CHAPTER 5

Evolution and Community Ecology
Black and White, and Spread All Over

• Zebra mussels and quagga mussels were accidentally introduced into Lake St. Clair in the late 1980s.
• They have since spread throughout the Great Lakes system and connecting rivers.
• The invasive mussels have a high economic and ecological cost.

Talk About It The Great Lakes are home to more than 20 native mussel species. Why are the zebra and quagga mussels so much more destructive than the lakes’ native mussels?
Scientists have identified and described over 1.5 million species. Millions more have yet to be discovered.
EQ: What role does the environment play in the survival and reproduction of an organism?

1. List and describe the mechanisms of evolution.
2. If a trait is not heritable, can it cause the eventual evolution of a species? EXPLAIN...
3. Is biological fitness related to the health of an organism? EXPLAIN
4. Can an organism be “fit” in one habitat but not in another? EXPLAIN
5. Why would artificial selection be used by humans? Give an example.
6. What is the difference between sympatric and allopatric speciation?
7. Explain the following...
   • Organisms mutate, Individuals are selected, populations evolve.
Evolution and Natural Selection

• **Gene:** A sequence of DNA that codes for a particular trait

• **Gene pool:** All the genes present in a population

• **Biological evolution:** The change in a population’s gene pool over time
EVOLUTION, NATURAL SELECTION, AND ADAPTATION

- Populations NOT individuals evolve by becoming genetically different

- Biological evolution by natural selection involves the change in a population’s genetic makeup through successive generations.
  - genetic variability
  - Mutations: random changes in the structure or number of DNA molecules in a cell that can be inherited by offspring.
The akiapola’au forages for insects, often under bark.

The iiwi feeds on nectar from ohia flowers.

The 'Apapane feeds on insects and ohia nectar.

The original species, now extinct, probably ate insects and nectar.

The Maui parrotbill tears back bark in search of beetles.

The Nihoa finch uses its heavy bill to crush seeds.

The Amakihi is a nectar-feeder, like the iiwi.
• Mutations can occur in 2 ways:
  • Exposure of DNA to external agents – x-ray, mutagens/chemicals
  • Random mistakes during mitosis or meiosis
• Mutations may occur in any cell but only mutations that occur in reproductive cells can be heritable – thus, a possible driving force of evolution
• Not all mutations are beneficial and lead to evolution – many are lethal.
Natural Selection, the key evolutionary mechanism Darwin identified, is really four key processes:

- **genetic variation** (difference in genomes among organisms in a given population)
- **overproduction of offspring**
- **struggle for existence** (competition for food, mating resources etc.)
- **differential survival and reproduction** (higher fitness, & better adaptation leads to more offspring).
The Theory of Evolution by Natural Selection

1. **Overproduction**
   Every species tends to produce more individuals than can survive to maturity.

2. **Variation**
   The individuals of a population have many characteristics that differ.

3. **Selection**
   Some individuals survive longer and reproduce more than others do.

4. **Adaptation**
   The traits of those individuals that survive and reproduce will become more common in a population.
A population has 3 possibilities when faced with environmental changes:

- Adapt – natural selection
- Migrate to new or better conditions
- Go extinct

Genes mutate, individuals are selected, populations evolve using these adaptations to become more successful in their current situation.
Peppered Moth
an example of anthropogenic natural selection
Artificial Selection

- Selection under human direction
- Throughout history, humans have chosen and bred animals and plants with beneficial traits.
Science Focus: Changing the Genetic Traits of Populations

SMP 18

• **Artificial selection**
  • Use selective breeding/crossbreeding

• **Genetic engineering, gene splicing**

• Consider
  • Ethics
  • Morals
  • Privacy issues
  • Harmful effects

• Florida Panthers / Texas Cougars
• Tasmanian Tiger
• GMO’s food production
Dead Panther Walking
http://www.tampabay.com/news/environment/wildlife/article1087962.ece#
THE FUTURE OF EVOLUTION

• Biologists are learning to rebuild organisms from their cell components and to clone organisms.
  • Cloning has lead to high miscarriage rates, rapid aging, organ defects.

• Genetic engineering can help improve human condition, but results are not always predictable.
  • Do not know where the new gene will be located in the DNA molecule’s structure and how that will affect the organism.
Controversy Over Genetic Engineering

• There are a number of privacy, ethical, legal and environmental issues.
• Should genetic engineering and development be regulated?
• What are the long-term environmental consequences?
These mice are an example of genetic engineering. The 6-month-old mouse on the left is normal; the same-age mouse on the right had a human growth hormone gene inserted into its cells. Mice with this gene grow two to three times faster than, and twice as large as, mice without it.
Pigs genetically modified with Green Fluorescent Protein (GFP)
GloFish, the first genetically modified animal to be sold as a pet

http://listverse.com/2008/04/01/top-10-bizarre-genetically-modified-organisms/
Speciation

• Process by which new species are generated

• Can occur in a number of different ways; the most important way is called *allopatric speciation*

• Has resulted in every form of life on Earth—today and in the past

Allopatric Speciation
Sympatric Speciation

Starting with a single large population....

Differences among individuals causes them to choose different habitats.

Nonrandom matings results in two genetically distinct and separate populations that become different species.
Extinction

• The disappearance of species from Earth

• Generally occurs gradually, one species at a time, when environmental conditions change more rapidly than the species can adapt

• There are five known mass extinction events, each of which wiped out a large proportion of Earth’s species.

Did You Know? During the Permo-Triassic extinction 250 million years ago, 70% of all land species and 90% of all marine species went extinct.