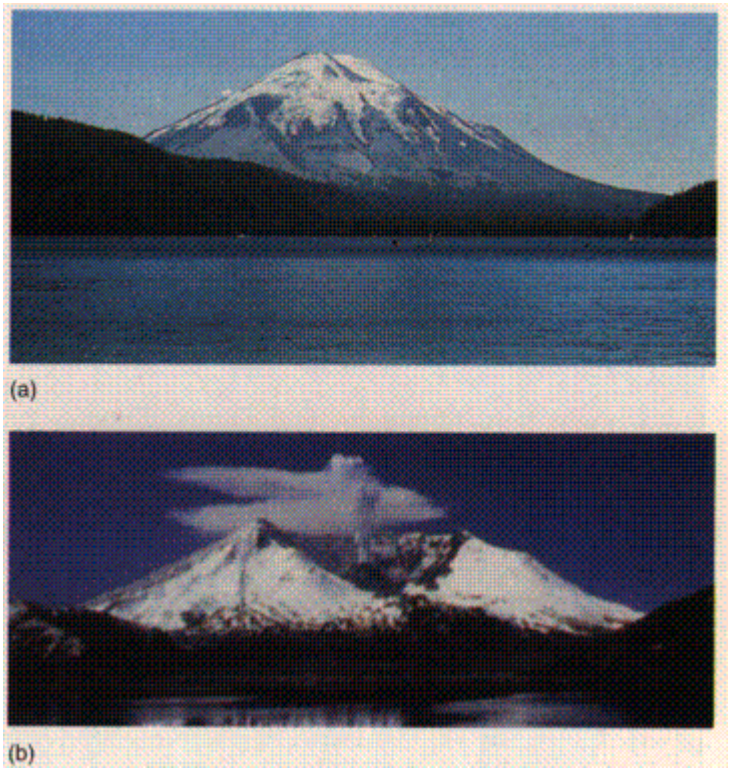
CLEARVIEW INVITATIONAL 2009

DYNAMIC PLANET (Earthquakes and Volcanoes)



Mt. St. Helens before and after its 1980 eruption.

School _____ Team # _____

Names of participants
1. _____2, _____

Raw score _____/_____ Rank _____

SHORT ANSWER: **Place the answer on your answer sheet**. You may write on this sheet for your own benefit but it will not be graded.

1. What is the point of origin of an earthquake?

2. What is the point on the surface nearest the earthquake?

3. What is an instrument used to study earthquakes?

4. Name the most deadly volcanic hazard,

5. Name the process that makes solid ground behave like a fluid .

6. Name the type of lava shown in Figure A.

7. Name the type of lava shown in Figure B.

8. Name the type of lava shown in Figure C.

Figure A

Figure B

Figure C

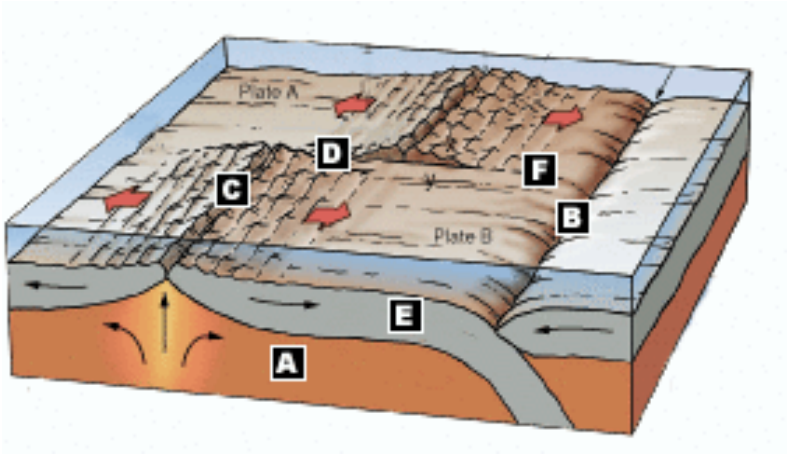
9. A Tsunami wave is caused by what kind of earthquake?

