Name _____ Date _____ Class _____

Review and Reinforce

Darwin's Theory 11-1

Understanding Main Ideas Use the book to answer.

1. Who was Charles Darwin, and what did he do on the *Beagle's* five-year voyage around the world? p. 375

2. What is evolution? p. 378

3. When members of a species compete, what do they compete for? p. 380-381

4. What happens when species overproduce offspring? p. 380

5. How do helpful variations accumulate in a species over time? p 381

Building Vocabulary

Fill in the blank to complete each statement.

6. A(n) _____ is a group of similar organisms that can mate with each other and produce fertile offspring.

7. A(n) _____ is a trait that helps an organism survive and reproduce.

8. A scientific _____ is a well-tested concept that explains a wide range of observations.

9. The process by which individuals that are better adapted to their environment are more likely to survive and reproduce is called _____.

10. That some newly hatched turtles can swim faster than others of the same species is evidence of _____ within a species.

variation
species
theory
adaptation
natural selection

Name _____ Date _____ Class _____

Ch. 11 Change Over Time

Darwin's Theory 11-1

Modified

If you had been a biologist in the 1800s, you would have had to decide between two main theories about how evolution occurred. Consider the long neck of a giraffe. How did that evolve? Read the two explanations below. Then use a separate sheet of paper to answer the questions that follow.

Two Theories of Evolution

Theory 1

The ancestors of giraffes had short necks, and there was great competition for the plant food near the ground. Some of the giraffes kept trying to stretch their necks to reach leaves higher in the trees. As they stretched and stretched their necks became longer. As their necks became longer, they were able to reach more food. Those ancestral giraffes survived to reproduce, while the giraffes that had not stretched their necks died. The offspring of giraffes with stretched necks inherited the longer necks. This process continued for generation after generation. In this way, giraffes evolved with longer and longer necks.

Theory 2

The ancestors of giraffes had short necks, and there was great competition for the plant food near the ground. Some of the ancestral giraffes naturally had slightly longer necks than others. The individuals with longer necks could reach leaves higher in trees, and therefore could eat more food. Because those ancestral giraffes ate more food, they survived to produce offspring, while the individuals with shorter necks did not. The offspring of giraffes with longer necks inherited the longer necks. This process continued for generation after generation. In this way, giraffes evolved with longer and longer necks.

1. In Theory 1, what caused the giraffe neck to become longer?

2. In Theory 2, what caused the giraffe neck to become longer?

4. Which of the two theories matches Darwin's theory of evolution? Explain.

Name _____ Section _____ Virtual Lab M

Evolution of Galapagos Island Finches

The finches on the Galapagos Islands look so different from one another that when Darwin first saw them he didn't realize they were all finches. The species he examined varied in the sizes and shapes of their beaks and in their feeding habits, as shown in Figure 1.

Figure 1 shows the Characteristics of Galapagos Island Finches.

Galapagos Islands Finches						
Shape of Head and Beak						
Common Name of Finch Species	Vegetarian tree finch	Large insectivorous tree finch	Woodpecker finch	Cactus ground finch	Sharp-beaked ground finch	Large ground finch
Main Food	Fruits	Insects	Insects	Cacti	Seeds	Seeds
Feeding Adaptation	Parrotlike beak	Grasping beak	Uses cactus spines	Large crushing beak	Pointed crushing beak	Large crushing beak
Habitat	Trees	Trees	Trees	Ground	Ground	Ground

Task: Type and place on a Google Doc or write on a separate piece of paper. 1, 2, 4 optional on Mod.

X Propose a hypothesis to explain the variety of finches found on the islands.

X Using beak size as an example, identify two things that must be true in order for natural selection to be capable of producing the diversity observed.

Peter and Rosemary Grant from Princeton University spent twenty years studying the finches in order to test the hypothesis that natural selection could account for the variety Darwin observed. They studied one species of finch by catching and identifying nearly every single bird of that species on one of the islands. Each year they recorded which birds were still alive and which had died, which had been successful in breeding and which had not. For each bird they also recorded wing length, leg length, beak length, beak depth, beak color, feather color, and body mass. During the rainy season, food is plentiful and finches will eat whatever is most available. During a drought, however, some foods are scarce.

