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Molecular Evolution

Midterm Info
• Midterm 1 is Wednesday Feb. 22
• 100 point exam
• 79 points will come from Quail lectures
• 21 points will come from Simison lectures

Evolution
What is your definition?

Natural Selection
What is your definition?

Goals
1. Understand Natural Selection and Evolution.

Today's Outline
1. Scientific Method.
2. Unity of Life.
4. Interdependencies Among Organisms.
5. Diversity & Nomenclature.
Scientific Method

• Make observations
• Ask questions
• Generate hypotheses
• Experiments are conducted
• Examine the results
• Confirm or contradict the hypotheses

The best hypotheses are presented in a way that can be falsifiable.

Evolution

What is your definition?
The observation that life on earth has changed through time.
A fact, not a theory

Natural Selection

What is your definition?
A theory explaining the observed fact that life on earth changes through time.

Unity of Life

Common Themes in All Organisms
1. Organisms are made of cells.
2. Organisms have same biological molecules - lipids, proteins, carbohydrates, nucleic acids. DNA is a nucleic acid that codes for proteins.
3. Organisms reproduce by passing along DNA. DNA guides development.

Unity of Life

4. Organisms obtain and convert energy from their surroundings. This part of a cell’s metabolism. Cells use energy for repair, growth, and reproduction.
5. Organisms sense changes in their surroundings. They respond in controlled ways that compensate. This involves homeostasis – staying within tolerable limits.
6. Organisms evolve. Their genes change from generation to generation.

Levels of Organization in Nature - a Hierarchy
(From Fig 1.1)
From very small to very large

atom → biosphere
Levels of Organization in Nature - a Hierarchy

Subatomic level – fundamental units of matter.

Composed of protons, Neutron and electrons.

Two or more atoms of the same or different elements join to form molecules.

The smallest unit that can live and reproduce on its own or as part of a multicelled organism.

A tissue, such as bone, consists of certain types and proportions of cells interacting in some task.

An organ consists of two or more tissues interacting in some task.
Levels of Organization in Nature - a Hierarchy

Organs interact physically, chemically, or both. Parrotfish skin consists of several layers of tissues and glands.

Levels of Organization in Nature - a Hierarchy

Cells of multicelled organisms are organized as tissues, organs and organ systems.

Levels of Organization in Nature - a Hierarchy

A group of individuals of the same species occupying a specified area.

Levels of Organization in Nature - a Hierarchy

All populations of all species in a specified area. A reef community in the Red Sea.

Levels of Organization in Nature - a Hierarchy

A community that is interacting with its physical environment. It has inputs and outputs of energy and materials.

Levels of Organization in Nature - a Hierarchy

The biosphere encompasses all regions of Earth’s waters, crust and atmosphere that contain organisms.
Interdependencies Among Organisms

1. Energy flows through organisms.
2. Producers – plants or other organisms that make their own food
3. Consumers – animals eat producers
4. Decomposers – break down sugars and other molecules which can be cycled back to producers
5. All energy is eventually returned to the environment.
6. Organisms are interconnected and this affects structure, size, and composition of populations and communities.

Producers, Consumers, Decomposers, and the Environment

Diversity and Scientific Nomenclature

• In 1735, Carolus Linnaeus devised a classification system to organize the diversity of nature. **Binomial nomenclature** - Every organism has a two-part name

• We can use the names we give each organism to indicate a degree of evolutionary relationship between organisms. We can group the names at higher and higher levels.

Diversity and Scientific Nomenclature

• The Linnaean classification scheme uses 7 nested levels:
  - Kingdom
  - Phylum
  - Class
  - Order
  - Family
  - Genus
  - Species

• The Linnaean classification system is hierarchical.

Classification of Homer’s Home

Location of Homer Simpson’s house:
- **Galaxy**: Milky Way
- **Solar System**: Sun System
- **Planet**: Earth
- **Continent**: North America
- **Country**: United States
- **State**: Kentucky?
- **County**: Springfield
- **City**: Springfield
- **Street**: Evergreen Terrace
- **House Number**: 742

Classification of Blue-dog

For the dog:
- **Kingdom**: Animalia
- **Phylum**: Chordata
- **Class**: Mammalia
- **Order**: Carnivora
- **Family**: Canidae
- **Genus**: Canis
- **Species**: familiaris
6 Kingdoms

1. **Archaebacteria** – bacteria that live in harsh environments such as hot springs, salt lakes, sewage treatment plants, guts of ruminants. They have special cell walls and cell membranes.

2. **Eubacteria** – “true bacteria” are widespread.

   The Archaeobacteria and Eubacteria are single celled prokaryotes (no nucleus or sac that surrounds the DNA).

3. **Protista** – most are bigger, more complex than bacteria. Includes producers, consumers, and decomposers. Includes “protozoans” and even includes giant, multicellular “seaweeds” or algae (kelps too).

4. **Fungi** – common grocery store mushroom. Most are multicellular decomposers and consumers that feed by secreting enzymes to digest food outside their bodies.

5. **Plantae** – most are photosynthetic producers with cellular pipelines to move water and solutes through roots, stems, and leaves.

6. **Animalia** – usually motile, consumers (herbivores, carnivores, parasites, scavengers).

   Last four Kingdoms (Protista, Fungi, Plantae, Animalia) are eukaryotes (have a nucleus).