

# CHAPTER 1

## Introduction: Biology Today

Figures 1.1 – 1.2

PowerPoint® Lecture Slides for  
*Essential Biology, Second Edition & Essential Biology with Physiology*

*Neil Campbell, Jane Reece, and Eric Simon*

Presentation prepared by **Chris C. Romero**

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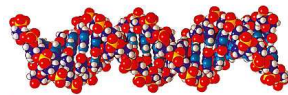
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- Biologists have identified about 1.7 million species of living organisms



- All organisms share a common chemical language for their genetic material, DNA.



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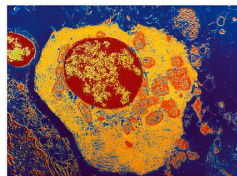
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- Scientists have determined the complete DNA sequences of humans, puffer fish, mosquitoes, and rice



- Amoebas, molds, trees, and people are all made from similar cells.



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- We are living in a golden age of biology
  - Biology is woven into the fabric of society as never before.



Figure 1.1

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## THE SCOPE OF BIOLOGY

- Biology is the scientific study of life
  - Life is structured on a size scale ranging from the molecular to the global
  - Biology's scope stretches across the enormous diversity of life on Earth.
    - ex. Population of humans or reproductive organ system.

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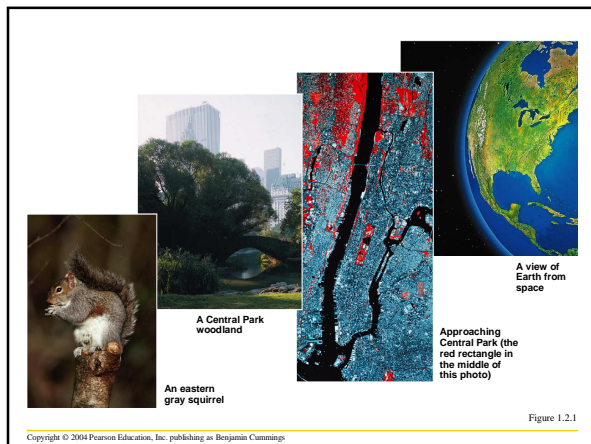


Figure 1.2.1

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## Life at Its Many Levels

- Biologists explore life at levels ranging from the biosphere to the molecules that make up cells.

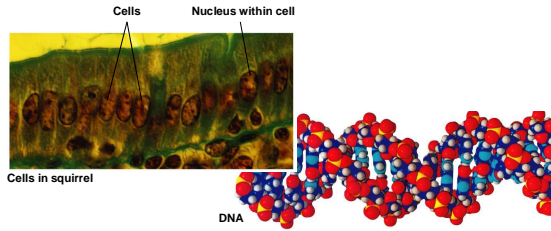


Figure 1.2.2

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## Ecosystems

- Each organism interacts continuously with its environment
  - Both organisms and environment are affected by the interactions
  - Ecology is the branch of biology that investigates these relationships between organisms and their environment.

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- The dynamics of any ecosystem depend on two processes

- Cycling of nutrients
- Flow of energy.

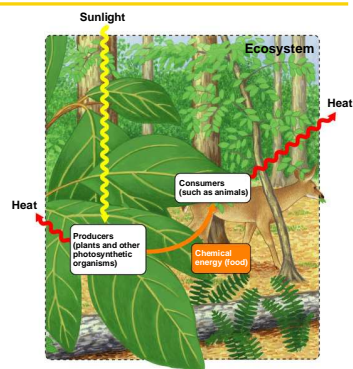


Figure 1.3

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### Cells and Their DNA

- The cell is the lowest level of structure that can perform all activities required for life
  - All organisms are composed of cells. (Cell Theory)

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- We can distinguish two major types of cells:
  - Prokaryotic
  - Eukaryotic

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- The prokaryotic cell is simple and contains no organelles
- The eukaryotic cell is more complex and contains organelles
  - The nucleus is the largest organelle in most eukaryotic cells.

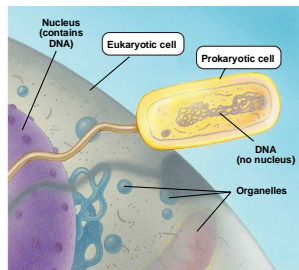


Figure 1.4

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- All cells use DNA as the chemical material of genes
  - Genes are the units of inheritance that transmit information from parents to offspring
- The language of DNA contains just four letters:
  - A, G, C, T



Figure 1.5

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- Genetic engineering and biotechnology have allowed us to manipulate the DNA and genes of organisms.



