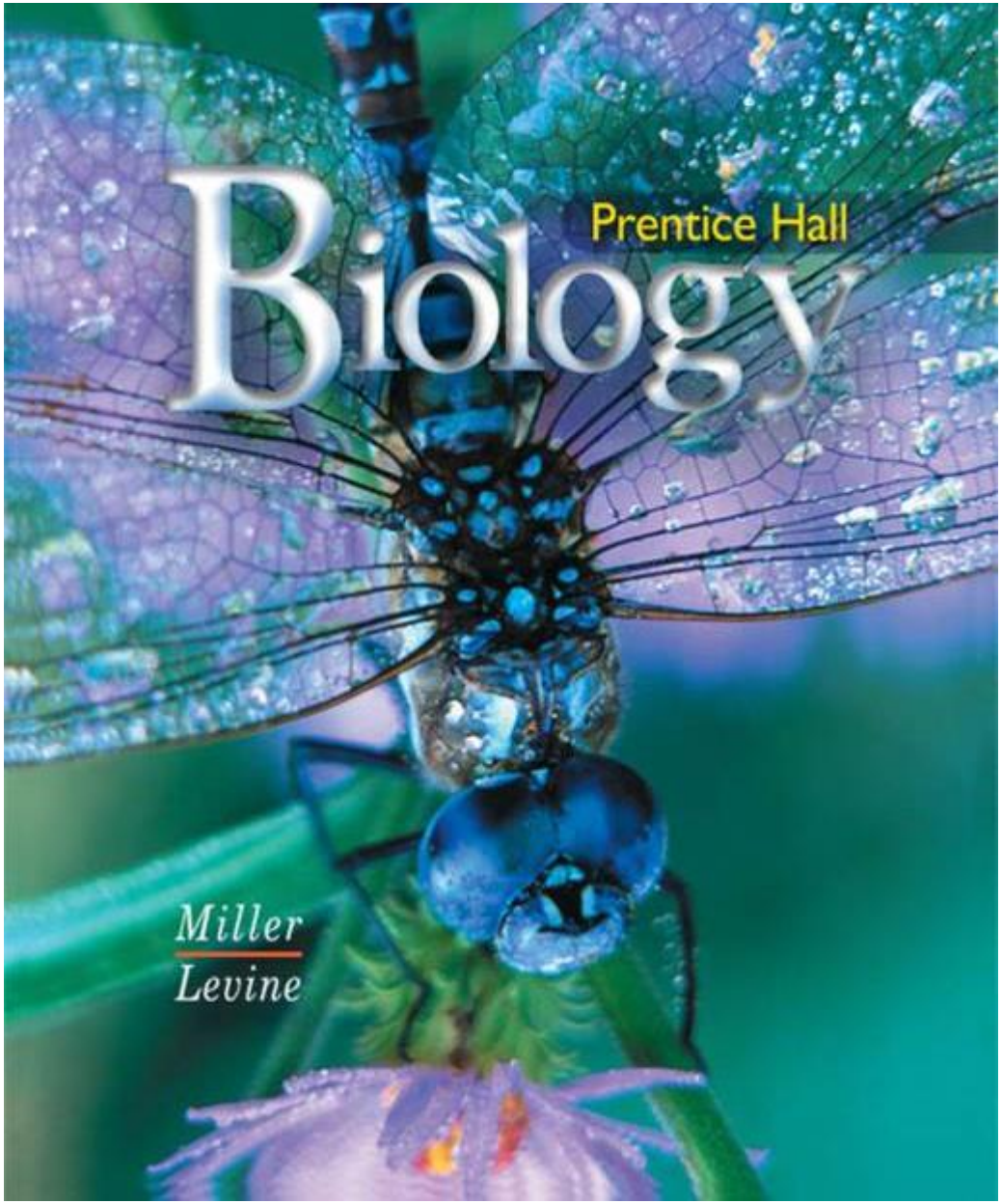
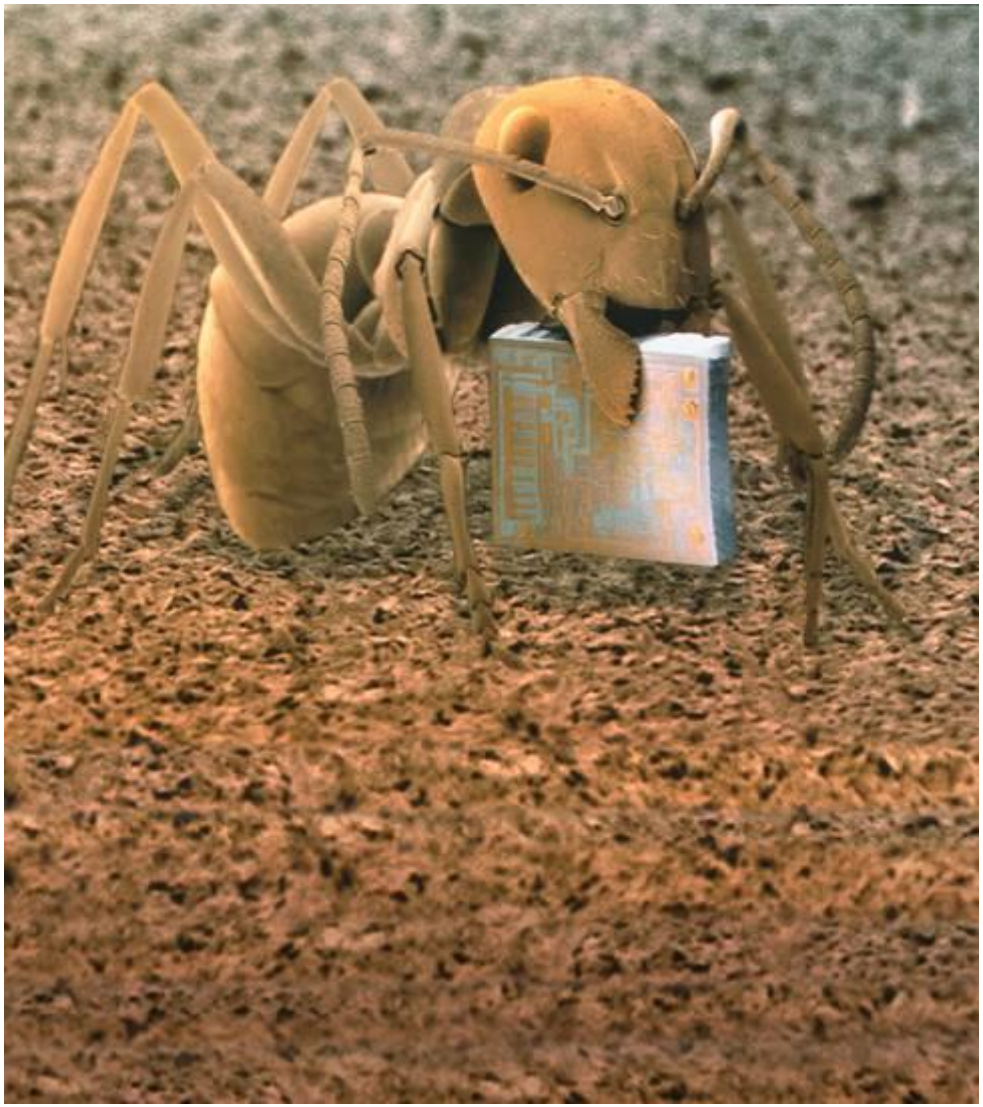


End Show

1-1 What Is Science?



End Show

What Science Is and Is Not

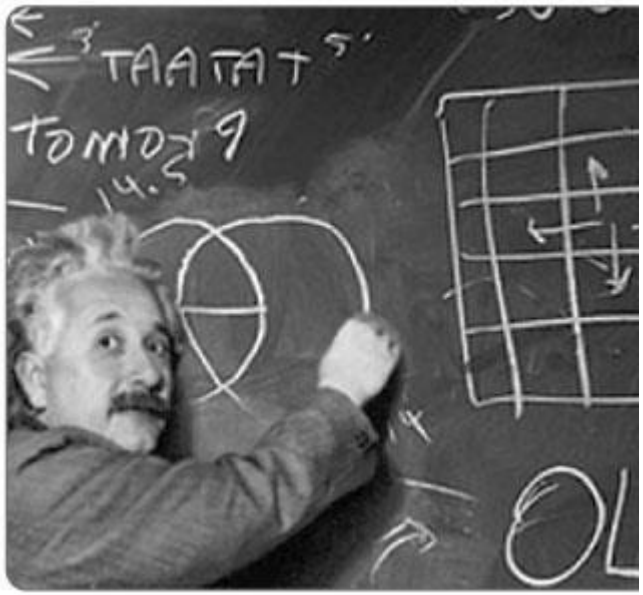
What is the goal of science?

