ancestor explains similar features, while the force of natural selection in different environments accounts for differences between organisms.

10. Focus on Information
Common ancestry explains this observation. The thousand-some-odd genes shared by humans and prokaryotes originated in early prokaryotes. They have been retained, with some modification, over the billions of years of eukaryotic evolution. These genes no doubt code for proteins and RNAs whose functions are essential for survival—for example, the genes that code for ribosomal RNA, which is important for protein synthesis in both prokaryotes and eukaryotes.

CHAPTER 2 THE CHEMICAL CONTEXT OF LIFE

Scientific Skills Exercise

Teaching objective: This exercise is designed to give students practice in figuring out what is shown on a graph, how to describe the major trend(s) in the data, and extracting values from the graph to calculate related information. The student is then led back to the biological context of the data to draw a conclusion.

Teaching tips: A version of this Scientific Skills Exercise can be assigned in MasteringBiology.

Most students can look at a graph and describe the slope of the data line. However, many struggle with writing out what the trend means in terms of the relationship between what was reported on one axis relative to the other axis. Thus, while a student may respond that the data line has a positive slope, they may also respond that a higher calcification rate results in a higher carbonate ion concentration. Helping them sort out dependent and independent variables should clear up the problem. Visual learners will benefit from drawing a mock-up of 1 square meter of the reef, with dots in the water to represent carbonate ions and arrows to indicate calcification.

In this example, students will need to make the additional mental step of reading the trend line right to left, instead of left to right (the natural tendency), to reach a conclusion about the effect of *decreased* carbonate ion concentration on calcification rate and reef growth.

Answers:

1. (a) The *x*-axis shows the concentration of carbonate ions in units of micromoles of carbonate ions per kilogram of seawater. (b) The *y*-axis shows the calcification rate in units of millimoles of calcium carbonate accumulated per square meter of reef per day. (c) Carbonate ion concentration is the independent variable. (d) Calcification rate is the dependent variable.

2. The data show that the rate of calcification is positively related to the concentration of carbonate ions in the seawater. As the concentration of carbonate ions increases, the rate of calcification increases.

3. (a) If the seawater carbonate ion concentration was 270 μmol/kg, the calcification rate would be approximately 19 mmol $CaCO_3/m^2 \cdot day$. It would take 1 square meter of reef approximately 1.6 days to accumulate 30 mmol of $CaCO_3$ [(30 mmol of $CaCO_3/m^2$) / (19 mmol $CaCO_3/m^2 \cdot day$) = 1.6 days]. (b) If the seawater carbonate ion concentration was 250 μmol/kg, the calcification rate would be approximately 12 mmol $CaCO_3/m^2 \cdot day$. It would take 1 square meter of reef 2.5 days to accumulate 30 mmol of $CaCO_3$ [(30 mmol of $CaCO_3/m^2$) / (12 mmol $CaCO_3/m^2 \cdot day$) = 2.5 days]. (c) If carbonate ion concentration decreases, the rate of calcification decreases, and it takes coral longer to grow.

4. (a) The final step of the process shown in Figure 2.24, the rate of conversion of CO_3^{2-} and Ca^{2+} into $CaCO_3$, is measured in this experiment. (b) The results do support the hypothesis that increased concentration of atmospheric CO_2 could lead to slower growth of coral reefs. It supports it because, according to the chemistry shown in Figure 2.24, more CO_2 entering the ocean will push the reactions toward formation of more bicarbonate ions, decreasing the amount of CO_3^{2-} available for formation of $CaCO_3$. The results in the graph show that, under the experimental conditions, the lower the concentration of CO_3^{2-}, the lower the rate of calcification, and thus the slower the growth of coral reefs (for example, 2.5 days versus 1.6 days to accumulate the same amount of calcium carbonate at a lower carbonate ion concentration, calculated in question 3).

Suggested Answers for End-of-Chapter Essay Questions

See the general information on grading short-answer essays and the suggested rubric at the beginning of this document.

10. Scientific Inquiry

The complex shapes of biological molecules determine the great specificity with which they interact with one another and form weak or strong bonds.

Hypothesis: Receptor cells on the filaments of the male silkworm moth's antennae contain cell-surface molecules that are complementary in shape to sex attractant molecules (pheromones) produced by the female silkworm moth.

This hypothesis leads to several testable predictions. (1) Silkworm moth pheromones will bind to specific sites on the cells of the filaments of the male's antennae. (2) If it is possible to synthesize molecules that are very similar in shape to silkworm moth pheromones, these molecules will also attract male silkworm moths. (3) Chemical or temperature treatments that modify the molecular shape of silkworm moth pheromones will reduce the attractiveness of these molecules to male silkworm moths.

An experiment could be designed to test the third prediction. A number of male silkworm moths could be exposed to two separate treatments. In the first treatment, unaltered pheromones would be released near male silkworm moths, and the response of the moths would be noted. The second treatment would be identical in every way except that the pheromone would be heated to permanently modify its molecular shape before it was released.

11. Focus on Evolution

It would be surprising if the percentages of naturally occurring elements in most organisms were *not* roughly the same, because all organisms evolved on Earth (with its unique elemental