

# Geology Research Task for Year 11's

## LOCATING EARTHQUAKES AND DETERMINING MAGNITUDE



**Photo 1: Earthquake Damage, San Francisco 1989**

Earthquakes occur because of a sudden release of stored energy. This energy has built up over long periods of time as a result of tectonic forces within the earth. Most earthquakes take place along faults in the upper 25 miles of the earth's surface when one side rapidly moves relative to the other side of the fault. This sudden motion causes shock waves (seismic waves) to radiate from their point of origin called the focus and travel through the earth. It is these seismic waves that can produce ground motion which people call an earthquake.

### **TASK**

Your task is to study an earthquake that occurred in the United States of America in the San Francisco area in 1989. From the data that you will be provided with, the aim is for you to determine both the **location and magnitude** of this earthquake.

All the resources you will need are available online at the following website:

<https://www.sciencecourseware.org/VirtualEarthquake/>

Read the information on the introductory page but do not click on the new virtual earthquake version. Scroll down to the bottom of the page and click: **"EXECUTE VIRTUAL EARTHQUAKE"**

This will bring you to page 1/12. This is an important page and must be read very carefully before you proceed any further. Once you have a good grasp of what an earthquake, earthquake waves and seismograms are you may proceed to **"let's have an Earthquake"**.

Choose, **San Francisco** and click: **submit choice**.

You will be given three seismograms from three locations: Eureka, Elko and Las Vegas all located in western USA.

### 1. Determining the earthquake epicentre

Your first task is to find out the S-P time interval from the seismograms which will help you determine the distance to the earthquake. Record your results both online and in the table below so that you have a record of your measurements:

LOCATION	S - P TIME INTERVAL (seconds)
Eureka	
Elko	
Las Vegas	

Click: **Convert S-P interval**

### 2. Determining the earthquake distance:

Read the introduction carefully which will tell you how to convert S-P interval into distances to the earthquake event using a graph.

Once you have understood what is required of you, use the data from your table above and the graph titled "**determining distance from S-P**" work out the distance to the earthquake and record your results in the table online but also in the table below:

LOCATION	DISTANCE TO EARTHQUAKE (Km)
Eureka	
Elko	
Las Vegas	

Click: **Find Epicentre**

### 3. Triangulation of the epicentre

Read the information in this section very carefully.

The computer programme will automatically draw three circles on a map of the northwest of the United States to show the epicentre of the earthquake. This is determined when all three circles coincide or cross on one location. Answer the following questions:

- On what geological feature was the earthquake likely to have occurred on in this part of America? You may need to research this!
- Why do you think the earthquake occurred?
- Which city do you think was most affected by this earthquake?

**Click: Compute Magnitude**

#### 4. Richter Magnitude

Read the information in this section very carefully.

Once you are clear about earthquake magnitude click: **Go to next page.**

#### 5. The Richter Nomogram

Read the information in this section very carefully

Once you are clear what a nomogram is click: **Go to next page**

The magnitude of an earthquake can be determined by measuring the amplitude (wave height) of the largest wave recorded on the seismograms. The three seismograms that you used earlier will be displayed again. Determine the amplitude of the largest wave from each seismogram and record your data online and in the table below:

LOCATION	AMPLITUDE OF HIGHEST WAVE (mm)
Eureka	
Elko	
Las Vegas	

**Click: Submit to nomogram**

Richter's nomogram with three lines representing the data you provided will be displayed. Use this diagram to estimate the Richter magnitude of this earthquake. This can be achieved where all three lines cross each other on the central scale. Record your determined magnitude below:

Magnitude of the 1989 San Francisco earthquake was =

**Click: Confirm Magnitude**

**Get certificate and produce a print out of it to prove that you completed the exercise.**

**Answer the following questions and complete the piece of research:**

a. How does your calculated magnitude compare to the actual magnitude for this earthquake?

b. In reality, where was the actual location of the epicentre for this earthquake? You may need to research this.

d. Was this earthquake considered to be a large or small earthquake? Give reasons for your answer.

e. **Research this earthquake.**

Produce a poster to show the destructive effects this earthquake had on the city of San Francisco.

**Include:** Areas that suffered the greatest damage, damage to buildings and other man-made structures, number of people injured and/or killed.

Research the phenomenon of: **liquefaction**

Why were only certain parts of the city affected by this phenomenon?

What effect did liquefaction have on the city?