10. What is the VEI?

11.. Volcanic eruptions can affect climate because:
   a. they heat the atmosphere
   b. volcanic dust and gas in the upper atmosphere reflects and absorbs solar
   c. they provide pollutants
   d. volcanoes have no effect on Earth's climate

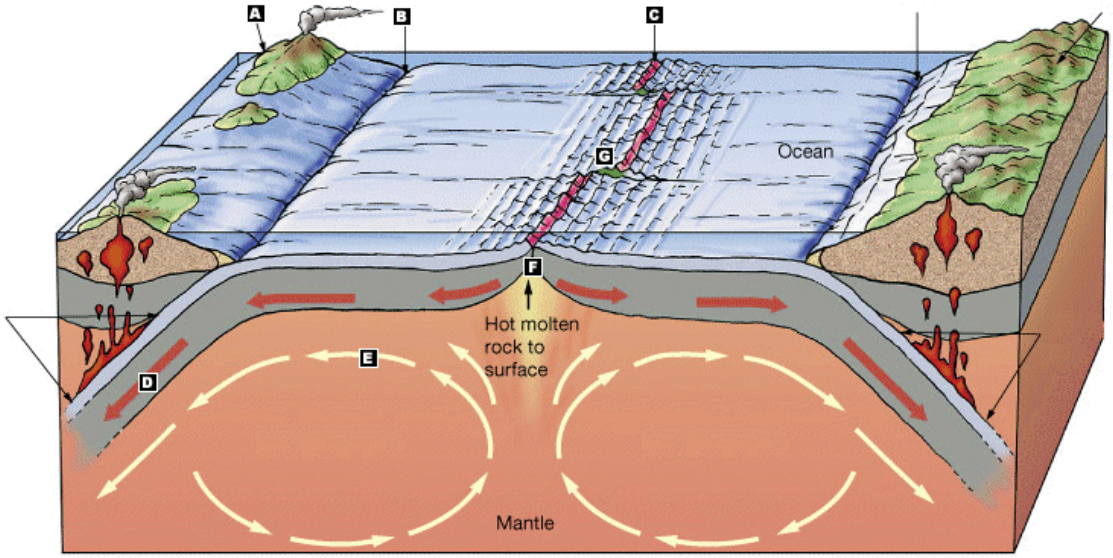
12. Magma with a high silica content tends to be:
   a. very hot b. very smelly c. very viscous d. very soluble

#13-18 Using the image below, match the correct letter with each phrase or question.



13. Fracture Zone
14. New crust formed here
15. active transform fault
16. lithosphere
17. asthenosphere
18. Trench

19-#23 The cross-section below shows a detailed view of plate tectonic processes and associated features. Match the correct letter to each item listed below**. Not all letters will be used.**



19. convection
20. subduction
21. mid-ocean ridge
22. Volcanic arc
23. sea floor spreading

24. Benioff Zones are associated with:
    a. mid-ocean ridges
    b. subduction zones
    c. ancient mountain chains
    d. all of these

25. Which of the following is characteristic of a tsunami?
    a. very low amplitude in the open ocean.
    b. very fast moving in the open ocean.
    c. very long wavelength in the open ocean
    d. all of these

26. Magma with a large amount of dissolved gases tends to be:
    a. very viscous b. very explosive c. very messy d. very light

27. Which of these is not a common gas in magma?
    a. water vapor b. carbon dioxide c. sulfur dioxide d. methane

28. The deadliest volcanic eruption that geologists have documented is:
    a. Toba, Indonesia`
    b. Krakatau, Indonesia
    c. Tambora, Indonesia
    d. Agung, Indonesia

29. An igneous rock made of pyroclasts has a texture called:
    a. fragmental b. porphyritic c. vesicular d. fine-grained

30. The most common type of volcano in the "Ring of Fire" is:
    a. a composite volcano
    b. a shield volcano
    c. a cinder cone
    d. a volcanic fissure

31. Mount St. Helens had an explosive eruption on May 18, 1980. What was the Richter scale reading for this eruption? C
    a. 3.5 b. 4.2 c. 5.1 d. 6.2 e. 6.8

32 What does an orange volcano alert mean?
    a. An eruption is likely within hours or days
    b. There is no immediate risk.
    c. Weak unrest.
    d. Intense unrest.
    e. An eruption is underway.

