Utah's Earthquake Threat
Slide Set/Captions

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Plate Tectonics

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TEXT for Slide Set

1. **Plot of earthquake epicenters worldwide** [courtesy of Utah Museum of Natural History]
Earthquakes occur worldwide. The locations of most earthquakes are along plate boundaries. But, if you look closely you will see that earthquakes also occur within plates. Look at the U.S. Can you see the "right arm" of earthquakes that extends inward and upward from California?

2. **Seismicity of the Intermountain Seismic Belt (ISB) from 1850 to 1974** [courtesy of *Places With Hazards* curriculum section: Earthquakes, Utah Geological Survey]
A close-up of that "right arm" shows that it extends across southern Nevada, up through the central part of Utah, Idaho, and Montana. We live in a seismically active area. Approximately 700 earthquakes are recorded annually in the Utah region by the University of Utah Seismograph Stations. Most are too small to be felt. However, since settlement in 1847, approximately forty earthquakes have caused significant damage. The most expensive was a magnitude 5.7 event that occurred in Cache Valley in 1962 causing one million dollars in property damage.

3. **Generalized map of Quaternary faults in Utah** [courtesy of University of Utah Seismograph Stations; data source Utah Geological Survey]
Earthquakes occur on faults. This is a generalized map of faults in Utah. The named faults are considered areas of significant seismic hazard. We have so many faults because we are part of the Great Basin—that area between the Sierra Nevada Mountains in California and our Wasatch Range—that has been extending (stretching) for approximately 15 million years. The stretching builds up strain energy in the crust until it suddenly breaks and moves in an earthquake.

4. **Cartoon of a typical misconception about what happens in an earthquake**. [courtesy of Utah Museum of Natural History]
Now that we know Utah is "Earthquake country," let's look at what happens in an earthquake. First, the earth <u>does not</u> split open and close again swallowing people and neighborhoods. This is a common misconception that Hollywood reinforces. Many movies and cartoons depict swallowing in earthquakes (e.g.; Superman, Shogun, Land Before Time, etc.).

Now let's look at what really happens in earthquakes. The geologic setting relevant to faulting and earthquake hazards is similar throughout the ISB. Data gathered in the last fifty years from large earthquakes that have occurred throughout the ISB, give us excellent information about what we can expect in Utah when a similar event occurs here.

5. **1983 Borah Peak, Idaho fault scarp** [courtesy of Utah Geological Survey; Bill Lund]
If the earthquake is large enough (magnitude 6.5 or greater for the ISB states), movement of blocks of rock along the fault will be enough to rupture the surface of the earth, producing a fresh cliff face or fault scarp. The magnitude 7.3 earthquake that occurred in central Idaho in 1983 produced this new fault scarp 26 miles long and with a maximum displacement of 9.8 feet. (Notice that the man is standing on the down thrown block of rock. There was no opening up.)

This is typical of what we expect to happen along the Wasatch fault in Utah—a maximum of a magnitude 7.5 earthquake with a displacement of six to eighteen feet.

6. **School in Anchorage, Alaska damaged by a landslide caused by the 1964 Good Friday earthquake** [courtesy, Utah Geological Survey; Bill Lund]
If a building were built across such a vertical fault, the damage would be similar that seen in this slide. Half a building can't be raised six to eighteen feet without splitting it in half.

7. **Wasatch fault in SL valley near 3900 South and Highland Dr.** [courtesy, Utah Geological Survey]
Salt Lake City has built heavily along the Wasatch fault. In the central part of this slide the fault shows up as a linear shadow. The location is approximately along Highland Dr. in the area of 3900 South. When this section of the fault moves again, many homes and businesses will be a risk to fault rupture. However, fault rupture occurs in a very limited area compared to the more widespread hazard of intense ground shaking.

8. **Graphic of horizontal ground shaking effect on a building** [courtesy of Utah Museum of Natural History]
The ground can move in all directions during an earthquake—up and down, side-to-side, and in a rolling motion similar to waves in the ocean. However, it is the side-to-side shaking that produces the most damage to buildings and other man-made structures that have not been specifically designed to withstand earthquakes.

9. **Nonstructural effects: fallen cabinets/shelves, etc. resulting from the 1994 Northridge earthquake** [courtesy Earthquake Engineering Research Institute]
This side-to-side shaking causes many objects to fall and is a significant cause of damage and injury. Top-heavy furnishings and anything on shelves can easily be thrown to the floor. Action taken ahead of time to anchor or rearrange such objects can greatly reduce losses.