X. Why is the observation that some food sources are scarce during a drought important for proving that natural selection could account for the finch variety?

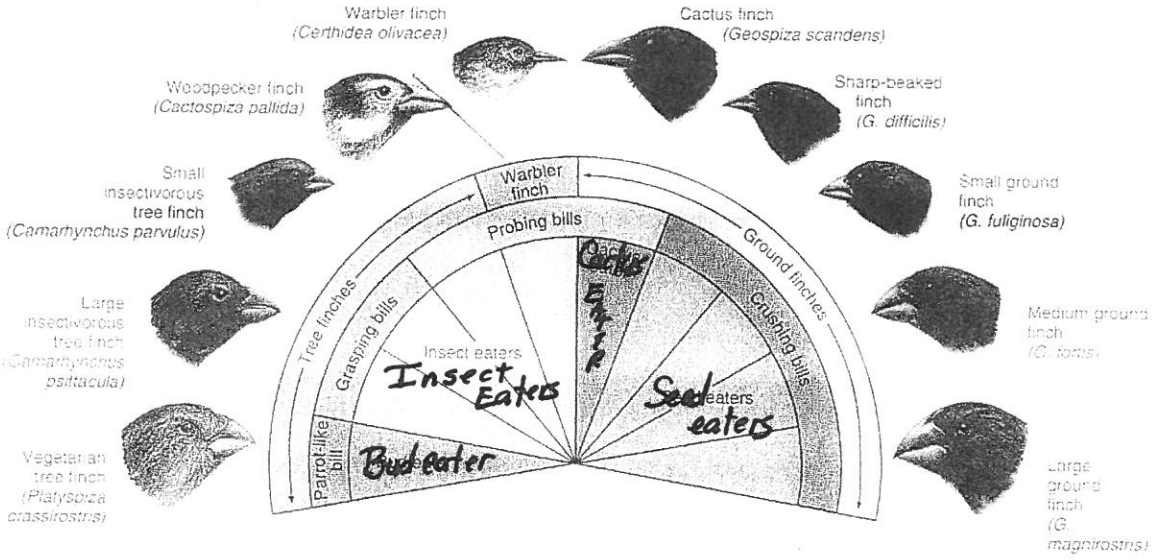
5. Using the Map of the Galapagos and the information in Figure one, fill out the chart "Prediction of Finch Distribution"