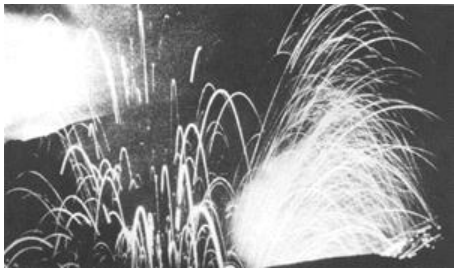
33. Which of the following observations suggested that the continents were once joined together in a supercontinent?
    a) Meteor impact craters are uniformly distributed around the world
    b) The continents fit together like jigsaw pieces
    c) Rocks from glaciers are found near the equator
    d) The same fast food restaurants are found all over the world

34. The San Andreas is what kind of fault?
    a) Normal dip-slip
    b) Thrust dip-slip
    c) Left-lateral strike-slip
    d) Right-lateral strike-slip

#35-37 Types of eruptions: Use the following choices to identify each of the following eruptions:

a. Hawaiian b. Pelean c. Phraetic
d. Pilian e. Strombolian f. Vesuvius g. Vulcanian

Question # **35**



Question # **36**

37. Which of the types of eruptions listed in Question 35 is most powerful?

#38-#42 Match the type of eruption with the description below: **Not all letters will be used.**

38. Strombolian
39. Peléan
40.. Plinian eruptions.
41. Vulcanian
42 Vesuvian

A. explosive ejection of relatively viscous lava

B. occur along fissures or fractures that serve as linear vents

C. huge clots of molten lava burst from the summit crater to form luminous arcs through the sky. Collecting on the flanks of the cone, lava clots combined to stream down the slopes in fiery rivulets.

D. great quantities of ash-laden gas are violently discharged to form cauliflower-shaped cloud high above the volcano.

E. a large quantity of gas, dust, ash, and incandescent lava fragments are blown out of a central crater, fall back, and form tongue-like, glowing avalanches that move downslope at velocities as great as 100 miles per hour.

F. dense cloud of ash-laden gas explodes from the crater and rises high above the peak. Steaming ash forms a whitish cloud near the upper level of the cone.

----------**Multiple choice again**-----

43. Which of the following is not a hazard of ash fall?
    a. contamination of surface water
    b. destruction of vegetation
    c. structural damage to buildings due to increased load on roofs
    d. irritation of people's respiratory system and eyes
    e. liquefaction

44. 'Devil's' Tower is an example of a(n)
    a. dike b. lava plateau c. alien landing site d. volcanic neck

45. The seafloor ridges are
    a) Hot, shallow, seismically active, young
    b) Seismically inactive but volcanically active
    c) Not well understood as they are buried deeply beneath sediments
    d) Relatively old but still hot and seismically active

46. The seafloor stripes are
    a) Magnetized bands of rock parallel to the seafloor ridges that give evidence that the geomagnetic field has reversed in the past and the seafloor is spreading
    b) Bands of rock at the seafloor that have preserved ancient species of marine plants and animals and show us how these species have evolved as the seafloor has spread
    c) An ancient myth
    d) Alternating colors of basaltic rocks at the seafloor ridges

47. In 1990, a pyroclastic flow from the Redoubt volcano in Alaska rapidly melted snow and ice, causing a large volume of sediment-laden water to discharge down the valley. What is this discharge called?
    a. lava flow
    b. debris flow
    c. snow avalanche
    d. basaltic flow
    e. poisonous gas

