Name _____ Class_____Date_____

Section 10.1: Early Ideas about Evolution

Study Guide

KEY CONCEPT

There were theories of biological and geologic change before Darwin.

VOCABULARY

evolution	fossil	gradualism
species	catastrophism	uniformitarianism

MAIN IDEA: Early scientists proposed ideas about evolution.

In a phrase, tell what each scientist did to help develop evolutionary theory.

Scientist	Contribution to Evolutionary Theory
1. Linnaeus	
2. Lamarck	

5. What two conditions must be true for a group of animals to be considered the same species?

_____

_____

6. Lamarck's ideas of evolution are known as the inheritance of acquired characteristics. What was incorrect about his theory of how organisms evolve?

_____

_____

7. In the 1700s, many people believed that species were fixed and did not change. How did plant hybridization—a type of crossing that could be observed in experiments—help change this view?

_____

_____

MAIN IDEA: Theories of geologic change set the stage for Darwin's theory.

8. Write a description of each theory in the space provided.

Geologic Theory	Description
catastrophism	
gradualism	
uniformitarianism	

Vocabulary Check

9. What word refers to traces of an organism that existed in the past?

_____

10. What is the process of biological change by which descendants come to differ from their ancestors?

_____

11. Events such as volcanoes, floods, and earthquakes are the basis of what geologic theory?

_____

12. What geologic theory can be summarized by the phrase "the present is the key to the past"?

_____

Name _____ Class_____Date_____

Principles of Evolution

Section 10.2: Darwin's Observations

Study Guide

KEY CONCEPT

Darwin's voyage provided insights into evolution.

VOCABULARY

variation	adaptation

MAIN IDEA: Darwin observed differences among island species.

1. What is variation among members of *different* species called?

_____

2. What is variation among members of *the same* species called?

_____

3. What island chain in South America was the source of many of Darwin's insights?

_____

4. Darwin saw populations of various species that seemed well-suited to their environment. What did this suggest?

_____

MAIN IDEA: Darwin observed fossil and geologic evidence supporting an ancient Earth.

5. Darwin observed fossils of huge animals such as *Glyptodon*, a giant armadillo. Why were these fossils of interest to him?

_____

6. Many people in the 1700s thought that Earth was only about 6000 years old. How did the fossil organisms Darwin saw lead him to think Earth must be much older than that?

_____

7. Darwin also observed fossil shells of marine organisms high up in the Andes mountains, and saw an earthquake move land that was underwater above sea level. How did he apply these insights to the evolution of organisms?

_____

8. Look at Figure 2.2 in your textbook. What differences between the two Galápagos tortoises can you identify from the two pictures?

_____

Vocabulary Check

variation	adaptation

_____ 9. the difference in the physical traits of an individual from those of other individuals in the group to which it belongs

_____ 10. a feature that allows an organism to better survive in its environment

_____ 11. A tortoise population lives in an area with high grass. These tortoises have longer necks than tortoises that live in other areas. The long necks are an example of this.

_____ 12. One bird in a population has a slightly thicker beak than its relatives. This thicker beak is an example of what in the population.

Be Creative

In the space below, draw a sketch of a bird that may eat the food choice that is given in the left column.

Food choice	**Sketch**
Eats large, hard-shelled nuts	
Eats fruit and insects	

Name _____ Class_____Date_____

Section 10.3: Theory of Natural Selection

Study Guide

KEY CONCEPT

Darwin proposed natural selection as a mechanism for evolution.

VOCABULARY

artificial selection	natural selection	fitness
heritability	population	

MAIN IDEA: Several key insights led to Darwin's idea for natural selection.

1. Why did artificial selection interest Darwin?

_____

_____

2. Why must selected traits be heritable?

_____

_____

3. In natural selection, what must be true of traits that are passed down through generations?

_____

_____

4. What important idea from Thomas Malthus inspired Darwin?

_____

_____

MAIN IDEA: Natural selection explains how evolution can occur.

variation	overproduction	adaptation	descent with modification

_____ 5. producing many offspring, some of which may not survive

_____ 6. individual differences that may be heritable

_____ 7. a structure well-suited for the environment

_____ 8. a heritable trait becoming common in a population

Use an organism of your choice to sketch the four principles of natural selection.

9. overproduction	10. variation
11. adaptation	12. descent with modification

MAIN IDEA: Natural selection works on existing variation.

13. Peter and Rosemary Grant observed natural selection acting on traits within a population of finches on the Galápagos Islands. A drought reduced the number of small, soft seeds but left plenty of large, tough-shelled seeds intact. The next year there was a(n) _____ (increase, decrease) in the number of large-beaked hatchlings.

