CASCADIA GPS ANALYSIS

Name: ____

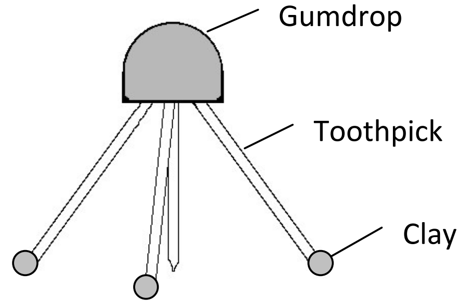
Today's Date: __________________________

PART I: Building a GPS 'Monument'

Materials:
4 toothpicks, 1 gumdrop, modeling clay, ruler, 1/4 sheet transparency

Procedure:

1. Insert 3 toothpicks diagonally into the gumdrop. These will act as the legs.
2. Insert a slightly shorter toothpick sticking straight down from the middle of the gumdrop. The tip of this toothpick should be just barely above the surface. This will be the *'place marker'*.
3. Put very small pieces of clay on the bottom of the legs (not the place marker). The clay will act as a cement to hold the GPS station in place. In reality the legs of a GPS station are cemented deep into the ground so that if the ground moves, so does the GPS station.
4. Position the GPS Monument on top of a piece of clear transparency.



PART II: Pinpointing Location

1. What do the tops of the string holders on the walls represent?

2. What does the length of string represent?

3. How many satellites are needed to pinpoint the location of a spot on the Earth?

4. Why wouldn't one or two satellites work? Expain and draw a diagram to show this.

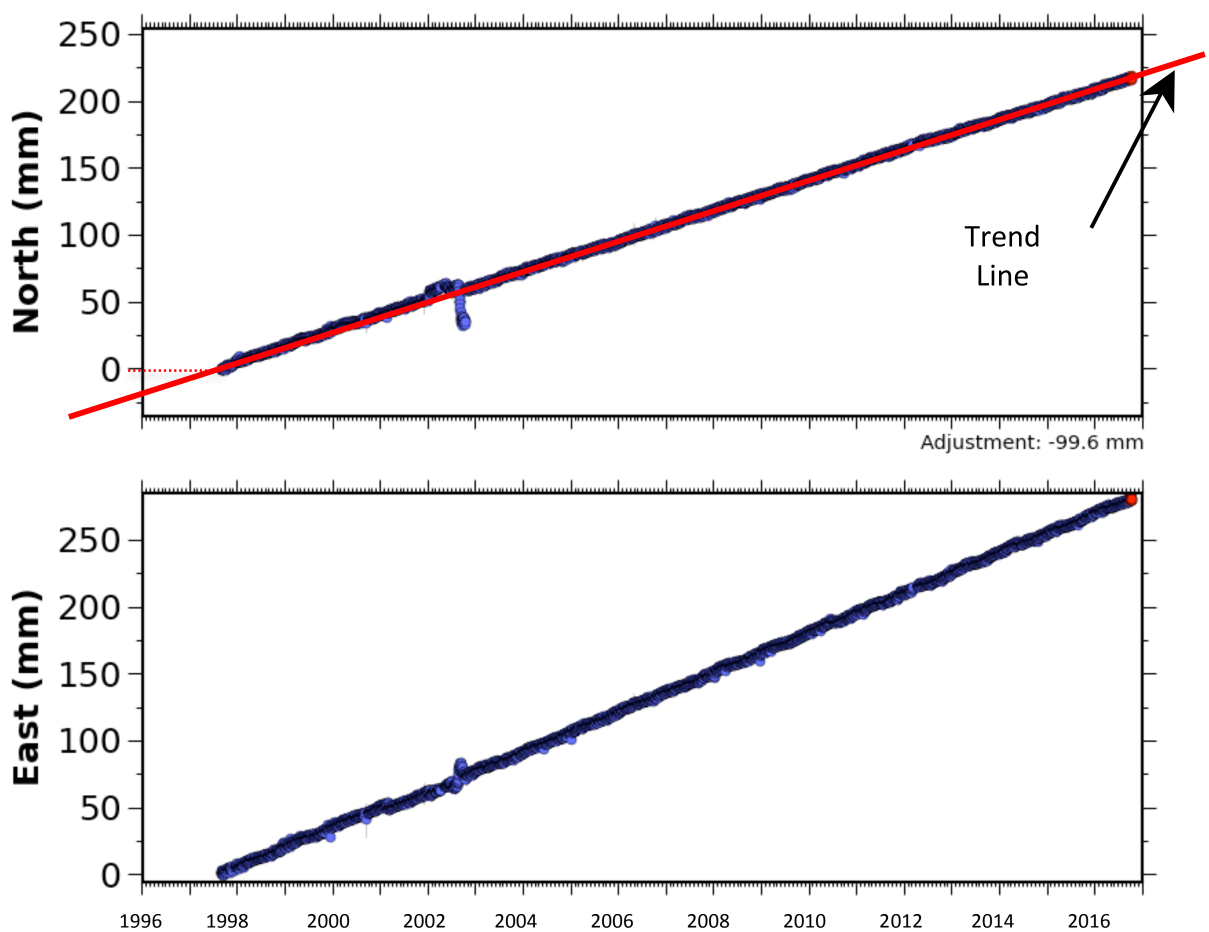
5. Draw the setup of the demonstration in the space to the right.

