

Chapter 1 Lecture Notes—an introduction to Biology

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Biol 100 – K. Marr

Topics Discussed in these notes

1. Biological Organization
2. The Characteristics of Life
3. The Cell Theory
4. Cell Types: Prokaryotes vs. Eukaryotes
5. DNA– the universal genetic language of life
6. The 3 domains of life
7. Evolution of life via Natural Selection
8. Self-test/Review Questions

Biological Organization— from organism to atom

1. Organ System: A group of body parts that carries out a particular function in an organism



2. Organ: A structure consisting of two or more tissues that performs specialized functions within an organism



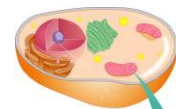
3. Tissue: A group of similar cells that carries out a particular function in an organism



The Characteristics of Life

1. **Order**—
2. **Metabolism**—organized synthesis and break down of molecules; can produce energy to power life processes.
3. **Motility**—organisms can move themselves or their parts.
4. **Responsiveness**—perceive and react to their environment
5. **Development**—develop from simple to more complex organism
6. **Heredity**—genes are passed from parent to offspring; genes control an organism's phenotype.
7. **Evolution**—populations change over time as they
8. **Adaptations**—the environment selects organisms with traits/ that are best suited for an organisms environment

Biological Organization— from organism to atom (cont.)



4. Cell: The simplest entity that has all the properties of life



5. Organelle: A structure within a cell that performs a specific function



6. Molecule: A cluster of atoms held together by chemical bonds

The Cell Theory

Cell Theory

a.)

b.)

There are two major types of cells

a.)

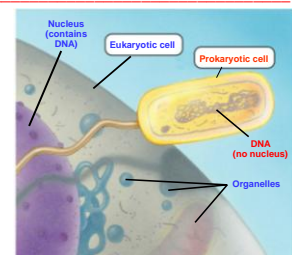
b.)

Prokaryotic vs. Eukaryotic Cells

Prokaryotic cells

Eukaryotic cells

- more complex
- contain organelles
- The _____ is the largest organelle in most eukaryotic cells
- Evolved after prokaryotes



DNA—the genetic language of life

1. All cells use DNA as the chemical material of genes

Genes: _____

2. The language of DNA contains just four letters (nitrogen bases): **A, G, C, T**

a. _____

3. **Mutation**—a change in a gene's sequence

a. _____

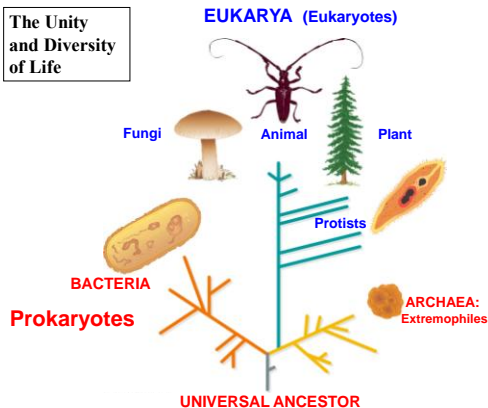
b. _____



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

The Unity and Diversity of Life



The Three Domains of Life

1. **Bacteria**

a.) _____

b.) _____

2. **Archaea**

a.) _____

b.) _____

3. **Eukarya**

a.) _____

b.) _____



The Four Kingdoms of Eukarya

1. **Protista**

- _____
- **Examples:** _____

Multicellular Eukaryotes:

2. **Plantae**

- _____
- **Examples:** _____

3. **Animalia**

- _____
- **Examples:** _____

4. **Fungi**

- _____
- **Examples:** _____

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

EVOLUTION: BIOLOGY'S UNIFYING THEME

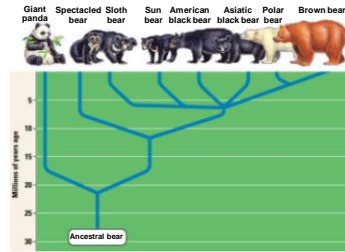
- The history of life is a saga of a restless Earth billions of years old
- **Fossils document this history**



Figure 1.10

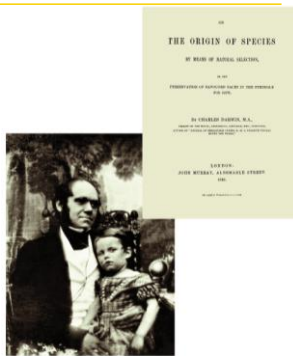
Life evolves

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



The Darwinian View of Life

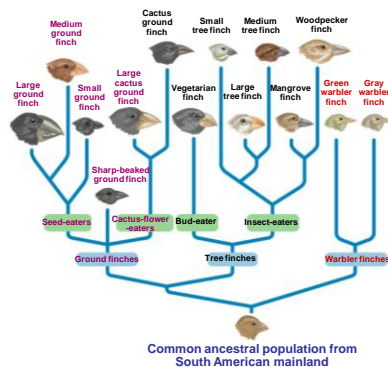
- The evolutionary view of life came into focus in 1859 when **Charles Darwin** published *The Origin of Species*
- Darwin's book developed two main points
 - Descent with modification
 - Natural selection



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**

- **14 species of Galápagos finches have beak shapes adapted to suit their environments**
- **Natural selection is the mechanism of evolution**



