SECTION 2
THE NATURE OF
THE EARTHQUAKE THREAT

OBJECTIVE

To present information on the history, consequences, and existing threat of moderate to major eaythquakes in Arkansas.

When people know what to expect in an emergency, even if only in general terms, they tend to react in a more reasonable, coherent manner. It is very important, therefore, to present realistic, believable expectations about earthquakes.

As educators, take advantage of the natural laboratory we live in. There are all kinds of lessons we can learn from earthquakes -- lessons in history, political science, urban planning, physics, and geology. You are educating children who may be able to make a difference in the future as engineers, seismologists, legislators, policy analysts -- all of whom can play a vital role in making our environment safer.

The magnitude 7.1 Loma Prieta earthquake (October 1989) provides us with an excellent example of the types of problems that arise in a major earthquake.

Following are some of the "geologic lessons" learned or reaffirmed from the Loma Prieta earthquake:

- There were no known short-term precursors to warn of the impending quake.

- The intensity of ground shaking was affected by local soil conditions. Damage in the Marina District in San Francisco and to structures such as the Bay Bridge and the Cypress section of Interstate 880 was enhanced due to poor soils in these areas.

- Seismic shaking triggered many landslides in areas of steep unstable slopes. The landslides damaged buildings and blocked many highways and roads.

- Damage to structures with adequate foundations on good ground was minimal. Serious damage was primarily restricted to older buildings and homes that predate recent building code changes.

The last damaging earthquake in the New Madrid Fault was on October 3 1, 1895. The epicenter was located near Charleston, MO at 39.0° N, 89.4° W. It was about a 6.2R episode.

Prior to that on January 5, 1843 a 6.OR earthquake occurred at or about Marked Tree, AR.

But the greatest recorded earthquake events occurred during a three month period of December 16, 1811 through March 15, 1812.

These were listed as follows:

DATE	LOCAL TIME	MAGNITUDE	EPICENTER	PRESENT CLOSET CITY
1811 Dec 16	2:15 am	8.6	35.8° N, 90.3° W	Marked Tree, AR
1811 Dec 16	8:15 a.m.	8.3	36.0° N, 90.0° W	Calumet, AR
1811 Dec 16	12:00 noon	8.0		Caruthersville, MO
1812 Jan 23	9:00 a.m.	8.4	36.2° N, 89.8° W	Caruthersville, MO
1812 Feb 7	3:45 a.m.	8.7	36.5° N, 89.6° W	New Madrid, MO

In addition, there were approximately 2,012 earthquake events in the New Madrid Fault occurring during that period of time:*

5 were about 7.7R
10 were about 6.7R
35 were about 5.9R
65 were about 5.3R
89 were about 5.OR
1,800 were between 3.OR to 45R

The fact that the New Madrid Fault is now much closer to densely populated areas means that damage and loss of life from similar quake sizes will be much greater.

It is inevitable that there will be damaging earthquakes in Arkansas, but they need not be major catastrophes. You hold some of the keys to reducing the risk posed by earthquakes, both in terms of making our schools safer places now and educating our children to understand and live wisely with earthquakes.

KEEP IN MIND

- Don't paint too gloomy a picture of potential earthquake damage. Keep it moderate and believable. People tend to lose motivation if they believe the only damaging earthquake is a catastrophic one.

- Try to tie these activities to student preparation for a damaging earthquake as well as to the existing earth science curricula.

- Staff, students and parents all should receive earthquake information. Remind staff that they need to have an earthquake plan at home so that they can -confidently remain at school. Communicate your plans to parents and encourage them to develop plans at home as well.

- Consider, if appropriate, bringing in an expert to discuss the earthquake threat with staff, or use video or slide shows to illustrate the threat.

ACTIVITIES

1. Use the attached **situation cards** to guide a discussion with staff about what would happen at your school in the event of an earthquake.

2. Review **The Earthquake Threat of the New Madrid Fault** and discuss the nature of the earthquake threat with staff. Identify how an earthquake could affect staff in terms of ability to get to work, to get home, etc.

THE EARTHQUAKE THREAT OF THE NEW MADRID FAULT

Seismologists have provided us with an estimated probability of 40% to 60% for the occurrence of a 6.5R earthquake happening in the New Madrid Fault within the next 15 years. Their probability projections for the 6.5R earthquake is 93 % to 98 % within the next 50 years.

Estimates for 6.5R earthquakes based on the actual seismic event occurrence is one to occur ever 55 to 85 years.

Looking at the last event in that range (6.2R) in 1895 and adding 85 years to that date, 6.5R activity should have presented itself during 1980.