PART III: Measuring Cascadia GPS/Tectonic Movement

Materials:
Colored pencil (for drawing trend lines), clear ruler, calculator

- High precision GPS stations collect data in 3 parts shown in **Time Series Plots (Time Series or TSP)**:
  - North/South movement over time (abbreviated N/S)
  - East/West movement over time (abbreviated E/W)
  - Height (up/down) movement over time (not shown in this activity)
- X-axis measures time.
- Each dot on the TSPs is the average position of the station for one day.

Pacific Beach, Washington GPS Data – Coastal Station



The first thing to do is draw a "**trend line**." Position a ruler (clear works best) so that the trend line represents the average of the plots above and below the line. Draw the line so that it crosses the axes on both sides. Note the example above. Draw a trend line for the East portion of the Pacific Beach TSP.

6. What are the units of measurement for these time series? Circle the best choice.

a) centimeters and months
b) meters and years
c) millimeters and years
d) centimeters and years

7. If each dot is the average position for any given day, how long of a timespan has this station been collecting data?

a) 10 years   b) 15 years   c) 19 years   d) 20 1/2 years

8. How far North did the Pacific Beach station move on the time series? Hint: calculate the *change* in position over time.

a) 200 millimeters   b) 215 milllimeters
c) 230 millimeters   d) 275 millimeters

9. Did the station move South over the period of time relative to its starting position (1st measurement)?

a) No, because trend line only moves up.
b) Yes, because trend line moves down.
c) Can't tell from time plots given.

10. How far East did the station (and therefore the Earth below it) move on the TSP? Remember to use a straightedge to help.