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

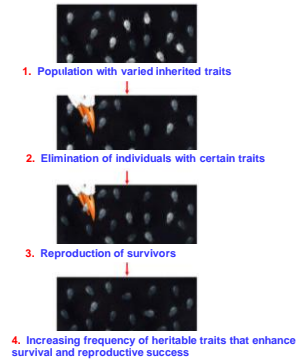
The Theory of Natural Selection

- **Observation 1:** _____
- **Observation 2:** _____
- **Darwin's Hypothesis:** _____
 - Some individuals are better suited to the environment than others and will therefore reproduce in larger numbers
- **It is this unequal reproductive success that Darwin called natural selection:**
 - Those organisms with *heritable* traits that are best suited for the environment will survive and pass those traits on to future generations
 - What does the selecting in natural selection? _____

The Theory of Natural Selection

- **Natural selection is the mechanism of evolution**
- **What are the two major causes of variation within a species?**

- 1.) _____
 2.) _____



Observing Natural Selection

Examples of natural selection in action

1. The development of antibiotic-resistant bacteria
2. Pima Indians
3. Arctic Hare
4. Long Distance Runners from East Africa
5. Cockroaches in Florida
6. Alcohol Metabolism in Asians vs. Europeans
7. Human Skin Color



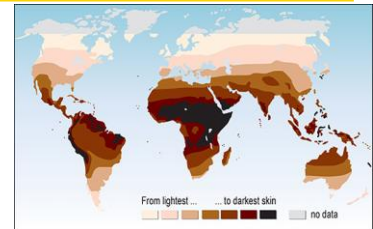
Tuberculosis

Observing Natural Selection: Human Skin Color

• **What role does Natural Selection Play in Determining Skin Color?**

Key Concepts...

- High doses of U.V. Light damages skin cells and DNA
- Our body needs some UV light to help us produce _____
- _____ regulates how much UV light our skin lets in.



• *"Your Family May Once Have Been A Different Color"* (NPR's Morning Edition 2-2-09): <http://www.npr.org/templates/story/story.php?storyId=100052939>

Observing Artificial Selection

Artificial selection—

- Selective breeding of domesticated plants and animal by humans



- 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**

Chapter 1 Lecture Notes—an introduction to Biology

Self-test/Review Questions

Use these questions as a self test and then discuss your responses with your study group/classmates—your responses will not be collected.

1. What are the defining characteristics of life?
2. Trace the organization of life from atoms to a complete organism:
atoms → _____ → _____ → _____ → _____ → **Organism**
3. Differentiate between prokaryotic and eukaryotic cells giving examples of each.
4. Differentiate between organelles and organs—are they the same thing? Give examples of each.
5. What are genes? What are genes made of? Why are genes important? Do genes evolve/change over time?

Self-test/Review Questions (cont.)

12. Explain how each of the following are examples of natural selection.
 - a. The development of antibiotic-resistant bacteria
 - b. Pima Indians
 - c. Arctic Hare
 - d. Long Distance Runners from East Africa
 - e. Cockroaches in Florida
 - f. Alcohol Metabolism in Asians vs. Europeans
 - g. Human skin color
13. What is the most important characteristic of an organism that leads to evolutionary change, and what role, if any, does the environment play?

Self-test/Review Questions (cont.)

15. Match the description with the appropriate term.
Terms: (a.) Adaptation (b.) Evolution (c.) Mutation (d.) Natural selection (e.) Kingdom (f.) None of the above
 - i. A category of classification of living things
 - ii. A change in the structure of a gene
 - iii. A structure or behavior in an organism that increases its ability to survive and reproduce
 - iv. The gradual accumulation of mutations that leads to changes in the kinds of organisms living on earth
 - v. The primary mechanism of evolution

Self-test/Review Questions (cont.)

6. What are the 3 domains of life? What are the distinguishing characteristics between the 3 domains of life?
7. Name the 4 kingdoms of eukarya. What are the distinguishing characteristics between the 4 kingdoms of eukarya?
8. What is the universal genetic language of life. Why is this significant?
9. Where can evidence be found that life evolved over time from simple organisms (e.g. unicellular prokaryotic organisms) to more complex organisms (e.g. multicellular eukaryotes)?
10. In your own words, state Darwin's theory of natural selection.
11. What does the selecting in natural selection?

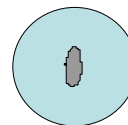
Self-test/Review Questions (cont.)

14. Match the description with the appropriate term.
Terms: (a.) Protista (b.) Fungi (c.) Plantae (d.) Animalia (e.) All of these (f.) None of these
 - i. A kingdom that includes mushrooms and yeast
 - ii. Composed of eukaryotic cells
 - iii. Multicellular
 - iv. A kingdom that includes mostly single-celled prokaryotes
 - v. A kingdom that includes mostly single-celled eukaryotes

Estimating the Size of an Object Viewed with a Microscope

- Calculate the length and width of the following microscopic object in both millimeters and micrometers. **1 mm = 1000 μ m**
- Base your calculations on the following field sizes:

Low power (40x): 4.5 mm
Medium power (100x): 1.8 mm
High power (400x): 0.45 mm



Object viewed at medium power (100x)

Remember: Field size decreases by the same factor as the magnification increases!

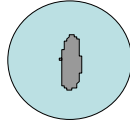
Estimating the Size of an Object Viewed with a Microscope

- Calculate the length and width of the following microscopic object in both millimeters and micrometers. **1 mm = 1000 μ m**
- Base your calculations on the following *hypothetical* field sizes:

Low power (30x): 4.0 mm = ___ μ m

Medium power (180x): ___ mm = ___ μ m

High power (300x): ___ mm = ___ μ m



Object viewed at high power (300x)

Remember: Field size decreases by the same factor as the magnification increases!