

Biology 10 - Introduction to Biology

West Valley College - Norris

Basic Concepts of Science

I. Definitions

- A. Biology (G. *bios* = “life: + *logos* = “study of”)
- B. Science (L. –“to know”)

II. Characteristics that Define Life

A. Cellular Organization

B. Metabolic Activity

- 1. Physics of Energy - 1st Law of Thermodynamics
2nd Law of Thermodynamics
- 2. Classification of Living Things (based on energy use)
 - Autotroph
 - Heterotroph

C. Irritability

- 1. Homeostasis

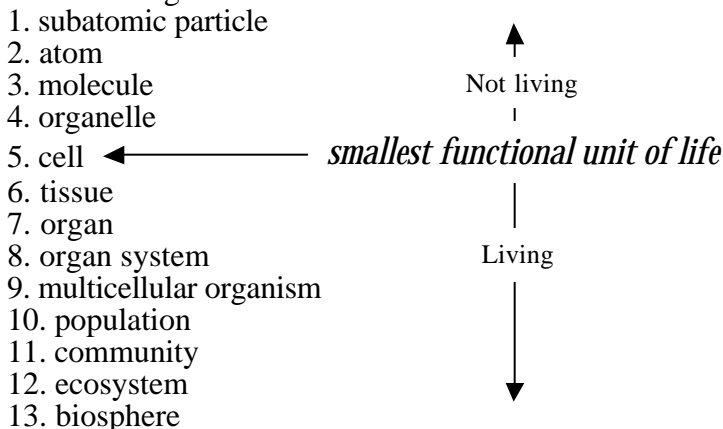
D. Growth and Reproduction

- 1. Growth
- 2. Reproduction

E. Life Evolves

- 1. Three major reasons:
- 2. Natural Selection / Evolution
 - Darwin’s concept of natural selection is based on three simple observations:
 - 1. organisms of a single species are not identical
 - 2. some of these differences are heritable
 - 3. more organisms are produced than survive. The basic premise is that inherited traits that are more adaptive increase the chance of survival and reproductive success - thus the more adaptive traits are more likely to be passed on

III. Levels of Organization



IV. Diversity of Life

The simplest level of classification is A) living and B) non-living as discussed above. Further similarities and differences help to divide life into five categories, the five kingdoms:

1. Monera (bacteria)
2. Protista (paramecium, slim molds, single celled algae)
3. Fungi (mushrooms, penicillin, yeast)
4. Plants (redwoods, poison oak, multicellular algae)
5. Animals (sponges, eagles, humans)

V. Scientific Inquiry

A. Essential characteristics of science:

1. it is guided by natural law
2. it must be explainable by reference to natural law
3. it is testable against the empirical world
4. its conclusions are tentative
5. it is falsifiable

B. Scientific method: accepted process of scientific inquiry

1. Observe - observations often lead to questions (i.e. How can I explain what I observed?)
2. Hypothesize - think up several educated guesses to explain your observations (a hypothesis is often presented as a prediction of a cause and effect outcome)
3. Experiment - test which hypotheses are most likely incorrect (unsupported)
(note: the scientific method cannot “prove” that any one hypothesis out of many is correct - it can only rule out incorrect hypotheses)

- Experimental Design: test only one causative factor (independent variable) at a time

Variables: independent = “cause” - factor that is manipulated

dependent = “effect” - factor that is affected and measured

control - factors that must be held constant or controlled. This is often accomplished by comparing an experimental group (where the independent variable is manipulated) to a control group (where the independent variable is not manipulated)

4. Assess the data that is acquired from experimentation
5. Repeat

A hypothesis that is supported by lots of experimental evidence (it repeatedly cannot be rejected) is raised to the level of “theory”. A theory is an idea or explanation that is so well supported that it is accepted as truth (although with future evidence it may be rejected)

Note: Science is NOT an accumulation of Facts, but rather a set of tentative answers to questions

VII. Additional Selected Key Terms

cell DNA energy evolution homeostasis hypothesis
macromolecule natural selection theory

Study Questions :

1. Define Biology.
2. Define Science.
3. What are the characteristics that define life? Describe each characteristic in some detail and explain how these characteristics might be recognized. Using these characteristics, is fire alive?
4. Define the first and second laws of thermodynamics.
5. Describe the different ways in which organisms may be classified based on energy use.
6. Describe homeostasis. What exactly is homeostasis?
7. Compare and contrast growth and reproduction.
8. What are the major factors cause life to evolve.
9. What is the scientific method? Explain each of the steps of the scientific method.
10. What is a hypothesis? What are characteristics of a good hypothesis?
11. Compare and contrast independent and dependent variables.
12. What is a “control group” and how is it different from an “experimental group”?
13. What is the difference between a hypothesis, conclusion, theory, and law?
14. Can an experiment *prove* a hypothesis to be true?
15. Is science an accumulation of facts? If not, then what is Science and how can I believe anything I learn?

“If I have seen farther than others it is because I have stood on the shoulders of giants”
Sir Isaac Newton