a) 205 millimeters   b) 215 milllimeters
c) 280 millimeters   d) 300 millimeters

11. What overall direction was this station moving?

a) North only   b) Northwest
c) Northeast   d) Southwest

12. What was the annual movement in the North direction? *(Hint: Divide distance traveled by # of years)*

a) 10 mm/yr   b) 11.3 mm/yr   c) 16 mm/yr   d) 200 mm/yr

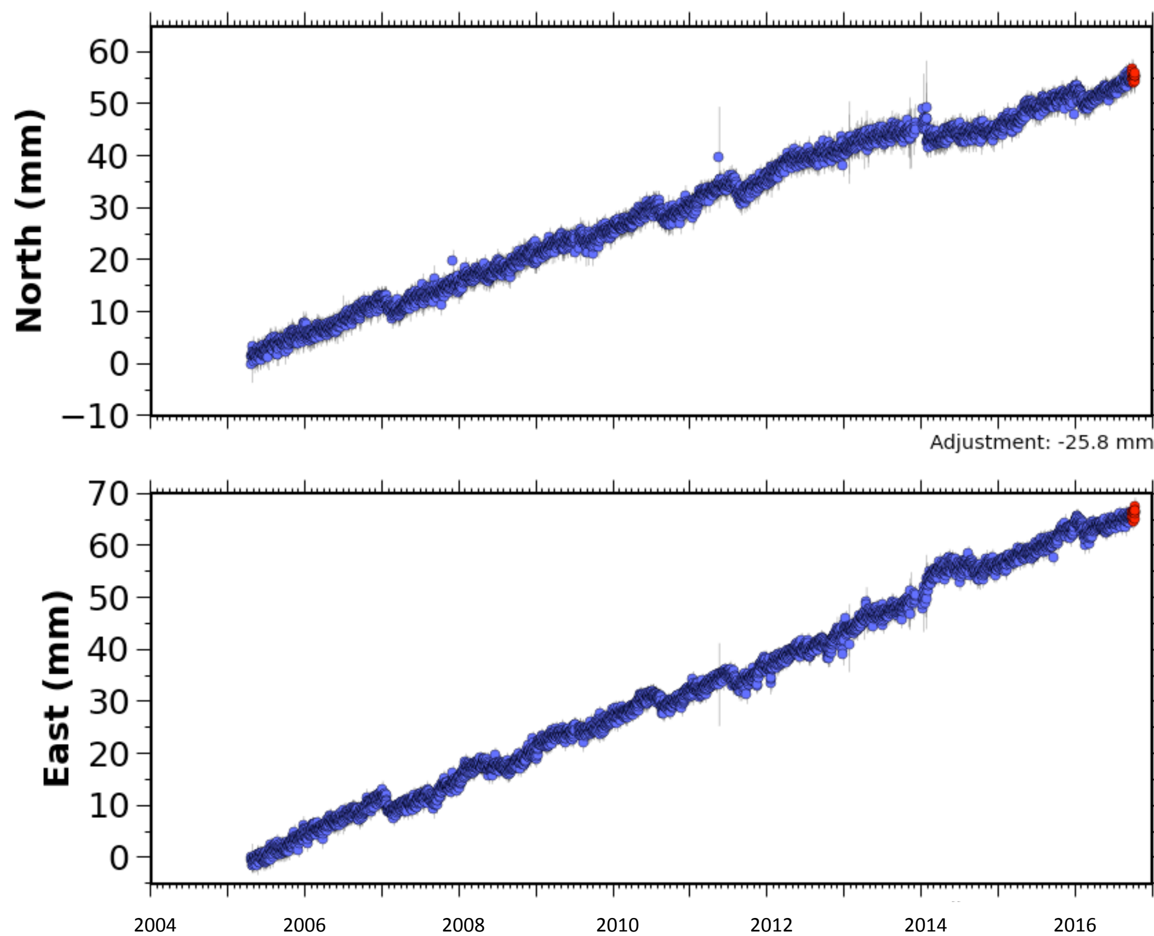
13. Calculate the annual Eastward movement:

a) 4 mm/yr   b) 13.3 mm/yr   c) 14.7 mm/year   d) 280 mm/yr

Using the TSPs below for Grapeview, WA and Lind, WA, calculate N/S and E/W motion and answer questions for each TSP. Start with drawing trend lines that cross both vertical axes.

Note that some positions (dots) are 'off' the general trend, or there is a gap in the data. Those might be times when maintenance was being done on the station, or there was some error that was being corrected. You can ignore those points when doing your trend lines and calculations.

Grapeview, Washington GPS Data – Urban Corridor Station



14. According to this data, how long of a time period has this station been in operation? *Note that each small line on X-axis is one month, or 1/12th of a year.*