14. After several years, the supply of large seeds went down after an unusually wet period. The increase in small, soft seeds brought a(n) _____ (increase, decrease) in the number of large-beaked hatchlings the following year.

Vocabulary Check

15. *Humans* are the selective agent in which type of process, artificial selection or natural selection?

_____

16. *The environment* is the selective agent in which type of process, artificial selection or natural selection?

_____

17. What is the measure of the ability to survive and produce more offspring relative to other members of the population called?

_____

18. What is the ability of a trait to be passed down from one generation to the next called?

_____

19. What are all the individuals of a species that live in an area called?

_____

Name _____ Class_____Date_____

Section 10.4: Evidence of Evolution

Study Guide

KEY CONCEPT

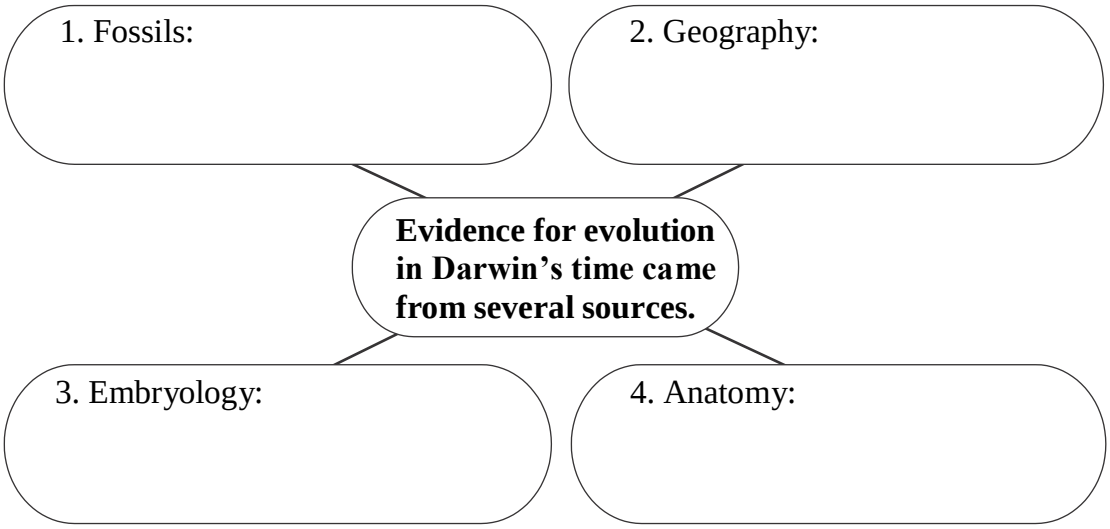
Evidence of common ancestry among species comes from many sources.

VOCABULARY

biogeography	analogous structure
homologous structure	vestigial structure

MAIN IDEA: Evidence for evolution in Darwin's time came from several sources.

In the diagram below, give examples of each type of evidence for evolution.



5. Why is it significant that vertebrates share several developmental homologies?

_____

_____

MAIN IDEA: Structural patterns are clues to the history of a species.

6. Vestigial structures seem to lack any useful function, or are at least no longer used for their original purpose. Give three examples of vestigial structures.

_____

_____

7. Many modern whale species have vestigial pelvic and leg bones. What does this suggest about the ancestry of modern whales?

_____

Vocabulary Check

homologous structure	analogous structure	vestigial structure

_____ 8. Feature that is similar in structure in different organisms but has different functions

_____ 9. Feature that performs a similar function in different organisms but is not similar in origin

_____ 10. Is *not* evidence of a common ancestor

_____ 11. Remnant of an organ or structure that had a function in an early ancestor

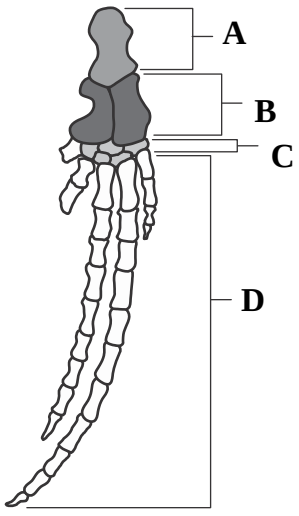
_____ 12. Examples include the wing of a bat and the hand of a human

_____ 13. Examples include the wing of a bird and the wing of an insect

_____ 14. Examples include the wing of an ostrich and the appendix of a human

Sketch It Out

Use Figure 4.4 to sketch a skeleton of a human hand next to the whale fin skeleton shown below. Draw lines to match the groups of bones that are homologous for these two structures.



Name _____ Class_____Date_____

Section 10.5: Evolutionary Biology Today

Study Guide

KEY CONCEPT

New technology is furthering our understanding of evolution.

VOCABULARY

paleontology

MAIN IDEA: Fossils provide a record of evolution.