The goal of science is to:

- investigate and understand the natural world.
- explain events in the natural world.
- use those explanations to make useful predictions.

Science is an organized way of using evidence to learn about the natural world.

Body of knowledge



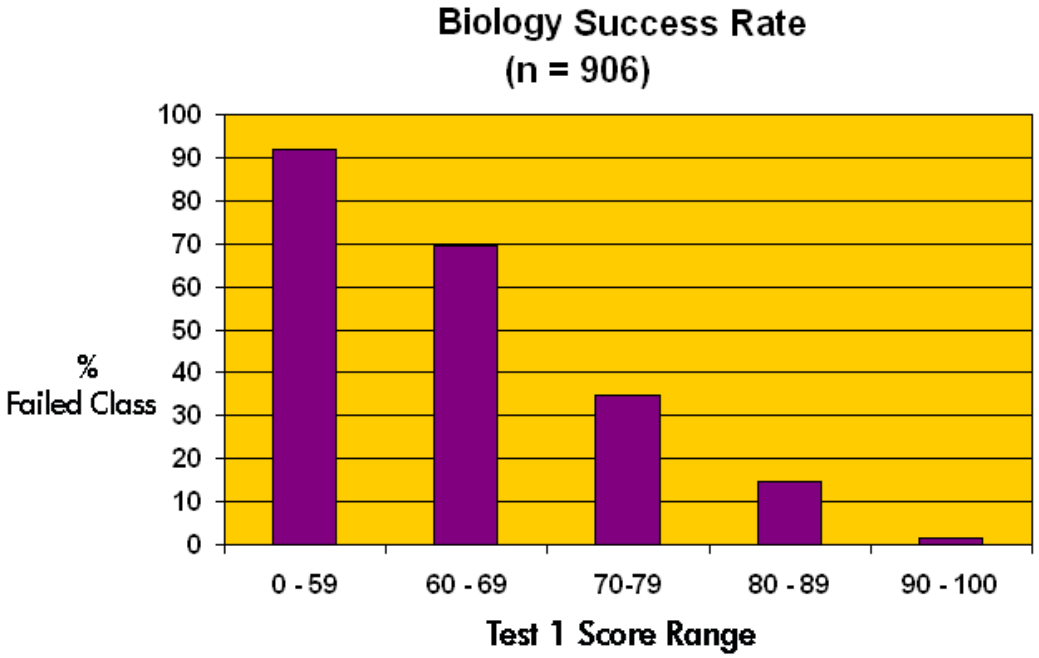
Thinking Like a Scientist

Scientific thinking begins with observation.

Observation is the process of gathering information about events or processes in a careful, orderly way.

The information gathered from observations is called **data.**

- **Quantitative data**
- **Qualitative data**



Scientists use data to make inferences.

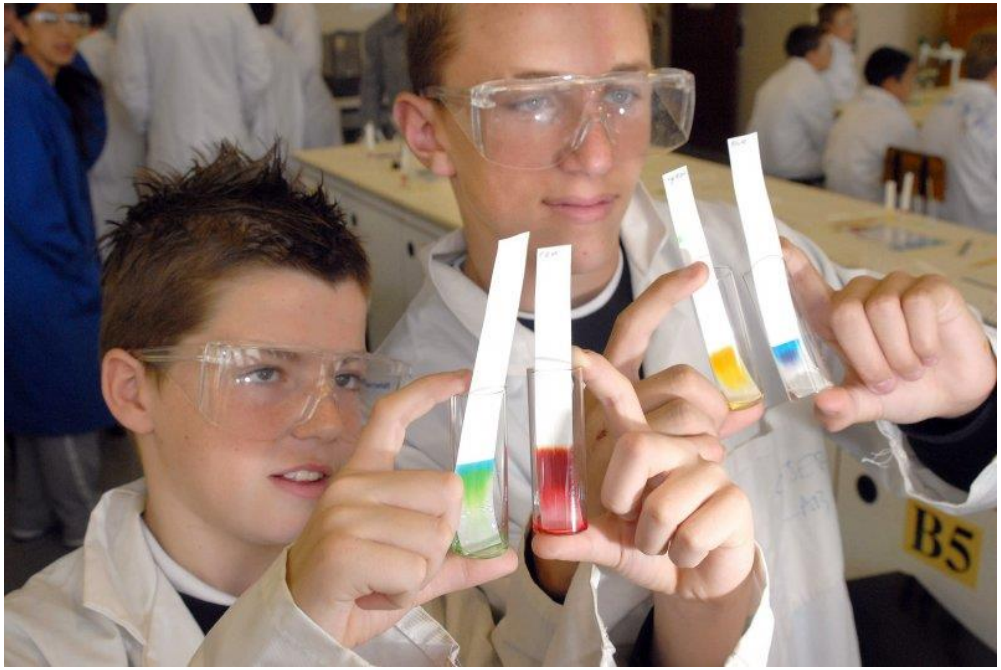
An **inference** is a logical interpretation based on prior knowledge or experience.

Explaining and Interpreting Evidence

A **hypothesis** is a proposed scientific explanation for a set of observations.

A hypothesis may be ruled out or confirmed.

Hypotheses are tested by performing **controlled experiments** or by **gathering new data**.



Researchers often work in teams to analyze, review, and critique each other's data and hypotheses.

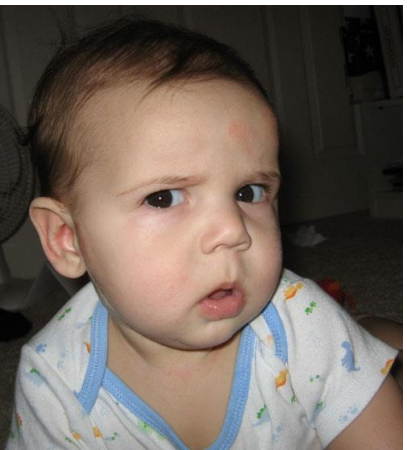
Science as a Way of Knowing

Science is an ongoing *process* that involves:

- asking questions
- observing
- making inferences
- testing hypotheses

Scientific understanding is always changing.

Good scientists are skeptics who question both existing ideas and new hypotheses.



Science and Human Values

An understanding of science and the scientific approach is essential to making intelligent decisions.

Decisions involve many factors besides scientific information, including:

- the society in which we live
- economic considerations
- laws
- moral principles

Citizens decide what to do when they vote.

1–1 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:

ExamView® QuickTake

End Show

1–1 Section QUIZ

1 Observations involving numbers are known as

a. qualitative observations.

b. hypothetical observations.

c. quantitative observations.

d. inferred observations.

2 Which of the following shows the interaction of science and human values?

a. the debate over the best way to produce electricity

b. investigating how a manatee behaves

c. Determining what causes a disease

d. using a hypothesis to test an explanation

3 A scientist takes paint chips from 10 apartments in a large building. She tests for the presence of lead in the paint and finds it in all 10 samples. She then concludes that lead paint is probably present in all 120 apartments in the building. This conclusion is an example of

a. a scientific fact.

b. a scientific error.

c. proof.

d. a reasonable inference.

4 A possible explanation for a set of observations is known as

a. data.

b. a hypothesis.

c. an inference.

d. a result.

5 A good scientific hypothesis must be

a. correct.

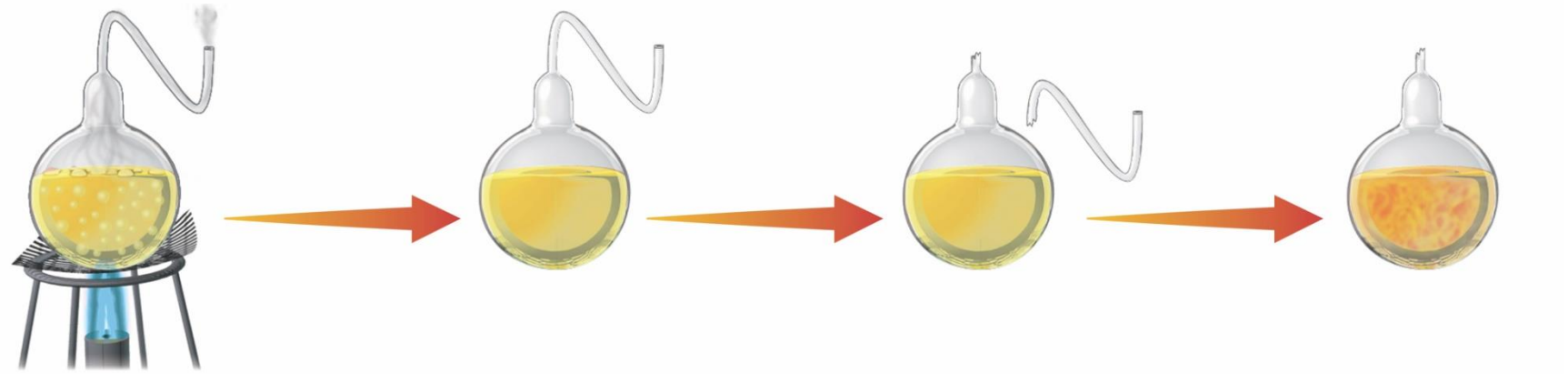
b. able to be tested.

c. obvious.

d. based on common sense.

