

EARTH SCIENCE ACTIVITY #5 The Mercalli Scale

All Grades 4 and Up

This activity is one of several in a basic curriculum designed to increase student knowledge about earthquake science and preparedness. The activities can be done at any time in the weeks leading up to the ShakeOut drill. Each activity can be used in classrooms, museums, and other educational settings. They are not sequence-bound, but when used together they provide an overview of earthquake information for children and students of various ages. All activities can be found at www.shakeout.org/schools/resources/.

Please review the content background (page 3) to gain a full understanding of the material conducted in this activity.

OBJECTIVE:

For students to draw isoseismals on a map that includes Mercalli intensity data.

MATERIALS/RESOURCES NEEDED:

- Overhead projector
- KWAT Television Script Key
- KWAT Television Script cards
- Transparency made from Modified Mercalli Scale
- Transparency made from Wattsville Map Key
- Handouts of Wattsville Map, for each student

PRIOR KNOWLEDGE:

In order to conduct this activity, students need to know how to use a city map and identify the Roman numeral expressions.

ACTIVITY:

Set-Up (20 minutes)

Print out one copy of the KWAT Television Script and cut them into cards. Make transparencies of the Modified Mercalli Scale and the Wattsville Map Key to place on the overhead projector. Make enough copies of the Wattsville Map for each student.

Procedure (35 minutes)

The italicized phrases are spoken suggestions for the instructor and those in parenthesis are possible answers students might provide.

1. Introduce the topic of earthquake measurement.
Today, we will learn of one method used to measure earthquakes. An earthquake's intensity is a measurement of ground shaking based on damage to structures and changes felt and observed by humans. It is expressed in Roman numerals on the Mercalli Scale.

2. Display the Modified Mercalli Scale on the overhead projector.
Here we have the Modified Mercalli Scale. It measures the shaking you feel during an earthquake. As you can see here, as the numbers get higher, the more you feel the shaking.
Review the Roman numerals and read their descriptions.
3. Students will determine intensity using reports.
We will be using data from reports of an earthquake that struck California in 1989 and the Modified Mercalli Scale of Intensity to see where it might have originated from.
4. Distribute the Wattsville Map handout to each student and one KWAT Television script card to each student. (If you have more than 21 students, have several of them represent one caller. If you have less than 21 students, give students multiple flashcards, or set the cards aside and read them out at the end.)
5. After the instructor reads the part of Jake Wilde, students read their cards.
Can Caller 1 read their flashcard aloud to the class?(Student reads section)
Using the clues in what he/she just read and the Modified Mercalli scale, which intensity number would you place the location of the caller? (VII)
Write this number in Roman numerals at the reported location on your maps.
Refer to the KWAT Television Script key for answers.
6. Continue to take “calls” until all the callers have given their reports and the students have written in all of the numbers on their maps.
7. Observe the patterns and draw rings.
I want everyone to look at their maps and the pattern of numbers. Draw rings around the locations with similar intensity values. This will help you determine where the earthquake might have originated.
Afterward, display the Wattsville Map Key for students to check their results.

CONTENT BACKGROUND:

The Magnitude Scale: A Measure of Size

Magnitude is the most common way of describing an earthquake's size. In the 1930s, Beno Gutenberg and Charles Richter at the California Institute of Technology developed a method to describe all sizes of earthquakes using a small range of numbers. Using recordings from seismographs, they measured how fast the ground moved at a set distance from earthquakes. If the ground moved 10 times faster in one earthquake than another, then the first earthquake was said to be one unit of magnitude larger. The Richter Scale, as it became known, is not a device, but the range of numbers used to compare earthquakes.

Seismologists have since developed a new measurement of earthquake size, called moment magnitude. Moment is a physical quantity more closely related to the total energy released in the earthquake than Richter magnitude. It can be estimated by geologists examining the geometry of a fault in the field or by seismologists analyzing a seismogram. Because the units of moment are very large, it has been converted to the more familiar range of magnitude values for communication to the public.

