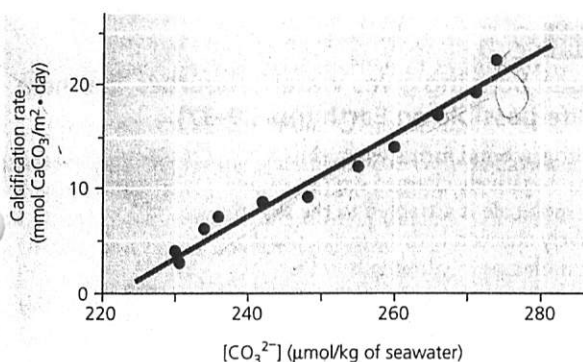


# Interpreting a Scatter Plot with a Regression Line

**How Does the Carbonate Ion Concentration of Seawater Affect the Calcification Rate of a Coral Reef?** Scientists predict that acidification of the ocean due to higher levels of atmospheric  $\text{CO}_2$  will lower the concentration of dissolved carbonate ions, which living corals use to build calcium carbonate reef structures. In this exercise, you will analyze data from a controlled experiment that examined the effect of carbonate ion concentration ( $[\text{CO}_3^{2-}]$ ) on calcium carbonate deposition, a process called calcification.

**How the Experiment Was Done** The Biosphere 2 aquarium in Arizona contains a large coral reef system that behaves like a natural reef. For several years, a group of researchers measured the rate of calcification by the reef organisms and examined how the calcification rate changed with differing amounts of dissolved carbonate ions in the seawater.

**Data from the Experiment** The black data points in the graph below form a scatter plot. The red line, known as a linear regression line, is the best-fitting straight line for these points. These data are from one set of experiments, in which the pH, temperature, and calcium ion concentration of the seawater were held constant.



## Interpret the Data

- When presented with a graph of experimental data, the first step in analysis is to determine what each axis represents. (a) In words,

explain what is being shown on the x-axis. Be sure to include the units. (b) What is being shown on the y-axis (including units)? (c) Which variable is the independent variable—the variable that was *manipulated* by the researchers? (d) Which variable is the dependent variable—the variable that responded to or depended on the treatment, which was *measured* by the researchers? (For additional information about graphs, see the Scientific Skills Review in Appendix F and in the Study Area in MasteringBiology.)

- Based on the data shown in the graph, describe in words the relationship between carbonate ion concentration and calcification rate.
- (a) If the seawater carbonate ion concentration is  $270 \mu\text{mol/kg}$ , what is the approximate rate of calcification, and approximately how many days would it take 1 square meter of reef to accumulate 30 mmol of calcium carbonate ( $\text{CaCO}_3$ )? To determine the rate of calcification, draw a vertical line up from the x-axis at the value of  $270 \mu\text{mol/kg}$  until it intersects the red line. Then draw a horizontal line from the intersection over to the y-axis to see what the calcification rate is at that carbonate ion concentration. (b) If the seawater carbonate ion concentration is  $250 \mu\text{mol/kg}$ , what is the approximate rate of calcification, and approximately how many days would it take 1 square meter of reef to accumulate 30 mmol of calcium carbonate? (c) If carbonate ion concentration decreases, how does the calcification rate change, and how does that affect the time it takes coral to grow?
- (a) Referring to the equations in Figure 2.24, determine which step of the process is measured in this experiment. (b) Do the results of this experiment support the hypothesis that increased atmospheric  $[\text{CO}_2]$  will slow the growth of coral reefs? Why or why not?

**Data from** C. Langdon et al., Effect of calcium carbonate saturation state on the calcification rate of an experimental coral reef, *Global Biogeochemical Cycles* 14:639–654 (2000).

**(MB)** A version of this Scientific Skills Exercise can be assigned in MasteringBiology.

As seawater acidifies, the extra hydrogen ions combine with carbonate ions ( $\text{CO}_3^{2-}$ ) to form bicarbonate ions ( $\text{HCO}_3^-$ ), thereby reducing the carbonate ion concentration (see Figure 2.24). Scientists predict that ocean acidification will cause the carbonate ion concentration to decrease by 40% by the year 2100. This is of great concern because carbonate ions are required for calcification, the production of calcium carbonate ( $\text{CaCO}_3$ ), by many marine organisms, including reef-building corals and animals that build shells. The **Scientific Skills Exercise** gives you an opportunity to work with data from an experiment examining the effect of carbonate ion concentration on coral reefs. Coral reefs are sensitive ecosystems that act as havens for a great diversity of marine life. The disappearance of coral reef ecosystems would be a tragic loss of biological diversity.

## CONCEPT CHECK 2.5

- Describe how properties of water contribute to the upward movement of water in a tree.
- How can the freezing of water crack boulders?
- The concentration of the appetite-regulating hormone ghrelin is about  $1.3 \times 10^{-10} \text{ M}$  in a fasting person. How many molecules of ghrelin are in 1 L of blood?
- Compared with a basic solution at pH 9, the same volume of an acidic solution at pH 4 has \_\_\_ times as many hydrogen ions ( $\text{H}^+$ ).
- WHAT IF?** What would be the effect on the properties of the water molecule if oxygen and hydrogen had equal electronegativity?

For suggested answers, see Appendix A.