END OF SECTION

1-2 How Scientists Work



How do scientists test hypotheses?

A hypothesis should be tested by an experiment in which only one variable is changed at a time.

Designing an Experiment

The process of testing a hypothesis includes:

- Asking a question
- Forming a hypothesis
- Setting up a controlled experiment
- Recording and analyzing results
- Drawing a conclusion

Asking a Question

Many years ago, people wanted to know how living things came into existence. They asked:

How do organisms come into being?

Forming a Hypothesis

One early hypothesis was **spontaneous generation**.

For example, most people thought that maggots spontaneously appeared on meat.

In 1668, **Redi** proposed a different hypothesis: *that maggots came from eggs that flies laid on meat.*

Setting Up a Controlled Experiment

manipulated variable

responding variable

active art click to start

Redi's Experiment

Redi's Experiment on Spontaneous Generation

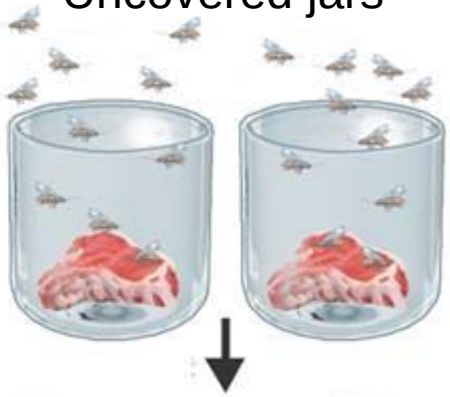
OBSERVATIONS: Flies land on meat that is left uncovered. Later, maggots appear on the meat.

HYPOTHESIS: Flies produce maggots.

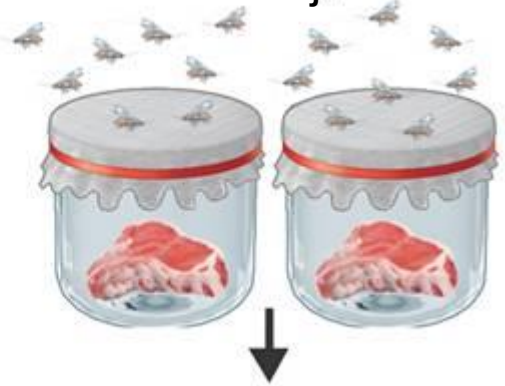
PROCEDURE

Controlled Variables: jars, type of meat, Location, temperature, time

Uncovered jars



Covered jars

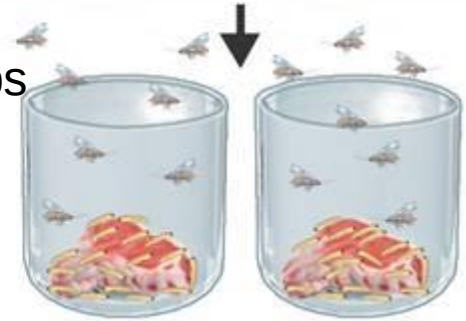


Redi's Experiment

Redi's Experiment on Spontaneous Generation

Manipulated Variable:
Gauze covering that keeps flies away from meat

Responding Variable:
whether maggots appear



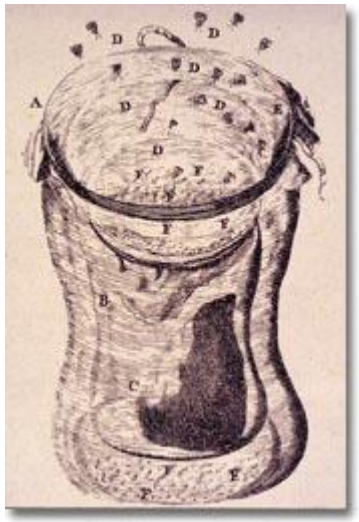
Maggots appear.

Several days pass.

No maggots appear.

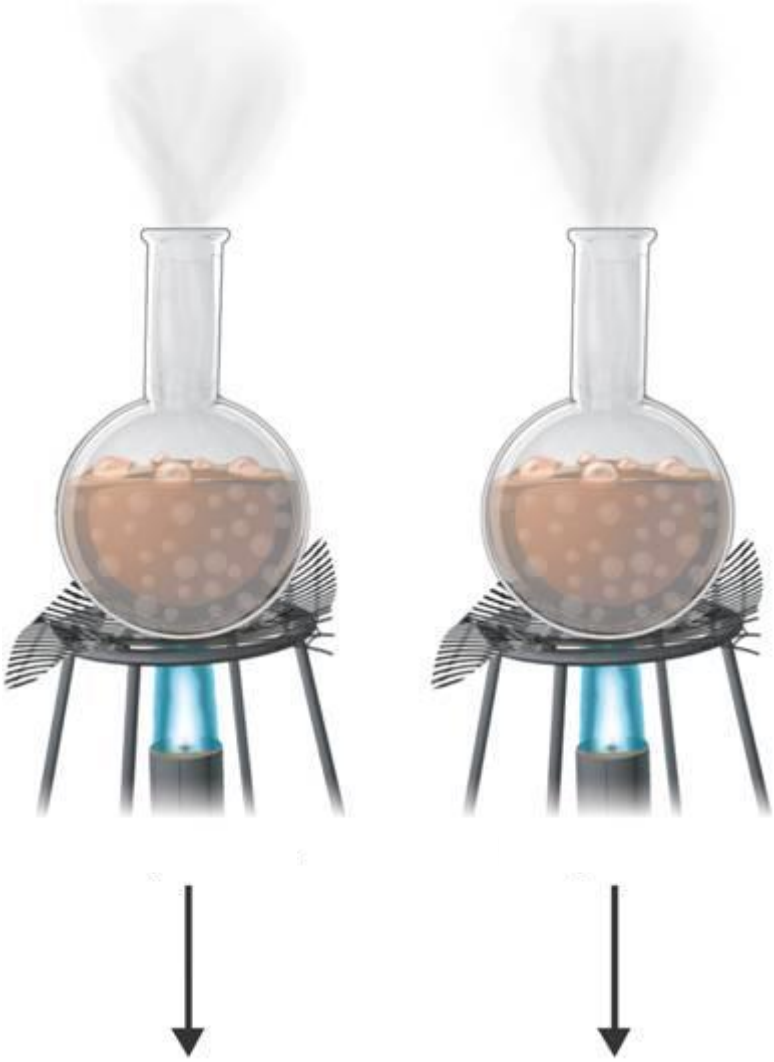
Drawing a Conclusion

Scientists use the data from an experiment to evaluate a hypothesis and draw a **valid conclusion**.



Spallanzani's Test of Redi's Findings

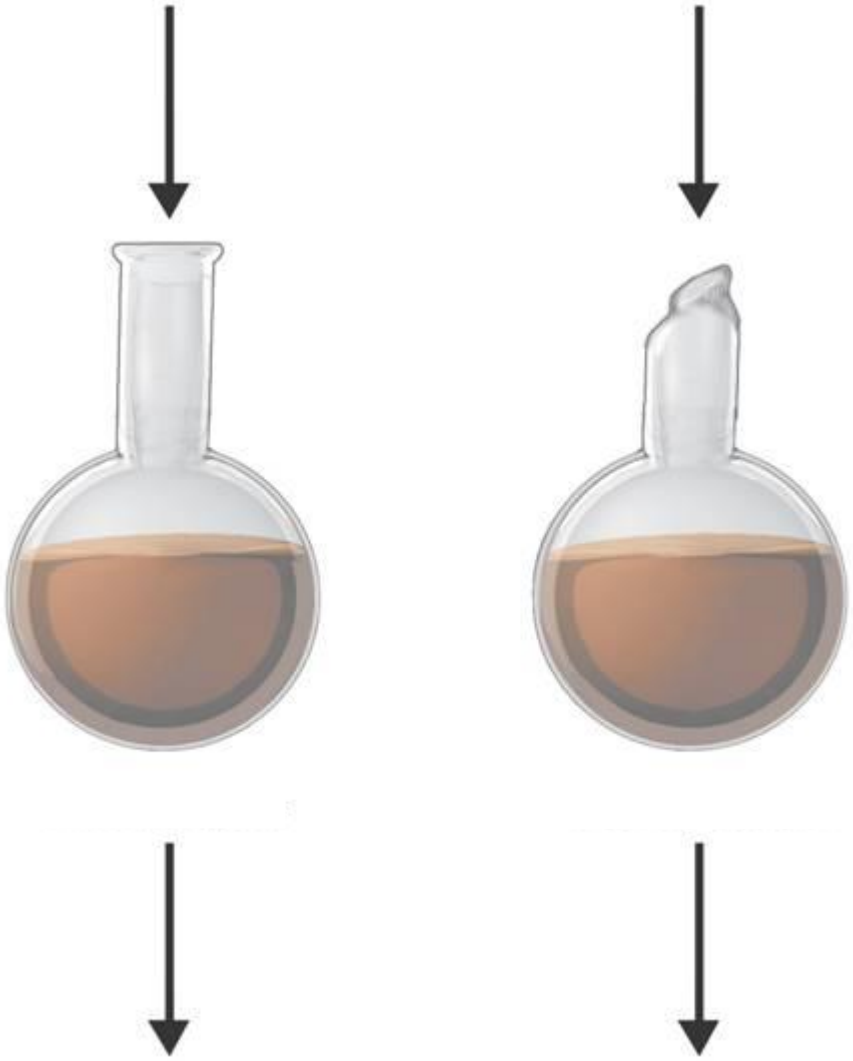
Gravy is boiled.