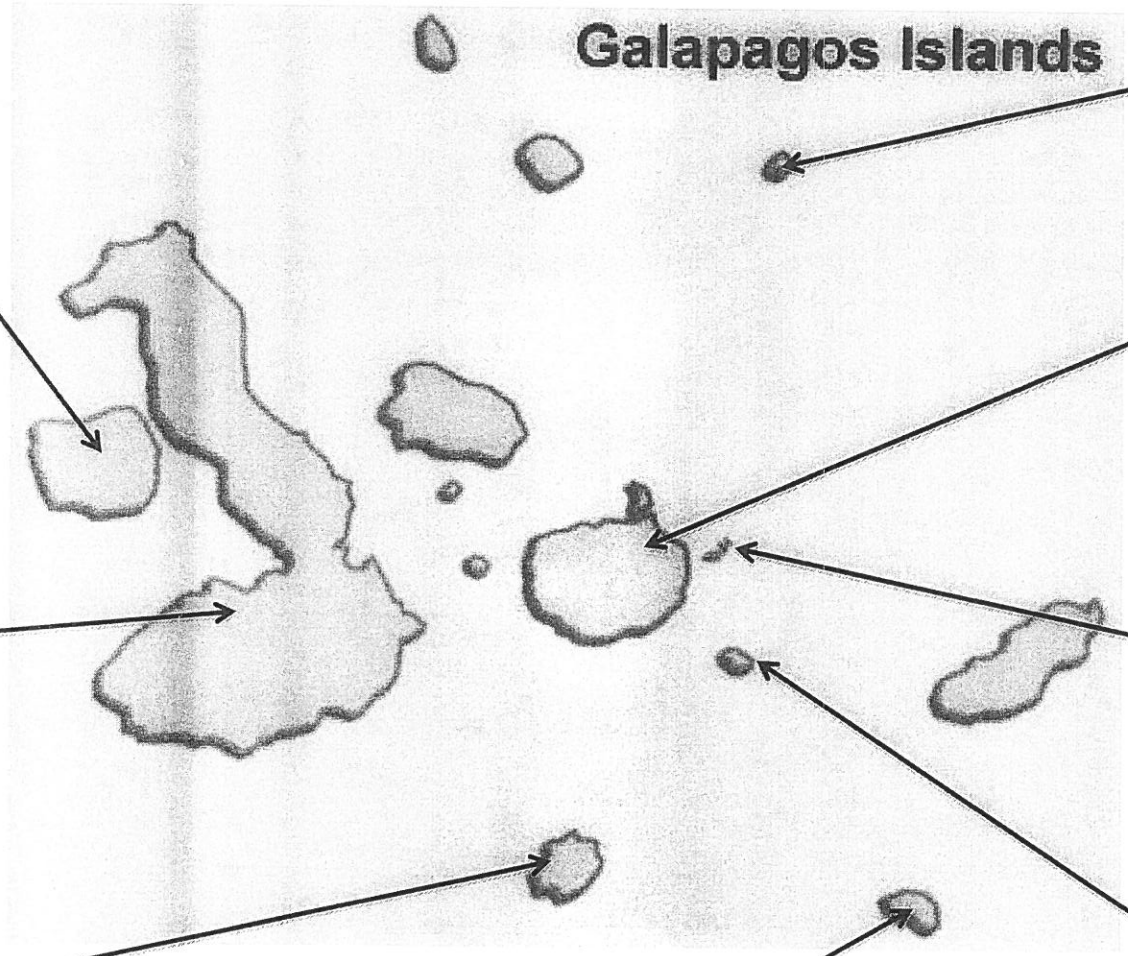
① Look at the map and see what there is to eat.
② Use the fan chart to see what each bird eats.
→ Match the bird with the island (Possible home)

Name _____ Section _____

Prediction of Finch Distribution * place a star or large asterisk in the boxes where you believe the finches may be found. (Use the Map to find out what each island has to offer.)

	Santa Cruz	Plaza	Santa Fe	Espanola	Florreana	Isabela	Fernandina	Genovesa
Large Ground Finch								
Cactus Finch								
Small Tree Finch								
Small Ground Finch								
Vegetarian Finch								
Large Tree Finch								
Warbler Finch								





Genovesa
Large seeds, cacti, small flying insects

Fernandina
Small and large seeds, small insects on leaves, grubs found inside twigs, fruit and flying insects

Santa Cruz
Small and large seeds, small insects on leaves, grubs found inside twigs, flying insects, fruit and cacti

Isabela
Small and large seeds, cacti, small insects on leaves, grubs found inside twigs, flying insects and fruit

Plaza
Small seeds and cacti

Santa Fe
Small flying insects and insects on leaves, small seeds and cacti

Floreana
Small seeds, cacti, small insects on leaves, grubs found inside twigs, flying insects and fruit

Espanola
Small flying insects, cacti and small seeds

Name _____ Date _____ Class _____

Lesson Quiz

Darwin's Theory 11-1

Write the letter of the correct answer on the line at the left.

1. ___ Members of a species can mate with each other and produce
   A gene pools
   B fertile offspring
   C variations
   ~~D adaptations~~

2. ___ The different shapes of bird beaks are examples of
   A fossils
   B adaptation
   C evolution
   ~~D naturalism~~

3. ___ Only the organisms with a desired characteristic are bred in
   A artificial selection
   ~~B natural selection~~
   C England
   D South America

4. ___ The preserved remains of an organism that lived long ago is a(n)
   A adaptation
   B Galápagos
   C fossil
   ~~D Beagle~~

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. (F) _____ Today scientists know that organisms are much <u>less</u> diverse than Darwin imagined.

6. (F) _____ In Darwin's book <u>*The Population of Species*</u>, he proposed that evolution occurs by means of natural selection.

7. _____ Without <u>variation</u>, all the members of a species would have the same traits.

8. (F) _____ To understand how evolution might occur, Darwin studied the offspring of <u>wild</u> animals that were produced by artificial selection.