48. What are the three Vs that control a volcanic eruption?
    a) vorticity, volatiles and viscosity
    b) viscosity, volatiles and volume
    c) volume, vigor and Vin Diesel
    d) volume, velocity and viscosity

49. What are the three major killers in volcanic eruptions?
    a) lava flows, ash fall and tsunami
    b) lahars, tsunami and lava flows
    c) ash fall, earthquakes and lightning
    d) tsunami, indirect (climate change) and pyroclastic flows

50. A typical rate of seafloor spreading in the North Atlantic Ocean basin is :
    a. 0.1 in/yr b. 1.5 in/yr c. 2 cm/yr d. 2 mm/yr e. 2 ft/yr

51. The Mt. St. Helens eruption killed about how many people?
    a) 10 b) none c) 500 d) 60

52. What is a pyroclastic flow?
    a) a fast moving mixture of water and volcanic debris
    b) a moving mass of burning trees
    c) a slow moving mixture of volcanic gas and lava
    d) a very fast moving mixture of hot gases and volcanic debris

53. What is the most viscous type of lava flow?
    a. Aa. b. Pahoehoe. c. Pillow lava. d. Pyroclastic.

54. What is a lahar?
    a) one of the main volcanic eruption styles
    b) a slow moving mixture of hot gases and volcanic debris
    c) a submarine slump
    d) a moderately fast moving mudflow

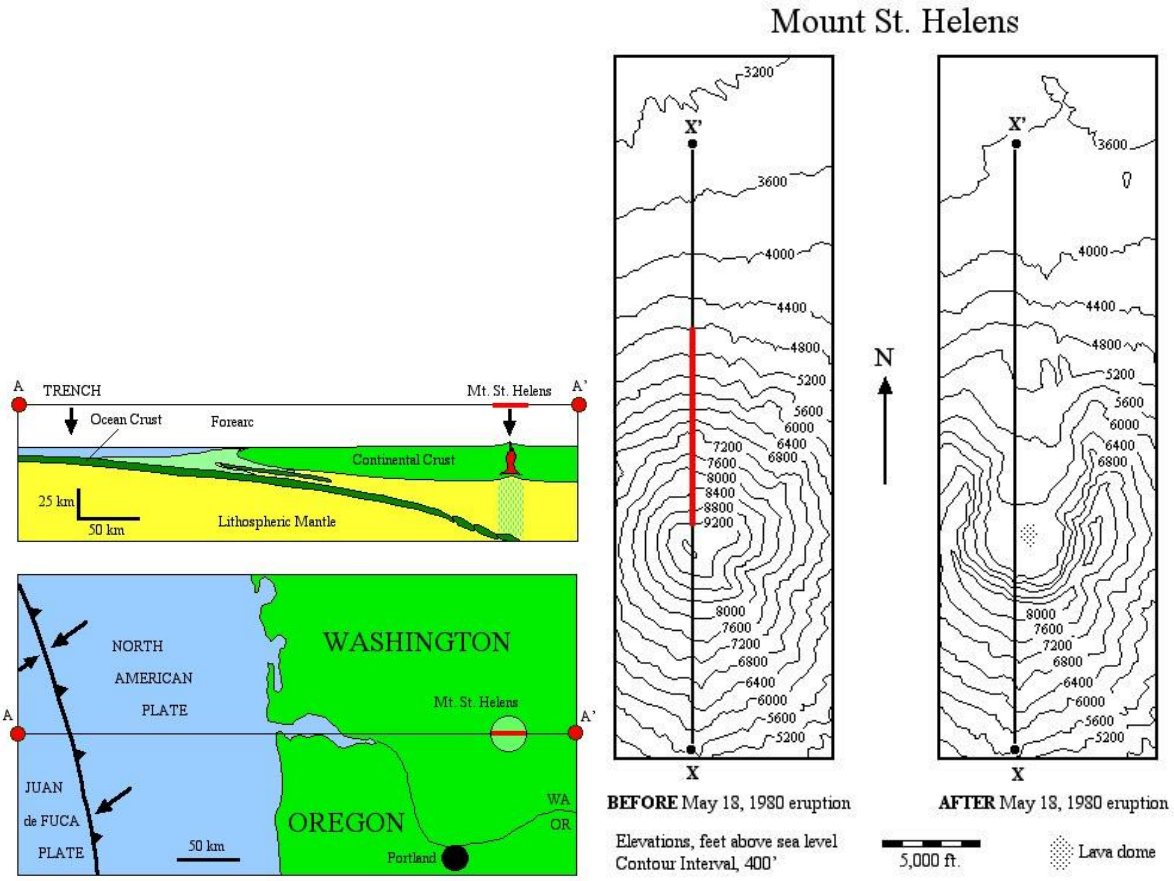
55. According to the plate tectonic theory, the rigid _____ floats on and slides over the ____.
    a. asthenosphere; lithosphere
    b. asthenosphere; Moho line
    c. lithosphere; asthenosphere
    d. mantle; Moho line