1. What are two reasons that the fossil record is not complete?

_____

2. What is one example of a transitional fossil that has been found?

_____

3. Why are transitional fossils important?

_____

MAIN IDEA: Molecular and genetic evidence support fossil and anatomical evidence.

In a phrase, explain how each of the following contribute to evolutionary theory.

Molecular Evidence	Contribution to Evolutionary Theory
4. DNA sequence analysis	
5. Pseudogenes	
6. Homeobox genes	
7. Protein comparisons	

MAIN IDEA: Evolution unites all fields of biology.

8. What two things combine to make up our modern evolutionary theory?

_____

_____

9. How has molecular evidence helped support fossil evidence in determining the early ancestor of modern-day whales?

_____

10. What is meant by the phrase "Evolution unites all fields of biology"?

_____

Vocabulary Check

11. How does paleontology contribute to evolutionary biology?

_____

_____

Sketch It Out

Look at the fossil evidence of whale evolution shown in Figure 5.3. Sketch one part of the skeletons (such as the skull, forelimbs, hindlimbs, or ribcages) of each of the whale ancestors. Briefly describe their differences and propose how these differences are well-suited for the habitat in which the animals lived.

Name _____ Class_____Date_____

Section 11.1: Genetic Variation within Populations

Study Guide

KEY CONCEPT

A population shares a common gene pool.

VOCABULARY

gene pool	allele frequency

MAIN IDEA: Genetic variation in a population increases the chance that some individuals will survive.

1. What kind of variation must exist in a population that has a wide range of phenotypes?

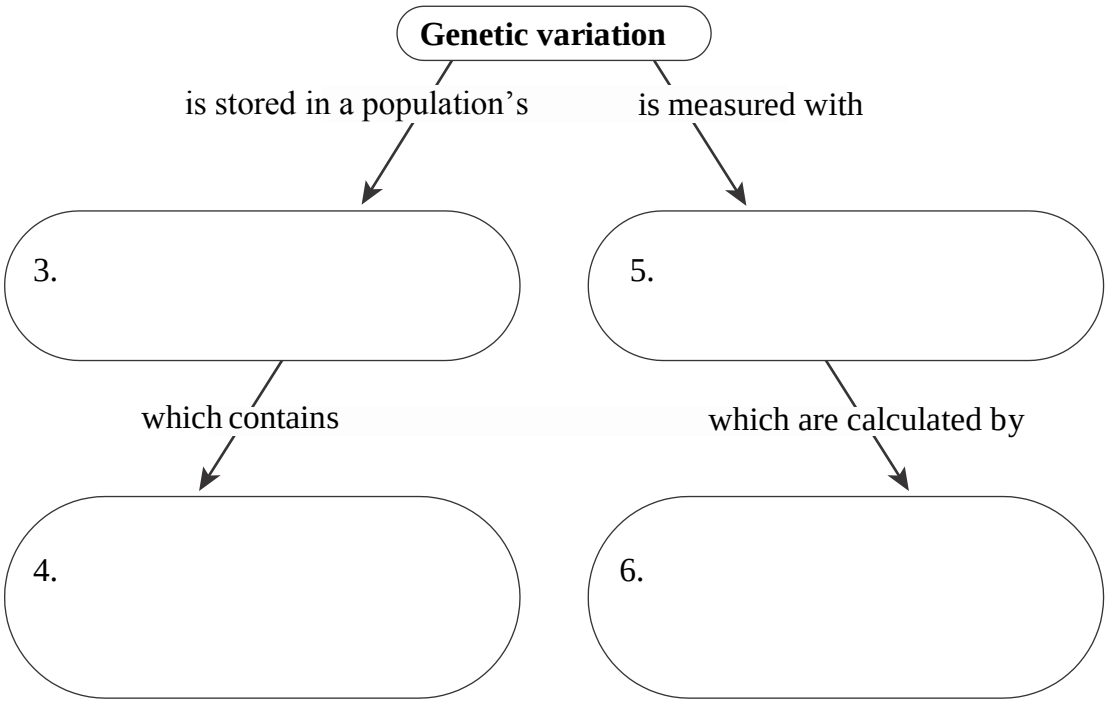
_____

2. How can a wide range of phenotypes increase the chance that some individuals will survive in a changing environment?

_____

_____

Fill in the concept map below.



MAIN IDEA: Genetic variation comes from several sources.

In a phrase, describe how each term below provides a source of genetic variation.

Source	How It Provides Genetic Variation
7. mutation	
8. recombination	
9. hybridization	

Vocabulary Check

10. How is a gene pool like a pool of genes?

_____

11. What does an allele frequency measure?

_____

Be Creative

In the space below, write a logo advertising the importance of genetic diversity to a population.

