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# EARTH SCIENCE

*Geology, the Environment, and the Universe*

# Study Guide for Content Mastery

## Student Edition

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# Earth Science: Geology, the Environment, and the Universe

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*Study Guide for Content Mastery, SE and TE*
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# Contents

# To the Student

This *Study Guide for Content Mastery* for ***Earth Science: Geology, the Environment, and the Universe*** will help you learn more easily from your textbook. Each textbook chapter has six study guide pages of questions and activities for you to complete as you read the text. These activities will help you understand the "big picture" of the chapter. The study guide pages are divided into sections that match those in your text. These pages will help you learn the vocabulary and main ideas of the sections. Each GeoDigest in your textbook has two study guide pages to complete.

You will find that the directions in the *Study Guide for Content Mastery* are simply stated and easy to follow. Sometimes you will be asked to answer questions. Other times, you will be asked to label a diagram or complete a table. By completing the study guide, you will gain a better understanding of the concepts presented in the text. These sheets also will prove helpful when studying for a test.

Before you begin your work, read the Study Skills section at the front of this booklet. The Study Skills section will help you

- improve your reading skills.
- improve your vocabulary skills.
- learn from visuals.
- make and understand idea maps.

# Study Skills

## A. Improve Your Reading Skills

Active readers are good readers.

**Active readers**

- get ready before they read.
- use skills that help them when they read.
- review to remember after they read.

Here's what you can do to become an active reader!

### *Before You Read*

**Get Ready to Read**

- Find a quiet time and place to read—library, study hall, home.
- Don't read when you're tired.
- Don't read when you're hungry.
- Wait until you have finished a section before you take a break.

**Scan**

- Quickly scan the material so you will know what it is about.
- Look at pictures and read the captions, titles, headings, and words in bold print.

**Write**

- Write notes about what you see when you scan.
- Write questions about what you see.
- Write topics you want to find out about when you read.
- Write a preview outline from the section topics.

### *As You Read*

- Find the main idea of each section or paragraph—this is usually in the first sentence.
- Study the pictures, maps, graphs, and tables, and think about the information in them.
- Write down the main ideas and other notes about what you read.
- After you read the whole section, reread the parts you didn't understand.

# Study Skills

### *After You Read*

- Review your outline or the notes you wrote while you were reading.
- If you still have questions, ask a classmate or your teacher for help.
- Write important facts or ideas on flash cards.
- Review your flash cards to help you remember what you've read.

## B. Improve Your Vocabulary Skills

Active readers learn the meanings of new words.

**Active readers**

- recognize clues to help find the meaning.
- look for familiar words and word parts in new words.
- use a dictionary often.
- practice new words so they can remember new meanings.

Here's how you can improve your vocabulary!

### *When You See a New Word*

**Scan**

- Read the sentence and look for clues about the meaning of the word. These are called context clues.
- Look for pictures or visuals that contain the word.

In the following table, you can find different kinds of context clues that you can use to help you figure out the meanings of new words.

# Study Skills

### Search for Context Clues

| | | |
|---|---|---|
| **Comparison and contrast** | The runner started the race with energy and excitement, but as she crossed the finish line, the *fatigue* and strain showed on her face. | This sentence contrasts the word *fatigue* with energy and compares it to strain. This tells you that someone who is fatigued is strained and has no energy. |
| **Definition and description** | Elena is a *geologist*, a scientist who studies Earth's materials and the processes that form and change those materials. | The sentence describes a *geologist* as someone who studies Earth's materials and the processes that form and change those materials. |
| **Synonyms** | Carl is very *dependable*. His teachers and his parents know that he is reliable and can be trusted. | The word *dependable* is described by the synonyms reliable and trusted. |
| **Tone and setting** | An air of *jubilation* surrounded the members of the science team as they received their medals for first place in the national competition. | The setting of the sentence and the action describe a situation that is positive and full of celebration. |
| **A series of clues** | Granite, gabbro, and diorite are all *intrusive* rocks. | The rocks that are mentioned are all coarse-grained. This tells you something about the word *intrusive*. |
| **Cause and effect** | The student group was known for its *boisterous* meetings, so the principal asked extra teachers to monitor the meeting and keep order. | *Boisterous* describes the meetings and tells you that something needs extra supervision. |

# Study Skills

### Break It Down

- Find the root word.
- Write it and ask questions about its meaning.
- Find the affix—the part in front of or after the root word.
- Write it down and use a dictionary to look up its meaning.

