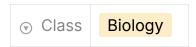


# **Chapter 1: The Science of Biology**



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# 1.1 — What is Science?

Scientists are **constantly** testing, debating, and revising scientific explanations of events in the natural world.

· Scientists either understand or don't

#### The Nature of Science

**Science:** the use of evidence to construct testable explanations and predictions of natural phenomena

- Science is a process (organized way to observe the natural world)
- Growing body of knowledge

Science deals **ONLY** with the natural world.

Orderly fashion

Explanations are based on evidence and understanding

#### The Goals of Science

The universe is composed of many parts that **INTERACT**.

All objects in the universe and their interactions are governed by natural laws

## **Scientific Uncertainty**

Much of nature is still a mystery

## The Scientific Methodology

· General style of scientific investigation

## **Observing & Asking Questions**

**Observation:** act of noticing and describing events or processes in a careful way

## Forming a Hypothesis

**Inference:** logical interpretation based on what scientists already know

Hypothesis: tentative explanation that can be tested

## **Controlled Experiments**

Variables: factors that can change

**Controlled Experiment:** an experiment in which one variable is changed while the others are kept constant

- Independent / Manipulated Variable: the variable that is deliberately changed
- **Dependent / Responding Variable:** the observed variable that changes in response to the independent variable

**Control Group:** an experimental group that has no change in its independent variable

## **Data Collection & Analysis**

Data: scientific information collected through experiments

- Quantitative → numerical
- Qualitative → descriptive

Scientists must use tools to structure and organize their observations.

• Error must be as avoidable as possible

## **Drawing Conclusions**

Analyzing data allows scientists to reach **conclusions**.

Not **ALL** hypotheses can be tested by experiments.

• Ethics can prevent experiments

# 1.2 — Science in Context

## **Exploration and Discovery**

**Scientific ideas** come from curiosity, skepticism, open-mindedness, and creativity.

Ideas for scientific investigations can arise from practical human issues.

Technology makes scientific experimentation easier

# **Communicating Results**

Scientists often collaborate in groups.

 Scientists must appropriately publish their scientific work to benefit the general public.

#### **Peer Review**

· Review of scientific research

Peer reviewers look for mistakes, oversights, unfair influences, or fraud.

## **Sharing Knowledge**

Once research is published, it can bring about new questions.

## **Scientific Theories**

**Theory:** a reliable scientific explanation of the natural world that combines many observations and incorporates hypotheses

• Phenomena that have not been observed yet

A theory is **NEVER** absolute truth.

• Science is always changing

# **Science & Society**

Science has limitations.

• Requires the understanding of society

Science only tells us facts about the natural world.

• No ethical or moral viewpoints

## **Avoiding Bias**

Bias: a personal point of view on a subject

Scientific data is interpreted in different ways

Recommendations with bias cannot be trusted.

## **Understanding & Using Science**

Science occurs when humans wonder about nature.

• Biology allows us to think about ourselves and life in nature

# 1.3 — Studying Life

# **Characteristics of Living Things**

Biology: the study of life

#### Living things are ...

- Made of cells
- · Based on genetic code
- Obtain and use energy
- Grow and develop
- Reproduce
- Respond to environmental stimuli
- · Maintain homeostasis
- Change over time

All living things are based on **DNA** (deoxyribonucleic acid).

Molecule that contains a cell's genetic code

Stimulus: a signal that an organism responds to

Comes from the environment

Homeostasis: keeping a stable internal environment

Even if the external environment is extreme

**Metabolism:** the combination of chemical reactions that occurs as an organism builds up or breaks down materials

# The Central Themes of Biology

All biological subjects are connected.

#### The Big Ideas of Biology

- Cellular Basis of Life
- Information & Heredity
- Matter & Energy
- Growth, Development & Reproduction
- Homeostasis
- Evolution
- Structure & Function
- Unity & Diversity of Life
- Interdependence in Nature
- Science as a "Way of Knowledge"

#### **Cellular Basis of Life**

All living things are made of cells.

• Some organisms are single-celled and some are multicellular.

## **Information & Heredity**

DNA and genetic code influences every part of you.

## **Matter & Energy**

Matter and energy allows for biological processes.

#### **Growth, Development & Reproduction**

New individuals grow into larger adults.

Cells become specialized for different tasks

#### **Homeostasis**

Homeostasis maintains the organism's internal environment

#### **Evolution**

Evolutionary change allows organisms to adapt.

#### **Structure & Function**

Each major part of a body has a different specialization.

• Performs different tasks

## **Unity & Diversity of Life**

Life is very different externally.

• On a cellular level, life is very similar.

## Interdependence in Nature

Biosphere: connections between all living things on Earth

Relationships create cycles of matter and flow of energy

## Science as a "Way of Knowledge"

Science is **NOT** a list of facts.

• Science is a way to understand.

## **Fields of Biology**

· Biology has many overlapping fields

## **Biotechnology**

• Field based on the editing of genetic code to redesign living things

#### **Building the "Tree of Life"**

Biologists want to organize all living things into a "Tree of Life".

• There are more organisms to be discovered

## **Infectious Diseases**

All diseases originate from a certain interaction between organisms and their environment

## **Genomics & Molecular Biology**

· Studies of DNA and cellular molecules

# **Performing Biological Investigations**

## **Scientific Measurement**

Most scientists use the **METRIC** system.

• International System of Units

## Safety

Lab Safety rules are crucial

Safety in biology for you and any living organisms you are studying.