Gravy is boiled.

Spallanzani's Test of Redi's Findings

Flask is open.



Flask is sealed.

Spallanzani's Test of Redi's Findings

Gravy is teeming with microorganisms.

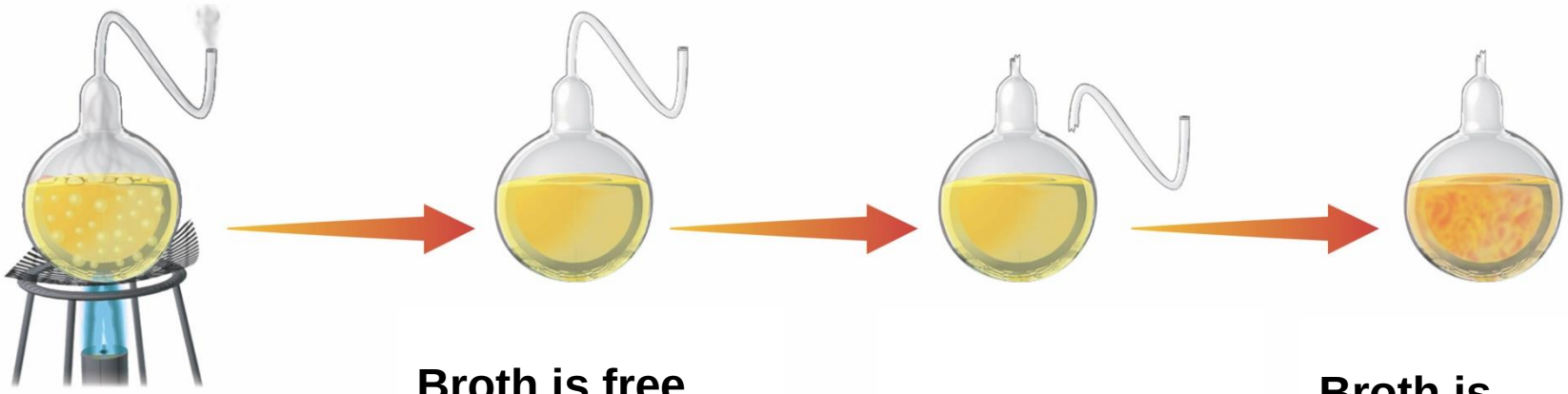
Gravy is free of microorganisms.

Pasteur's Test of Spontaneous Generation

- **Louis Pasteur** conclusively disproved the hypothesis of spontaneous generation.
- Pasteur showed that all living things come from other living things.

active art click to start

Pasteur's Experiment



Broth is boiled

Broth is free of microorganisms for a year.

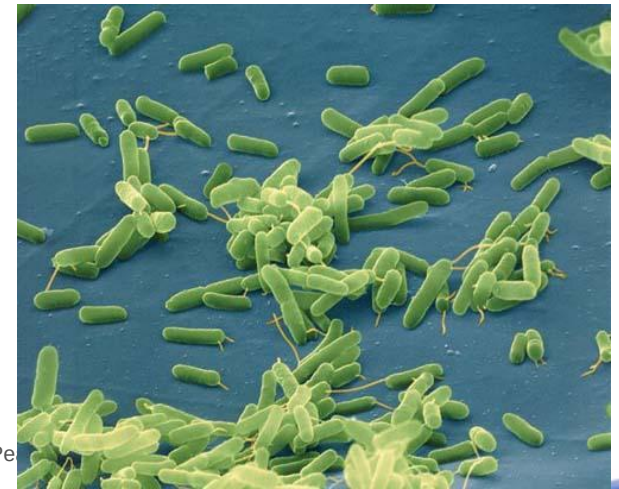
Curved neck is removed.

Broth is teeming with microorganisms.

The Impact of Pasteur's Work

Pasteur saved the French wine industry, which was troubled by unexplained souring of wine.

He began to uncover the nature of infectious diseases, showing that they were the result of microorganisms.



How does a scientific theory develop?

How a Theory Develops

As evidence from numerous investigations builds up, a hypothesis may become so well supported that scientists consider it a theory.

In science, the word *theory* applies to a <u>well-tested explanation that unifies a broad range of observations</u>.

Major Theories in Biology

- Germ Theory
- Evolutionary Theory
- Cell Theory
- Gene Theory

1–2 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:

ExamView® QuickTake

End Show

1–2 Section QUIZ

1 In an experiment, the variable that is deliberately changed is called the

a. control.

b. manipulated variable.

c. responding variable.

d. constant control

2 The mistaken belief that living organisms can arise from nonliving matter is called

a. biogenesis.

b. Pasteur's theory.

c. spontaneous generation.

d. Spallanzani’s hypothesis.

3 Which of the following was the manipulated variable in Redi's experiment?

a. the kind of meat used

b. the temperature the jars were kept at

c. the gauze covering on some jars

d. the kind of fly that visited the jars

4 A well-tested explanation that unifies a broad range of observations is a

a. hypothesis.

b. variable.

c. control.

d. theory.

5 A scientific explanation does not become a theory until

a. a majority of scientists agree with it.

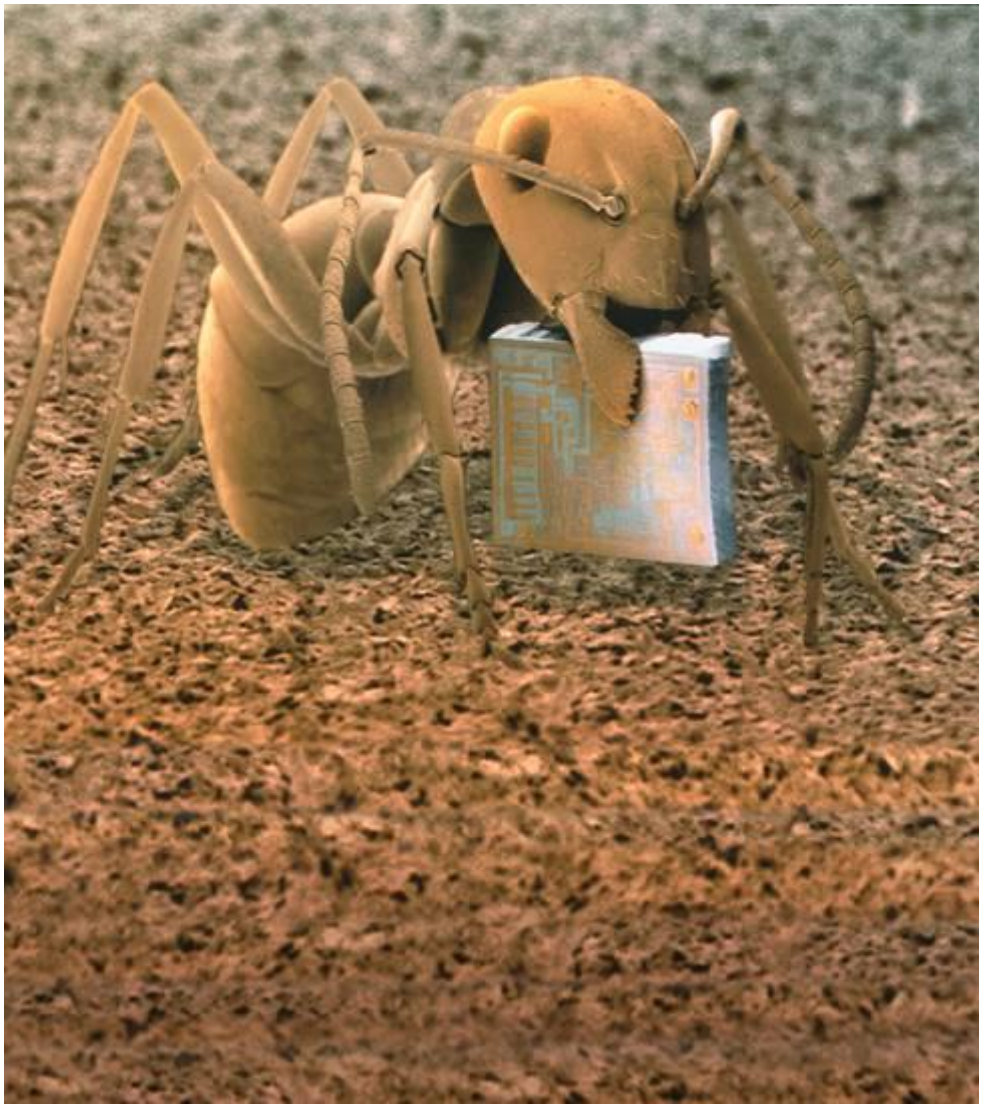
b. it has been supported by evidence from numerous investigations and observations.

c. it is first proposed as an explanation.

d. it is published in a textbook.