**public • ize**

In this table, you can see how to break words into their roots and affixes.

| Word | Root | Affix and Meaning | Meaning |
|---|---|---|---|
| imperfect | perfect | im- (not) | not perfect |
| semicircle | circle | semi- (half) | half of a circle |
| teacher | teach | -er (one who) | one who teaches |
| backward | back | -ward (in the direction of) | to the back |
| publicize | public | -ize (make) | make public |

### Remember New Words

- Say the word aloud.
- Write another sentence using the word.
- Make flash cards that include the word and its meaning.
- Review your flash cards to help you remember the meanings of the new words.

# Study Skills

## C. Learn From Visuals

Tables, graphs, photographs, diagrams, and maps are called visuals. Good readers use all kinds of visuals to help them learn.

**Active readers**

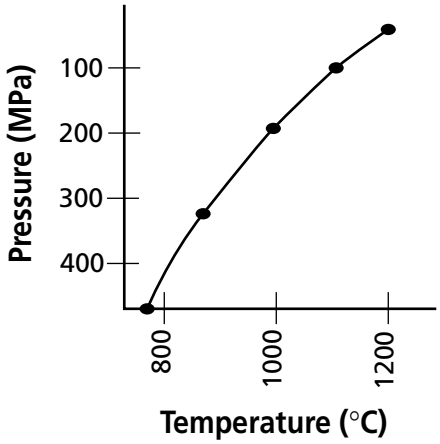
- find the purpose for the visual they see.
- find information in the visual.
- connect the information they find to what they are studying.

Here's how you can improve your skill in learning from visuals.

### *When You First Look at a Visual*

**Scan**

- Look at the visual.
- Decide its purpose. Why is it there?
- Find the title.
- Read the caption.




**Write**

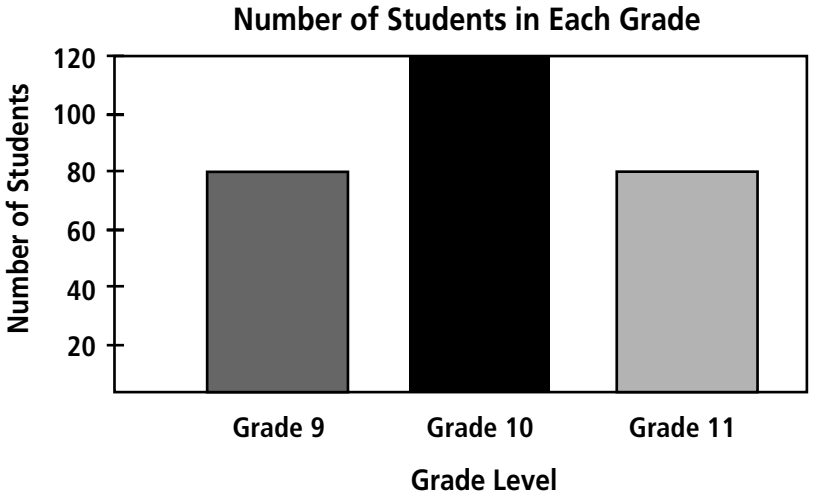
- Write the purpose of the visual. Why is it there?
- Write the key information.
- Write the title of the visual.
- Write the main idea or message.

# Study Skills

## *As You Study the Visual*

### Graphs

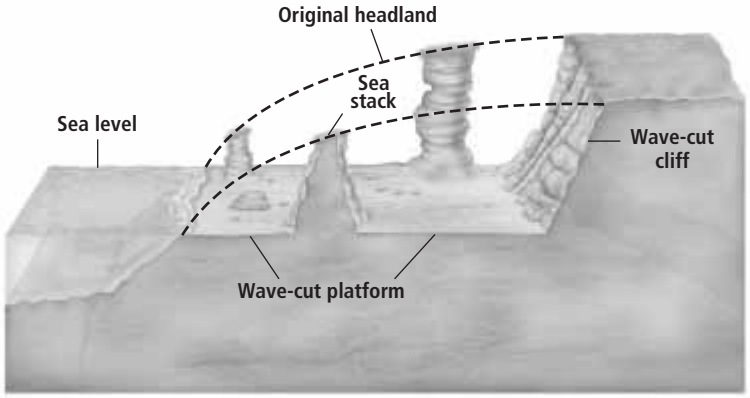
Graphs are pictures of related information. A graph tells you something about a specific situation. There are many kinds of graphs. One of the most common is the bar graph.




A bar graph helps you compare similar information about different items. The separate items being measured are shown as rectangles side by side on the graph.

### Diagrams

A diagram is a drawing that has labels on it. It can show how something works or what the parts are called.




A diagram often gives the names of the parts of something, like this diagram of a rocky headland. Science books often have many diagrams.

