OREGON MARINE SCIENTIST AND EDUCATOR ALLIANCE

Sea Floor Graveyard - Student Worksheet #5

Hypoxia - Temperature and Dissolved Oxygen

TEACHER KEY

Use Desmos to create a linear regression model of given data. Between July and September 2020, Oregon State University scientists collected data near the Oregon shore that appears to show that the higher the water temperature (in degrees Celsius), the greater amount of dissolved oxygen in the water (in mol/kg), and that this relationship may be modeled by a linear function. Let's plot some points and see if this is true!

1. Enter the following data points into a Table in Desmos. The x-axis represents the amount of dissolved oxygen in the water (in mol/kg). The y-axis represents the water temperature (in ∘C).

   (30,7), (80,8), (140,9), (185,10), (250,11), (300,12), and (340,13)

2. Use Desmos to create a linear regression (or "line of best fit"). We do this by using $y_1 \sim mx_1 + b$. You'll note that this looks very similar to the slope-intercept form of a line (y = mx + b). But notice that we use the symbol ~ instead of =, and both the x and y values have "subscripts" to correspond with the data in the Table you created in Step 1. Once you've done this, Desmos will give you the slope (m) and y-intercept (b) of the line that best fits the data. Enter that information here:

   Slope (m): **.02 (rounded)** Y-intercept (b): **6.4 (rounded)**

   Since we know the slope (m) and the y-intercept (b), we can now write the equation (or function) in slope-intercept form (y = mx + b):

   y = .02x + 6.4

   Is the slope positive or negative? And what does that tell us generally about the "rate of change" (or the relationship between the water temperature and the oxygen levels)?

   The slope is positive. Generally that tells us that as the oxygen levels increase, so does the temperature (or vice versa).

<u>Use the Graph you created to predict other outcomes</u>. Now you can use the Graph to predict or estimate other outcomes. To make the graph more "user-friendly" to look at, you can use the tool button in the upper right (looks like a wrench) to change the x- and y-axes scales, *OR* you can simply use the "Zoom Fit" button near the bottom left of the Table you created (looks like a + sign inside of a magnifying glass!). Use the graph to answer the following questions:

1. What is the y-intercept, and what does it represent? Y-intercept (b): **(0, 6.4)**

   The y-intercept represents: **if the temperature were to fall to 6.4°C, then theoretically there would be no oxygen in the water**

2. If the water temperature were to climb to 14° or 18° or 20° C, what would you estimate the oxygen levels to be?

   14° C: **approx 401** (mol/kg)

   18° C: **approx 613** (mol/kg)

   20° C: **approx 719** (mol/kg)

3. What would you estimate the water temperatures to be if the oxygen levels were 50 or 100 or 220 mol/kg?

   50 mol/kg: **approx 7.4** °C

   100 mol/kg: **approx 8.3** °C

   220 mol/kg: **approx 10.6** °C

4. How do you think scientists actually ***USE*** this information to make predictions, look for patterns, infer causes, and make suggestions about solutions?____________________________________

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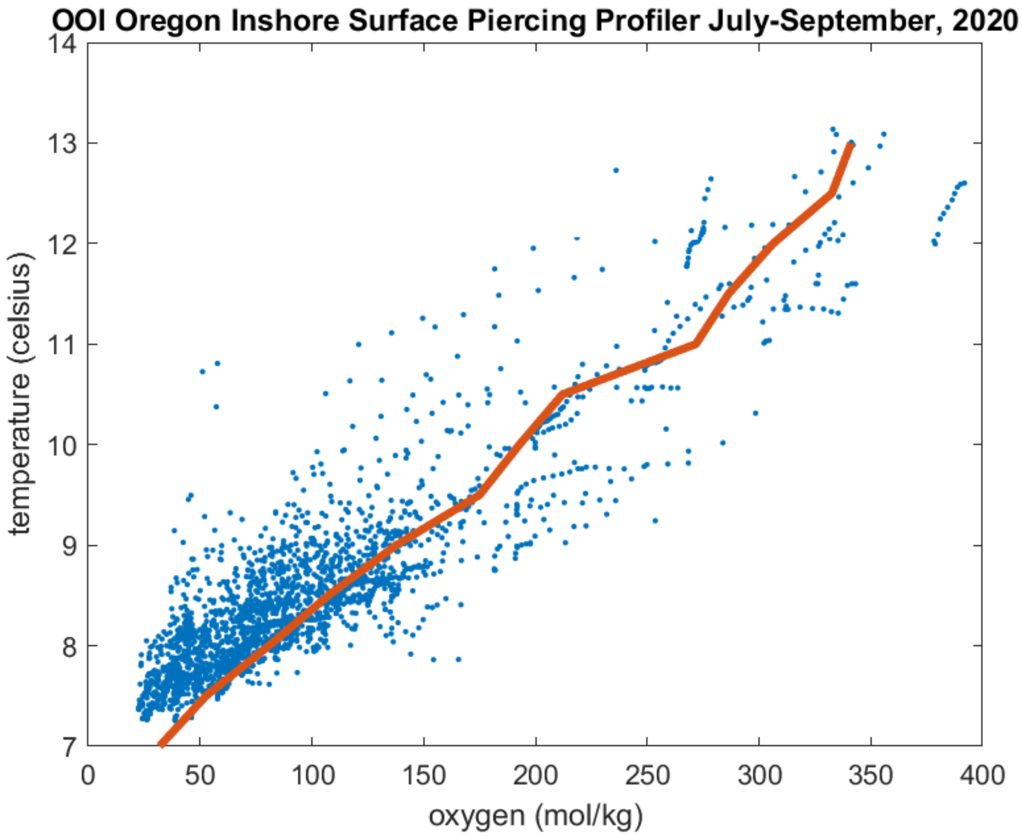
   ____.