9. _____ In 1858, <u>Alfred Russel Wallace and Charles Darwin</u> proposed an explanation for how evolution occurs.

10. (F) _____ Darwin made a number of important observations on the <u>Hawaiian</u> Islands.

Name _____ Date _____ Class _____

Key Concept Summary

Evidence of Evolution 11-2

What Evidence Supports Evolution?

Since Darwin's time, scientists have found a great deal of evidence that supports the theory of evolution. **Fossils, patterns of early development, similar body structures, and similarities in DNA and protein structures all provide evidence that organisms have changed over time.**

By examining fossils, scientists can infer the structures of ancient organisms. The fossil record provides clues about how and when new species evolved and how organisms are related.

Scientists also infer evolutionary relationships by comparing the early development of different organisms. Similarities can suggest that species are related and share a common ancestor.

An organism's body structure is its basic body plan, which, in vertebrates, includes how its bones are arranged. Fishes, amphibians, reptiles, birds, and mammals all have an internal skeleton with a backbone. This similarity provides evidence that these animal groups evolved from a common ancestor. Similar structures that related species have inherited from a common ancestor are known as **homologous structures.**

To infer how closely related two or more species are, scientists compare the sequence of nitrogen bases in their DNA. The more similar the DNA sequences, the more closely related the species are. The DNA bases along a gene specify what type of protein will be produced. Therefore, scientists can also compare the order of amino acids in a protein to see how closely related two species are. Evidence from DNA and protein structure has confirmed conclusions about evolutionary relationships among organisms based on fossils, embryos, and body structure.

State and briefly explain four kinds of evidence that support the theory of evolution.

1. Fossils (p 285)
2. Patterns of early development (p 285)
3. Similar body structures (p 286)
4. Similarities in DNA (p 286)

Name _____ Date _____ Class _____

Lesson Quiz

Evidence of Evolution 11-2

Write the letter of the correct answer on the line at the left.

1. ___ The millions of fossils that scientists have collected are called the fossil
   A architecture
   B record
   C data base
   ~~D library~~

2. ___ Scientists infer evolutionary relationships by comparing the early development of different
   ~~A dinosaurs~~
   B backbones
   C proteins
   D organisms

3. ___ Scientists infer that species with similar body structures and development patterns had a common
   A environment
   B predator
   C ancestor
   ~~D gene~~

4. ___ Scientists have found a great deal of evidence that supports Darwin's theory of
   A atomic structure
   B creation
   C evolution
   ~~D relativity~~

Fill in the blank to complete each statement.

5. Similar structures that related species have inherited from a common ancestor are called _____ structures.

6. Scientists compare the _____ bases in the DNA of different species to infer how closely related the species are.

7. In most cases, evidence from DNA and _____ has confirmed conclusions about evolutionary relationships based on fossils, embryos, and body structure.

8. An organism's _____ is its basic body plan.

9. Fishes, amphibians, reptiles, birds, and mammals all have an internal skeleton with a _____.

10. Scientist can compare the order of _____ in a protein to see how closely related two species are.

USEFUL WORDS

nitrogen
body structure
homologous
backbone
amino acids
protein structure

Name: _____ Date: _____

Student Exploration: Natural Selection

Log onto Explorelearning.com

Vocabulary: biological evolution, camouflage, Industrial Revolution, lichen, morph, natural selection, peppered moth

Sign in with your user name and password

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)


Photo by Maarten Sanne

The **peppered moth** (*Biston betularia*) is a common moth found in Europe, Asia, and North America. It is commonly found in two forms, or **morphs**: a dark morph and a light, speckled morph. Birds are a frequent predator of the peppered moth.

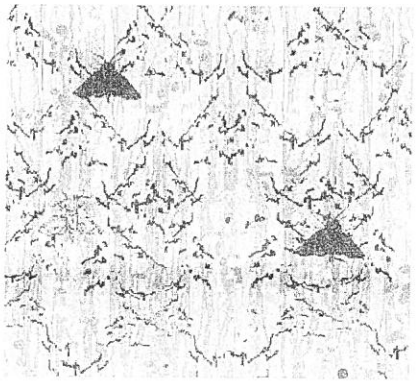
1. Which morph do you think would be easier to see on a dark tree trunk? _____

2. Which morph do you think would be easier to see on a light tree trunk? _____

No wrong answers!