Name _____ Class_____Date_____

Section 11.2: Natural Selection in Populations

Study Guide

KEY CONCEPT

Populations, not individuals, evolve.

VOCABULARY

normal distribution	microevolution	disruptive selection
stabilizing selection	disruptive selection	

MAIN IDEA: Natural selection acts on a distribution of traits.

1. What is a phenotypic distribution?

_____

2. What can you learn from looking at a phenotypic distribution?

_____

_____

3. In a population that is not undergoing natural selection for a certain trait, what does the phenotypic distribution look like?

_____

In the space provided below, draw the phenotypic distribution for a trait that follows a normal distribution. Be sure to label the axes as well as the mean phenotype.

MAIN IDEA: Natural selection can change the distribution of a trait in one of three ways.

In the table below, take notes about the three patterns of natural selection.

Type of Selection	How It Works	Graph
4. directional selection		
5. stabilizing selection		
6. disruptive selection		

Vocabulary Check

7. The observable change in _____ over time is called microevolution.
8. During _____ selection, the intermediate phenotype is selected for.
9. During _____ selection, both extreme phenotypes are selected for.
10. During _____ selection, the mean phenotype changes.

Name _____ Class_____Date_____

Section 11.3: Other Mechanisms of Evolution

Study Guide

KEY CONCEPT

Natural selection is not the only mechanism through which populations evolve.

VOCABULARY

gene flow	bottleneck effect	sexual selection
genetic drift	founder effect	

MAIN IDEA: Gene flow is the movement of alleles between populations.

Fill in the word or phrase that best completes each statement.

1. When an individual _____ from its population, its alleles are no longer part of that population's gene pool.
2. When an individual _____ into a new population, the genetic diversity of this new population increases.
3. Gene flow among neighboring populations helps to keep the _____ of these populations similar.

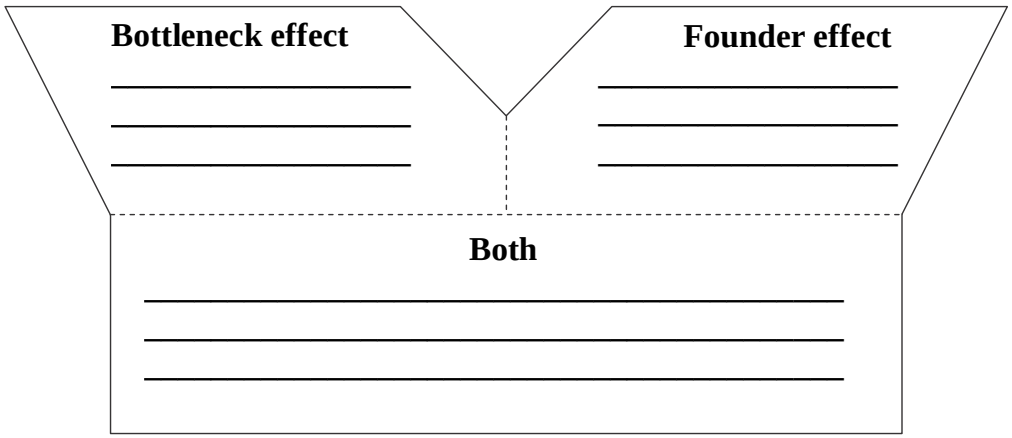
MAIN IDEA: Genetic drift can occur in small populations.

4. How is genetic drift different from natural selection?

_____

_____

Use Y-notes to compare and contrast the bottleneck effect and the founder effect.



5. Why is genetic drift more likely to occur in smaller populations?

_____

_____

6. What are some problems that can result from genetic drift?

_____

_____

MAIN IDEA: Sexual selection is a source of evolutionary change.

7. Why is the cost of reproduction different for males and females?

_____

_____

8. What is sexual selection?

_____

_____

9. _____ selection involves fighting among males for a female, whereas _____ selection involves males displaying traits to impress females.

Vocabulary Check

In the spaces provided below, draw pictures that help you to remember the definitions of the vocabulary words.

Gene Flow	**Bottleneck Effect**	**Founder Effect**

Name _____ Class_____Date_____

Section 11.4: Hardy-Weinberg Equilibrium

Study Guide

KEY CONCEPT

Hardy-Weinberg equilibrium provides a framework for understanding how populations evolve.

VOCABULARY

Hardy-Weinberg equilibrium

MAIN IDEA: Hardy-Weinberg equilibrium describes populations that are not evolving.

1. What variable remains constant, or in equilibrium, in the Hardy-Weinberg model?

_____

2. Name the five conditions required for a population to be in Hardy-Weinberg equilibrium.

_____

_____

3. Name two ways that population biologists can use Hardy-Weinberg equilibrium.

_____

_____

MAIN IDEA: The Hardy-Weinberg equation is used to predict genotype frequencies for a population.