15. Was Grapeview moving North or South? How do you know?

16. How far did North or South did it move since data has been recorded?

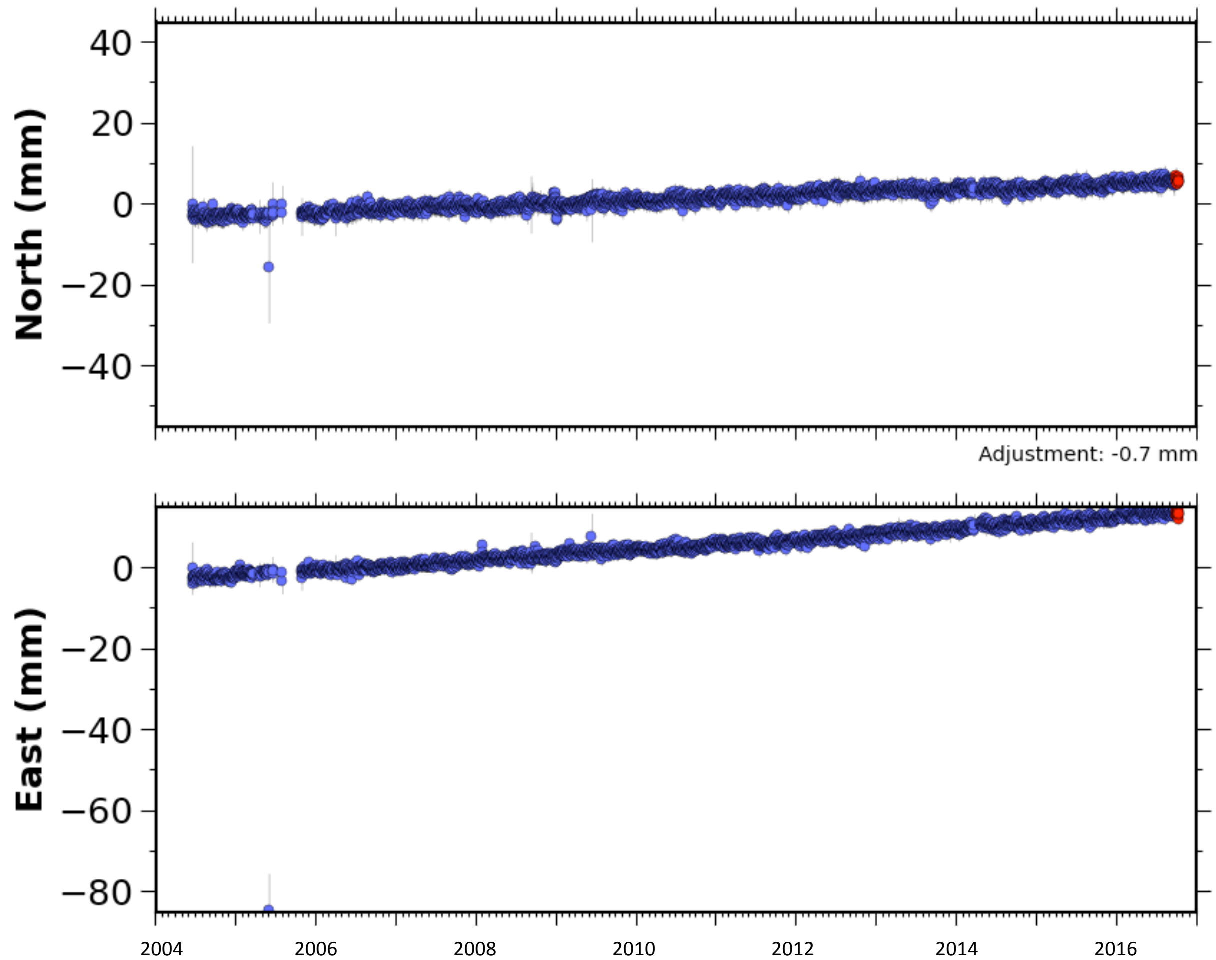
17. Overall, was Grapeview station moving East or West? How do you know?

18. How far East or West did it move over the whole time period of data collection?

19. Were there any times when the station wasn't moving NW? If so, when, and what direction??

20. Calculate annual motions in N/S and E/W directions.

Lind, Washington GPS Data – Eastern Station



21. According to this data, how long of a time period has this station been in operation?

22. Was Lind moving North or South? If so, how far? *Be careful with measurements. Use the trend line to better indicate the starting position. Hint: it's below '0'.*