Gizmo Warm-up

The *Natural Selection* Gizmo allows you to play the role of a bird feeding on peppered moths. The initial population of 40 moths is scattered over 20 tree trunks. Click on moths to capture them. Click the **Next tree** button (or the **spacebar** on your keyboard) to advance to the next tree.


How many moths can you find?

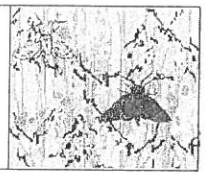
1. Check that LIGHT TREES is selected. Click **Play** (▶), and hunt moths for one year.

   A. How many dark moths did you capture? _____

   B. How many light moths did you capture? _____

   C. **Camouflage** is coloring or patterns that help an organism to blend in with the background. Which type of moth is better camouflaged on light bark? _____

2. If a forest contained mostly light-colored trees, which type of moth would you expect to be most common? _____

Activity A: **Light trees**	Get the Gizmo ready: • Click **Reset** ( ). • Check that the LIGHT TREES tab is selected.	

Introduction: Before the 19th century in England, the air was very clean. The bark on trees was usually light in color. Abundant **lichens** growing on tree trunks also lightened their appearance.

Question: How does the color of a peppered moth affect survival?

1. Predict: Over time, what will to happen to the populations of light and dark moths on light trees? _____

2. Experiment: Click **Play** and hunt peppered moths on light tree trunks for five years. In each year, try to capture as many moths as you can. Note: You can use the **spacebar** on your keyboard to quickly advance to the next tree.

   After 5 years, select the TABLE tab and record the percentages of each moth type. (Note: The table shows current populations of each moth, not the number of captured moths.)

Year	Dark moths	Light moths
0		
1		
2		
3		
4		
5		

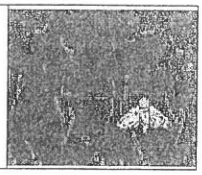
3. Analyze: What do your results show? Over time, the proportion of _____ moths increases as light moths _____.

4. Apply: Which type of moth do you think was more common before the 19th century, when most trees were light in color? _____ moths were more common because they _____.

5. Extend your thinking: What strategies did you use to hunt for moths? _____

_____

_____

Activity B: **Dark trees**	Get the Gizmo ready: • Click **Reset**. • Select the DARK TREES tab.	

Introduction: The 19th century was the time of the **Industrial Revolution** in England. Most of the new industries used coal for energy, and the air was polluted with black soot. In forests near factories, the soot coated trees and killed lichens. As a result, tree trunks became darker.

Question: How did air pollution affect moth populations?

1. Predict: Over time, what will to happen to the populations of light and dark moths on dark trees? _____

2. Experiment: Click **Play** and hunt peppered moths on dark tree trunks for five years. In each year, try to capture as many moths as you can.

   When you are done, select the TABLE tab and record the percentages of each moth type.

Year	Dark moths	Light moths
0		
1		
2		
3		
4		
5		

3. Analyze: What do your results show? Over time, the proportion of dark moths _____ while the proportion of _____ moths _____.

4. Apply: Which type of moth do you think was more common during the 19th century? Why?

   _____ moths were more common because they were harder to see on _____.

(Activity B continued on next page)

Name _____ Date _____ Class _____

Enrich

Rate of Change 11-3

In the fossil record, new species of organisms sometimes appear rapidly in a process known as punctuated equilibrium. Read the passage below. Then use a separate sheet of paper to answer the questions that follow.

Punctuated Equilibrium

Punctuated equilibrium is a process used to explain the evolution of certain species in which rapid change takes place in a short period of time. This change usually occurs as a result of some significant geological event. The following example describes this process: A

1. A population of mice live in a coastal area. This population is stable, with members living, dying, and getting fossilized over time.

2. A rise in the sea level creates an island along the coast. A small group of mice is isolated on the island away from the rest of the population on the coast.

3. The isolated population of mice experiences rapid change because of the small population size and the new environment. Because the population is small, any mutations in individual mice influence the evolution of the population. Also, there are no major predators on the new island. Over a short period of time, the mice become larger in size.