4. Write the Hardy-Weinberg equation:

_____

5. Fill in the missing information about the variables involved in the Hardy-Weinberg equation.

Variable	**What It Represents**
	frequency of dominant homozygous genotype
2pq	
	frequency of recessive homozygous genotype
p	
	frequency of recessive allele

6. In what types of systems can the Hardy-Weinberg equation be used?

_____

7. What variables must be known in order to use the Hardy-Weinberg equation?

_____

8. What can be concluded if real genetic data do not match the frequencies predicted by the equation?

_____

MAIN IDEA: There are five factors that can lead to evolution.

9. Take notes about these five factors in the table below.

Factor	**How It Can Lead To Evolution**
genetic drift	
gene flow	
mutation	
sexual selection	
natural selection	

Vocabulary Check

10. A population is said to be in Hardy-Weinberg equilibrium for a trait if _____ stay the same from generation to generation.

Name _____ Class_____Date_____

Section 11.5: Speciation through Isolation

Study Guide

KEY CONCEPT

New species can arise when populations are isolated.

VOCABULARY

reproductive isolation	speciation	behavioral isolation
geographic isolation	temporal isolation	

MAIN IDEA: The isolation of populations can lead to speciation.

Fill in the term from the box that best completes each statement.

speciation	gene flow	species	gene pools
environments	mutation	mate	genetic drift

1. Two populations are said to be isolated if there is no longer any _____ between them.
2. Over generations, the _____ of isolated populations may become more and more different.
3. Isolated populations may become genetically different as they adapt to new _____, or through random processes such as mutation and _____.
4. When members of two isolated populations can no longer _____ successfully, the populations are said to be reproductively isolated.
5. Reproductive isolation is the final step of _____, which is the rise of new _____.
6. The experiment illustrated in Figure 5.1 shows how just one _____ can provide enough genetic difference to result in reproductive isolation.

MAIN IDEA: Populations can become isolated in several ways.

7. Name the three types of barriers that can isolate populations.

_____

8. In the chart below, take notes about the three ways in which populations can become isolated, leading to reproductive isolation.

Type of Isolation	How It Works	Example
behavioral isolation		
geographic isolation		
temporal isolation		

Vocabulary Check

9. What is speciation?

_____

10. Which type of isolation involves factors of time?

_____

11. Which type of isolation can involve mating or courtship rituals?

_____

12. Which type of isolation can involve physical barriers?

_____

Name _____ Class_____Date_____

Section 11.6: Patterns in Evolution

Study Guide

KEY CONCEPT

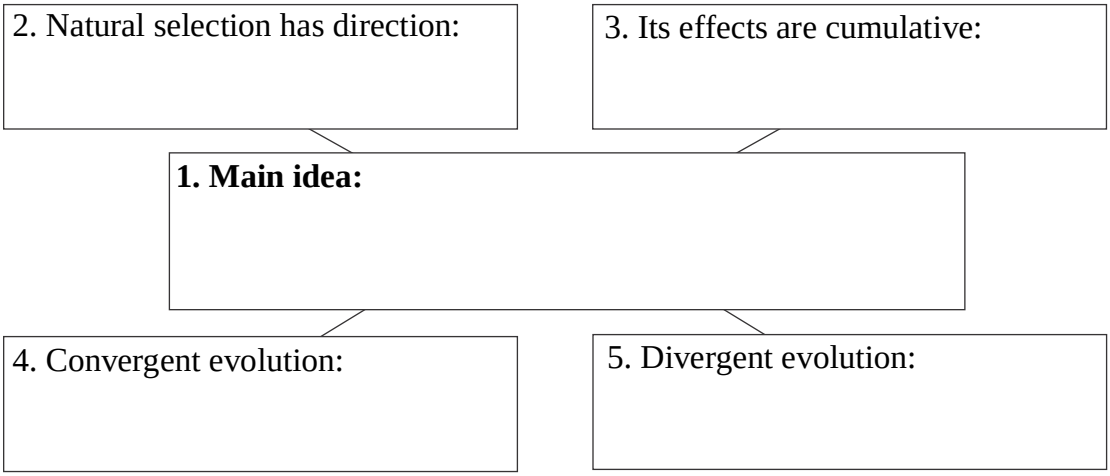
Evolution occurs in patterns.

VOCABULARY

convergent evolution	coevolution	punctuated equilibrium
divergent evolution	extinction	adaptive radiation

MAIN IDEA: Evolution through natural selection is not random.

Fill in the Main Idea in the center of the Main Idea Web below. Then take notes based on the phrases in the surrounding boxes.