23. Was Lind station moving East or West? If so, how far? *Again, be careful.*

24. What are the annual motions in the N/S and E/W directions?

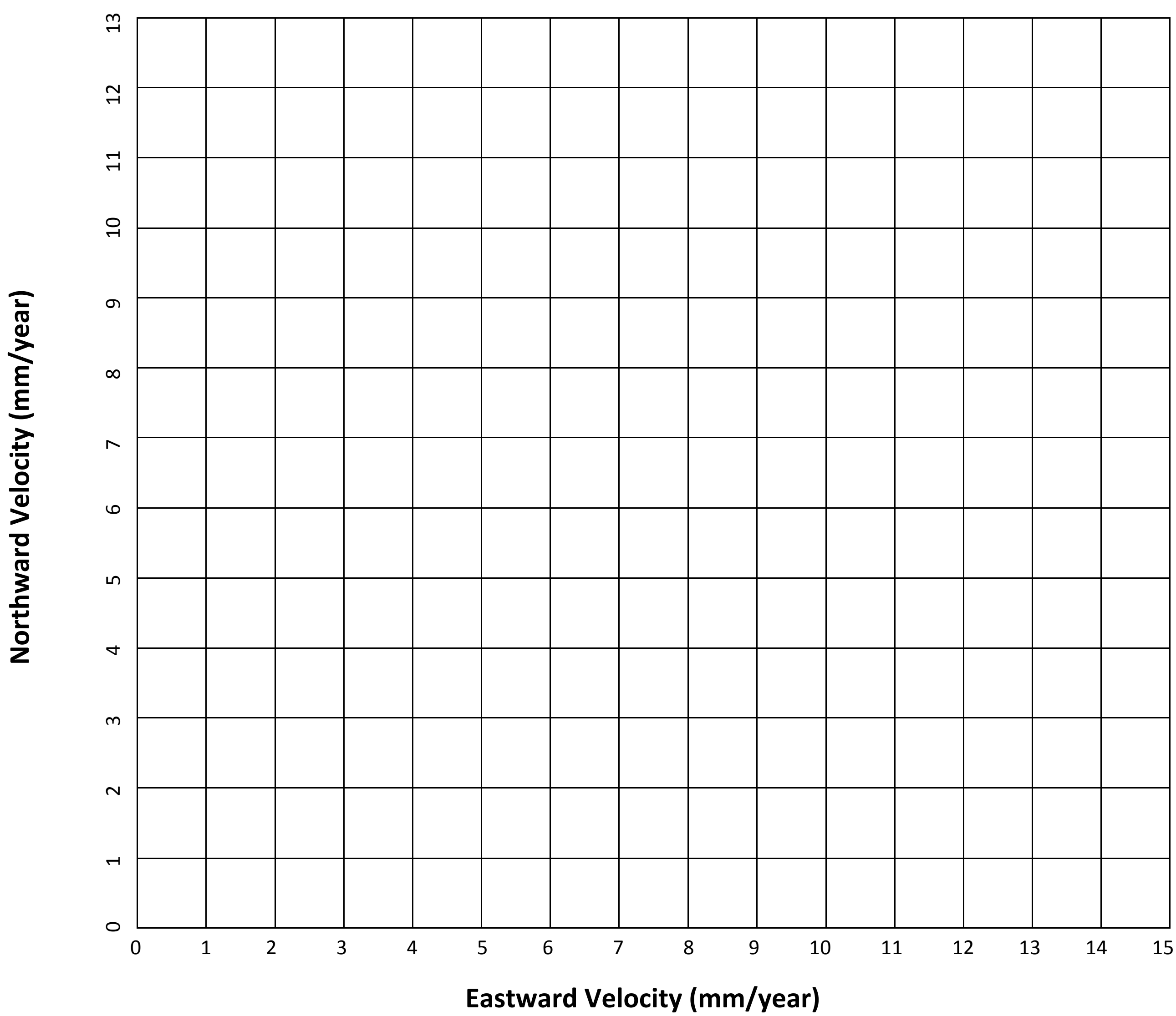
PART IV: Plotting GPS Station Motion

Materials:
Cascadia GPS Analysis Grid (next page of packet), 3 different colored pencils, ruler

Procedure:

1. Using one colored pencil, start at (0,0) and draw a faint arrow to show the **annual** North movement of the Pacific Beach station.
2. From *end point* of the North arrow, draw an arrow to show the **annual** East motion.
3. Draw a diagonal arrow from (0,0) to the end point of the ***East*** arrow. This final arrow (vector) shows the overall annual direction and distance of motion of the Pacific Beach GPS station.
4. Using a centimeter ruler, measure the length of the final vector and label the vector with distance in mm/year. **Note**: Scale on grid is centimeters, but actual movement is millimeters – that's why you label 'mm/year'.
5. Using different colors, draw vectors for Grapeview and Lind stations.
6. Complete key indicating colors of your 3 GPS station vectors.

