

Chapter 1

Scientific Process and Themes of Biology



What is Science?

- ◆ Scientific knowledge is acquired using a rigorous process
 - ◆ Science is an organized way of gathering and analyzing evidence about the natural world
 - ◆ Don't be fooled by pseudoscience (false science)!
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Scientific Methodology

- ◆ Collecting observations
- ◆ Asking questions
- ◆ Inferring and Forming a Hypothesis
- ◆ Designing a Controlled Experiment
- ◆ Collecting and Analyzing Data
- ◆ Drawing Conclusions

Observations

- ◆ Observation-the act of noticing and describing events or processes in a careful, orderly way
- ◆ Document your observations, and use your senses to collect them

Asking Questions

- ◆ Ask questions based on your observations
 - ◆ What was causing your observation?
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Inferring and Forming a Hypothesis

- ◆ Hypothesis-a scientific explanation for a set of observations that can be tested in ways that support or reject it
- ◆ Inference-a logical interpretation based on what scientists already know

Designing a Controlled Experiment

- ◆ Controlled Experiment-an experiment in which only one variable is changed, with all other variables remaining constant
- ◆ Must include key design aspects to be considered a valid experimental design

- ◆ Independent Variable-the variable that is deliberately changed
 - ◆ Dependent Variable-variable that is observed and that changes in response to the independent variable
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Control vs. Experimental Groups

- ◆ Control Group-exposed to the same conditions as the experimental group except for one independent variable
- ◆ Why is the control group essential?

Collecting and Analyzing Data

- ◆ Data-information collected from experiments
 - ◆ Quantitative data are numbers collected by counting or measuring
 - ◆ Qualitative data are descriptive and involve characteristics that cannot be counted
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Sources of Error

- ◆ Choosing the correct measurement tools is essential
- ◆ Eliminating possible sources of error is important in the design planning

Drawing Conclusions

- ◆ Data from experiments used to support, reject, or revise the hypothesis being tested
 - ◆ Not whether it is right or wrong!
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Communicating Results

- ◆ Peer Review happens when scientists share findings by publishing results, which are then reviewed by other experts
- ◆ Allows researchers to share ideas and to test and evaluate each other's work

Scientific Theory

- ◆ Scientific Theory-a well-tested explanation that unifies a broad range of observations and hypotheses and that enables scientists to make accurate predictions about new situations
- ◆ How is this different from the use of the word theory outside of the scientific community?

Characteristics of Life

- ◆ Cellular Organization
 - ◆ Reproduction
 - ◆ Metabolism
 - ◆ Homeostasis
 - ◆ Heredity
 - ◆ Responsiveness
 - ◆ Growth and Development
 - ◆ Evolution
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Cellular Organization

- ◆ Can be unicellular or multicellular.

Reproduction

- ◆ Living organisms must be able to reproduce.
- ◆ Can either be sexual reproduction (cells from two parents unite to form the first cell of a new organism) or asexual reproduction.
- ◆ Asexual reproduction is when a single organism produces offspring identical to itself.

Metabolism

- ◆ Metabolism is the combination of chemical reactions through which an organism builds or breaks down materials.
- ◆ Digestion, Cellular Respiration, Photosynthesis ect.

Homeostasis

- ◆ Keeping your internal cellular environment stable even while external conditions are changing is called homeostasis.
- ◆ Osmosis, Diffusion, Active Transport, Passive Transport

Heredity

- ◆ All life is linked by a common genetic code.
- ◆ The genetic code is written in a molecule called DNA.
- ◆ DNA (Deoxyribonucleic acid)

Responsiveness

- ◆ All life detect and respond to stimuli from the surrounding environment.
- ◆ A stimulus is a signal to which an organism responds.

Growth and Development

- ◆ All life grows and develops during the course of a life time.
 - ◆ Growth is becoming larger, development is becoming more complex.
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Evolution

- ◆ Living things as a group, evolve over time.
 - ◆ Evolution does not mean that all species develop into another species.
 - ◆ Evolution simply means the change in allele (form of a gene) frequency changes over time within a species.
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