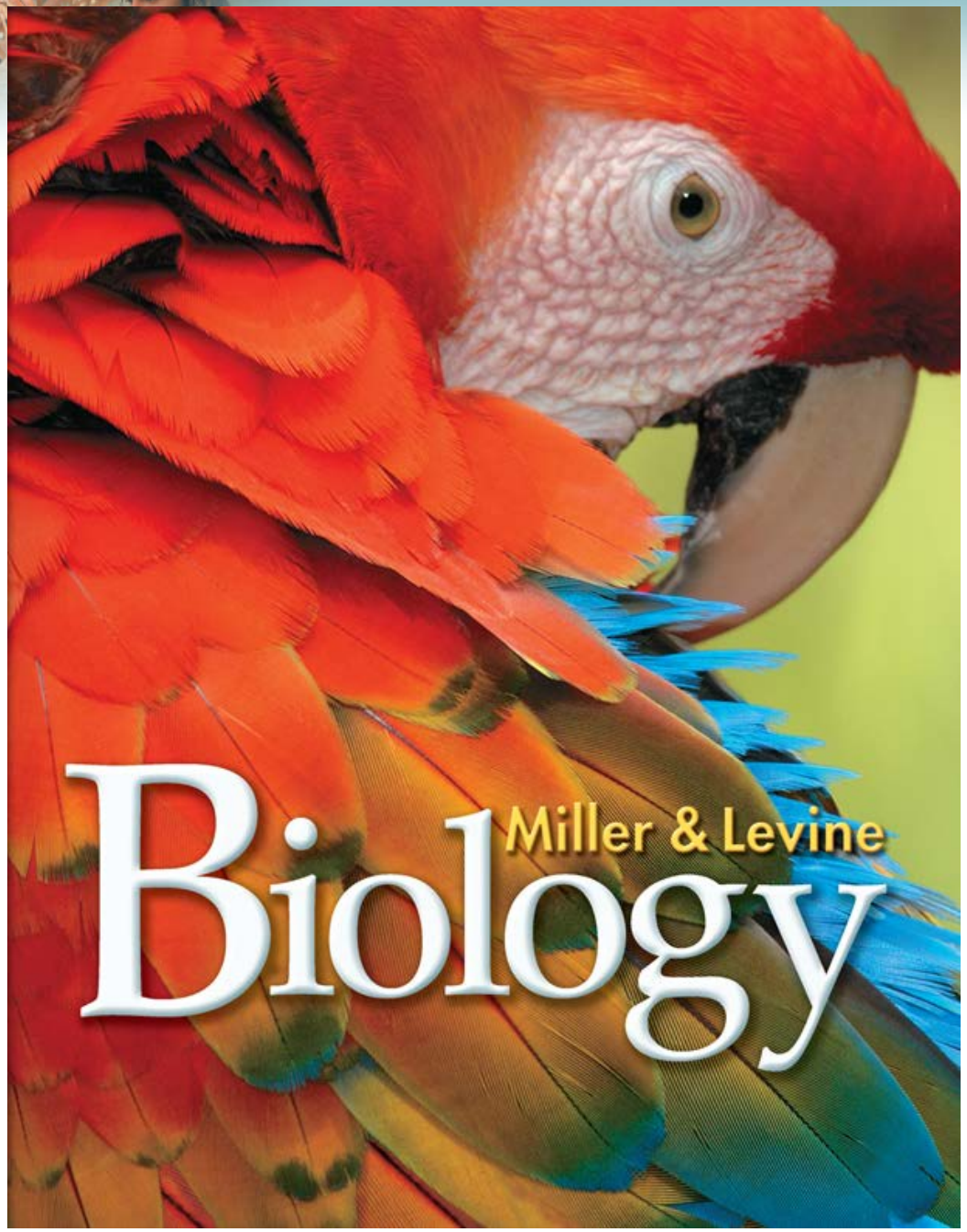


Lesson Overview

1.2 Science in Context

THINK ABOUT IT

Scientific methodology is the heart of science. But that vital “heart” is only part of the full “body” of science.

Science and scientists operate in the context of the scientific community and society at large.

Exploration and Discovery: Where Ideas Come From

- What scientific attitudes help generate new ideas?

