DEEP SEA MISSIONS
Teaching Guidelines

Subject: Mathematics

Topics: Algebra—Coordinate Systems; Linear Equations and Functions

Grades: 8 - 12

Knowledge and Skills:

- Can plot a point in a two-dimensional coordinate system, given the coordinates, or determine the coordinates of a given point
- Understands that linear functions are characterized by the fact that the ratio of change in independent variable to change in dependent variable is constant.
- Can determine the equation of a linear function that closely matches a set of points

Answers:

1. At sea level the pressure is 14.7 pounds per square inch (lb/in.^{2}). For each 10 meters of depth, add an additional 14.7 pounds per square inch. For example, 70 meters of depth is 7 "tens of meters," so the amount to add is 7 x 14.7 lb/in.^{2} = 102.9 lb/in.^{2}, which is added to the original 14.7 lb/in.^{2} to give 117.6 pounds per square inch.

Sample Number	Sample Type	Depth Sample Taken (meters)	Pressure (pounds/ square inch
2201A	biological	10	*29.4*
2201B	biological	30	*58.8*
2201C	geological	70	*117.6*
2201D	biological	80	*132.3*
2201E	water sample	150	*235.2*
2201F	geological	190	*294.0*

2. Use this graph as an opportunity to investigate the behavior of linear functions. For example, ask students to determine exactly where the line crosses the *y* axis, and help them to figure out that it crosses at 14.7 lb/in.^{2} because that is the pressure at a depth of 0 meters.

Another tactic would be to ask students to compare the change in pressure from 30 meters to 70 meters to the change in pressure from 150 meters to 190 meters, leading to an investigation of the ratio of "change in pressure" to "change in depth" and the realization that this ratio is always the same value.

3. 1043.7 pounds per square inch.

4. The rule could be stated in many ways. Example 1: Start with 14.7 lb/in.^{2} for sea level pressure. Count how many tens there are in the depth, and add 14.7 lb/in.^{2} for each of those. Example 2: Divide the depth by 10, multiply the answer by 14.7 lb/in.^{2}, then add 14.7 lb/in.^{2} to your answer. Example 3: Pressure = 14.7 + (14.7 x depth divided by 10). Once students have created their own rules, discuss them in class and show that the rules are forms of the linear equation, $p = 1.47d + 14.7$.

MEMO

To: Mission Planning Staff
From: Jim McFarlane/Monterey Bay Aquarium Research Institute
Subject: Pressure at varying ocean depths

I will be out all day on a mission. Please handle the following items while I am gone:

1. In our last mission, mission #2201, we collected samples at several different depths. I have been asked to supply the lab with the pressure at each sample depth. Remember that pressure at sea level is 14.7 pounds per square inch, and that it increases by 14.7 pounds per square inch for every 10 meters of depth. Please fill out the following table:

Sample Number	Sample Type	Depth Sample Taken (meters)	Pressure (pounds/ square inch
2201A	biological	10	
2201B	biological	30	
2201C	geological	70	
2201D	biological	80	
2201E	water sample	150	
2201F	geological	190	

2. Please draw a line graph that shows the pressures you calculated for each of the given depths. Plot depth in meters on the horizontal axis and pressure in pounds per square inch on the vertical axis.

3. We went all the way to the bottom on this mission, to 700 meters. What would you predict was the pressure at that depth, based on the above data?

4. It would be helpful to have a general rule for computing the pressure at a given depth. Try to figure out such a rule and test it with some of the pressures you calculated for mission #2201.