56. Volcanic eruptions can affect climate because:
    a. they are tall mountain peaks.
    b. they recycle water vapor to make clouds
    c. they heat the atmosphere.
    d. none of these

57. The theory of continental drift was first presented in 1912 by:
    a. Alfred Wegener.
    b. Harry Hess
    c. Leonardo di Vinci
    d. Robert Dietz.

58. Which type of volcano is large and has a low slope, such as Hawaiian volcanoes?
    a. Caldera. b. Cinder cone. c. Composite volcano d. Pluton. e. Shield volcano.

59. That the oceanic crust is geologically young and the parallel magnetic stripes on the ocean floor is symmetrical about oceanic ridges was conclusively shown by ___.
    A. radiometric dating of oceanic rocks and sequences from continents
    B. the unusally thin layer of oceanic sediments and ages of contained fossils
    C. the existence of the same patterns in all ocean basins
    D. A and B
    E. all of the above



60. Use the map above and to the left to determine how far Mount St. Helens is from the convergent plate boundary separating the Juan de Fuca and North American plates.

61. You may look at the front page to see the before and after photos of Mt. St. Helen's eruption and view the topo maps at the right above. The radius of Mount St. Helens is about 6 km at the base, and the elevation of the base is about 2.55 km above sea level. Before the eruption of May, 1980, the elevation at the top of Mount St. Helens was 2.95 km. Using this information, and modeling the volcano as a simple cone-shape, estimate the volume of volcanic material in Mount St. Helens, in cubic kilometers (km^3) before the eruption. [Hint: volume of a cone= $(1/3)\ \pi\ r^2h$] [Answer with three digits please.]

62. One source estimated that 6.5 km^3 of material was removed from Mount St. Helens during the eruption. What percent of the volcano was lost during the eruption?

63. What is the slope and angle of the slope of the surface of Mount St. Helens along the heavy bar in the "before" topo map above? The length of the red bar is 10,000 ft.

64. What is the standardized distance from an earthquake epicenter for measuring Richter magnitudes?
a. 10 km b. 100 km c. 500 km d. 1000 km

65. When a basalt undergoes partial melting, what kind of rock generally forms from the resulting magma?
a. Andesite. b. Basalt. c. Granite. d. Peridotite. e. Rhyolite.

