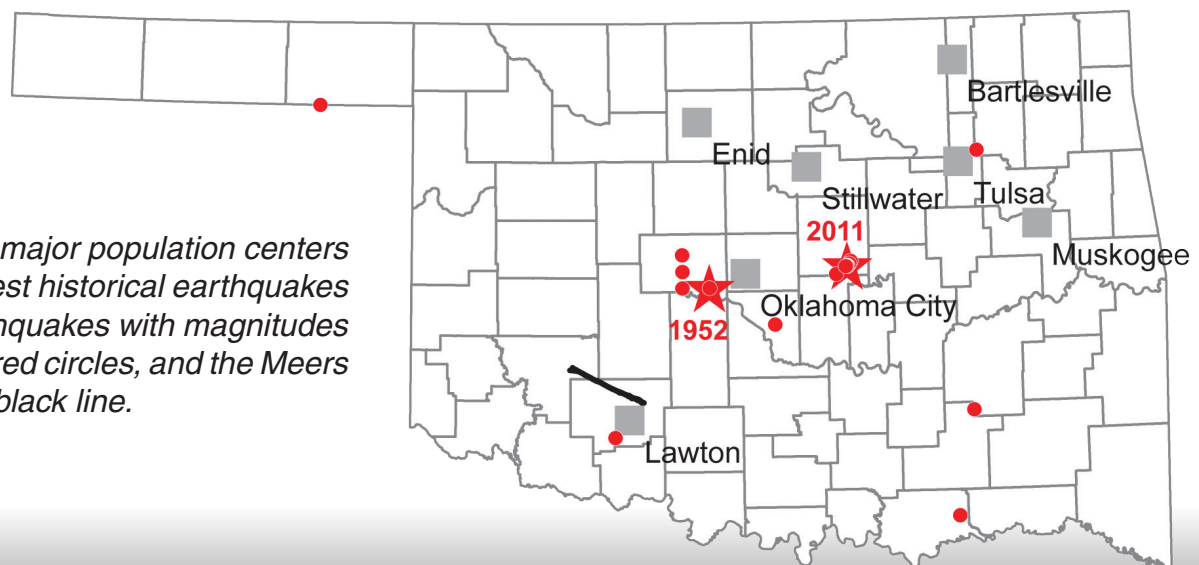
People don't think about earthquakes when they think about natural disasters in Oklahoma because each year more damage is done from weather-related hazards such as tornadoes and hail than has ever occurred due to earthquakes. Large earthquakes occur more often on plate tectonic boundaries such as the 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 historical times in Oklahoma. Hundreds of buildings were damaged and several homes were damaged beyond repair. While earthquakes of this size rarely occur in Oklahoma, there is no way to know when or where a large earthquake will occur. This earthquake is not the only earthquake to have caused 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. Both earthquakes were felt over very large regions of the central U.S., and are considered moderate earthquakes. There have been no deaths associated with earthquakes in Oklahoma.

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. The buildings in and around San Salvador were not built as well as buildings here in Oklahoma, which resulted in so much damage in San Salvador and only minor damage and injuries from Oklahoma's largest historical earthquakes.

This map of Oklahoma shows major population centers in grey boxes and the two largest historical earthquakes as red stars. Locations of earthquakes with magnitudes greater than 4.0 are shown as red circles, and the Meers fault is shown as a thick solid-black line.





The two earthquakes that caused damage here in Oklahoma may be quite small compared to earthquakes that have occurred in the past and could occur in the future. The Meers fault located in southwestern Oklahoma is the only fault known to have had a large earthquake in recent geologic time. The last earthquake to have occurred on the Meers fault was about 1,300 years ago and could have been as large as a magnitude 7. We know this because the fault is visible at

the surface and we can obtain ages for the soils which were offset by the earthquake as the fault ruptured to the surface. While large earthquakes may not occur regularly in Oklahoma they certainly have occurred in the past and could again occur in the future.