QUESTION: What is the likelihood that another damaging earthquake will occur in the New Madrid area in my lifetime?

ANSWER: The U.S. Geological Survey estimates a 40% to 60% chance of a large earthquake--magnitude 6.5 R or greater--in the New Madrid Fault area.

QUESTION: What are the most dangerous areas in Arkansas relating to the New Madrid Fault?

ANSWER: The 24 counties in Arkansas most likely to sustain damage from large earthquakes in the southern part of the New Madrid Fault are:

Mississippi	Crittenden
Poinsett	Cross
St. Francis	Lee

Clay	Greene
Craighead	Lawrence
Jackson	Wooodruff
Monroe	Prairie
Arkansas	Phillips
Randolph	Sharp
Independence	White
Lonoke	Lincoln
Desha	Chicot

Had the area above, which was affected by the past damaging quakes been heavily populated, as it is now, with today's many unreinforced masonry structures and non-seismically built roads, bridges and overpasses, the death and destruction would have been enormous.

Seismologists expect a 6.5R occurrence to happen once every 55 years to 85 years, a 7.0R every 200-300 years and an 8.0 to 8.8R every 600-1,000 years. *

*DATA FROM: Estimation of Earthquake Effects Associated with Large Earthquakes in the New Madrid Zone by Margaret G. Hopper, USGS and The Effects of Earthquakes In The Central United States, by Otto W. Nuttli

Because all of the counties listed are in an alluvial plane that consists of a water saturated sandy loam type soil to a 3 to 5 mile depth, strong ground motion can cause great damage to non-seismically built buildings.

Also because of unstable soils, in the event of an 8.6R or larger quake, serious damage can occur in parts of an additional 22 to 30 counties to the west and southwest of the above mentioned counties.

Most highways, bridges, utility systems and other lifeline networks in the New Madrid Fault Zone are constructed on or beneath these unstable soils as well. This fragile infrastructure could be seriously disrupted for an extended period of time following a significant earthquake.

QUESTION: Which lifelines are at greatest risk from strong ground shaking?

ANSWER: Movement along highways and streets built on soft soils will be severely impaired and will hamper emeraency response activities. Another reasonable assumption i s that all utilities will be out for part of the time in the first 72 hours after a major earthquake.

QUESTION: Which types of buildings are at greatest risk from strong ground shaking"

ANSWER: The most vulnerable building types are unreinforced masonry (UFAI). tilt-up concrete, and pre-1972 non-ductile concrete frame buildings. There are thousands of URMs in the cities and hundreds of tilt-ups and concrete frame structures were built in the 50s and 60s in the downtowns and industrial parks of communities.

QUESTION: I'm in a well-designed and engineered building; are there other potential hazards besides structural collapse I should be aware of?

ANSWER: Yes. Nonstructural hazards such as unbraced bookcases and file cabinets, light fixtures, glass, and electronic equipment may fall, shatter, and fly about. Contents can be just as hazardous as unsafe buildings.

Earthquakes cannot be prevented; however, damage, destruction, loss of life, and even disruption can be significantly reduced by preparing homes, neighborhoods, schools, workplaces, and communities for the next inevitable quake.

SITUATION I

It's midday and all classrooms are full. You feel a sharp jolt and immediately call for "duck and cover". A couple of seconds later the building begins to shake again, but more violently. Glass windows break and shower students with glass shards. Light fixtures and other nonstructural elements fall on top of desks. The heavier items don't hurt the children, but the broken glass causes many minor cuts. Power is out and you are waiting for a decision on evacuation.

Discussion Points:

1. Who makes the decision to evacuate and how is this communicated to the classroom in a timely fashion? (Remember the power is out.?

2. While waiting for the evacuation decision, what should the.teacher be doing?

3. Given the possibility of aftershocks occurring, how can student anxiety be reduced'?

4. Could any of these nonstructural problems have been prevented or reduced"

SITUATION 2

The time is 2:30 PM and a major earthquake of about 7 magnitude has struck near your school. Most major highways and surface streets are either damaged or clogged with cars and debris. It may be several hours before highways are passable. There are some injuries at school, but most students are only shaken and ready to go home. The power, water, and--most importantly--telephone systems are not functioning.

Discussion Points:

1. Does the school (or the district) have a policy for the release of students?

2. Before any students are released, especially to a person other than a parent, what procedures must be followed?

3. How are school grounds secured and students accounted for?

4. What preparations have been made to keep students into the evening or overnight?

5. Which staff have been designated to remain on duty overnight if it becomes necessary?