Compare your Graph to the "REAL" Graph. Now that you've learned how to use Desmos to create a linear regression (or "line of best fit") that matches your data, let's take a look at the "real" graph created by OSU scientists to see how accurate we were, and to see if there is any other information we can learn from it.



1. How accurate was your graph? Explain the similarities: ___________________________________

   ____.

2. Where do most of the data points seem to fall? Explain why you think this is: _______________

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   ____.

3. Why do you think the y-axis starts at "7" and not at "0"?__________________________________

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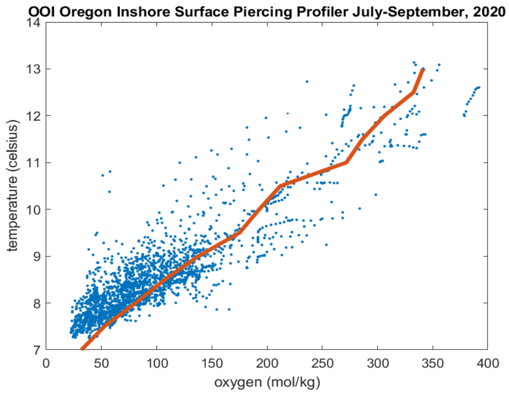

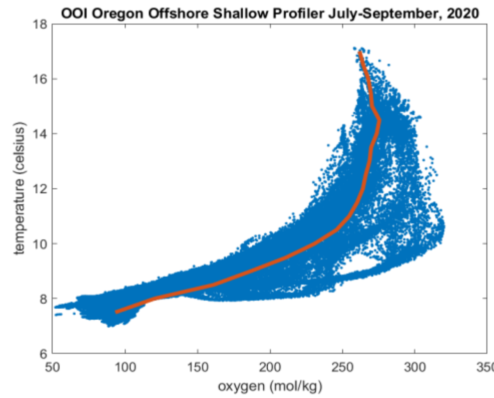

<u>EXPLAIN: Compare and Contrast the Graphs of Inshore Data vs. Offshore Data</u>. The graph on the left is the same graph you worked with on the previous page and shows the data near the shore ("inshore"). The graph on the right shows the data from "offshore". Let's compare them side by side.

First, name 3 <u>similarities</u> you notice about the two graphs, ***and explain*** how these similarities might be important in helping to describe or explain the upwelling phenomenon we've been discussing in class.

1. ____

____.

2. ____

____.

3. ____

____.

Now, name 3 <u>differences</u> you notice about the two graphs, ***and explain*** how these differences might be important in helping to describe or explain the upwelling phenomenon we've been discussing in class.

4. ____

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5. ____

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6. ____

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Now let's look a little more closely at the graph on the right ("offshore data") and answer some questions about it:

1. Does the graph appear to model the data as a linear function? ***Explain*** your reasoning:

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2. Could we model the data as a "piecewise" function of two or three different linear functions? How might we go about doing that? Would that be helpful to our understanding of the similarities and differences between the two graphs?

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3. Notice that the water temperature offshore tends to be several degrees warmer than the water temperature inshore. Why do you think this is the case? _________________________________

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4. In your own words, explain what "upwelling" is, why it leads to low oxygen levels inshore, and why scientists think it has been occurring over the last several decades:

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