

Section Summary

Biology is the science of life. All living organisms share several key properties such as order, response to stimuli, reproduction, adaptation, growth and development, homeostasis, and energy processing. Living things are highly organized following a hierarchy that includes atoms, molecules, organelles, cells, tissues, organs, and organ systems. Organisms are grouped as populations, communities, ecosystems, and the biosphere. Evolution is the source of the tremendous biological diversity on Earth today. A diagram called a phylogenetic tree can be used to show evolutionary relationships among organisms. Biology is very broad and includes many branches and sub-disciplines. Examples include molecular biology, microbiology, neurobiology, and ecology, among others.

Exercises

- Which of the following statements is false?
 - Tissues exist within organs which exist within organ systems.
 - Communities exist within populations which exist within ecosystems.
 - Organelles exist within cells which exist within tissues.
 - Communities exist within ecosystems which exist in the biosphere.
- The smallest unit of biological structure that meets the functional requirements of “living” is the _____.
 - organ
 - organelle
 - cell
 - macromolecule
- Which of the following sequences represents the hierarchy of biological organization from the most complex to the least complex level?
 - organelle, tissue, biosphere, ecosystem, population
 - organ, organism, tissue, organelle, molecule
 - organism, community, biosphere, molecule, tissue, organ
 - biosphere, ecosystem, community, population, organism
- Briefly explain how evolution is a source of species diversity.

Answers

- (b)
- (c)
- (d)
- Evolution leads to genetic changes in a population. For example, if you had a population of insects that live on a maple tree, some insects may begin to feed selectively on the bark of the tree, while others may selectively feed on the leaves. Over time, genetic changes can occur that may prevent these two groups from breeding with one another. In this case, a speciation event has occurred, increasing species diversity.

Glossary

atom: a basic unit of matter that cannot be broken down by normal chemical reactions

autotroph: an organism that can make its own food from materials in its environment

biology: the study of living organisms and their interactions with one another and their environments

biosphere: a collection of all ecosystems on Earth

cell: the smallest fundamental unit of structure and function in living things

community: a set of populations inhabiting a particular area

domain: the highest level of the taxonomic hierarchy; includes the Eukarya, Archaea, and Bacteria

ecosystem: all living things in a particular area together with the abiotic, nonliving parts of that environment

eukaryote: an organism with cells that have nuclei and membrane-bound organelles

evolution: the process of gradual change in a population that can also lead to new species arising from older species

heterotroph: an organism that cannot make its own food and must consume other organisms to obtain its energy

homeostasis: the ability of an organism to maintain constant internal conditions

macromolecule: a large molecule typically formed by the joining of smaller molecules

molecule: a chemical structure consisting of at least two atoms held together by a chemical bond

organ: a structure formed of tissues operating together to perform a common function

organ system: the higher level of organization that consists of functionally related organs

organelle: a membrane-bound compartment or sac within a cell

organism: an individual living entity

phylogenetic tree: a diagram showing the evolutionary relationships among biological species based on similarities and differences in genetic or physical traits or both

population: all individuals within a species living within a specific area

prokaryote: a unicellular organism that lacks a nucleus or any other membrane-bound organelle

tissue: a group of similar cells carrying out the same function

1.2 The Process of Science

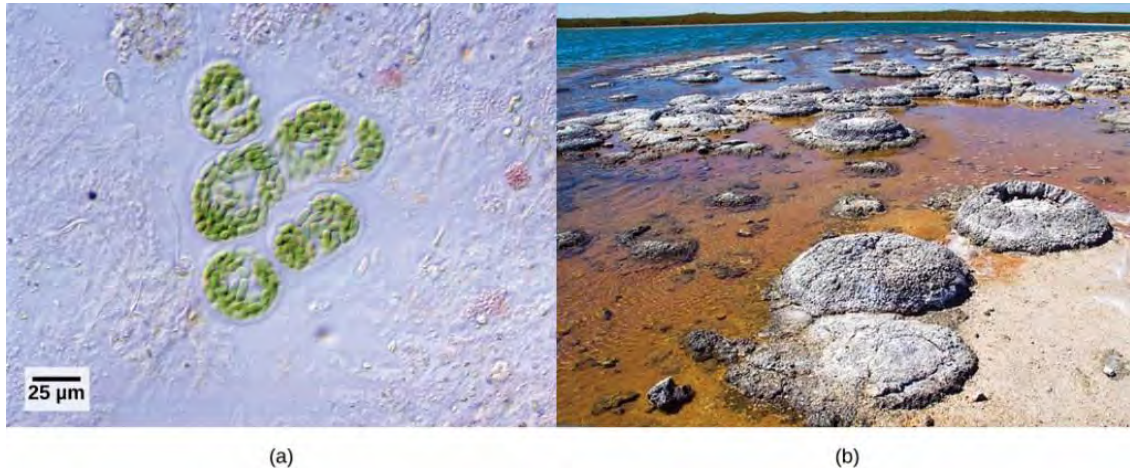


Figure 1.18 (a) cyanobacteria seen through a light microscope are some of Earth's oldest life forms (b) stromatolites along the shores of Lake Thetis in Western Australia are ancient structures formed by the layering of cyanobacteria in shallow waters. (credit a: modification of work by NASA; scale-bar data from Matt Russell; credit b: modification of work by Ruth Ellison / Concepts of Biology OpenStax)

Learning objectives

By the end of this section, you will be able to:

- *Understand the process of scientific inquiry*
- *Know the steps of the scientific method and be able to apply it*
- *Be prepared to explain how a hypothesis is different than a theory*
- *Compare inductive reasoning with deductive reasoning*
- *Describe the goals of basic science and applied science*
- *Be prepared to define and explain all bolded terms*

Biology is a science that gathers knowledge about the natural world (Figure 1.18). Specifically, **biology** is the study of life. Biological discoveries are made by a community of researchers who work both individually and together using agreed-on methods. The methods of science include careful observation, record keeping, logical and mathematical reasoning, experimentation, and submitting conclusions to the scrutiny of others. Science also requires considerable imagination and creativity; a well-designed experiment is commonly described as elegant or beautiful. Science has significant practical implications and applications, for example, in the prevention of disease (Figure 1.19). Other types of science are motivated by curiosity. Whatever its goal, there is no doubt that science, including biology, has transformed human existence and will continue to do so.