END OF SECTION

1-3 Studying Life



What are some characteristics of living things?

Living things share the following characteristics:

- made up of units called **cells**
- reproduce
- based on a universal genetic code
- grow and develop
- obtain and use materials and energy
- respond to their environment
- maintain a stable internal environment
- change over time

movie
click to start

Big Ideas in Biology

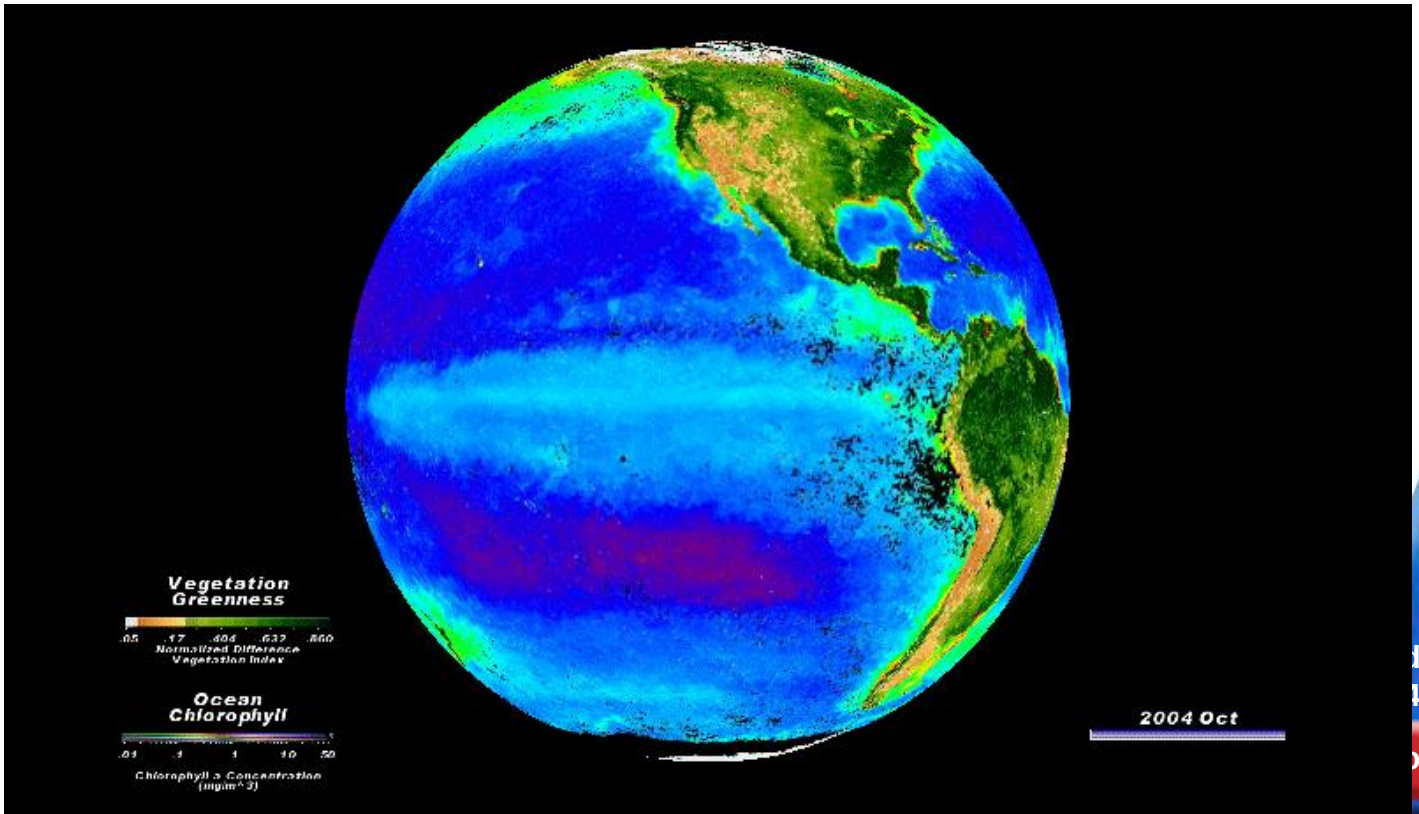
Science as a Way of Knowing

Science is not just a list of “facts.”

The job of science is to use observations, questions, and experiments to explain the natural world.

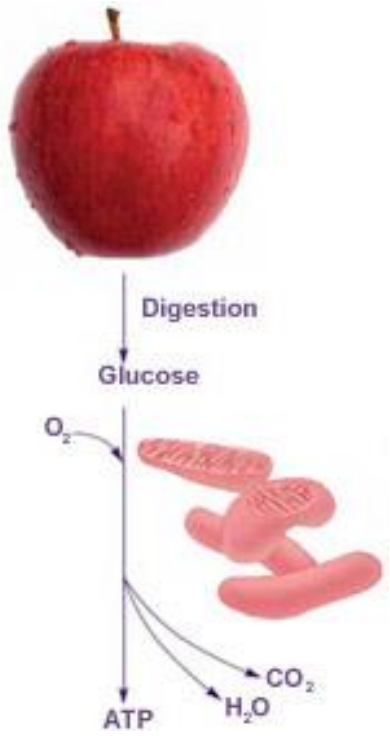
Interdependence in Nature

All forms of life on Earth are connected together into a **biosphere**, which literally means “living planet.”



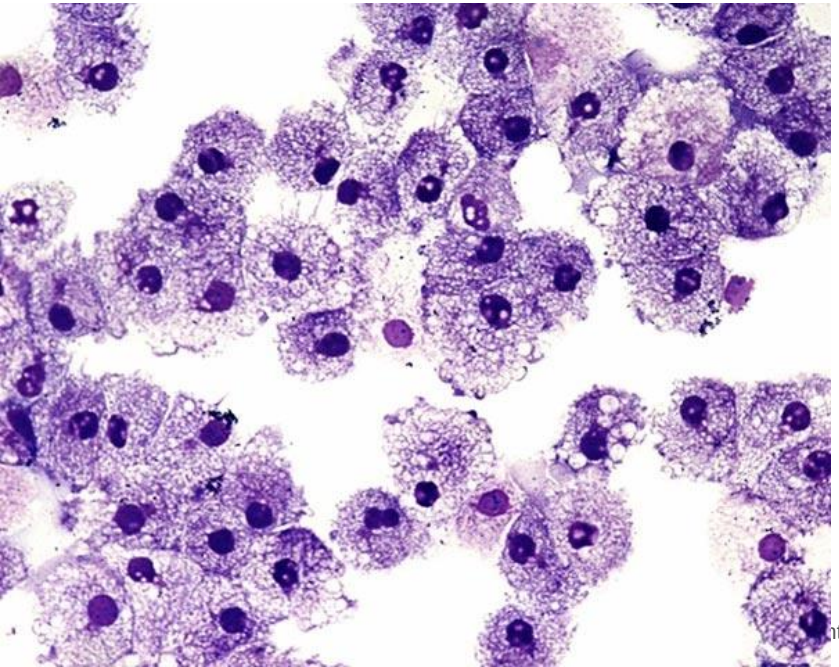
Matter and Energy

Matter serves as nutrients to build body structure and energy to fuel the processes of life.



Cellular Basis of Life

Organisms are composed of one or more **cells**, which are the smallest units that can be considered fully alive.



