

Grade 10 NTI Day #1 Biology

Assignment: Please read the following excerpt, then complete the questions below.

What Is Science?


KEY QUESTIONS

- What are the goals of science?
- What procedures are at the core of scientific methodology?
- What is a scientific theory?

VOCABULARY

observation
inference
hypothesis
controlled experiment
independent variable
dependent variable
control group
data
theory

READING TOOL

List in order the parts of a typical experiment that uses scientific methodology. Use the headings in your text as a guide to fill in the chart in your  **Biology Foundations Workbook**.



Humans have wondered about their place in the cosmos since the earliest time. How do we fit into the grand scheme of nature? How much power do we hold over nature? What are the limits to our abilities? These and other questions are more relevant today than ever before. This chapter begins our effort to show you how science tries to answer those questions.

What Science Is and Is Not

This book will help you understand how biologists try to make sense of nature. These pages are filled with many scientific “facts” and ideas. But one of the first things you should understand is that scientific knowledge is always changing. Some “facts” and ideas you’ll find here may have changed since this text was written, and others will change soon. Why? Because scientists are constantly testing, debating, and revising scientific explanations of events in the natural world. That constant testing and revising helps explain why scientists don’t “believe” in scientific facts or ideas. Scientists either understand and accept a particular scientific explanation of the natural world, or they reject that explanation. But if science is not a list of unchanging facts and beliefs, what is it?

The Nature of Science The term *science* is usually defined as the use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process. Most importantly, science is a process—an organized way of observing and asking questions about the natural world, developing those questions into testable explanations, and gathering and analyzing data that support or reject those explanations. The word *science* can also refer to the constantly growing and changing body of knowledge that the process of science generates.

How is science different from other ways of explaining how the world works? First, science deals only with the natural world. Scientific research never concerns, in any way, supernatural phenomena of any kind. Second, scientists collect and organize information in an orderly way, looking at events for patterns and connections of cause and effect. Third, scientists propose explanations based on evidence and understanding, not belief. Some ways that scientists study the natural world are shown in **Figure 1-1**.

The Goals of Science Science is based on the view that the physical universe is composed of interacting parts and processes. From a scientific perspective, all objects in the universe, and all interactions among those objects, are governed by universal natural laws. The same natural laws apply whether the objects and events are large (like a hurricane) or small (like the cells in your body).

Greek philosophers were among the first to try to explain the natural world in terms of events and processes they could observe. Modern scientists continue that tradition. 🔗 **One goal of science is to provide natural and testable explanations for events in the natural world. Science also aims to use explanations supported by data to understand patterns in nature, and to make useful predictions about natural events.**

VIDEO

Discover how scientists use scientific processes to discover the wide diversity of insects that live in people's homes.

INTERACTIVITY

CASE STUDY

Figure 1-1
Studying the Natural World


How do chimpanzees interact with one another? What is the ideal temperature for basil plants in a hydroponics system? What kinds of fish live in the Colorado River? Researchers can use science to answer these questions and many others.



Science, Change, and Uncertainty Scientists have gathered lots of important information that helps cure and prevent disease, grow food, and link the world electronically. Yet much of nature remains a mystery. Almost every scientific discovery raises more questions than it answers. Often, research yields surprises that point future studies in new and unexpected directions. This constant change doesn't mean science has failed. On the contrary, it shows that science continues to advance.

That's why studying science means more than just memorizing what we know. It also means understanding what we don't know. You may be surprised to hear this, but science rarely "proves" anything. Scientists aim for the best understanding of the natural world that current methods can reveal. Uncertainty is always part of the scientific process, and is part of what makes science exciting!

We hope to show you that understanding science isn't just about learning "facts." We hope you'll gain some understanding of the spirit of scientific inquiry, of the way scientists think, and of both the process and excitement of discovery. Don't just memorize today's scientific facts and ideas. And please don't believe them, just because they are in a textbook! Instead, try to understand how scientists developed those ideas. Pose the kinds of questions scientists ask. Try to see the thinking behind the experiments we describe.

 **READING CHECK** **Construct an Explanation** How is scientific knowledge different from other types of knowledge?




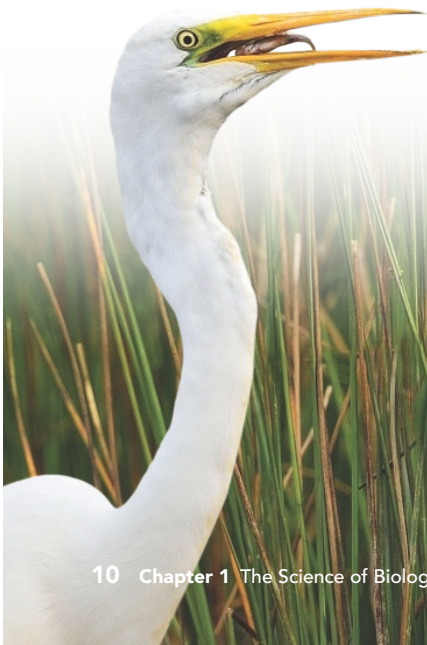
INTERACTIVITY

Discover the power of scientific methodology.

Scientific Methodology

Is science a mysterious process that only scientists do under special circumstances? Nope! You use scientific thinking all the time! Suppose your family's car won't start. What do you do? You use what you know about cars to ask questions. Is the battery dead? You test that idea by turning the key in the ignition. If the starter motor works but the engine doesn't start, you reject the dead battery idea. Is the car out of gas? A glance at the fuel gauge tests that idea. Again and again, you apply scientific thinking until the problem is solved—or until you run out of ideas and call a mechanic!

Scientists work in pretty much the same way. There isn't a single, cut-and-dried "scientific method." But there is a general style of investigation we call scientific methodology, which is a fancy way of saying "the way science works."  **Scientific methodology involves observing and asking questions, forming hypotheses, conducting controlled experiments, collecting and analyzing data, and drawing conclusions.** Figure 1-2 shows how one research team used scientific methodology in its study of one particular species of marsh grass in a New England salt marsh.



Assignment: What Is Science?

Multiple Choice (Choose the correct answer for each question)

- 1. What is one of the primary goals of science?**
 - a) To explain supernatural phenomena
 - b) To memorize facts
 - c) To provide testable explanations for events in the natural world
 - d) To believe in unchanging truths
- 2. Which of the following is NOT a characteristic of science?**
 - a) Science deals only with the natural world
 - b) Science relies on belief rather than evidence
 - c) Science aims to make predictions about natural events
 - d) Science collects and organizes information in an orderly way
- 3. Why is scientific knowledge constantly changing?**
 - a) New information and discoveries lead to revisions in our understanding
 - b) Scientists often make mistakes in their experiments
 - c) The natural world is unpredictable and random
 - d) Science aims to prove all ideas absolutely
- 4. Which of the following best describes a scientific theory?**
 - a) An untested idea or hypothesis
 - b) A statement that has been proven true
 - c) A well-supported explanation for a wide range of observations
 - d) A single experiment that has been repeated many times
- 5. In scientific methodology, what is the role of a controlled experiment?**
 - a) To test multiple hypotheses simultaneously
 - b) To ensure that only one variable is changed at a time
 - c) To observe and record as many variables as possible
 - d) To prove that the hypothesis is true
- 6. Which of the following statements about science is true?**
 - a) Science aims to prove everything with certainty
 - b) Science only works under special conditions and in laboratories
 - c) Scientists accept or reject explanations based on evidence
 - d) Scientific knowledge is always final and unchanging

Short Answer

- 7. In one to two sentences, explain how scientific methodology helps scientists develop reliable explanations for natural phenomena.**