Wattsville and Mercalli Booklet

Lesson Concept: Observable phenomena are used to determine the intensity of earthquakes using the Mercalli Scale.

Link

Lesson 6.8 demonstrated how triangulation of P and S waves are used to find the epicenters of earthquakes. The Wattsville and Mercalli Booklet activity is used to show how observations of phenomena can be used to find origination area of an earthquake. Lesson 6.9 deepens understanding of measuring earthquake force by using the Richter scale.

Time

60 minutes

Materials

Whole class
Overhead projector/Document Camera
KWAT Television Script Key
KWAT Television Script cards
Transparency made from Modified Mercalli Scale
Transparency made from Wattsville Map Key

Individual
H1 Modified Mercalli Scale handout
H2 Wattsville Map handout
H3a,b Script Cards (one to two sets per class)

Resources
R1a,b KWAT Television Script Key
R2 Wattsville Map Key
R2 Teacher Background

Advance Preparation:

1. Duplicate student copies of handout H1 (Modified Mercalli Scale) and H2 Wattsville Map Handout. Copy and cut H3a,b (Script cards).
2. Review R3 (Teacher background) explaining the development of the Mercalli Scale.
3. Review Wattsville Script and map key (R1a,b).
Procedure:

Engage: (10 minutes) Seismologists establish earthquake intensity in order to understand how much damage earthquakes can cause.

1. Show students photographs (digital or document camera) of earthquake damage. Ask students to discuss the effects of earthquakes on different kinds of human structures. What helps some buildings stand while others fall? Share ideas in the class.

Punchline: 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.

Explore: (35 minutes) Interpreting the Modified Mercalli scale and assigning values based on this scale.

2. Ask students to describe what they have felt in an earthquake? What did you notice about furniture, lamps swaying, or windows rattling? Chart responses.

3. Explain to students that earthquakes are measured in several different ways but one way is the damage to structures and descriptions that humans report.

4. Distribute H1 (Modified Mercalli Scale) and display the scale on the projector. Explain that today, we will learn one method called the Mercalli scale used to measure earthquakes.

5. Select one of the charted responses from #2 and ask partners to find the Roman numeral that identifies the intensity of the shaking? Record the number on the chart. Continue adding Roman numerals to another charted response.

Teacher Note: 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.

6. Discuss the Modified Mercali Scale with students. Ask partners to figure out which would have greater intensity of the ground shaking a I or a V? Review descriptors with students.

7. Explain to students that descriptors from people can be used to determine where the earthquake may originate. We will use data from a California earthquake in 1989 and the Modified Mercalli Scale of Intensity to show how this works.

8. Distribute the Wattsville Map handout to each student and one KWAT Television script card to each student.

Teacher Note: 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. Refer to KWAT Teacher Script for Answer Key.
9. Explain to students that we will be doing a role-play of the announcements on KWAT television station right after an earthquake. The teacher plays the role of Jack Wilde, the announcer while students are people calling the station with descriptions on the cards.

10. Ask the student with the flashcard for Caller #1 to read their card to the class. Ask the students to find the level of intensity on the Modified Mercalli Scale (Roman Numeral). Where would you place the location of the caller? (VII) Ask students to write the level of intensity on the map at the caller’s location.

11. Ask another caller to report in while students record intensity on maps. 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.

**Explain:** (10 minutes) Using Mercalli values to construct isoseismal map and to determine the epicenter.

12. Ask students to observe the patterns of the data on the map. What do you notice?

13. Ask students to draw rings around the locations with similar intensity values. How will this help determine where the earthquake originated?

14. Display the Wattsville Map key and ask students to compare their results to the key. Discuss any differences.

**Extend:** (10 minutes) Apply Mercalli Scale to observable phenomena in pictures.

15. Redisplay photos used in the Engage and ask students to rate the damage using the Mercalli Scale. Explain how you know to a partner.

**Evaluate:** (10 minutes) Observable phenomena are used to determine the intensity of earthquakes using Modified Mercalli Scale.

16. Ask students to use their labeled Wattsville map with scale Roman Numerals, rings and write an explanation of how “caller descriptions” can be used to identify where an earthquake originates.

**Optional Extend:** (30 minutes) Further practice using the Mercalli Scale

17. Ask students to develop a 12 page Mercalli Scale Booklet (see Booklet Handout).
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.
<p>| <strong>Caller 1:</strong> | “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.” |
| <strong>Caller 2:</strong> | “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.” |
| <strong>Caller 3:</strong> | “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.” |
| <strong>Caller 4:</strong> | “Hi Jake, I’m Susan calling from the Faithful Church. When the earthquake struck, our bell tower collapsed.” |
| <strong>Caller 5:</strong> | “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.” |
| <strong>Caller 6:</strong> | “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!” |
| <strong>Caller 7:</strong> | “Hi, this is Fernando. I work at the Sunrise Senior Center. Many of our clients were frightened. All our supplies fell off the shelves.” |
| <strong>Caller 8:</strong> | “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.” |
| <strong>Caller 9:</strong> | “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.” |
| <strong>Caller 10:</strong> | “Hi Jake, this is Ben. I was at Blue Lake Resort when all the cars in the parking lot started rocking back and forth.” |
| <strong>Caller 11:</strong> | “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.” |
| <strong>Caller 12:</strong> | “Hi, this is Diana calling from Happy Slurps Ice Cream. Over here we thought that a big truck had hit the building.” |</p>
<table>
<thead>
<tr>
<th><strong>Caller 13:</strong></th>
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<tbody>
<tr>
<td>“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.”</td>
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<tr>
<th><strong>Caller 14:</strong></th>
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<tbody>
<tr>
<td>“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.”</td>
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<th><strong>Caller 15:</strong></th>
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<tbody>
<tr>
<td>“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.”</td>
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<th><strong>Caller 16:</strong></th>
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<tbody>
<tr>
<td>“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.”</td>
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<tr>
<th><strong>Caller 17:</strong></th>
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<tbody>
<tr>
<td>“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.”</td>
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<tr>
<th><strong>Caller 18:</strong></th>
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<tbody>
<tr>
<td>“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.”</td>
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<tr>
<th><strong>Caller 19:</strong></th>
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<tbody>
<tr>
<td>“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!”</td>
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<tr>
<th><strong>Caller 20:</strong></th>
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<tbody>
<tr>
<td>“Hello Jake, this is Martha at Cottage Inn. All of our customers were frightened. Nearly all of our little cottages moved off their foundations.”</td>
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<th>** Caller 21:**</th>
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<tbody>
<tr>
<td>“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.”</td>
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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.”

**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.”

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6.9 Wattsville-Mercalli Booklet: Earthquakes and Volcanoes

※Science Matters
Caller 12: “Hi, this is Diana calling from Happy Slurps Ice Cream. Over here we thought that a big truck had hit the building.”

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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.”
Wattsville Map Key

Name ________________________

Key
1. VII
2. V
3. V
4. VIII
5. VI
6. VIII
7. VI
8. V
9. V
10. IV
11. VI
12. IV
13. VI
14. IV
15. VII
16. VII
17. VII
18. VI
19. V
20. VIII
21. IV

Note: Isoseismal lines and locations may vary.
**Teacher Background:**

**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.