Day 2 Worksheet: Solving Real-World Problems with Linear Equations

Context:

Geophysicists often use tools to estimate soil moisture by measuring the electrical resistance of the ground. They develop linear models based on their data.

A geophysicist might say:

> ***"For this type of soil, we observed a linear relationship: as resistance increases, soil moisture decreases."***

Problem 1: Predicting Soil Moisture

A geophysicist finds that the soil moisture can be modeled by the equation:

M = -2.5R + 40

Where:

M = soil moisture percentage

R = electrical resistance (in ohms)

a. What is the soil moisture if the resistance is 6 ohms?
b. What resistance would result in exactly 22.5% soil moisture?
c. What do the slope and y-intercept mean in this context?

Problem 2: Wave Speed in Wet vs. Dry Soil

In another study, the time it takes a seismic wave to travel through the soil (T in milliseconds) is modeled by:

T = 1.8D + 2.5
Where:

D = depth in meters

T = time in milliseconds

a. How long will it take a wave to travel through 5 meters of soil?
b. What is the depth if the wave took 11.5 milliseconds?
c. What does the y-intercept of this model tell us about wave speed at the surface?

Problem 3: Comparing Two Soil Types

Two different soil types have the following equations for moisture (M) in relation to resistance (R):

Soil A: M = -1.6R + 35

Soil B: M = -3.2R + 48

a. For a resistance of 5 ohms, which soil has more moisture?
b. What does the steeper slope of Soil B's equation suggest about how moisture changes with resistance?

Problem 4: Interpreting Graphs and Equations

You are given this graph showing the relationship between depth and wave travel time.
(Insert graph or describe it verbally if no visuals.)

The graph shows a straight line crossing (0, 2) and (4, 10).

a. Write the equation of the line.
b. What is the slope? What does it mean in this situation?
c. Estimate the wave time at 6 meters of depth using your equation.

Open-Ended Reflection:

In the real world, do you think these relationships are always perfectly linear? Why might scientists still use linear models? What assumptions are we making when using them?