Problem-Based Task: Healing the Waters

Coaching Sample Responses

a. What is the concentration of the acid-producing chemical at the beginning of the project?

The concentration of the acid-producing chemical can be found by rewriting the pH formula.

$$\text{pH} = \log_{10}\left(\frac{1}{C}\right)$$

$$\text{pH} = -\log_{10} C$$

$$C = 10^{-\text{pH}}$$

In other words, the pH is the power of 10 of the concentration. At the beginning of the project, the pH is 5.2, so the concentration is $10^{-5.2}$, which is a number that can be difficult to evaluate without the use of a calculator.

Evaluated using a calculator, $10^{-5.2} \approx 0.000006$.

The concentration of the acid-producing chemical is about 6 millionths of a milligram per liter.

b. What is the concentration of the acid-producing chemical after one month?

Substitute the pH of the river after one month, 5.4, into the rewritten expression for the concentration C from part a. Then, evaluate using a calculator.

$$C = 10^{-\text{pH}}$$

$$C = 10^{-(5.4)}$$

$$C \approx 0.000004$$

After one month, the concentration of the acid-producing chemical is about 4 millionths of a milligram per liter.

c. Describe the change over the first month in terms of the pH and in terms of the acid-producing chemical concentration.

The concentration of the acid-producing chemical was reduced from 6 millionths of a milligram per liter to 4 millionths of a milligram per liter over one month, a reduction factor of $\frac{1}{3}$.

d. Was the river more or less acidic at the beginning of the project than after one month of cleanup? Explain.

According to the data in the problem, at the beginning of the project the river's pH was 5.2, which is less neutral than "pure" water, which has a pH of 7. After one month, the pH had increased to 5.4. The pH represents a negative exponent, so a smaller negative exponent means a greater concentration of the acid-producing chemical. Therefore, the river was more acidic at the beginning of the project.

e. Will the river be more or less acidic at the end of the project year? Explain.

If the pH changes continue at the same rate for 12 months, the change in the pH can be given by the expression $12 \bullet (5.4 - 5.2) = 2.4$. Therefore, the pH of the river after one year will be $5.2 + 2.4$ or 7.6. This pH level is almost equal to the neutral pH of 7. Any solution with a pH greater than 7 is described as being an alkaline solution, as opposed to an acidic solution for pH levels less than 7. The river will be less acidic at the end of the project year, but what made it slightly alkaline will have to be monitored, too.

Recommended Closure Activity

Select one or more of the essential questions for a class discussion or as a journal entry prompt.