

Section 1-1

1. natural world **2.** Observation **3.** inference
4. hypothesis **5.** Scientists know that systems in the natural world are consistent in their behavior, so knowledge gained in a previous study can be applied to other systems. Previous knowledge allows scientists to interpret data and observations. **6.** Scientists use their observation skills to gather data, their interpretation skills to understand what was observed, and their explanation skills to explain why the data either supports or disproves a hypothesis. **7.** Qualitative observations cannot be easily measured, such as an observation about the color of an object. Quantitative observations involve numbers such as measuring the mass of an object. Possible student answer: A red (qualitative) balloon has a mass of 16 grams (quantitative). **8.** Possible student answer: The computer is not plugged into the outlet. A student would need to find the power cord and check to see that it is plugged into an outlet. **9.** An observation is the gathering of information using your five senses, and an inference is the use of previous knowledge to come to a logical explanation. Observations do not explain a situation; they are merely recordings of features of the natural world. **10.** Yes, the hypothesis can be tested; therefore, it is a valid hypothesis.

Section 1-2

1. Examples of variables include the objects and equipment used, temperature, time, type of material, and amount of material. The control group and the group in which the variable was altered are compared to see if changing the variable had an effect.
2. Students should mention either Redi's, Needham's, Spallanzani's, or Pasteur's experiments which all tested spontaneous generation. Redi's control group consisted of open jars, and his experimental variable was gauze which kept flies away from the meat. Needham's control was a non-boiled, sealed container of gravy, and his experimental variable was boiling. Spallanzani's control was an open flask of boiled gravy, and his experimental variable was sealing the flask after boiling. Pasteur's control was a flask of boiled gravy. The variable was the shape of the neck of the flask. **3.** A theory is a well-tested explanation that unifies a broad range of observations. **4.** B **5.** D **6.** E **7.** A **8.** C **9.** Scientists need to record and publish their results so that other scientists may also be able to conduct the experiment. Theories are developed from experiments that can be tested again and again to validate the results as facts. **10.** Theories are based on well-tested explanations. Experiments that have several variables cannot provide valid explanations, because a scientist cannot be sure whether one variable or several variables have consistently produced the experiment's results.

Section 1-3

1.–8. Student answers should include the following eight characteristics in any order: living things are made up of units called cells, reproduce, are based on a universal genetic code, grow and develop, obtain and use materials and energy, respond to their environment, maintain an internal balance, and as a group they change over time. **9.** Community and its nonliving surroundings **10.** Populations that live in a defined area **11.** Groups of organisms of one type that live in the same area **12.** Tissues, organs, and organ systems **13.** Smallest functional unit of life **14.** Possible student answer: A human would respond to an environmental change such as an increase in air temperature by sweating. **15.** Both unicellular and multicellular organisms display all of the characteristics of living things, but unicellular organisms are smaller and made up of only a single cell, while multicellular organisms have many cells of different types.

Section 1-4

1. The metric system is a universal system of measurement. **2.** The two main types of electron microscopes are the scanning electron microscope (SEM) and transmission electron microscope (TEM). **3.** light microscope **4.** light microscope **5.** both **6.** electron microscope **7.** The laboratory technique appropriate to study cell responses under varying environmental conditions is the use of cell cultures. This technique allows a single cell to reproduce, so that many cells may then be studied in varied conditions. **8.** Answers will vary. Students may discuss the problems of interpreting the data and reproducing the experiment. **9.** Cell fractionation provides information about the composition of an organelle; light microscopy can give information about the function of an organelle in the living cell. Both can give some information about the relative size of an organelle compared to other components of the cell. **10.** 1 kilometer; 10,000 centimeters is equivalent to 100 meters or 0.1 kilometers.

Chapter Vocabulary Review

1. Science is an organized way of using evidence to learn about the natural world. **2.** Observation is a method of gathering information by use of the senses. **3.** An inference is made using prior knowledge and experience to make a logical interpretation. **4.** A controlled experiment tests only one variable at a time; the manipulated variable is the variable that is deliberately changed. The responding variable is the one that is observed and changed in response to the manipulated variable. **5.** In sexual reproduction, two cells from different parents unite to produce a new organism. In asexual reproduction, a single

parent reproduces by itself. **6.** c **7.** d **8.** f **9.** h **10.** i
11. a **12.** j **13.** b **14.** g **15.** e **16.** d **17.** a **18.** b
19. c **20.** b

Enrichment

1. Students' answers should show an understanding of how Jenner made the connection between his hypothesis and a means of treatment. They might also comment on his lack of observation and testing before he administered his treatment. For example, Jenner's methods involved infecting people with a disease. He used human subjects, children in particular, and infected them with cowpox. His methods may have been controversial because he used human subjects, or because he did not test his methods slowly, over time. Students might argue that Jenner was up against a very dangerous foe: smallpox. Although his methods were risky, he did find a cure. While this is no excuse for using potentially dangerous methods, he was acting as quickly as possible to combat a lethal enemy. **2.** A possible student answer might suggest that, although dangerous to humans, the smallpox virus is still a living organism that should be treated with the same consideration we give dolphins, baby seals, or other familiar organisms. Some students may express the opinion that humans do

not have the right to cause the deliberate extinction of any organism. However, other students may express the opinion that because of its potential danger and the possibility of an accident, the virus should be completely eliminated. They may see the continued culturing of an often lethal organism as a dangerous practice.

Graphic Organizer

1. Biosphere **2.** Ecosystem **3.** Population **4.** Organism **5.** Groups of cells **6.** Molecules

Exploration

Answers to Analyze and Conclude

1. The high-power objective has a greater magnification, but it also has a narrower field of view. **2.** Bacteria are too small to swallow up plant cells, but are small enough to enter them. **3.** The image was magnified, inverted, and reversed. The image moved in the opposite direction. **4.** Answers will depend on the fibers used. A sample student answer could be that they were ordered in decreasing number series.