Moment magnitude has many advantages over other magnitude scales. First, all earthquakes can be compared on the same scale. (Richter magnitude is only precise for earthquakes of a certain size and distance from a seismometer.) Second, because it can be determined either instrumentally or from geology, it can be used to measure old earthquakes and compare them to instrumentally recorded earthquakes. Third, by estimating how large a section of fault will likely move in the future, the magnitude of that earthquake can be calculated with confidence.

The Mercalli Scale: A Measure of Intensity

Earthquake intensity is a measure of the effects of an earthquake at a particular place. It is determined from observations of an earthquake's effects on people, structures, and the Earth's surface. A 10-value scale which had been in use in Europe since 1883 was refined in 1902 by an Italian seismologist, Giuseppe Mercalli. In 1931, two Americans, H.O. Wood, and Frank Neumann, modified Mercalli's 12-value scale into what we use today. It uses Roman numerals from I to XII to rank relative levels of destruction, ground motion, and impact on humans.

The intensity (or impact) of an earthquake in a given area depends on the geological structures in the area as well as the types of buildings. Houses built on rock will receive less damage than those built on sediments at the same distance from an earthquake's epicenter. Poorly built houses will be more damaged than those that have been reinforced to withstand earthquakes. In general, the further a site is from the earthquake's focus, the less damage it will sustain.

Even though the main shocks lasts for such a short time the effects of a major earthquake may reach a long way in both space and time. People hundreds of miles away from the epicenter may experience shaking or damage. This is especially true in the eastern United States, where quakes are felt over a much larger area than they are in the West. An *isoseismal* map shows zones or bands where earthquake effects of the same intensity have been reported.

This activity is adapted from *Seismic Sleuths*, a product of the Federal Emergency Management Agency (FEMA) and the American Geophysical Union (AGU).

KWAT Television Script Key

Jake Wilde: “We interrupt our regularly scheduled programming on KWAT to bring you a special bulletin. This is KWAT news anchor, Jake Wilde. Moments ago the town of Wattsville was shaken by a strong earthquake. Residents in the KWAT broadcast area are invited to call our emergency response number, 555-KWAT, and give us your name, your location, and a brief summary of what you experienced during the quake. Stay tuned for the latest reports of what your neighbors saw and felt. To report your observations, call 555-KWAT. We have caller number 1 on the line.”

Caller 1: “Hi, this is Charles from the hospital. We only had slight to moderate damage in the new, well-built Children’s Care building. The building containing most of our records was old and poorly built; damage there was considerable.”
(VII)

Caller 2: “Hello my name is Roy, and I’m calling from the RQB Ranch. We were just sitting around the kitchen table, when suddenly coffee sloshed out of all our cups. Several cabinet doors opened up and dishes fell and broke.”
(V)

Caller 3: “Hi, this is Carmen at Long Valley Boutique. We have a mess here. When the quake struck, it moved all of our wall displays, and all our little ceramics fell and broke.”
(V)

Caller 4: “Hi Jake, I’m Susan calling from the Faithful Church. When the earthquake struck, our bell tower collapsed.”
(VIII)

Caller 5: “Hi. This is Jo from Southside City Junior High School. Students felt it and did the drop, cover, and hold on drill. We only had slight damage to the building, just some cracked plaster in the walls. A few pictures also fell.”
(VI)

Caller 6: “Hey Jake, this is Hank and I’m calling from the basement of the First Bank in the center of Wattsville. This old building has partially collapsed and people are trapped down here. Please send help!”
(VIII)

Caller 7: “Hi, this is Fernando. I work at the Sunrise Senior Center. Many of our clients were frightened. All our supplies fell off the shelves.”
(VI)

Caller 8: “Hello Jake, this is Debbie. We were picnicking at the Great Bend Park. When the quake struck, it woke up Granny and we saw trees and a flagpole sway back and forth.”
(V)

Caller 9: “Hi, this is Lee Quon. When the quake hit, I was at Hot Springs Ranch visiting friends. Nearly everyone felt it. All the doors that were opened slammed shut.”
(V)