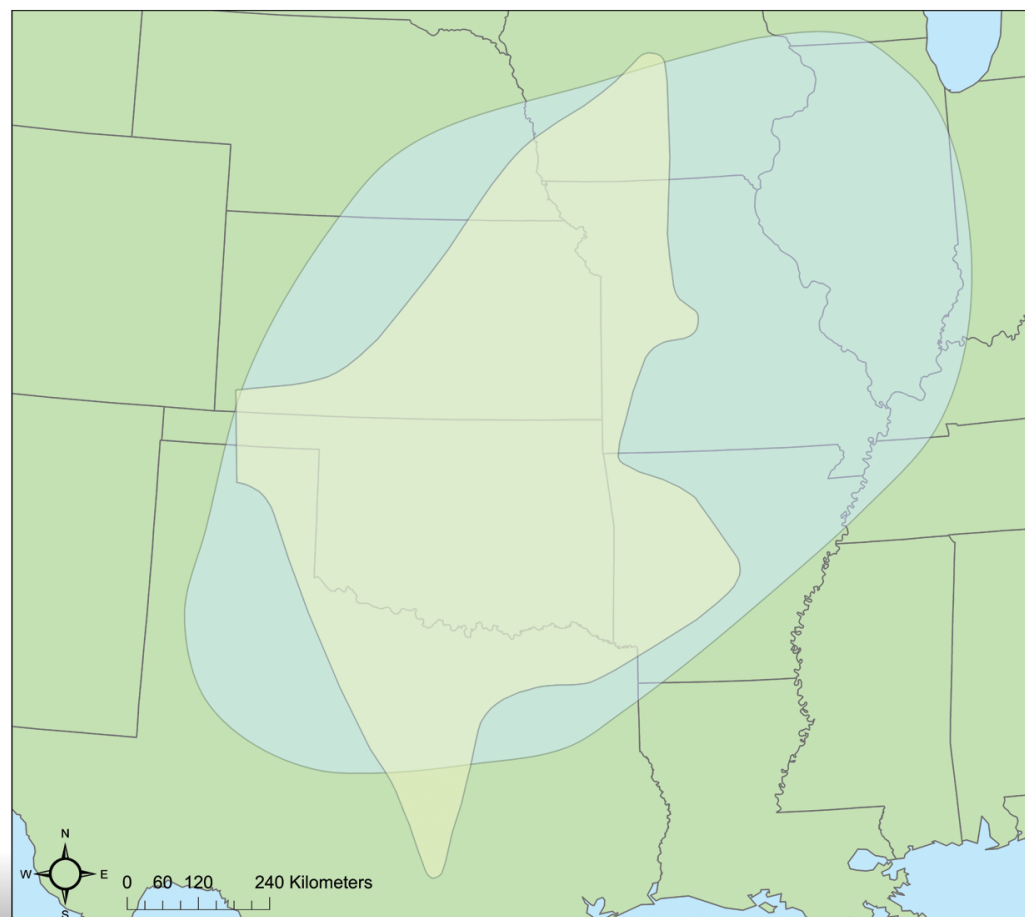
The map below shows the areas of the central U.S. where people reported feeling both the 1952 and 2011 earthquakes.

Map of the Central U.S. where people reported feeling both the 1952 and 2011 earthquakes



Data from the USGS

Projected Coordinate System:
USA_Contiguous_Albers_Equal_Area_Conic
Geographic Coordinate System:
GCS_North_American_1983





HOW TO PREPARE 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.
- Stay informed about what is happening and what public officials are asking citizens to do. Be prepared to follow their instructions.
- If you know of friends, neighbors or families with disabilities or special needs, talk to them about their plans and ensure that they are safe in case of a natural or man-made disaster.
- 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

Steps to take in creating a household emergency plan include:

- 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.
- Because it is often easier to successfully contact someone in another state during an emergency than within the affected area, choose an out-of-state friend or relative whom all family members will call if separated during an emergency.
- 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 water- and fireproof safe. Inexpensive models can be purchased at most hardware stores.