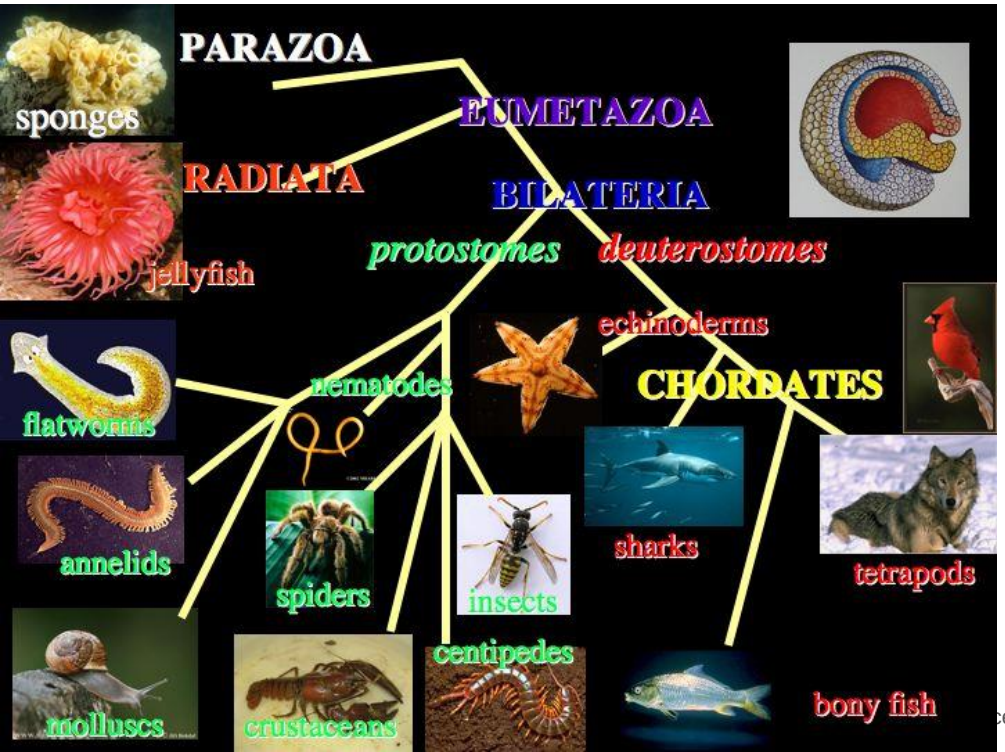
Information and Heredity

Genetic code is common, with minor variations, to every organism on Earth.

That information, carried in **DNA**, is copied and passed from parents to offspring.

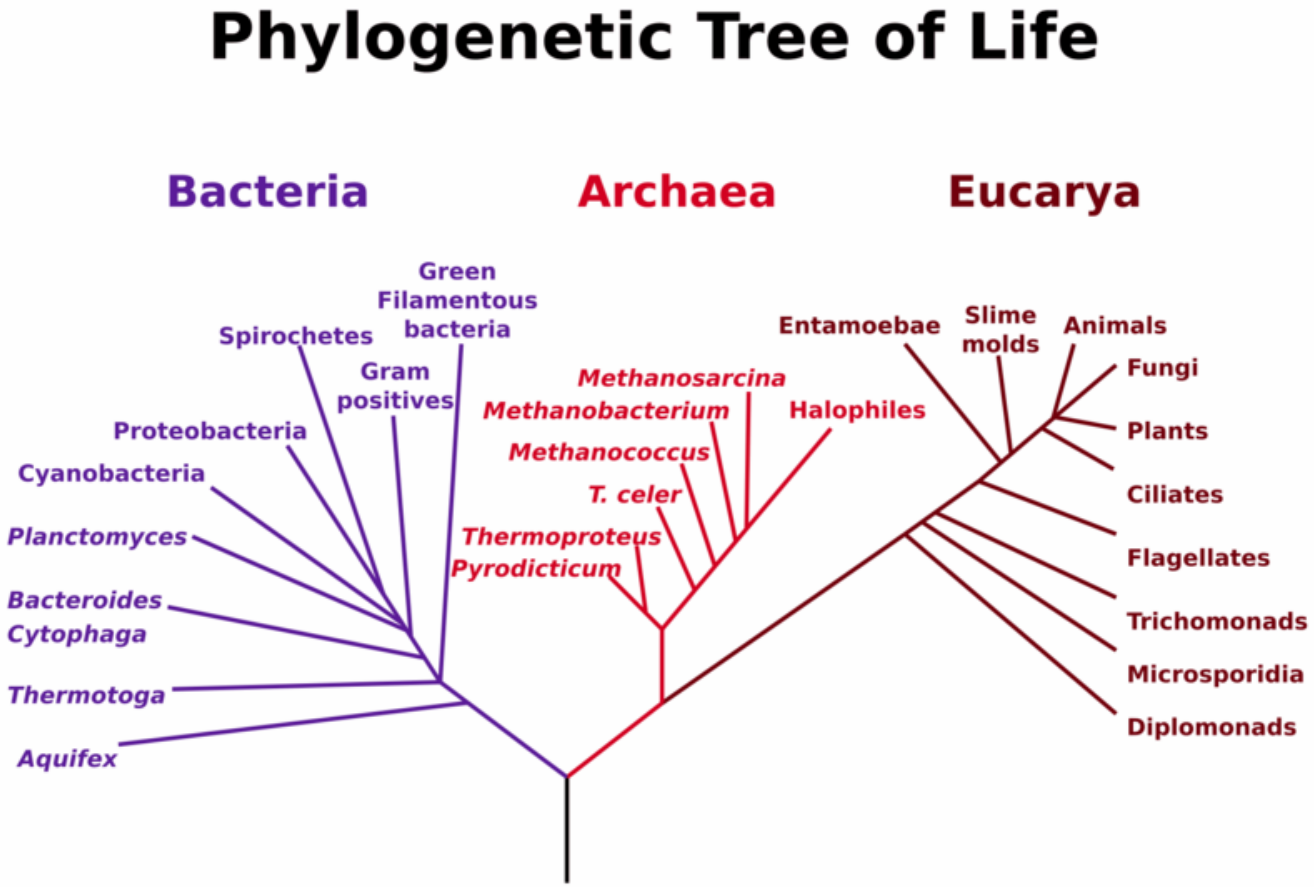
Unity and Diversity of Life

All living things are fundamentally alike at the molecular level, even though life takes an almost unbelievable variety of forms.



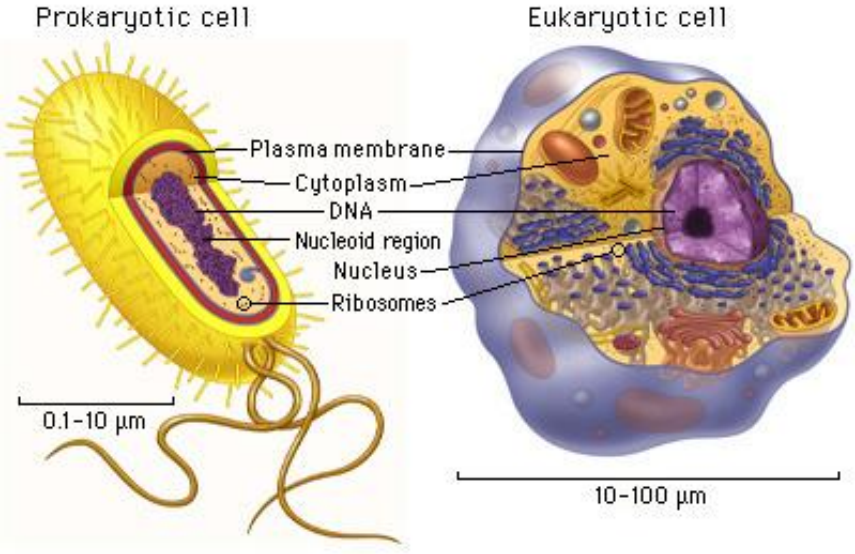
Evolution

In biology, **evolution**, or the change in living things through time, explains inherited similarities as well as the diversity of life.



Structure and Function

Structures evolve in ways that make particular functions possible, allowing organisms to adapt to a wide range of environments.



Homeostasis

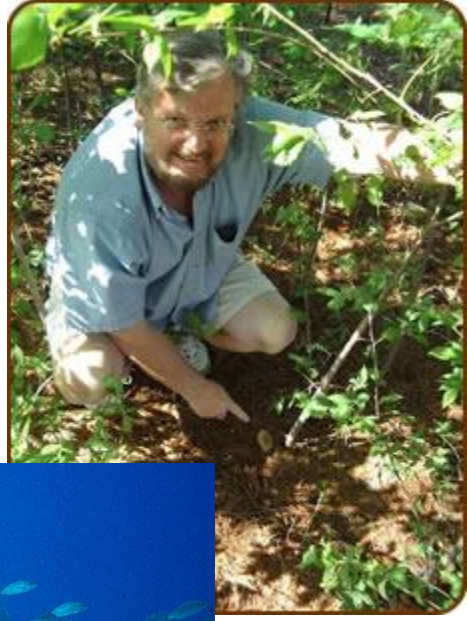
An organism's ability to **maintain a relatively stable internal environment**.