4. The fossil record for this time period does not contain many fossils showing this transition from smaller to larger mice. This is due to the small population size, the rapid pace of change, and the isolated location of the island. >3

5. The sea level drops again and the island becomes part of the mainland again. The new population of large mice comes into contact with the older population of small mice. The large mice now out-compete the small mice for food and shelter, resulting in the extinction of the small mice. B

6. The population of large mice now achieves stability, with members living, dying, and getting fossilized over time.

1. What is punctuated equilibrium? (A)

_____

_____

_____

2. In the example above, why do the small mice become extinct? (B)

_____

_____

_____

3. Imagine that you are a scientist studying the mice described in the example above. Describe what you would see in the fossil record for these mice.

_____

_____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Rate of Change 11-3

How Do New Species Form?

Natural selection explains how variations can lead to changes in a species. But how could a new species form? **A new species can form when a group of individuals remains isolated from the rest of its species long enough to evolve different traits that prevent reproduction.** Natural barriers such as a river, volcano, or mountain range may separate group members.

What Patterns Describe the Rate of Evolution?

The fossil record has provided scientists with a lot of information about past life on Earth. Sometimes new species appear rapidly, at other times they appear as the result of gradual changes. **Scientists have developed two patterns, gradualism and punctuated equilibrium, to describe the rate of evolution.**

Gradualism involves tiny changes in a species that gradually add up to major changes over very long periods of time.

Intermediate forms of organisms in the fossil record show gradual change over time. Scientists call this slow pattern of evolution gradualism. The fossil record also shows a pattern of long periods of little to no change, then rapid change in short periods of time. Scientist call this pattern punctuated equilibrium.

Today most scientists think that evolution can occur gradually at some times and more rapidly at others.

Name and summarize the two patterns that describe the rate of evolution.

Gradualism-

involves tiny changes in a _____ adding up to a major change.

Punctuated equilibrium-

Species evolve during short periods of very _____ change, separated by long periods of _____.

Name _____ Date _____ Class _____

Lesson Quiz

Rate of Change 11-3

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

1. _____ A new species can form when a group of individuals remains completely separated from the rest of its family long enough to evolve different traits that prevent reproduction.

2. _____ A natural catastrophe such as a river or volcano, may separate group members.

3. _____ The Kaibab squirrel and the Abert's squirrel are members of the same species.

4. _____ Scientists have developed three patterns to describe the rate of evolution. ← number

5. _____ The fossil record shows patterns of gradualism over short periods of time.

6. _____ Evolution explains how variations can lead to changes in a species.

Fill in the blank to complete each statement.

7. _____ occurs when some members of a species become cut off.

8. The cow and the dog are separate species, unable to _____ with each other.

9. _____ is a pattern of new species forming over very long periods of time.

10. _____ is a pattern of new species evolving during short periods of rapid change.

Useful WORDS

long species natural selection

punctuated barrier mate

equilibrium isolation

gradualism

Quizlet

Ch. 11 Change Over Time

Study online at quizlet.com/_3b5nks

1. **adaptation**	a trait that increases an organism's ability to survibe and reproduce
2. **Biodiversity**	total number of different species on Earth, including those on land, in the water, and in the air
3. **evolution**	the process of change over time
4. **fossil**	the preserved remains or traces of an organism that lived in the past
5. **gradualism**	tiny changes in a species that gradually add up to major changes over very long periods of time
6. **natural selection**	The process by which organisms that are best adapted to their environment are mostlikely to survive and reproduce
7. **punctuated equalibrium**	species evolve during short periods of rapid change and then do not change for periods of time
8. **scientific theory**	a well-tested explaination for a wide range of observations
9. **species**	a group of similar organisms that can mate with each other and produce fertile offspring
10. **variation**	any difference between individuals of the same species

Name: _____ Class: _____ Date: _____ ID: A

Ch. 11 Change Over Time Pearson <Open Book Test>

Multiple Choice

Identify the choice that best completes the statement or answers the question.

____ 1. Differences between members of the same species are called
~~a. predators.~~
b. selections.
c. traits.
d. variations.