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### Life in Its Diverse Forms

- Diversity is the hallmark of life
  - The diversity of known life includes 1.7 million species
  - Estimates of the total diversity range from 5 million to over 30 million species.

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### Grouping Species: The Basic Concept

- Biodiversity can be both beautiful and overwhelming
- Taxonomy is the branch of biology that names and classifies species
  - It formalizes the hierarchical ordering of organisms



Figure 1.7

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### The Three Domains of Life

- The three domains of life are:
  - Bacteria
  - Archaea
  - Eukarya



Figure 1.8.1

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- Bacteria and Archaea are both prokaryotic domains.



Figure 1.8.2

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- Eukarya includes at least four kingdoms

- Protista
- Plantae
- Fungi
- Animalia

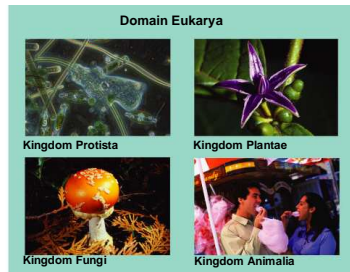


Figure 1.8.3

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### Unity in the Diversity of Life

- Underlying the diversity of life is a striking unity, especially at the lower levels of structure
  - Example: the universal genetic language of DNA
- Evolution accounts for this combination of unity and diversity

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- The universal architecture of eukaryotic cilia

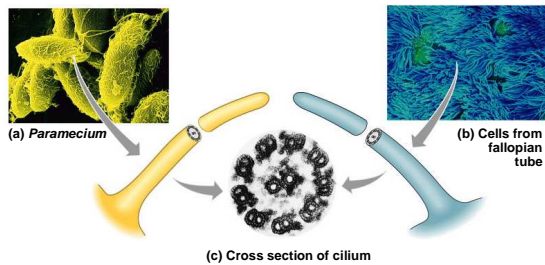


Figure 1.9

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- Life evolves
  - Each species is one twig of a branching tree of life extending back in time

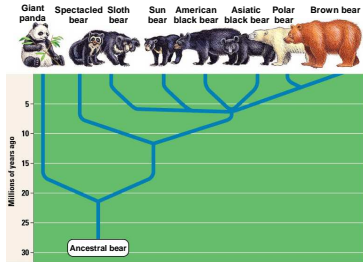


Figure 1.11

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- Charles Darwin's book, *Origin of Species*, developed two main points
  - Descent with modification
  - Natural selection

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### Natural Selection

- Darwin was struck by the diversity of animals on the Galápagos Islands
- He thought of adaptation to the environment and the origin of new species as closely related processes
  - As populations separated by a geographic barrier adapted to local environments, they became separate species

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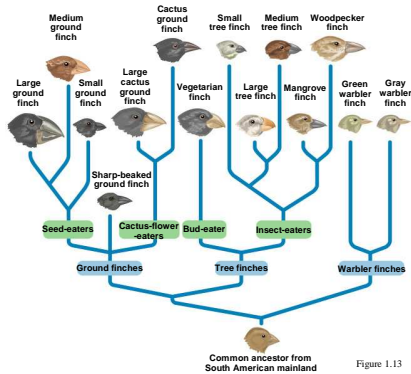
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- Fourteen species of Galápagos finches have beak shapes adapted to suit their environments.



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Figure 1.13

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### Darwin's Inescapable Conclusion

- Darwin synthesized the concept of natural selection from two observations that were neither profound nor original.
  - Others had the pieces of the puzzle, but Darwin could see how they fit together

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- Fact 1: Overproduction and struggle for existence
- Fact 2: Individual variation
- The inescapable conclusion: Unequal reproductive success.
  - It is this unequal reproductive success that Darwin called natural selection
  - The product of natural selection is adaptation

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- Natural selection is the mechanism of evolution.

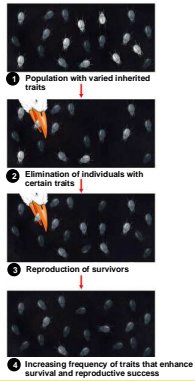


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### Observing Artificial Selection

- Artificial selection is the selective breeding of domesticated plants and animal by humans.



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### Observing Natural Selection

- There are many examples of natural selection in action
  - The development of antibiotic-resistant bacteria is one.



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- 
- Darwin's publication of *The Origin of Species* fueled an explosion in biological research
    - Evolution is one of biology's best demonstrated, most comprehensive, and longest lasting theories
    - Evolution is the unifying theme of biology

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### THE PROCESS OF SCIENCE

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- The word *science* is derived from a Latin verb meaning "to know"
  - Science is a way of knowing
  - Science developed from our curiosity about ourselves and the world around us

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