MAIN IDEA: Species can shape each other over time.

In the table below, take notes about two ways in which species can coevolve.

Type of Coevolution	How It Works	Example
6. beneficial relationship		
7. evolutionary arms race		

MAIN IDEA: Species can become extinct.

In the table below, take notes about background and mass extinctions.

Type of Extinction	Possible Causes	Outcome
8. background extinction		
9. mass extinction		

MAIN IDEA: Speciation often occurs in patterns.

10. The theory of punctuated equilibrium states that relatively brief episodes of _____ are followed by long periods of little evolutionary _____.

11. Adaptive radiation is a process in which one ancestral species diversifies into many _____ species.

12. Adaptive radiation occurred after the extinction of the dinosaurs, because they left a wide range of _____ into which mammals could diversify.

Vocabulary Check

13. *Converge* means "to come together" and *diverge* means "to branch out." How do these meanings apply to the terms *convergent* and *divergent* evolution?

_____

_____

14. The prefix *co-* means "together." How does this meaning apply to the term *coevolution*?

_____

15. *Punctuate* means "to interrupt periodically." How does this meaning apply to the term *punctuated equilibrium*?

_____

Name _____ Class_____Date_____

Section 12.3: Origin of Life

Study Guide

KEY CONCEPT

The origin of life on Earth remains a puzzle.

VOCABULARY

nebula	ribozyme

MAIN IDEA: Earth was very different billions of years ago.

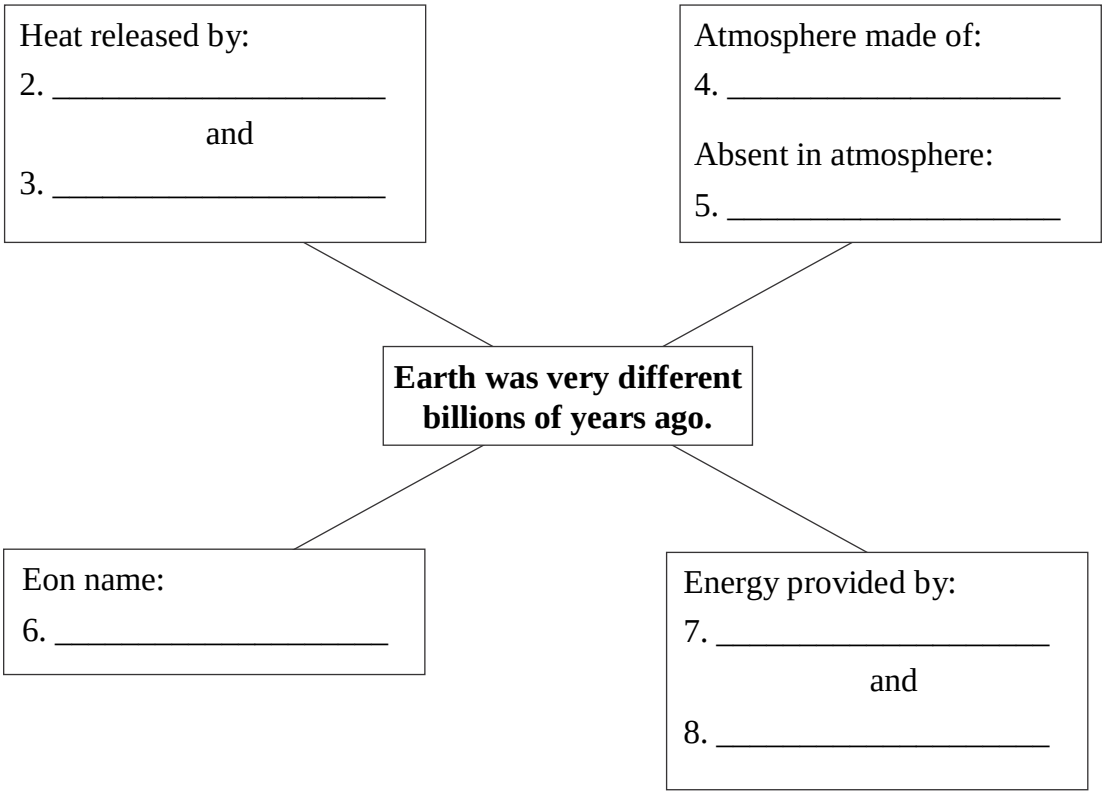
1. Most scientists agree on two points about Earth's origins. What are they?

_____

_____

_____

Fill in the Main Idea Web with the descriptions of early Earth.



An organism dies.

Name _____ Class_____Date_____

MAIN IDEA: Several sets of hypotheses propose how life began on Earth.

In the column on the left labeled "Hypothesis," write the hypothesis from the readings about how life began on Earth. In the column labeled "Evidence," list the evidence that supports the hypothesis. Finally, answer the question at the end of the table.