Now we'll look at what can happen to buildings themselves.

10. **Building in Challis, Idaho after 1983 Borah Peak earthquake.** [courtesy of *The Challis Messenger* newspaper]
A typical result of severe ground shaking is that building facings or facades fall onto the sidewalk below. A small rock-faced second-hand clothing store in the small town of Challis, Idaho lost its front facade during the 1983 Borah Peak earthquake with tragic results. Two children walking to school were killed by the falling rock. If you are outside during an earthquake, you must move away from buildings as soon as you feel the ground begin to shake! If you are inside, don't panic and run outside. You may not get further than the sidewalk! Your best response is to duck under a table or a desk until the shaking stops.

11. **School in Mexico City after 1985 magnitude 7.1 earthquake.** [courtesy of photographer, Bill Gates, Dames & Moore, Oakland, CA; available as poster from Utah PTA.]
Even in the worst-case-scenario of building collapse, it is possible to survive if you take a duck,

cover and hold position under or next to sturdy pieces of furniture. The heavy floors of this Mexico City school collapsed, but were held off the floor by the furnishings. No one was in the school when this earthquake occurred, but had they been, a quick "duck, cover, hold" response to ground shaking would have saved lives. Building collapse is rare compared to falling facades and nonstructural damage.

12. **Collapse of Route 10 freeway overpass in 1994 Northridge Earthquake** [courtesy of Earthquake Engineering Research Institute]
In addition to buildings, bridges and overpasses are vulnerable to ground shaking. This is one of the overpasses that collapsed during the Northridge earthquake.

13. **Pickup truck driven into section of road buckled by an earthquake**. [courtesy of Utah Geological Survey, Bill Lund]
Roads may be impassable after an earthquake. Pavement cannot easily withstand the rolling of earthquake waves, especially if it causes the soil beneath it to settle. You may need a four wheel drive to get around after an earthquake.

14. **Pipe broken by earthquake-induced liquefaction** [source uncertain? Possibly from LesYoud, BYU]
Pipes underground can easily rupture during an earthquake. What problems can that cause?

15. **Flood and fire due to broken water mains and gas lines in Northridge EQ**. [courtesy of Earthquake Engineering Research Institute]
Flooding and fire occurred in the Los Angeles area after the Northridge earthquake broke water and gas mains.

16. **Springdale landslide caused by 1992 St. George, Utah earthquake** [courtesy, Utah Geological Survey; data is from *Places With Hazards* curriculum, UGS]
This landslide destroyed three homes, two water tanks, and several other structures in the Balanced Rock Hills subdivision near the entrance to Zion National Park. It also forced temporary evacuation of condominiums and businesses near the toe of the slide. State Route 9 was damaged and closed for a brief time. This landslide is one of the largest ever recorded resulting from an earthquake of 5.9 magnitude. It is also located further from the epicenter than landslides of this type previously recorded (28 miles). The scarp is the fresh light-brown colored face below the cliff bands, and ranges up to 80 feet in height. The slide mass encompasses an area about 3600 feet wide and 1600 feet long. It moved down slope about 40 feet and crossed the road in several places, surrounding, but miraculously not touching a restaurant.

17. **Boulder that landed next to house in Challis, Idaho; Borah Peak earthquake** [courtesy of the Ogden Standard Examiner]
This car-sized boulder, rolled down a hill, across a small bridge, and after snapping a power pole, it bounced off the porch of this home and came to rest in its front yard. Luckily, no one was injured.

18. **Utah Seismicity with earthquakes color-coded by magnitude.** [courtesy of University of Utah Seismograph Stations]
Many areas of Utah are at risk to damaging earthquakes. The red starbursts indicate earthquakes of magnitude 5.5 or greater.

19. **Be Prepared Graphic** [courtesy, Utah Museum of Natural History]
No one yet knows when or on which fault the next major earthquake will occur in Utah. All agree that it could happen any time. Everyone needs to know earthquake safety. You cannot stop an earthquake from occurring , but you can take action ahead of time to lessen the risks. Learn what to do during an earthquake. Make your surroundings more safe by removing, rearranging, or anchoring objects that could fall during ground shaking. Put together an emergency response kit that will allow you to handle immediate needs without help.

20. **Cartoon: Earthquake Clock is Ticking** [Natural Hazards Observer]
Forces in the earth's crust due to plate tectonics are still at work. It is only a matter of time until the next earthquake. The earthquake clock in Utah is ticking.