66. Which of the following rocks is pyroclastic?
a. Diorite. b. Gabbro. c. Granite. d. Peridotite. e. Tuff.

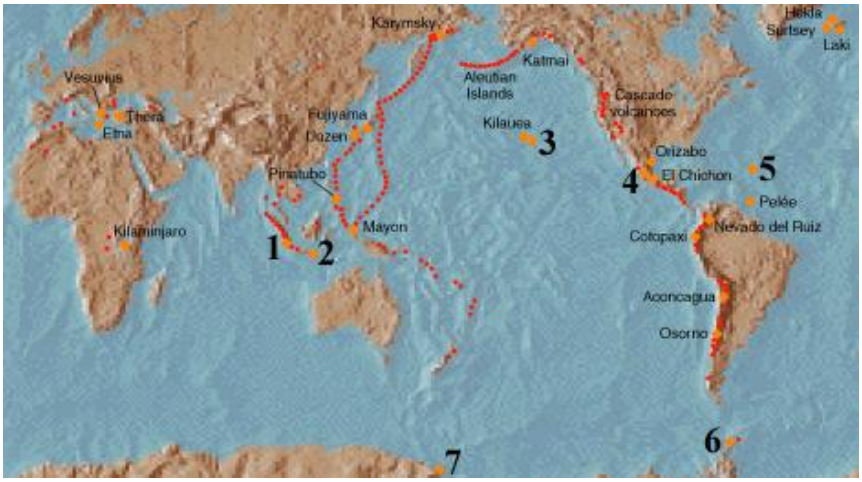
67. Which type of pluton is lens-shaped and arches up the overlying rock?
a. Batholith. b. Dike. c. Laccolith. d. Sill. e. Volcanic neck.

68. Which type of pluton is concordant and is most likely to develop columnar jointing?
a. Batholith. b. Dike. c. Laccolith. d. Sill. e. Volcanic neck..

69. Which term refers to a glowing cloud of hot air-cushioned ash?
a. fumarole b. hot spot **c.** Nuée ardente d. pipe e. vent

70. Which volcanic feature connects a volcano to a nearby magma chamber below?
a. fumarole b. hot spot **c.** Nuée ardente d. pipe e. vent

71. Which volcanic feature emits only gas?
a. Fumarole. b.Hot spot. c. Nuée ardente.d. Pipe. e. Vent.



Match the numbered volcanoes in the image above to the volcano names in the list on the right.

	Volcano	**Names**
72.	#1	A. Popocatepetl
73.	#2	B. Tambora
74.	#3	C. Mauna Loa
75.	#4	D. Soufriere Hills
76.	#5	E. Deception Island
77.	#6	F. Mt. Erebus
78.	#7	G. Krakatoa

Match the Modified Mercalli Intensities below with their descriptions on the right.

	Mercalli Intensities Levels	**Answer choices**
79.	I	**A** Felt by only a few persons at rest, especially on upper floors of buidlings.
80.	II	**B** Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built structures.
81.	III	**C** Few (if any) masonry structures remain standing. Bridges destroyed. Broad fissures in ground.
82.	IV	**D** Damage slight in specially designed structures; considerable in well-built structures with partial collapse; great damage in poorly built structures.
83.	V	**E** Felt quite noticeable indoors, especially on upper floors of buildings.
84.	VI	**F** Damage total. Waves observed on ground surface by witnesses.
85.	VII	**G** Felt by all; many frightened and run outdoors. Some heavy furniture moved.
86.	VIII	**H** Damage considerable in specially designed structures; ;great in well-designed buildings with partial collapse; ground cracked conspicuously.
87.	IX	**I** Felt by many during the day indoors, outdoors by few. At night, some awakened.
88.	X	**J** Felt by nearly everyone; many awakened from sleep.
89.	XI	**K** Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked.
90.	XII	**L.** Not felt except by a very few under especially favorable circumstances.

ACTIVITY: LOCATING AN EPICENTER --

Introduction:

As you have learned in class, earthquakes are vibrations caused by large releases of energy. These energy releases can occur as a result of fault movements, asteroid impacts, volcanic eruptions, and movements of magma, as well as by explosions. As a result, vibrations can begin both in and on the Earth's crust. The energy released radiates away from the point of origin. Commonly, when describing the location of an earthquake, scientists and the media often talk about the earthquake's **epicenter.**

In this lab, you will use seismograms from three locations to determine the epicenter of an earthquake. You will use the P- and S-wave arrival time difference to determine distance to epicenter, then use a compass to record the distance radius measured by each station. Remember, accuracy is important- take care to make accurate measurements!

