Chapter 7

The Evolution of Living Things

Table of Contents

Section 1  Change over Time
Section 2  How Does Evolution Happen?
Section 3  Natural Selection in Action
Chapter 7

Section 1 Change over Time

Objectives

• **Identify** two kinds of evidence that show that organisms have evolved.

• **Describe** one pathway through which a modern whale could have evolved from an ancient mammal.

• **Explain** how comparing organisms can provide evidence that they have ancestors in common.
Chapter 7  Section 1  Change over Time

Differences Among Organisms

- **What Is a Species?** A *species* is a group of organisms that can mate with one another to produce fertile offspring. A characteristic that helps an organism survive and reproduce in its environment is called an *adaptation.*
Do Species Change over Time? Scientists observe that species have changed over time. The process in which populations gradually change over time is called evolution.
Evidence of Change over Time

• **Fossils**  The remains or imprints of once-living organisms found in layers of rock called **fossils**.

• **The Fossil Record**  By studying fossils, scientists have made a timeline of life known as the fossil record. The fossil record organizes fossils by their estimated ages and physical similarities.
Evidence of Ancestry

- Order of Life  The fossil record provides evidence about the order in which species have existed.

- Drawing Connections  Scientists have named and described hundreds of thousands of living and ancient species. Scientists use information about these species to sketch out a “tree of life” that includes all known organisms.

http://www.youtube.com/watch?v=iYAOKzdO3vw
Chapter 7  Section 1  Change over Time

Examining Organisms
- Case Study: Evolution of the Whale  Scientists think that the ancient ancestor of whales was probably a mammal that lived on land and that could run on four legs.

- Walking Whales  The organisms shown on the next slide form a sequence between ancient four-legged mammals and modern whales. Several pieces of evidence indicate that these species are related by ancestry.

- 1. Vestigal Structures:  Many organisms have features that seem to serve no useful function. These apparently useless features are said to be vestigial. Vestigial features were useful to an ancestor, but they are not useful to the modern organism that has them.
Chapter 7  
Section 1  
Change over Time

Evidence of Whale Evolution: A

**Pakicetus** (pāk ih see tuhs)
Scientists think that whales evolved from land-dwelling mammals that could run on four legs. One of these ancestors may have been Pakicetus, which lived about 50 million years ago. The fossil skeleton and an artist’s illustration of Pakicetus are shown here. Pakicetus was about the size of a wolf.

**Ambulocetus** (am byoo loh see tuhs)
This mammal lived in coastal waters about 49 million years ago. It could swim by kicking its legs and using its tail for balance. It could also waddle on land by using its short legs. Ambulocetus was about the size of a dolphin.
Chapter 7  Section 1  Change over Time

**Evidence of Whale Evolution: B**

**Dorudon** (DOH roo don)
This mammal lived in the oceans about 40 million years ago. It resembled a giant dolphin and propelled itself with its massive tail. *Dorudon* had tiny hind limbs that it could not use for walking or swimming.

**Modern toothed whale**
Modern whales’ forelimbs are flippers. Modern whales do not have hind limbs, but they do have tiny hip bones. Modern whales range in size from 1.4 m porpoises to 33 m blue whales.

http://www.youtube.com/watch?v=OAw3akpRe8
Comparing Organisms

2. Comparing Skeletal Structures  The structure and order of bones of a human arm are similar to those of the front limbs of a cat, a dolphin, and a bat. These similarities suggest that cats, dolphins, bats, and humans had a common ancestor.
Chapter 7

Section 1 Change over Time

Comparing Skeletal Structures

Human arm

Cat leg

Dolphin

Bat wing
Comparing Organisms, continued

2. Comparing DNA  The greater the number of similarities in DNA between species, the more closely those two species are related through a common ancestor.

   - The fact that all existing species have DNA supports the theory that all species share a common ancestor.
Chapter 7

Section 2  How Does Evolution Happen?

Objectives

• **List** four sources of Charles Darwin’s ideas about evolution.

• **Describe** the four parts of Darwin’s theory of evolution by natural selection that gradual processes had changed the Earth’s surface over selection.

• **Relate** genetics to evolution.
Chapter 7

Charles Darwin

- Darwin’s Excellent Adventure  After Charles Darwin graduated from college, he served as naturalist on a ship called the HMS Beagle. During a voyage around the world, Darwin collected thousands of plant and animal samples.
• **Darwin’s Finches**  Darwin noticed that the finches of the Galápagos Islands were a little different from the finches in Ecuador. And the finches on each island differed from the finches on the other islands.
Chapter 7

Section 2 How Does Evolution Happen?