Science, Technology, and Society

Science seeks to provide useful information, but only a public that truly understands science and how it works can determine how that information should be applied.

A Few Branches of Biology

- Zoologists
- Botanists
- Paleontologists
- Cell Biologists
- Geneticists
- Microbiologists
- Ecologists



How can life be studied at different levels?

Some of the levels at which life can be studied include:

- molecules
- cells
- organisms
- populations
- communities
- biomes
- the biosphere

Biosphere

The part of Earth that contains all ecosystems

Ecosystem

Community and its nonliving surroundings

Levels of Organization

Hawk, snake, bison, prairie dog, grass, stream, rocks, air

Community

Populations that live together in a defined area

Hawk, snake, bison, prairie dog, grass

Population

Group of organisms of one type that live in the same area

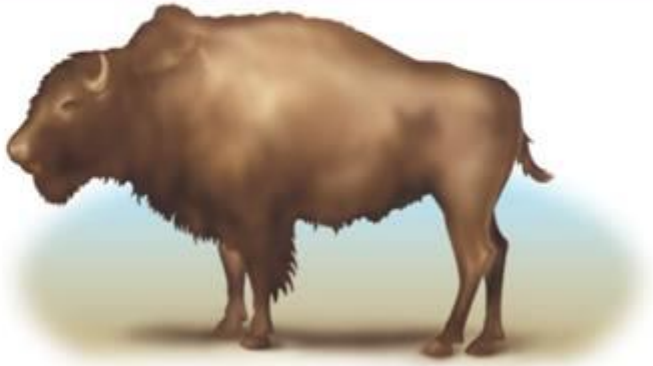
Levels of Organization

Bison herd

Organism

Individual living thing

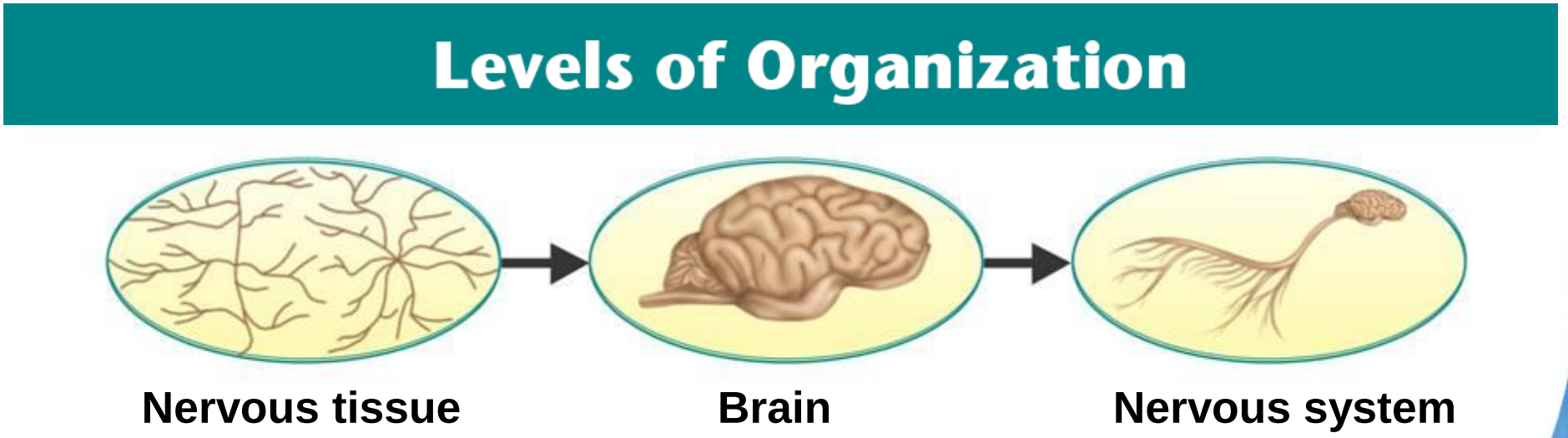
Levels of Organization



Bison

Groups of Cells

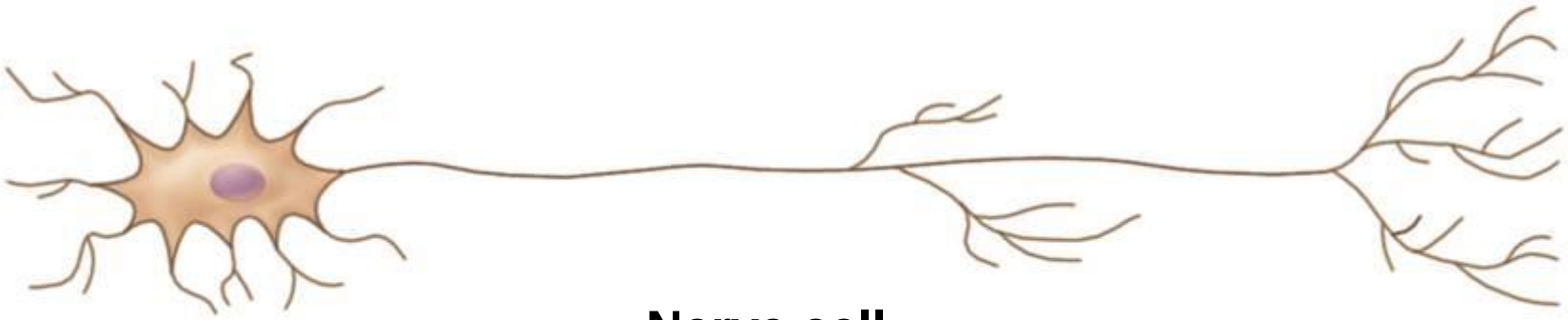
Tissues, organs, and organ systems



Cells

Smallest functional unit of life

Levels of Organization

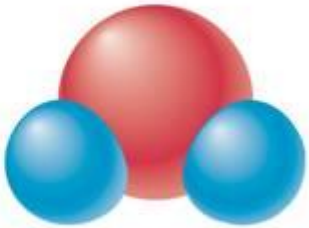


Nerve cell

Molecules

Groups of atoms; smallest unit of most chemical compounds

Levels of Organization



Water

DNA

Biology in Everyday Life

More than any other area of study, biology touches your life every day.

How?

1-3 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:

End Show

1-3 Section QUIZ

1 An increase in size is known as

a. growth.

b. metabolism.

c. development.

d. differentiation.

2 Which of the following is NOT a characteristic of all living things?

a. use of energy

b. made of cells

c. stable internal environment

d. need for oxygen

3 Which of the following are branches in the study of biology?

a. cells, tissues, organs, and organisms

b. botany, cell biology, ecology, and zoology

c. populations, communities, and ecosystems

d. the genetic code, evolution, and the biosphere

1-3 Section QUIZ

4 The genetic code is carried in

a. Water.

b. DNA.

c. proteins.

d. soil.

End Show

5 Which of the following shows the levels of organization in correct order from the simplest to the most complex?

a. organisms, cells, populations, molecules, ecosystems

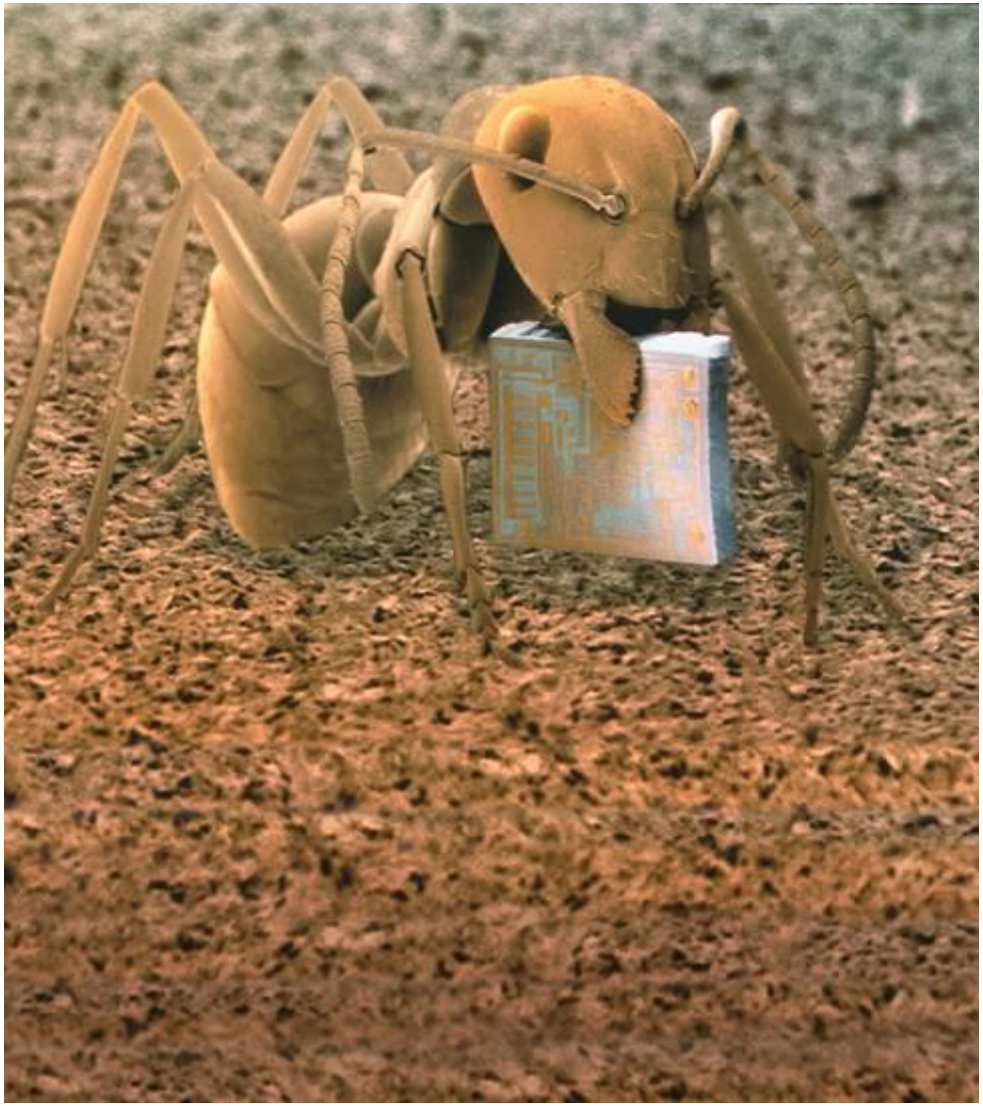
b. ecosystems, populations, organisms, cells, molecules

