Teacher Notes and Answers

SECTION 3
Instant Replay

1. many possible answers, e.g., observing, because she is looking at something and collecting information, or taking notes

2. The processes that scientists follow must be somewhat flexible to allow for differing experimental conditions.

3. The independent variable is the variable that the scientist manipulates, or changes, in an experiment. The dependent variable is the variable that the scientist measures to see how it was affected by the independent variable.

4. A hypothesis is a possible answer for a scientific question. A theory is an explanation that is supported by much evidence, accepted by the science community, and that explains a wide range of things.

5. written sources, such as scientific journals, science fairs and symposia, and webpages

Vocabulary Check

1. independent variable
2. constant
3. data

The Big Picture

4. so that you can tell what the effects of the independent variable are

5. Theories are based on hypotheses that have been supported by much evidence.

6. Scientific information is more reliable if it has been peer reviewed and provides evidence that supports the scientific claim. The information should include such things as experimental results and conclusions, methods, data, and details needed to recreate the investigation.
Like all science, biology is a process of inquiry.

Science is a process of inquiry, or investigation. Science is one way we try to understand the world around us. All sciences have certain things in common, but there is no one way of doing science.

Observations Science begins with observation, or collecting information about a topic. Some observations are made directly with our senses. Other observations might involve using tools and technology.

Data When observations are recorded, saved, or written down, they are called data. Sights, sounds, and smells are examples of qualitative data. They describe a “quality” of an observation. Mass, volume, and temperature are examples of quantitative data. They can be measured.

Hypotheses Scientists use observations and data to form a hypothesis. A hypothesis (plural, hypotheses) is a possible answer to a scientific question. A hypothesis must be able to be tested.

What part of science do you think the young woman in the picture is involved in? Why?
A hypothesis leads to testable predictions of what would happen if the hypothesis is valid. For scientists, just one test of a hypothesis is usually not enough. Most of the time, it is only by repeating tests that scientists can be more certain that their results are not mistaken or due to chance. After scientists collect data, they use statistics to mathematically analyze whether the data supports the hypothesis. Experimental methods and results are then evaluated by other scientists in a process called peer review. Only after this process are the results of the research accepted. Whether the results of an experiment support an existing theory or disagree with earlier research, they are often used as a starting point for new questions.

**Biologists use experiments to test hypotheses.**

Scientific experiments allow scientists to test hypotheses and find out how something happens. In an experiment, scientists change one factor, or variable, to see how it affects the outcome of a situation. The factor that is changed in an experiment is called the **independent variable**. For example, suppose a scientist is testing how much of a medicine is necessary to treat high blood pressure. The independent variable is the dose of medicine, or how much medicine a patient gets. Then, the scientist sees how changes in the independent variable affect the dependent variable. The **dependent variable** is what the scientist measures as the outcome or result of the experiment. In this example, the dependent variable is blood pressure. The change in blood pressure depends on the amount of medicine given.

The independent variable should be the only part of a controlled experiment that changes. All other conditions should not change. The factors that do not change are called **constants**. For example, the form of medicine would be a constant—it would always be a pill.

**What is the difference between the dependent variable and the independent variable in an experiment?**
A theory explains a wide range of observations.

Many words have several different meanings. Depending on how a word is used, its meaning can change completely. For example, the word *right* could mean *correct*, or it could refer to a direction. Similarly, the word *theory* has different meanings. In everyday conversation, the word *theory* can mean a wild idea, or something that is imagined to be true. In science, the meaning of *theory* is very different.

Recall that a hypothesis is a proposed answer to a scientific question. A **theory** is a proposed explanation for a wide range of observations and experimental results that is supported by a wide range of evidence. Both gravity and natural selection are scientific theories.

Science is an ongoing process. Theories can change based on new evidence. New theories that better explain observations and experimental results can replace older theories. Our understanding of the world around us has changed very much over the past few decades*, and the study of biology has changed and expanded as well.

What is the difference between a scientific theory and a hypothesis?

---

Scientists communicate information in many different ways.

Scientific information is communicated in many ways. Scientific information may be presented at science fairs and symposia. Many written sources include scientific information, such as product advertisements, magazine articles, or webpages.

Recall that new scientific research is reviewed by other scientists through the peer review process. Once scientific research is peer-reviewed, it is published in scientific journals. Articles in scientific journals include experimental results and conclusions, methods, data, and details that other scientists would need to recreate the investigation.

Not all information that is presented as scientific is reliable. When evaluating scientific information, consider the evidence that supports the scientific claim and whether or not the source of information might be biased.

List three ways that scientists can communicate scientific information?

---

* ACADEMIC VOCABULARY

**decades** periods of ten years
1. In the list above, circle the word that means “what a scientist changes in an experiment.”

2. Put a box around the word that means “a factor that does not change.”

3. Underline the word that means “a written record of observations.”

4. Why are most factors held constant in a scientific experiment?

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

5. How are hypotheses and theories related?

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

6. What are two traits of an information source that may indicate the information given is scientifically unreliable?

   ____________________________________________________________
   ____________________________________________________________