Caller 10: “Hi Jake, this is Ben. I was at Blue Lake Resort when all the cars in the parking lot started rocking back and forth.”
(IV)

Caller 11: “Jake, this is Gene at White Water Manufacturing. All the heavy furniture in the showroom was moved by the quake, and some of the plaster cracked and fell off the walls.”
(VI)

Caller 12: "Hi, this is Diana calling from Happy Slurps Ice Cream. Over here we thought that a big truck had hit the building."
(IV)

Caller 13: "Hi Jake, this is Ken at River City Video. Our large collection of DVDs fell off the shelves and onto the floor, and all our posters fell off the walls."
(VI)

Caller 14: "Hi, this is Maria and I'm calling from Plants-R-Us. During the quake, all our hanging plants were swaying and all our windows were rattling."
(IV)

Caller 15: "Hi Jake, this is David from Wattsville University. Everyone in our class felt the quake. Good buildings were slightly damaged, and some of the older, more poorly built buildings had more damage."
(VII)

Caller 16: "Hello Jake, This is Steve from the South End Mall. All the shoppers were having a hard time standing during the quake. We had a lot of breakage, especially in our furniture shops."
(VII)

Caller 17: "Hey Jake! Jed here. Over at the Roundup Truck Stop, the trucks were shaking with the quake. The drivers at the gas pumps had to hold on to the pumps to keep standing."
(VII)

Caller 18: "Hi Jake, this is Jenny. When the quake struck we were mowing lawns at the West Side Subdivision. We saw trees and bushes shake and everyone was finding it difficult to walk."
(VI)

Caller 19: "Hi Jake, this is Juan at White Water Pets. During the quake, water sloshed out of all our small aquariums. That sure woke up any sleeping fish!"
(V)

Caller 20: "Hello Jake, this is Martha at Cottage Inn. All of our customers were frightened. Nearly all of our little cottages moved off their foundations."
(VIII)

Caller 21: "Hi Jake, this is Marty at Big Bear Ski Resort. The quake rattled our dishes and windows. I saw some parked cars rocking. Most folks who were outdoors didn't feel the shaking."
(IV)

KWAT Television Script Cards

<p>Caller 1: “Hi, this is Charles from the hospital. We only had slight to moderate damage in the new, well-built Children’s Care building. The building containing most of our records was old and poorly built; damage there was considerable.”</p>	<p>Caller 2: “Hello my name is Roy, and I’m calling from the RQB Ranch. We were just sitting around the kitchen table, when suddenly coffee slobbered out of all our cups. Several cabinet doors opened up and dishes fell and broke.”</p>
<p>Caller 3: “Hi, this is Carmen at Long Valley Boutique. We have a mess here. When the quake struck, it moved all of our wall displays, and all our little ceramics fell and broke.”</p>	<p>Caller 4: “Hi Jake, I’m Susan calling from the Faithful Church. When the earthquake struck, our bell tower collapsed.”</p>
<p>Caller 5: “Hi. This is Jo from Southside City Junior High School. Students felt it and did the drop, cover, and hold on drill. We only had slight damage to the building, just some cracked plaster in the walls. A few pictures also fell.”</p>	<p>Caller 6: “Hey Jake, this is Hank and I’m calling from the basement of the First Bank in the center of Wattsville. This old building has partially collapsed and people are trapped down here. Please send help!”</p>
<p>Caller 7: “Hi, this is Fernando. I work at the Sunrise Senior Center. Many of our clients were frightened. All our supplies fell off the shelves.”</p>	<p>Caller 8: “Hello Jake, this is Debbie. We were picnicking at the Great Bend Park. When the quake struck, it woke up Granny and we saw trees and a flagpole sway back and forth.”</p>
<p>Caller 9: “Hi, this is Lee Quon. When the quake hit, I was at Hot Springs Ranch visiting friends. Nearly everyone felt it. All the doors that were opened slammed shut.”</p>	<p>Caller 10: “Hi Jake, this is Ben. I was at Blue Lake Resort when all the cars in the parking lot started rocking back and forth.”</p>
<p>Caller 11: “Jake, this is Gene at White Water Manufacturing. All the heavy furniture in the showroom was moved by the quake, and some of the plaster cracked and fell off the walls.”</p>	<p>Caller 12: “Hi, this is Diana calling from Happy Slurps Ice Cream. Over here we thought that a big truck had hit the building.”</p>

