ACT® Coach

Science

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Contents

Chapter 1

Scientific Inquiry

The Practice of Science

Key Words • science • scientific inquiry • hypothesis • prediction • experiment • procedure • analyze • conclusion • laboratory report • replicate

Getting the Idea

The word *science* comes from a Latin word that means "knowledge." In its broadest sense, **science** refers to the study of anything related to the natural world. The specific methods and techniques used to study different aspects of the natural world can vary. For example, field ecologists study animals in the wild, while experimental physicists build machines to study particles that are not normally found in nature. However, the discovery of all scientific knowledge is guided by the same basic principles.

The Inquiry Process

The discovery of scientific knowledge is driven by scientific inquiry. **Scientific inquiry** involves posing a question and then using a variety of scientific techniques to find the answer to that question.

Most questions that drive scientific inquiry come from observations. Imagine you are watching a newscast about winter weather in a northern state. You see trucks spreading salt on highways to melt snow. You wonder, "If salt decreases the temperature at which ice melts, how does salt affect the boiling point of water?" You are asking a question that can be studied through further observation, testing, and analysis. In fact, this question has been studied by chemists.

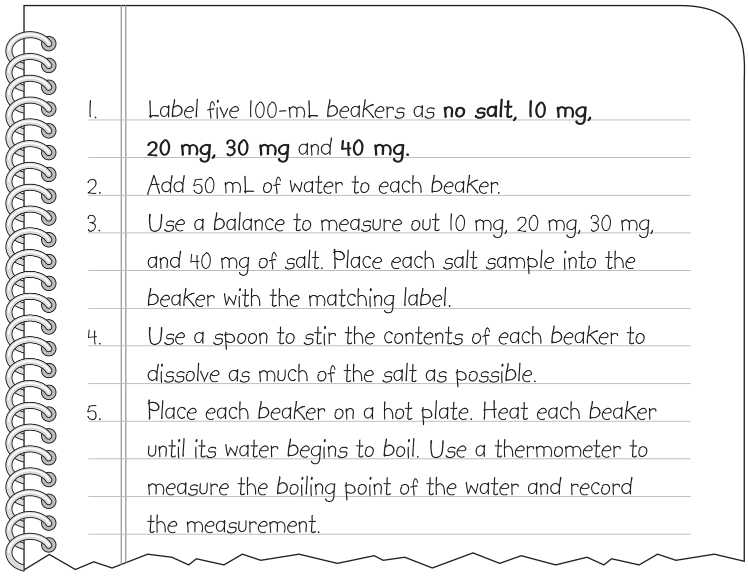
Formulating a hypothesis and testing it with an investigation is often part of scientific inquiry. A **hypothesis** (pl. *hypotheses*) is a possible answer to a scientific question. It can be a **prediction** of what will happen if you alter something in a certain way. A hypothesis must be testable. In other words, there must be some way to show whether the hypothesis is supported. (A hypothesis can be testable even if the technology to test it does not currently exist. A hypothesis may be made but not tested until many years later, when new techniques and equipment are available.)

Scientists develop hypotheses through logical reasoning, direct observations, and a knowledge and understanding of basic science. Reading scientific literature is crucial to understanding the science leading to a hypothesis. Sources include scientific journals and the published research results of other scientists.

Suppose you read the scientific literature and find that salt lowers the freezing point of water. You might then form this hypothesis: Adding salt to water will lower the boiling point of the water.

After forming a hypothesis, a scientist develops a test for the hypothesis. This test is called an **experiment**. When you design an experiment, you plan the specific steps you will follow. A **procedure** is the written step-by-step plan for an experiment. The procedure includes the tools and materials that will be needed to carry out the experiment and states how those tools and materials will be used to gather information.

In your experiment on how salt affects the boiling point of water, your procedure might look like the one shown here:



Recording Experimental Results

Scientists keep a written record of the experimental procedures they perform. This record allows other scientists to review their work and repeat the experiment themselves.

Scientists create a written record by taking detailed notes during their investigations. These notes include all information derived from their research, observations, measurements, and experiments. The scientists use their notes to **analyze**, or study and interpret, this information. The analysis allows a scientist to form a conclusion about the results of a scientific investigation. A **conclusion** explains whether the observations support the hypothesis. You will learn more about drawing conclusions in Lesson 2.

All this information is then used to create a laboratory report. A **laboratory report** is a written account of the purpose, procedure, results, and conclusions of an experiment. One goal of a laboratory report is to show others how to repeat the work.

Communication in Science

Sharing information is an essential part of science. By communicating with each other, scientists build on what is already known about the natural world. Scientists communicate with each other and with the public by speaking at lectures and press conferences or in interviews. Scientists also publish their research in *scientific journals*—magazines used for communicating scientific findings to other scientists. When scientists share information about their research, they need to explain the goal of their work, how the research was done, and their conclusions. They must report their results honestly and objectively.

In science, a conclusion will not be accepted as accurate unless other people can repeat the procedures and obtain similar results—that is, until they can **replicate** the research. When other scientists replicate a research finding, they can be more confident about discoveries and conclusions. Conclusions are more likely to be correct when research is replicated and the same results are obtained. A hypothesis that is verified by many different scientists is likely to become accepted. However, scientists may interpret the same results in different ways. This can lead to disagreements about scientific studies. Such disagreements can help scientists ask better questions, form better hypotheses, and develop better procedures.

Discussion Question

Suppose you performed the experiment described in this lesson to test the hypothesis about the boiling point of water. What would you do if the results of the experiment did not support the hypothesis? Would you conclude that the hypothesis was inadequate, incorrect, or untestable?

Lesson Review

1. A scientist observes that members of a species of gray moths tend to land on trees with gray bark. Which of these is a reasonable hypothesis to test, based on these observations?

- **A.** If there is no rain, predators will attack both moths and trees.
- **B.** If the air is polluted, it will harm the trees but not the moths.
- **C.** When a moth lands on a tree, it changes color to blend in with the bark.
- **D.** When a moth looks at a tree, it can distinguish the color of the bark.

2. If your experimental results do not support your hypothesis, you should

- **A.** change your data to support the conclusion you would like.
- **B.** report your data and conclusion honestly.
- **C.** report your hypothesis but not your data.
- **D.** change your hypothesis to match the data.

3. Which is the correct order in which the terms below are applied in a scientific investigation?

- **A.** hypothesis, procedure, experiment, results, analysis, conclusion
- **B.** procedure, experiment, hypothesis, analysis, conclusion, results
- **C.** hypothesis, procedure, experiment, analysis, results, conclusion
- **D.** procedure, hypothesis, experiment, results, conclusion, analysis