c. molecules, cells, organisms, populations, ecosystems

d. molecules, organisms, cells, populations, ecosystems

END OF SECTION

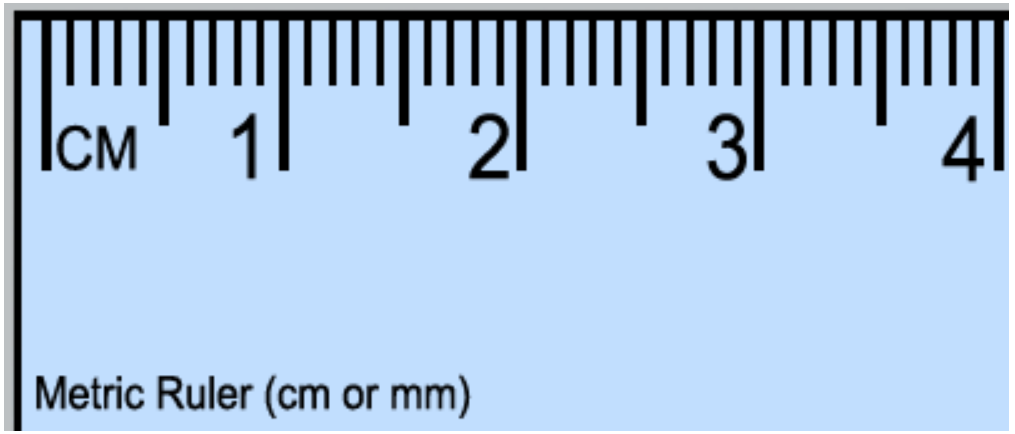
1-4 Tools and Procedures



What measurement system do most scientists use?

Most scientists use the metric system when collecting data and performing experiments.

Because the metric system is based on multiples of 10, it is easy to use.



Metric Ruler (cm or mm)

Common Metric Units	
Length	**Mass**
1 meter (m) = 100 centimeters (cm) 1 meter = 1000 millimeters (mm) 1000 meters = 1 kilometer (km)	1 kilogram (kg) = 1000 grams (g) 1 gram = 1000 milligrams (mg) 1000 kilograms = 1 metric ton (t)
Volume	**Temperature**
1 liter (L) = 1000 milliliters (mL) 1 liter = 1000 cubic centimeters (cm^3)	0^0C = freezing point of water 100^0C = boiling point of water

How are light microscopes and electron microscopes similar? How are they different?

Microscopes

Microscopes are devices that produce magnified images of structures that are too small to see with the unaided eye.

Light Microscopes

The most commonly used microscope is the **light microscope.**

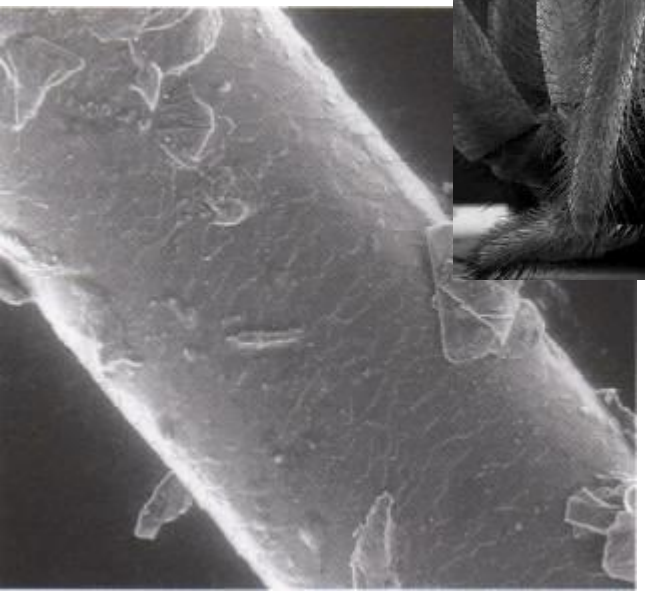
Light microscopes produce clear images of objects at a magnification of about 1000 times.

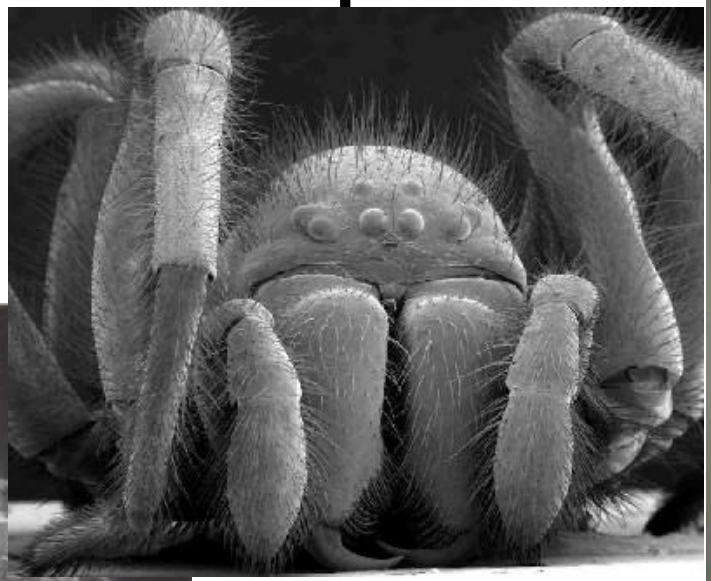
1-4 Tools and Procedures

Compound light microscopes allow light to pass through the specimen and use two lenses to form an image.

Electron Microscopes

To study even smaller objects, scientists use **electron microscopes**.





Laboratory Techniques

Cell Cultures

A single cell is able to reproduce so that a group of cells, called a **cell culture**, develops from the single original cell.

Cell Fractionation

Biologists often use a technique known as **cell fractionation** to separate the different cell parts.

Follow safe practices.

- Study the safety rules.
- Read all the steps and safety precautions.
- Follow your teacher's instructions and textbook directions exactly.
- If in doubt, ask your teacher for an explanation.
- Wash your hands thoroughly with soap and warm water after every scientific activity.

1-4 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:

ExamView® QuickTake

End Show

1 A single measurement system is commonly used in science because

a. it allows scientists to easily replicate one another's experiments.

b. basic units of mass, length, and volume are unrelated to one another.

c. more kinds of measurements can be made.

d. computers can store large amounts of scientific data.

2 Compared to a light microscope, an electron microscope is used to observe

a. larger objects with less detail.

b. larger objects with more detail.

c. smaller objects with more detail.

d. smaller objects with less detail.

3 A device that separates cell parts is a

a. centrifuge.

b. cell culture.

c. light microscope.

d. electron microscope.

4 A technique in which cells are grown in a nutrient solution is known as

a. staining.

b. cell fractionation.

c. cell culturing.

d. cell fertilizing.

5 When you work in a biology laboratory situation, your first priority should be to

a. make sure all materials are available.

b. modify any instructions that do not make sense.

c. familiarize yourself with all safety rules before beginning to work.

d. know ahead of time what kinds of results to expect.

END OF SECTION