Hypothesis	Evidence
I. ORGANIC MOLECULE HYPOTHESES	
9.	Demonstrated that organic compounds could be made by passing electrical current through a closed system that held a mixture of gases
10. Meteorite hypothesis	

Vocabulary Check

_____11. A cloud of gas and dust in space

_____12. An RNA molecule that can catalyze specific chemical Reactions

Name _____ Class_____Date_____

Section 12.4: Early Single-Celled Organisms

Study Guide

KEY CONCEPT

Single-celled organisms existed 3.8 billion years ago.

VOCABULARY

cyanobacteria	endosymbiosis

MAIN IDEA: Microbes have changed the physical and chemical composition of Earth.

1. What are two ways that early single-celled organisms changed Earth's surface?

_____

2. What have scientists inferred from fossil stromatolites?

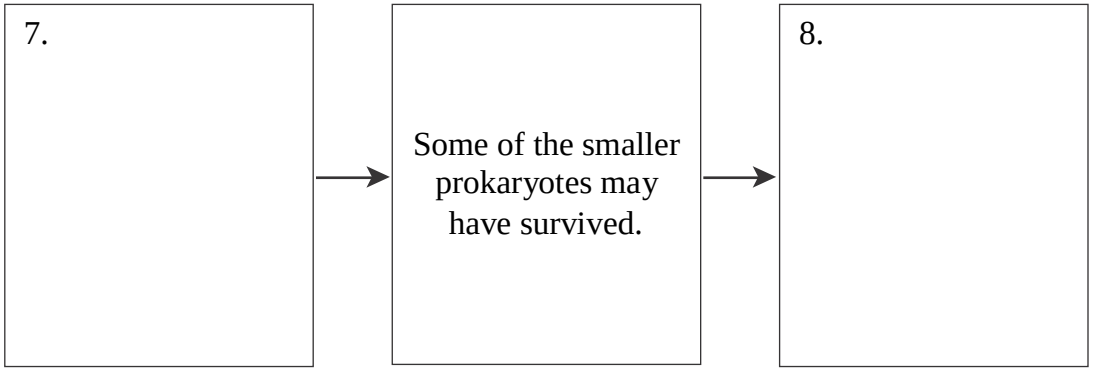
_____

MAIN IDEA: Eukaryotic cells may have evolved through endosymbiosis.

Fill in the blanks with the correct terms.

3. Although prokaryotes existed as long as 3.5 billion years ago, _____ arose about 1.5 billion years ago.
4. Eukaryotes have a _____ and membrane-bound organelles.
5. Eukaryotes are _____, which means they need oxygen to survive.
6. While the first eukaryotes were made of only one _____, later eukaryotes were made of many.

Use the sequence diagram below to summarize the theory of endosymbiosis.



An organism dies.

Name _____ Class_____Date_____

Study Guide B *continued*

9. Describe the role that cyanobacteria play in the theory of endosymbiosis.

_____

_____

_____

MAIN IDEA: The evolution of sexual reproduction led to increased diversity.

10. What is the main advantage of asexual reproduction?

_____

11. Sexual reproduction increases genetic variation in a population. Why might this be beneficial to the population?

_____

Vocabulary Check

12. Bacteria that can carry out photosynthesis are called _____.
13. The mutually beneficial relationship in which one organism lives within the body of another is called _____.
14. The term *endosymbiosis* can be broken down into parts. *Endo-* means "within." What is another term you have heard that starts with *endo-*?

_____

15. The term *cyanobacteria* can be broken down into parts. *Cyan-* means "greenish blue," because cyanobacteria are often blue-green in color. Not too long ago, cyanobacteria were known as blue-green algae. Why do you think they were considered algae?

_____

Name _____ Class_____Date_____

Section 12.5: Radiation of Multicellular Life

Study Guide

KEY CONCEPT

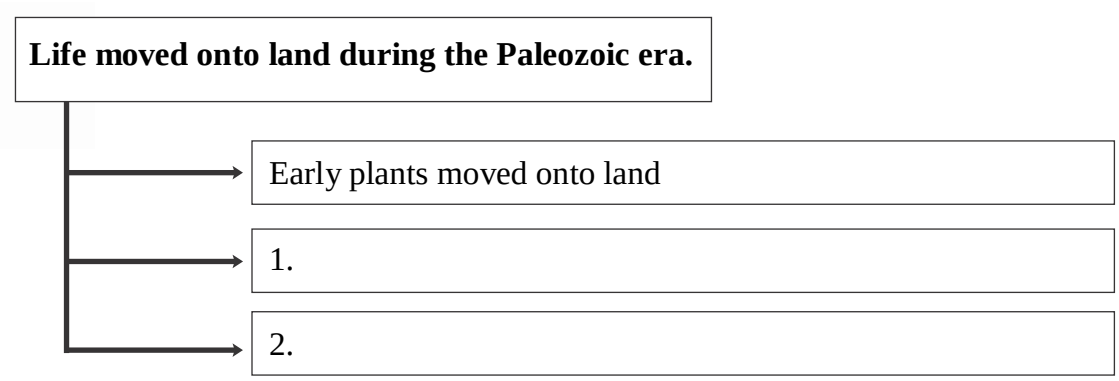
Multicellular life evolved in distinct phases.

