Locating the Epicenter of an Earthquake



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Locating The Epicenter of An Earthquake Using Triangulation

Triangulation is one method scientists use to locate the epicenter of an earthquake. Seismic recording stations are located all over the world. Data from three recording stations are needed to use triangulation. Scientists time the arrival of the seismic waves from three recording stations. The epicenter is the location at the surface of the Earth that represents the focus inside the Earth where the earthquake originates on a fault line. Recording stations closer to the epicenter are going to arrive sooner and this information is converted into distance from the station to the earthquake. Using the station as the center, circles are drawn with the radius equaling the distance. Earthquakes can occur at any point on the circle, however, when three separate circles are drawn, the circles will intersect at one point, which represents the epicenter of the earthquake.

In order to practice triangulation we will use data from three separate earthquakes and locate three epicenters. The chart below shows the distance of three separate earthquakes (October 9, October 16, and March 17) from each of the recording stations provided on the data map.

Directions:

- 1. Tape the data map in the middle of a half a piece of newsprint paper (18" x 24").
- 2. Set the compass at the recording station (October 9th data) using the distance on the map for the radius to make a complete circle (the circle will extend beyond the map onto the newsprint). At Van Nuys the radius of the circle is 7.5 mi., Westwood the radius of the circle is 8.5 mi., Simi Valley the radius is 4 mi.). Don't forget the map key says that 1cm = 1 mi.
- 3. Go over your circles (draw in pencil first) in red marker or crayon.
- 4. You will notice that the three circles intersect, which is the epicenter of this earthquake. Now, what is the city is closest to the epicenter? Write this city on the chart.
- 5. Follow these same steps for the October 16th and the March 17th earthquakes.

Recording Station	October 9 (red circles)	October 16 (blue circles)	March 17 (green circles)
Van Nuys	7.5 mi.	8.5 mi.	4.5 mi.
Westwood	8.5 mi.	4.0 mi.	8.0 mi.
Simi Valley	4.0 mi.	8.0 mi	11 mi.
City nearest to Epicenter			



Scale: 1cm = 1mi



LOCATING THE EPICENTER OF AN EARTHQUAKE NOTES





- <u>P waves</u> reach the seismometer at a specific location first
- Then follow the <u>S waves</u>.
- The difference is P and S waves determine the distance from the <u>Epicenter</u>.
- <u>Epicenter</u> is the point where the earthquake occurs directly above the <u>focus point</u>.
- <u>Focus point</u> is where the earthquake actually occurs (where the ground releases energy)

Determining The Earthquake Epicenter

This Earthquake's Seismograms are Below

Use these three seismograms to estimate the S-P time interval for each of the recording stations. Record your measurement for the S-P interval in the box below each seismogram.









Station		
	Seconds	KM
	Seconds	KM
	Seconds	KM
	500000	

THE EPICENTER OF THE EARTHQUAKE ____

800 700	8.0	-500 - -200
600	7.0	100
500 - 400 -	6.0	- 50 - - -
300	5.0	10
200	4.0	-5
100		·
60 - 40 - 30 -	2.0	- 0.5 - - - 0.2
20	1.0	٤ _{0.1}
Distance (kilometers)	Magnitude	Amplitude (millimeters)

Recording Station	Epicentral Distance (km)	S Wave Amplitude
Fresno, Ca		
Las Vegas, Nv		
Phoenix, Az		

WHAT'S THE MAGNITUDE OF THAT EARTHQUAKE _____.



Locating The Epicenter Of An Earthquake in Southern California

Determining The Earthquake Epicenter

This Earthquake's Seismograms are Below

Use these three seismograms to estimate the S-P time interval for each of the recording stations. Record your measurement for the S-P interval in the box below each seismogram.



Eureka, CA Seismic Station S-P Interval = seconds







Station		
	Seconds	KM
	Seconds	KM
	Seconds	KM
THE <u>EPICENTER</u> OF THE EARTHQUAKE		

E 008	8.0	500
700		-200
600	7.0 🛔	E 100
500	ŧ	50
400	6.0 +	20
300 -	5.0 [‡]	10
200	4.0	- 5
	ŧ	2
100		··
60 -	2.0 +	- 0.5
30 -		0.2
	1.0	٤ <mark>0.1</mark>
20 -	-	Avec ulity de
(kilometers)	Magnitude	Amplitude (millimeters)

Recording Station	Epicentral Distance (km)	S Wave Amplitude
Eureka, Ca		
Elko, Nv		
Las Vegas, Nv		

WHAT'S THE MAGNITUDE OF THAT EARTHQUAKE ______.



Bibliography:

Materials:

Class set of Compasses Newsprint paper 3 different colored thin tipped markers Overhead transparencies Straight edge (rulers) Make copies of handouts for students

Activity #1 – Locating epicenter of 3 different earthquakes

Activity #2 – Locating the epicenter of earthquakes using seismographs.

Activity #3 – Locating the Epicenter (reinforcement) using "Virtual Earthquake" Software online.

Novak, Gary. "Virtual Earthquake." <u>Science Course Ware</u>. Online. 1999 <http://www.sciencecourseware.org/VirtualEarthquake/VQuakeExecute.html> 16 March 2007.