Exploration and Discovery: Where Ideas Come From

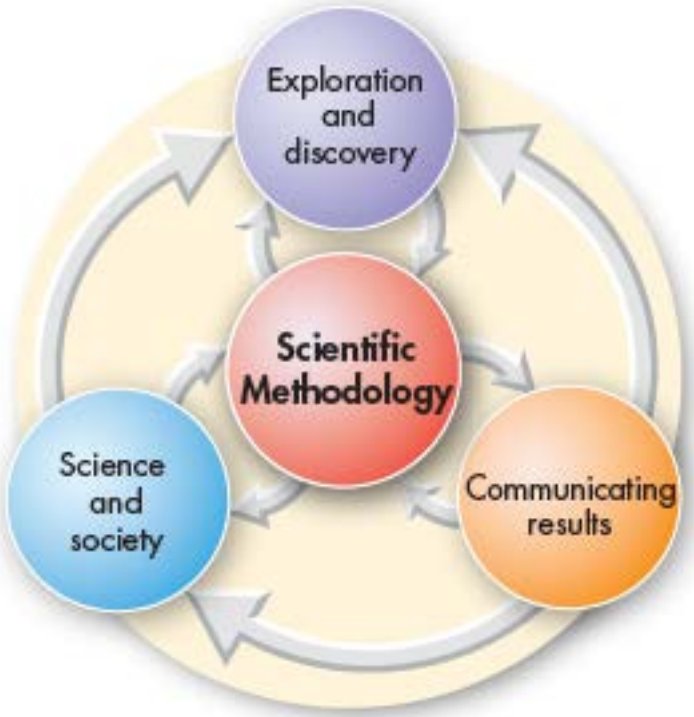
- What scientific attitudes help generate new ideas?

- Curiosity, skepticism, open-mindedness, and creativity help scientists generate new ideas.

Exploration and Discovery: Where Ideas Come From

Scientific methodology is closely linked to exploration and discovery.

Scientific methodology starts with observations and questions that may be inspired by scientific attitudes, practical problems, and new technology.



Adapted from Understanding Science, UC Berkeley, Museum of Paleontology

Scientific Attitudes

Good scientists share scientific attitudes, or habits of mind, that lead them to exploration and discovery.

Curiosity, skepticism, open-mindedness, and creativity help scientists generate new ideas.

Curiosity

A curious researcher, for example, may look at a salt marsh and immediately ask, “What’s that plant? Why is it growing here?”

Often, results from previous studies also spark curiosity and lead to new questions.

Skepticism

Good scientists are skeptics, which means that they question existing ideas and hypotheses, and they refuse to accept explanations without evidence.

Scientists who disagree with hypotheses design experiments to test them.

Supporters of hypotheses also undertake rigorous testing of their ideas to confirm them and to address any valid questions raised.

Open-Mindedness

Scientists must remain open-minded, meaning that they are willing to accept different ideas that may not agree with their hypothesis.

Creativity

Researchers need to think creatively to design experiments that yield accurate data.

Practical Problems

Sometimes, ideas for scientific investigations arise from practical problems. For example, people living on a strip of land along a coast may face flooding and other problems.

These practical questions and issues inspire scientific questions, hypotheses, and experiments.

The Role of Technology

Technology, science, and society are closely linked.

Adapted from Understanding Science, UC Berkeley, Museum of Paleontology

The Role of Technology

Discoveries in one field of science may lead to new technologies, which enable scientists in other fields to ask new questions or to gather data in new ways.

Technological advances can also have big impacts on daily life. In the field of genetics and biotechnology, for instance, it is now possible to mass-produce complex substances—such as vitamins, antibiotics, and hormones—that before were only available naturally.

Communicating Results: Reviewing and Sharing Ideas

- Why is peer review important?

Communicating Results: Reviewing and Sharing Ideas

- Why is peer review important?

- Publishing peer-reviewed articles in scientific journals allows researchers to share ideas and to test and evaluate each other's work.

Peer Review

Scientists share their findings with the scientific community by publishing articles that have undergone peer review.

In peer review, scientific papers are reviewed by anonymous, independent experts.

Reviewers read them looking for oversights, unfair influences, fraud, or mistakes in techniques or reasoning. They provide expert assessment of the work to ensure that the highest standards of quality are met.

Adapted from Understanding Science, UC Berkeley, Museum of Paleontology

Sharing Knowledge and New Ideas

Once research has been published, it may spark new questions. Each logical and important question leads to new hypotheses that must be independently confirmed by controlled experiments.

For example, the findings that growth of salt marsh grasses is limited by available nitrogen suggests that nitrogen might be a limiting nutrient for mangroves and other plants in similar habitats.

Scientific Theories

- What is a scientific theory?

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- In science, the word theory applies to a well-tested explanation that unifies a broad range of observations and hypotheses and that enables scientists to make accurate predictions about new situations.