RECOMMENDED ITEMS TO INCLUDE IN A BASIC EMERGENCY SUPPLY KIT:

- A three-day supply of water, nonperishable food and snacks
- Battery-powered or hand crank AM/FM radio and a NOAA
- NOAA All Hazards Weather Radio with tone alert and extra batteries
- Flashlight and extra batteries
- First aid kit and manual
- Cash
- 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

- Can opener for food
- Local maps
- Cell phone with chargers
- Essential medicines
- Complete change of clothing including a long-sleeve shirt and long pants
- Sturdy shoes
- Baby supplies
- Fire extinguisher
- Mess kits, paper cups, plates, utensils, and paper towels
- Important family documents
- Paper and pencil
- Toiletries
- Books, toys and games
- Pet food and extra water

ACTIVITY:

Prepare an Earthquake Safety Kit for the classroom:

Ask the kids to create a kit for their homes, either by drawing a kit with each item or by bringing the kit to class to show and tell.



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.





IDENTIFY YOUR SAFE PLACES

Before an emergency strikes, take time to identify your safest place at home, at school, or other places such as office buildings, church, stores 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. Avoid tall furniture that could fall over. Look for a safe place in each room you might be in when an earthquake occurs.

QUAKE TIPS:

- When in a **TALL BUILDING**, move against an interior wall if you are not near a desk or table. Protect your head and neck with your arms. Do not use the elevators.
- When **OUTDOORS**, move to a clear area away from trees, signs, buildings, or downed electrical wires and poles.
- When on a **SIDEWALK NEAR BUILDINGS**, duck into a doorway to protect yourself from falling bricks, glass, plaster and other debris.
- 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**, move away from display shelves containing objects that could fall. Do not rush for the exit.
- When in a **STADIUM OR THEATER**, stay in your seat, get below the level of the back of the seat and cover your head and neck with your arms.

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.



IDENTIFYING EARTHQUAKE HAZARDS

Earthquakes can strike suddenly, so it is important to be prepared. There are many things in our homes, school, and community 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

