Earthquake Epicenter Location

Name_____
Date_____
Per_____

Task: Your task is to use earthquake data to map a possible fault line and then evaluate the risk of damage from earthquakes near this fault line.

Materials:

- Seismograms showing the arrival of p- and s-waves at 3 different locations from 3 different earthquakes
- Location map for this exercise
- Colored pencils
- Drawing compass
- Ruler
- Calculator

Background:
To establish the risk for an earthquake, geologists first collect seismic data from many locations to find the centers for earthquake activity. When the data is plotted on a map, they can locate the point on the Earth's surface above the earthquake which is called the earthquake epicenter. Mapped patterns of earthquake date accumulated over time may reveal fault lines hidden over time by other geologic processes.

Procedure:

1) On the Seismic Data Sheet, use the edge of a piece of paper and measure the distance between the P-wave and the S-wave arrival times.

2) Use the time scale at the bottom of the page to determine the difference in arrival times in seconds. (In all but one case, the number should be a decimal less than 1)

3) Divide the difference in arrival times by 0.15 sec/km. (This is the difference in the velocity of the two waves). Your answer will be in km.

4) Using the distance scale at the bottom of the map to measure, open the compass to the distance obtained in step #3.

5) Using the appropriate seismograph location as the center, draw a circle with the compass.

6) Label the circle earthquake #1 (or earthquake #2 or #3 depending on which data set you are working on). Use a different color for each earthquake (e.g. earthquake #1 = red, earthquake #2 = blue, earthquake #3 = brown).

7) Repeat steps 1 through 5 for each seismograph reading.

8) Mark the location where the circles for earthquake #1 cross or come closest to crossing and label this point Epicenter of earthquake #1.

9) Repeat steps 1 – 7 for earthquakes #2. Then do earthquake #3.

10) Draw a "best fit" line using these 3 points (extend this line to both edges of the paper). This represents an active fault line.

Conclusion:

Use your completed map and your knowledge of earthquakes to answer the following questions:

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1. Geologists have studied this active fault and have determined that earthquakes up to a magnitude 7.2 occur about every 20 years in this area. When an earthquake of this magnitude occurs again, what major safety hazards would people who live in this area have to deal with?

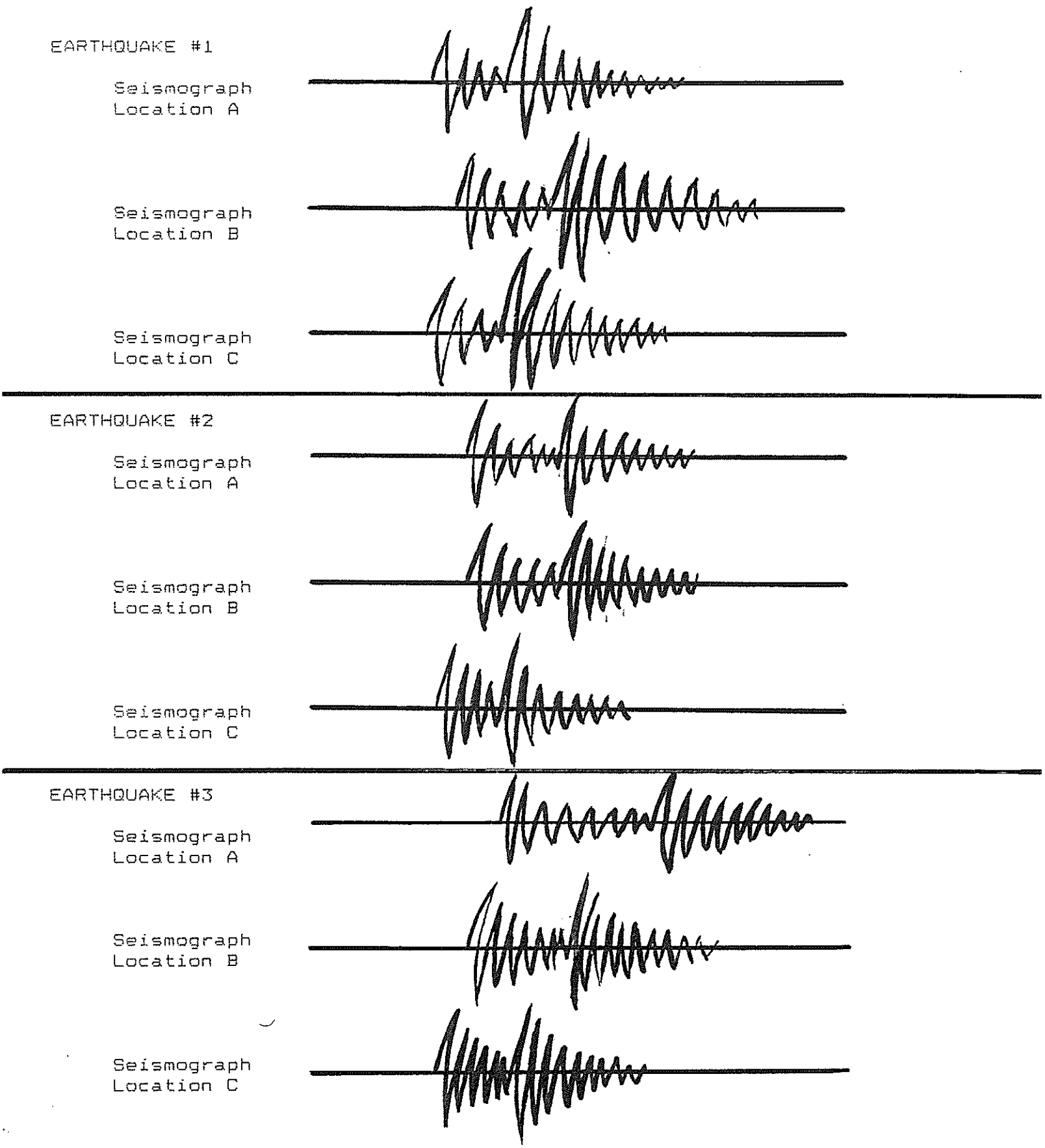
2. Safety is a big factor that cities need to consider in advance of a large earthquake. Assume that the prevailing wind blows from south to north in this area and that large earthquakes occur on a 20-year interval. List 3 things that people in the town of Opal (population 20,000) might need to do to prepare for a large earthquake.