____ 2. Which of these is one of the main ways that a new species forms?
a. Cross-breeding occurs within the species.
b. A group is separated from the rest of the species.
c. Competition occurs between members of the species.
~~d. Mutations occur in the alleles of members of the species.~~

____ 3. Scientists combine evidence from fossils, body structures, early development, DNA, and protein structures to
a. determine what bones an animal has in its forelimbs.
b. determine the evolutionary relationships among species.
~~c. decide which fossils are older than others.~~
d. determine whether an organism will have gills during its early development.

____ 4. A trait that helps an organism survive and reproduce is called a(n)
a. mutation.
b. selection.
c. adaptation.
~~d. variation.~~

____ 5. Which term refers to the process by which individuals that are better adapted to their environment are more likely to survive and reproduce?
a. natural selection
b. overproduction
~~c. competition~~
d. variation

____ 6. Darwin concluded that organisms on the Galápagos Islands
a. had changed over time.
b. had remained the same.
~~c. were the result of selective breeding.~~
d. had no variations.

____ 7. How does natural selection lead to evolution?
~~a. Stronger offspring kill weaker members of the species.~~
b. Helpful variations accumulate among surviving members of the species.
c. Overproduction provides food for stronger members of the species.
d. Environmental changes favor weaker members of the species.

Quizlet

NAME_____

10 Matching questions

1. ____ Biodiversity
2. ____ natural selection
3. ____ variation
4. ____ gradualism
5. ____ fossil
6. ____ species
7. ____ adaptation
8. ____ scientific theory
9. ____ evolution
10. ____ punctuated equalibrium

A. any difference between individuals of the same species

B. species evolve during short periods of rapid change and then do not change for periods of time

C. total number of different species on Earth, including those on land, in the water, and in the air

D. The process by which organisms that are best adapted to their environment are mostlikely to survive and reproduce

E. tiny changes in a species that gradually add up to major changes over very long periods of time

F. the preserved remains or traces of an organism that lived in the past

G. a group of similar organisms that can mate with each other and produce fertile offspring

H. the process of change over time

I. a trait that increases an organism's ability to survibe and reproduce

J. a well-tested explaination for a wide range of observations

Guided · Notes
Copy into Comp. Bk

Ch. 11 Sec 1 p. 374

Big ? How do life forms change over time?

1831 Charles Darwin set sail on the British Ship HMS Beagle. On the voyage the ship was stranded in the Galapagos Island for some time
→ as the ships naturalist Darwin studied the new species and the new fossils he discovered. He made many comparisons to species he was familiar with.

Species def p375

Galapogos Finch study
- Darwin noticed that birds were different from one island to the next.
- He concluded they all began with the same ancester and had changed or adapted to changes in their environment

Adaptation def p377

Evolution def p378

Bold p. 378

& Darwin hypothesized that species change over ~~time~~ many generations and become better adapted to new conditions.

scientific theory def p. 378

natural selection p. 380

Natural Selection Causes:

1. Overproduction species that produce far more offspring than can survieve

* Some are better equipt to survive because of variations

variation def p. 381

2. Variation causes Competition

3. Competition leads to the best suited to survive and pass their genes on to the next generation

p. 2

p381

∝ Darwin proposed that, over a long time, natural selection can lead to change. Helpful variations accumulate in a species, while unfavorable ones may disappear.

* Last Sentance of text p. 382
!! Only traits that are inherited, or controlled by genes that are passed on to offspring, can be acted upon by Natural selection

See example of Monkey Flowers fig 6.

11-2 Evidence

Bold Statement p. 385

What Evidence Supports Evolution
In your own words summarize how each is proof

p.385 1. Fossils

p3

p. 385

2. Similarities in Early Development

3. Similarities in Body Structure

homologous structures def p. 386

11-3 Rate of Change

Copy Bold p. 388

∠ a new species can form when a group of individuals remain isolated from the rest of

Ex. Kaibab and Abert's Squirrels p. 389

The Rate of Evolution

Bold p. 390

∠ Scientists have developed patterns to describe the pace of evolution:

gradualism - punctuated equilibrium

gradualism (p. 391)

punctuated equilibrium (p. 391)