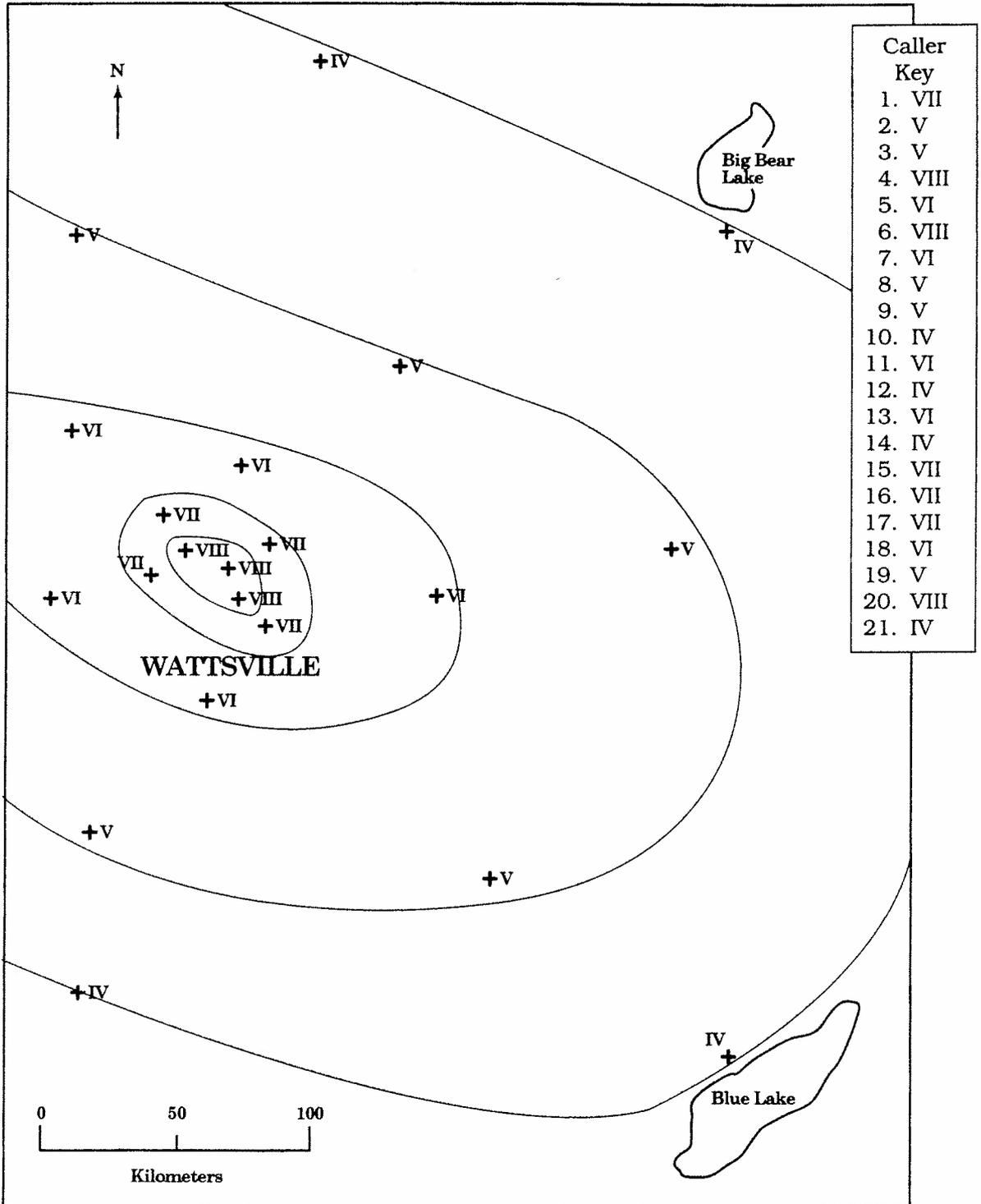
<p style="text-align: center;">Caller 13:</p> <p>“Hi Jake, this is Ken at River City Video. Our large collection of DVDs fell off the shelves and onto the floor, and all our posters fell off the walls.”</p>	<p style="text-align: center;">Caller 14:</p> <p>“Hi, this is Maria and I’m calling from Plants-R-Us. During the quake, all our hanging plants were swaying and all our windows were rattling.”</p>
<p style="text-align: center;">Caller 15:</p> <p>“Hi Jake, this is David from Wattsville University. Everyone in our class felt the quake. Good buildings were slightly damaged, and some of the older, more poorly built buildings had more damage.”</p>	<p style="text-align: center;">Caller 16:</p> <p>“Hello Jake, This is Steve from the South End Mall. All the shoppers were having a hard time standing during the quake. We had a lot of breakage, especially in our furniture shops.”</p>
<p style="text-align: center;">Caller 17:</p> <p>“Hey Jake! Jed here. Over at the Roundup Truck Stop, the trucks were shaking with the quake. The drivers at the gas pumps had to hold on to the pumps to keep standing.”</p>	<p style="text-align: center;">Caller 18:</p> <p>“Hi Jake, this is Jenny. When the quake struck we were mowing lawns at the West Side Subdivision. We saw trees and bushes shake and everyone was finding it difficult to walk.”</p>
<p style="text-align: center;">Caller 19:</p> <p>“Hi Jake, this is Juan at White Water Pets. During the quake, water sloshed out of all our small aquariums. That sure woke up any sleeping fish!”</p>	<p style="text-align: center;">Caller 20:</p> <p>“Hello Jake, this is Martha at Cottage Inn. All of our customers were frightened. Nearly all of our little cottages moved off their foundations.”</p>
<p style="text-align: center;">Caller 21:</p> <p>“Hi Jake, this is Marty at Big Bear Ski Resort. The quake rattled our dishes and windows. I saw some parked cars rocking. Most folks who were outdoors didn’t feel the shaking.”</p>	