VOCABULARY

Paleozoic	Mesozoic
Cambrian explosion	Cenozoic

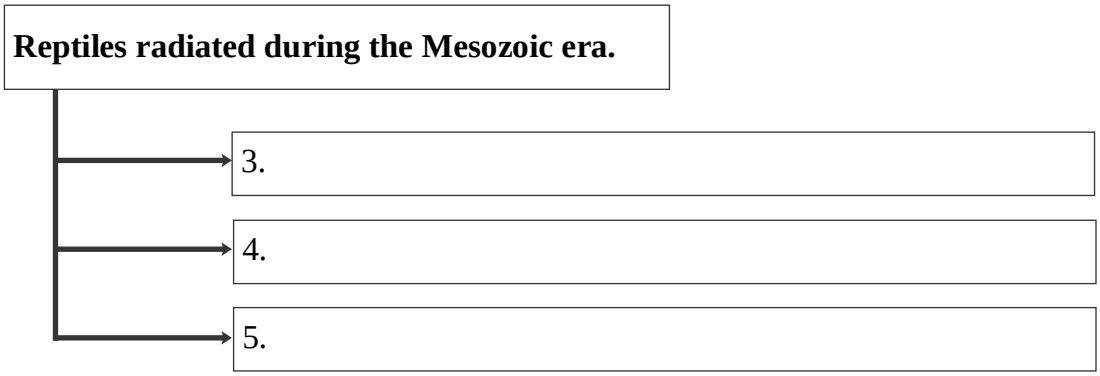
MAIN IDEA: Life moved onto land during the Paleozoic era.

Fill in a Main Idea and Supporting Information Diagram describing the Paleozoic era.



MAIN IDEA: Reptiles radiated during the Mesozoic era.

Fill in a Main Idea and Supporting Information Diagram describing the Mesozoic era.



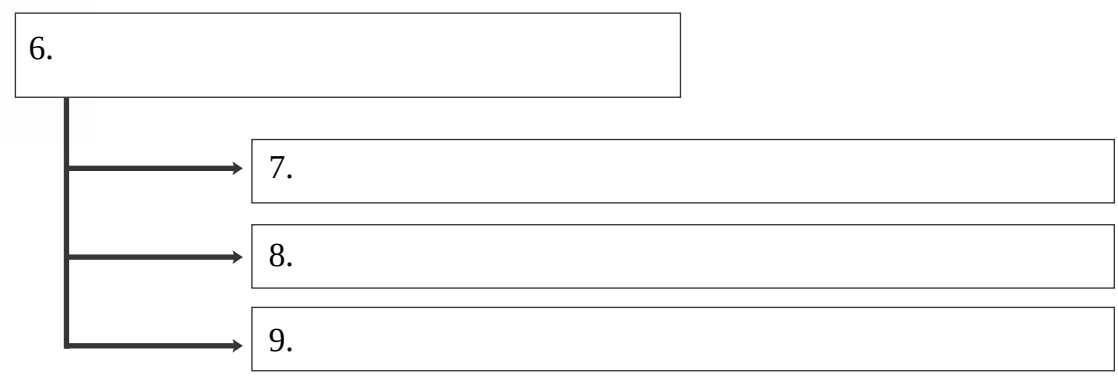
An organism dies.

Name _____ Class_____Date_____

Study Guide B *continued*

MAIN IDEA: Mammals radiated during the Cenozoic era.

Fill in a Main Idea and Supporting Information Diagram describing the Cenozoic era.



Vocabulary Check

Paleozoic	Cambrian explosion	Mesozoic	Cenozoic

_____10. Divided into the Triassic, Jurassic, and Cretaceous periods

_____11. Ended with a mass extinction with more than 90 percent of all marine life extinct

_____12. Earliest part of Paleozoic era

_____13. Primates evolved during this era

_____14. Trilobites were abundant then

_____15. Rise of the first marsupial mammals

_____16. Divided into Tertiary and Quarternary periods

_____17. Life moved onto land

_____18. Includes the Carboniferous period

_____19. Dinosaurs roamed the earth

_____20. Continues today