3. Given the wind direction outlined above, list 3 things (different from #2) that should be a part of a plan for the town of Churn (population 10,000).

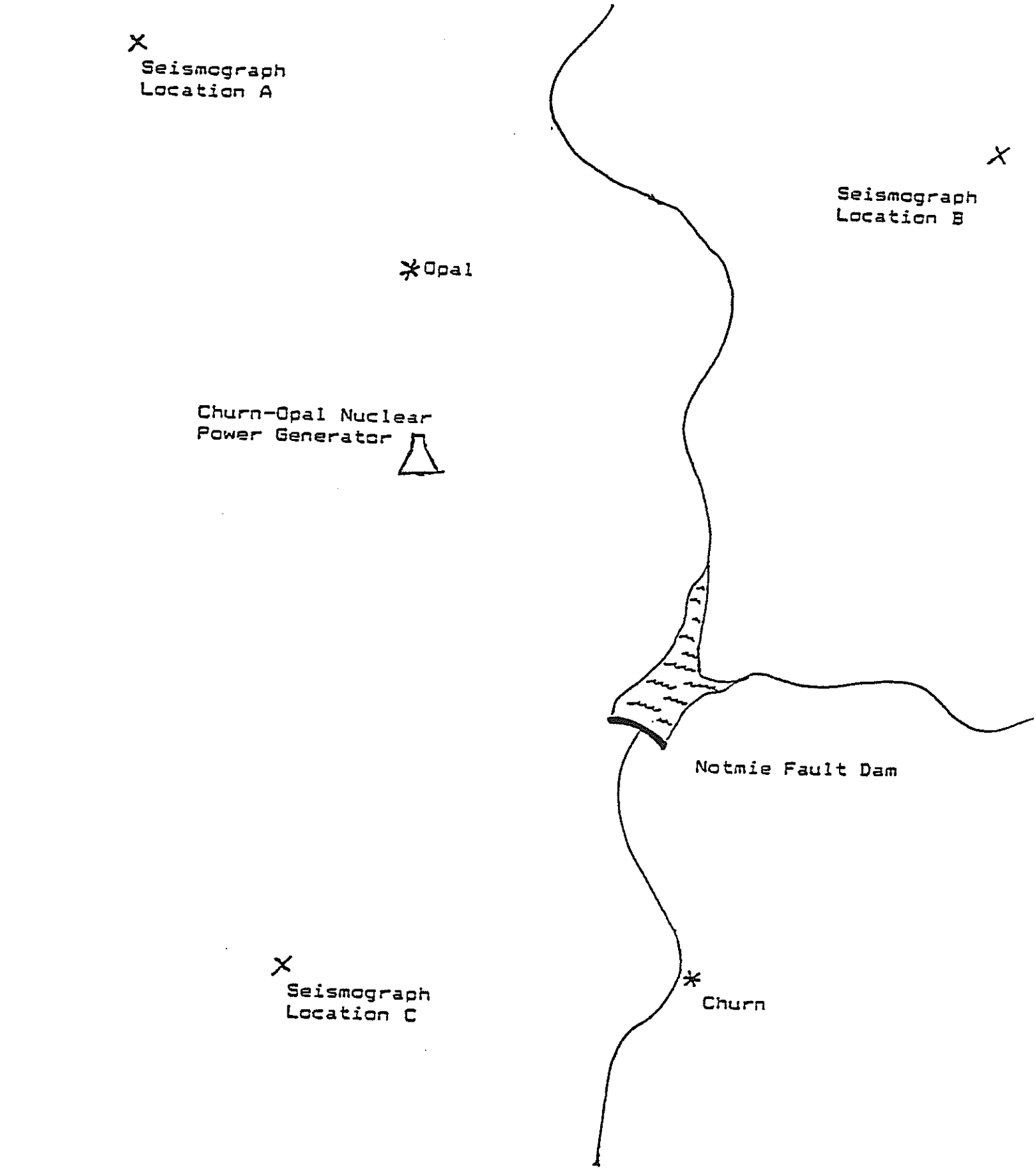
4. The builders of Notmie Fault Dam had to work within a budget to design the dam. Choices for building materials were concrete or earth-fill (a design that we talked about while doing the stream table exercise). Why might the earth-fill option not be such a good idea for this area?