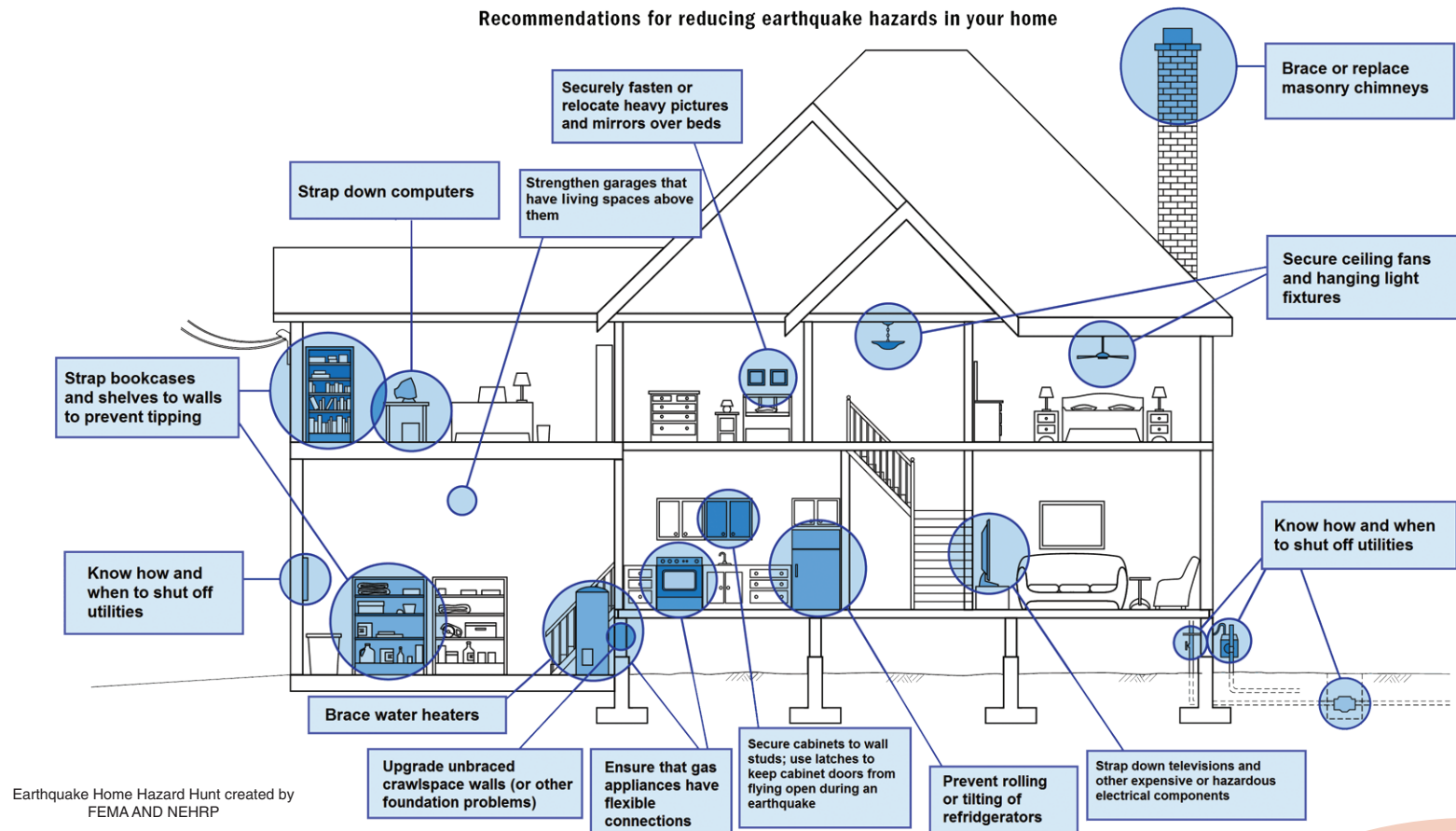
QUAKE-SAFE HOME CHECKLIST

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



Earthquake Home Hazard Hunt created by
FEMA AND NEHRP

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 homes?
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?"

AFTER AN EARTHQUAKE

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.

When the earthquake is over:

- Check on the status of your family's physical health and the safety of your home.
- Travel may be impossible for three days or more if roads or bridges are damaged or blocked, or you live in a remote area. Be prepared with supplies until help arrives.
- Take one step at a time and ask for help if you need it.

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.



Photo provided by FEMA

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

Oklahoma Geological Survey
www.okgeosurvey1.gov

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

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

Ready.Gov
www.ready.gov

American Red Cross
www.redcross.org

American Veterinary Medical Association
www.avma.org



The Great Central U.S. ShakeOut™

GET READY TO SHAKEOUT!

At 10:15 a.m. on February 7, 2013, millions will “Drop, Cover, and Hold On” in The Great Central U.S. ShakeOut, the largest earthquake drill ever! All schools are encouraged to participate in the drill (or plan a more extensive exercise) at 10:15 a.m. on 2/7!

More than 2 million people in communities throughout the states of Alabama, Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri, Oklahoma and Tennessee will participate in this event.

Major earthquakes may happen anywhere in the Central U.S. The ShakeOut is our chance to practice how to protect ourselves, and for everyone to become 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 register 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 10:15 a.m. on February 7. 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.
- Plan how reporters will cover the drill.
- Posters, flyers, and other materials for promoting the ShakeOut are at www.ShakeOut.org/centralus/resources.
- Share your experience at www.shakeout.org/centralus/share.

On February 7, 2013 at 10:15 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