Darwin’s Thinking

• Ideas About Breeding The process in which humans select which plants or animals to reproduce based on certain desired traits is called selective breeding.

• Ideas About Population Only a limited number of individuals survive to reproduce. Thus, there is something special about the offspring of the survivors.
Chapter 7

Section 2 How Does Evolution Happen?

Darwin’s Thinking, continued

• Ideas About Earth’s History  Darwin had begun to think that species could evolve over time. It became clear to Darwin that Earth was much older than anyone had imagined.
Chapter 7  

Section 2  How Does Evolution Happen?

Darwin’s Theory of Natural Selection

* What Is Natural Selection? * Darwin proposed the theory that evolution happens through a process that he called **natural selection**. Individuals that are better adapted to their environment survive and reproduce more successfully than less well adapted individuals.

* Genetics and Evolution * Today, scientists have found most of the evidence that Darwin lacked. They know that variation happens as a result of differences in genes.
Chapter 7  

Section 2  How Does Evolution Happen?

Four Parts of Natural Selection

1. Overproduction: A tarantula's egg sac may hold 500–1,000 eggs. Some of the eggs will survive and develop into adult spiders. Some will not.

2. Inherited Variation: Every individual has its own combination of traits. Each tarantula is similar to, but not identical to, its parents.

3. Struggle to Survive: Some tarantulas may be caught by predators, such as this wasp. Other tarantulas may starve or get a disease. Only some of the tarantulas will survive to adulthood.

4. Successful Reproduction: The tarantulas that are best adapted to their environment are likely to have many offspring that survive.

http://www.youtube.com/watch?v=vPVQdrvXoBg
Chapter 7  Section 3  Natural Selection in Action

Objectives

• **Give** three examples of natural selection in action.

• **Outline** the process of speciation.
Chapter 7  

Section 3  Natural Selection in Action

Changes in Populations

• **Adaptation to Hunting**  People hunt elephants for their tusks. As a result, fewer of the elephants that have tusks survive to reproduce, and more of the tuskless elephants survive.

• **Insecticide Resistance**  A few insects in a population may be naturally resistant to a chemical insecticide. These insects pass their resistance trait to their offspring, and an insect population gradually becomes resistant to the insecticide.
Chapter 7  
Section 3  Natural Selection in Action  
Changes in Populations, continued

**Natural Selection of Insecticide Resistance**

1. An insecticide will kill most insects, but a few may survive. These survivors have genes that make them resistant to the insecticide.

2. The survivors then reproduce, passing the insecticide-resistance genes to their offspring.

3. In time, the replacement population of insects is made up mostly of individuals that have the insecticide-resistance genes.

4. When the same kind of insecticide is used on the insects, only a few are killed because most of them are resistant to that insecticide.
Changes in Populations, continued

• **Competition for Mates**  Many species have so much competition for mates that interesting adaptations result. For example, the females of many bird species prefer to mate with males that have colorful feathers.
Chapter 7  Section 3  Natural Selection in Action

Forming a New Species

• Sometimes, drastic changes that can form a new species take place. The formation of a new species as a result of evolution is called speciation.
Chapter 7  

Section 3  Natural Selection in Action

**Evolution of the Galápagos Finches**

1. Some finches left the mainland and reached one of the islands (separation).

2. The finches reproduced and adapted to the environment (adaptation).

3. Some finches flew to a second island (separation).

4. The finches reproduced and adapted to the different environment (adaptation).

5. Some finches flew back to the first island but could no longer interbreed with the finches there (division).

6. This process may have occurred over and over again as the finches flew to the other islands.
Forming a New Species, continued

- **Step 1: Separation** Speciation often begins when a part of a population becomes separated from the rest.

- **Step 2: Adaptation** Populations constantly undergo natural selection. After two groups have separated, natural selection may act on each group in different ways.
• **Step 3: Division**

Over many generations, two separated groups of a population may become very different until the point when they can no longer mate with one another. At this point, the two groups are no longer the same species.
evolution
evidence
extinct species
living species
common ancestors
DNA
time
body structures
fossil record
evidence
of

evolution

exists in the

fossil record
of
extinct species
that changed over
time

DNA
of
living species
that descended from
common ancestors

body structures