5. Mark and label a spot on the map where you would build your home. I selecting your home site, take into account the various safety problems and locate your home in what you feel is the safest place. Explain why you would build your home there.

SEISMIC DATA FOR EARTHQUAKE EPICENTER LOCATION EXERCISE



MAP FOR EARTHQUAKE EPICENTER LOCATION EXERCISE



Teacher Notes for Epicenter Activity

To begin with, I use a slinky and a very long (8') tightly coiled spring to demonstrate how p-, s-, and l-waves travel. Once this is accomplished, I start a discussion revolving around the difference between the epicenter and the focus of an earthquake, emphasizing that earthquake location reporting in the newspaper usually just gives the epicenter. This activity illustrates how the epicenter of an earthquake is found. I also will take them through the general process of how find the difference in arrival times of p- and s-waves can be used to find a distance to an earthquake and how using data from 3 seismograph stations is used to locate the epicenter.

To complete the activity, some prior preparation is required. You will need an overhead transparency, a transparency of the map for the activity, and a transparency of the seismograms. You will also need to run off a copy of the activity including the seismograms and map.

- On one transparency, use a ruler to draw a red line right along the edge of the transparency. Since I did a number of preps of this same lesson, I used a permanent marker for this.
- Start with the map of the area. Point out the locations of the 3 seismograph stations and the major features shown on the map (very few kids know if Chernobyl any more so the pun on the reactor name mostly goes unnoticed).
- Next, put the seismogram transparency on the overhead. Have the students find this same page in their packet. Notice that data from three earthquakes have been recorded at 3 different stations. Direct students to get out a piece of scratch paper that they can use as a straight edge. On the overhead, show students that your scratch paper will show up as the red line on the edge of the transparency.
- Lay the red line on the edge of the transparency along the midline of the first seismogram. Place a tic mark where the p-wave begins and again where the s-wave starts. Compare the spacing of the tic marks with the scale at the bottom of the sheet to obtain a time lag (difference in arrival time). Write this number to the left of this seismogram.
- Then divide this by 0.15 sec/km to find a distance from the seismograph to the epicenter of the earthquake. Write this number to the right of the seismogram.
- Go to the location map. Have students set a compass to the distance calculated using the scale at the bottom of the map.
- Go to seismograph station A and draw the circle. I have the students use a different color for each earthquake since there will be 9 circles when the map is completed. Color coding helps clear some of the confusion.
- From here on, students should be able to follow the directions to complete the activity. Make sure that they clearly mark each epicenter of each earthquake and that they use a "best fit" line to connect the 3 epicenters. This line will be considered a rough approximation of a fault line.
- **Question # 4 in the conclusion is referencing a dam that we built in a previous activity on a stream table. You will probably need to substitute something else for this question.**