Procedure: 2- 3 day lesson plan

- 1. Pass out copies of triangulation directions, triangulation map, markers, compasses, and newsprint paper to each group of 4-6 students.
- 2. Go over notes on how to read a seismograph.
- 3. Pass out Southern California triangulation handout packet, compasses, and rulers.
- 4. Work with students.
- 5. Pass out Northern California triangulation handout packet, compasses and rulers.
- 6. Have students work alone.
- 7. Give students the opportunity to do the virtual earthquake lab via the website for homework.(see website above)
- 8. Have student print out a certificate.
- 9. Have students do a 5 word poster* and gallery walk.

The End

* see following page on how to do a 5 word poster

Time needed: One class period

Materials: Large newsprint paper

Markers, colored pencils

Rulers Pencils

Lab journal (Students use information here to describe words) Students need to be in cooperative groups (4-6 students/group) Tell students that they are going to create a poster of five vocabulary

Procedure:

Tell students that they are going to create a poster of five vocabulary words related to what we have been studying. This poster is going to be very different than what you have ever made before. Even though this will be a vocabulary poster, the only thing that you can put on the poster to describe or explain the vocabulary words are **<u>PICTURES!</u>** You <u>CAN</u> <u>NOT</u> write any words on the poster. When we are finished we will use a gallery walk format to share our vocabulary word posters with members of our class.

**Each Student draws their own sample of the group poster in their own science journal. You can have one person in each group draw one of the pictures on the poster. Encourage collaboration.

Gallery Walk

Time:	One class period
Materials:	Question cards (optional)
	Put students in groups based on # of posters made. For example, if you
	have 8 posters, then each gallery walk group should have one person
	(some will have 2 students depending on your cooperative groupings) per
	poster.
Procedure:	Teacher will time the process.
	Give each group about 5 min. per poster.
	The student(s) who made the poster explains the "five word pictures" to
	the group. If there is time, question cards can be used.
	Examples of questions that can be asked:
	"Why do you feel this (picture) represents (vocabulary)?"
	"Is there a relationship between (one picture) and another?"
	"Could you have added anything to your (picture) to demonstrate the
	(vocabulary word)?"
	"Which picture represents the most important word?" (justify your
	answer)
Homework:	Students share their 5 word drawing (in their journals) with a family
	member.
	•
Reference:	www.google.com search: teaching strategy gallery walk

http://serc.carleton.edu/introgeo/gallerywalk/step.html

Earthquake Quiz (paste into Journal after graded)

The map shows the location of 3 cities: Fresno, Las Vegas, and Phoenix. Scientists know that an Earthquake happened at 8:15 am with an Epicenter that was 350 km way from Fresno and 395 km away from Las Vegas.



• Phoenix

What other information would most help scientists determine the epicenter?

- A. the distance of Fresno from Las Vegas
- B. the types of seismic waves that reached Phoenix
- C. the time at which the seismic waves reached Phoenix
- D. the size of the seismic waves that reached Phoenix

How do scientists determine the epicenter of an earthquake?

- A. The scientists located the epicenter by finding the area with the most damage.
- B. The scientists locate the epicenter by determining the p-wave arrival times at several locations.
- C. The scientists locate the epicenter my measuring the earthquakes magnitude using p-waves and s-waves
- D. The scientists locate the epicenter by determining the arrival time of p-waves and s-waves from several locations

What kind of waves move inside the earth?

- A. seismic waves
- B. sound waves
- C. air waves
- D. frequency waves

The map shows LA as the epicenter of an earthquake. All four locations have same geology. Which location experienced the most damage?

A. Location A B. Location B

C. Location C

D. Location D



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A. Location A B. Location B C. Location C D. Location D



http://tlc.discovery.com/convergence/quakes/interactives/makeaquake.html

(circle your choice)	(circle your choice)	(circle your choice)
 Stable, solid ground seems safest, but in a quake-prone area, all construction is a calculated risk. Building along a fault zone has its risks but is often unavoidable. Loose, gravely soil. Prepare to go deep for support. Coastal ground quality varies. When near water, there are many dangers to consider. Conclusion: Was the ground safe for this construction? 	 Reinforced building materials give concrete and masonry structures more tensile strength. Foundation anchoring keeps a structure and its base moving as a unit when the ground begins to quake. Base isolation allows a structure's foundation and the ground to move as one, minimizing the forces on the building itself. Pile foundations reach down through unstable soil to the bedrock beneath for added stability. Conclusion: What would be a better choice of construction? 	 Tremor - a minor quake of magnitude 2 to 4.9 rarely causes more than minor damage. Quake - at magnitude 5 to 6.9, not the "Big One," but damage and injuries are to be expected. Superquake - at magnitude 7.0 to 9.5, these are the monster quakes. Expect heavylosses in populated areas. Conclusion: What kind of damage (intensity) would this earthquake cause to buildings.
What kind of construction is in your reg	gion? What kind of damage to building wou	ld occur in your region.

Ground Type	Prevention Construction	Magnitude of Earthquake
(circle your choice)	(circle your choice)	(circle your choice)
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