Procedure:

1. Examine Figure 1, which shows seismograms of an earthquake recorded at three different locations. Note that the first set of zigzags at each city indicate the arrival of P-waves, and the second set of zigzags indicate the arrival of S-waves. In order to determine the time of arrival for each P- and S-wave, move your finger in a straight line down to the **time axis** beneath the wave. **NOTE SCALE UNITS VARY!**

2. **Estimate to the nearest ten seconds,** the times of the first arrival of the P-waves and S-waves at each station in Figure 1. Then, subtract the S minus P: (3 pts)

COMPLETE THE CHART ON YOUR ANSWER SHEET

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3. Now use the **S** minus **P** times and the **P- and S-wave Travel Time Curve** (Page 11 ESRT's) to estimate the distance from the epicenter for each location. Refer to the following procedure to accomplish this:

a. Lay a strip of blank paper along the time axis of the Travel Time Curve (Page 11 ESRT's). Mark two dots on the edge of the paper corresponding to the **S-P** time difference calculated for the first location above.

b. Keeping the edge of the paper parallel to the vertical lines on the graph, slide the paper along the **S** and **P** curves until the two dots lie exactly on the **S** and **P** curves.

c. A vertical line through the **S** and **P** curves at these points should intersect the horizontal axis. This is the distance between the seismograph at this location and the earthquake's epicenter.

d. Record this distance in the table below. Repeat this procedure for the next two **S-P** times.

COMPLETE THE CHART ON YOUR ANSWER SHEET

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4. Next, find the earthquake's epicenter, using the distances just obtained and the procedure below.

a. Use the **scale** in Figure 2 to set the appropriate radius on your compass. You can do this by opening your compass to a length equal to the **Distance to Epicenter** determined for **San Jose, Costa Rica**, as recorded in the chart above.

NOTE: You may notice that the distance is LONGER than the scale. Open the compass to the entire length of the scale (3,000 km). Then, move the compass to the LEFT until the point that WAS on 3,000 touches 0. Then, continue opening it the REMAINING length.

b. Place your compass point on the circle labeled **San Jose** on your map. Scribe a complete circle around the seismic station.

c. Repeat this procedure for **New York** and **San Francisco**.

d. The circles you should draw should intersect near one point. **This point is the epicenter**!

DRAW THE CIRCLES AND SHOW THE POINT OF INTERSECTION ON THE ANSWER SHEET

Questions relating to this activity:

98. What is the origin time of the earthquake?

99. Which seismograph recorded the earliest P-wave arrival?

100. Which state or country was the location of the epicenter?

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Names_____ and _____

School _____Team Number_____

SHORT ANSWERS: Place all answers below.
Any answers written on the test copy will not be counted.

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9 _____
5. _____ 10. _____

MULTIPLE CHOICE—All answers must be legible to be considered correct. If I have to guess what the letter is, I will guess wrong!

11._____	12._____	13. _____	14. _____	15. _____
16._____	17._____	18. _____	19. _____	20. _____
21._____	22._____	23. _____	24. _____	25. _____
26._____	27._____	28. _____	29. _____	30. _____
31._____	32._____	33. _____	34. _____	35. _____
36._____	37._____	38. _____	39. _____	40. _____
41._____	42._____	43. _____	44. _____	45. _____
46._____	47._____	48. _____	49. _____	50. _____
51._____	52._____	53. _____	54. _____	55. _____
56._____	57._____	58. _____	59. _____	60._____
61._____	62. ._____	63. _____	64. _____	65._____
66. _____	67. _____	68. _____	69.. _____	70. _____

71._____ 72._____ 73. _____ 74. _____ 75. _____

76._____ 77._____ 78. _____ 79. _____ 80._____

81._____ 82._____ 83. _____ 84. _____ 85. _____

86._____ 87._____ 88. _____ 89. _____ 90. _____

Paste Table 1 here

3pt

Paste Table 2 here

3pt

BIG MAP HERE

2pt.

99. _____ 100. _____