Scientific Theories

Evidence from many scientific studies may support several related hypotheses in a way that inspires researchers to propose a scientific **theory** that ties those hypotheses together.

In science, the word theory applies to a well-tested explanation that unifies a broad range of observations and hypotheses and that enables scientists to make accurate predictions about new situations.

A useful theory that has been thoroughly tested and supported by many lines of evidence may become the dominant view among the majority of scientists, but no theory is considered absolute truth. Science is always changing; as new evidence is uncovered, a theory may be revised or replaced by a more useful explanation.

Science and Society

- What is the relationship between science and society?

Science and Society

- What is the relationship between science and society?

- Using science involves understanding its context in society and its limitations.

Science and Society

Many questions that affect our lives require scientific information to answer, and many have inspired important research. But none of these questions can be answered by science alone.

Scientific questions involve the society in which we live, our economy, and our laws and moral principles.

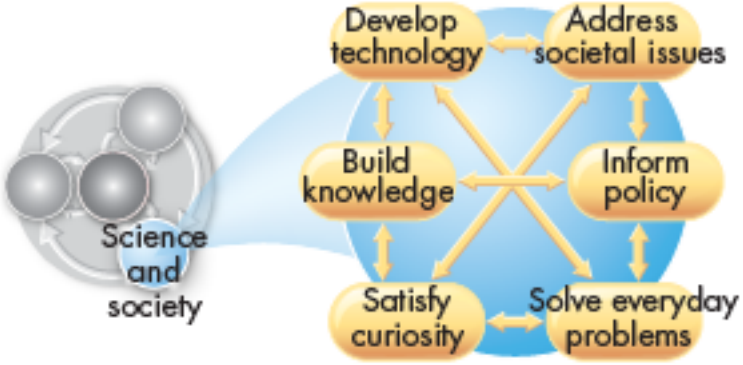
For example, researchers test shellfish for toxins that can poison humans. Should shellfish be routinely screened for toxins?

Science, Ethics, and Morality

When scientists explain “why” something happens, their explanation involves only natural phenomena. Pure science does not include ethical or moral viewpoints.

For example, biologists try to explain in scientific terms what life is and how it operates, but science cannot answer questions about why life exists or what the meaning of life is.

Similarly, science can tell us how technology and scientific knowledge can be applied but not whether it should be applied in particular ways.



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Avoiding Bias

The way that science is applied in society can be affected by **bias**, which is a particular preference or point of view that is personal, rather than scientific.

Science aims to be objective, but scientists are human, too. Sometimes scientific data can be misinterpreted or misapplied by scientists who want to prove a particular point.

Recommendations made by scientists with personal biases may or may not be in the public interest. But if enough of us understand science, we can help make certain that science is applied in ways that benefit humanity.

Understanding and Using Science

Don’t just memorize today’s scientific facts and ideas. Instead, try to *understand* how scientists developed those ideas. Try to see the thinking behind the experiments and try to pose the kinds of questions scientists ask.

Understanding science will help you be comfortable in a world that will keep changing, and will help you make complex decisions that also involve cultural customs, values, and ethical standards.

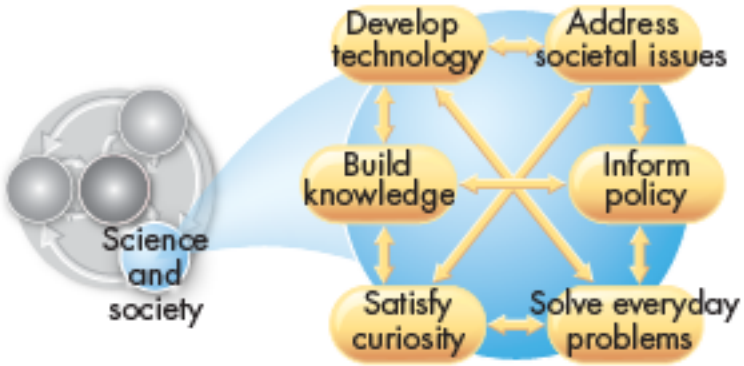
Understanding and Using Science

Understanding biology will help you realize that we humans can predict the consequences of our actions and take an active role in directing our future and that of our planet.

Understanding and Using Science

Scientists make recommendations about big public policy decisions, but it is the voting citizens who influence public policy by casting ballots.

In a few years, you will be able to exercise the right to vote. That's why it is important that you understand how science works and appreciate both the power and the limitations of science.



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