KEY:	Color	Station Location	Station Group (Coastal, Urban Corridor, or Eastern)



Procedure (continued):

7. Place gumdrop station (on top of transparency) at 0,0 and move the transparency sheet along one of the Northeast vectors to simulate the direction of the land at that point.

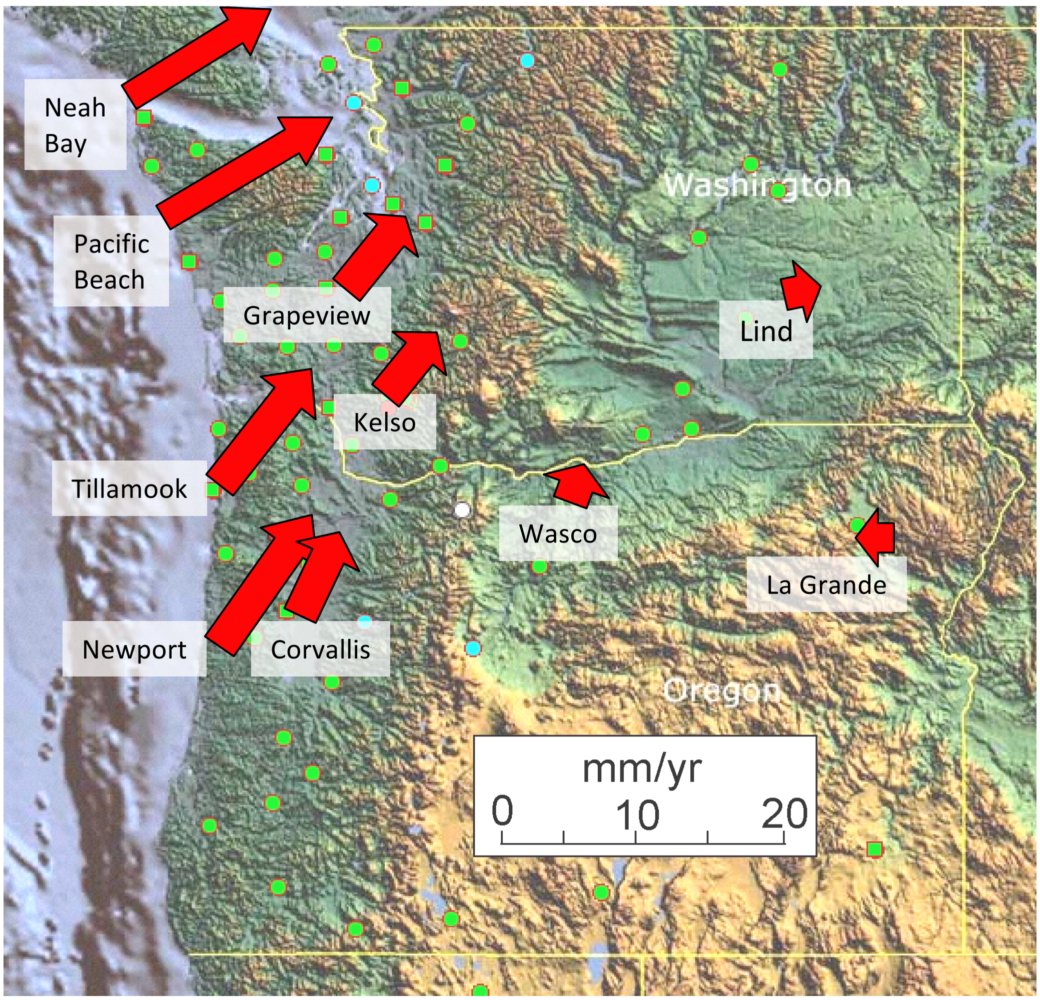
PART V: Analysis of GPS Station Motion

25. The map below shows the direction and speed of several GPS stations in the Pacific Northwest. What do you observe about:

    a) the stations along the coast?

    b) the stations slightly inland (Grapeview, Kelso, Corvallis)?

    c) stations east of the Cascades (Wasco, Lind, La Grande?



26. Over time, what will happen to the distance between stations on the coast and stations east of the Cascades?

    a) Distance gets shorter
    b) Distance gets longer
    c) Distance stays the same

27. What does this indicate about the forces acting on the Pacific Northwest? What's happening to the edge of the continent?