Modified Mercalli Scale

- I.** People do not feel any Earth movement.
- II.** A few people might notice movement if they are at rest and/or on the upper floors of tall buildings.
- III.** Many people indoors feel movement. Hanging objects swing back and forth. People outdoors might not realize that an earthquake is occurring.
- IV.** Most people indoors feel movement. Hanging objects swing. Dishes, windows, and doors rattle. The earthquake feels like a heavy truck hitting the walls. A few people outdoors may feel movement. Parked cars rocked.
- V.** Almost everyone feels movement. Sleeping people are awakened. Doors swing open or close. Dishes are broken. Pictures on the wall move. Small objects move or are turned over. Trees might shake. Liquids might spill out of open containers.
- VI.** Everyone feels movement. People have trouble walking. Objects fall from shelves. Pictures fall off walls. Furniture moves. Plaster in walls might crack. Trees and bushes shake. Damage is slight in poorly built buildings. No structural damage.
- VII.** People have difficulty standing. Drivers feel their cars shake. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings, considerable in poorly-built buildings.
- VIII.** Drivers have trouble steering. Houses that are not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Well-built buildings suffer moderate damage. Poorly-built structures suffer severe damage. Tree branches break. Hillsides might crack if the ground is wet. Water level in wells might change.
- IX.** Well-built buildings suffer considerable damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks. Reservoirs suffer serious damage.
- X.** Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas. Railroad tracks are bent slightly.
- XI.** Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed. Railroad tracks are badly bent.
- XII.** Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Wattsville Map Key

Name _____



Note: Isoseismal lines and locations may vary.

Wattsville Map

Name _____