# Study Skills

### Tables

Tables organize words and numbers for easier reading. They have a title, columns (up and down), and rows (side to side). In this table, the columns show the innings, and the rows show the points each team scored.

| Points Earned in the Baseball Game | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Inning** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **Total Points** |
| **Green Team** | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 3 | 0 | 5 |
| **Blue Team** | 1 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | 6 |

### Maps

Maps give all kinds of different information. Some examples are location, direction, and land features. They can have words, symbols, numbers, lines, and colors.

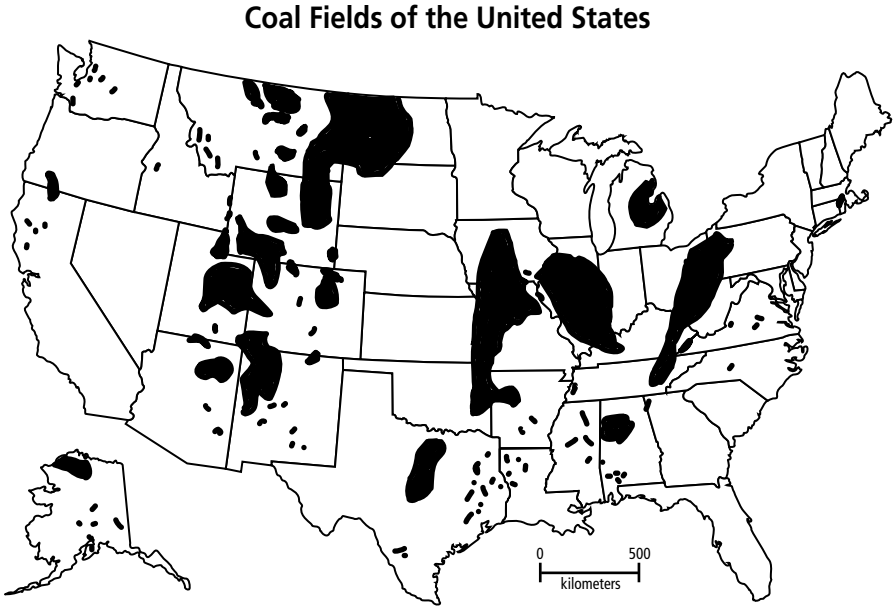



**Figure 6.11**

Coal is the most abundant fossil fuel on Earth. The coal deposits of the United States are mainly bituminous coal, which is preferred for electric power generation.

# Study Skills

## D. Make Chapter and Section Idea Maps

Active readers organize the information they read.

**Active readers**

- divide the information into smaller units.
- put the information in a logical order.

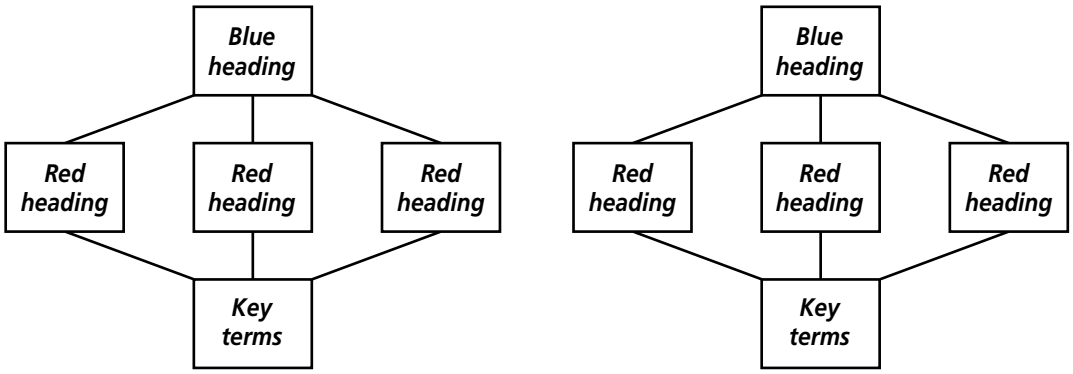
### *Starting Out*

**Scan and Write**

- Scan the chapter for main topics and subheadings—in your Earth science textbook, blue headings are main topics and red headings are subtopics.
- Scan for **boldface** key terms.
- Scan for any visuals.
- Write the information in some kind of graphic map.

Here's an example of one kind of idea map.

**Idea Map**



Name Class Date

CHAPTER 1 STUDY GUIDE FOR CONTENT MASTERY

# The Nature of Science

## SECTION 1.1 *Earth Science*

*In your textbook, read about the scope of Earth science.*
**Use the terms below to identify of the major area of Earth science that studies each subject. Each term can be used more than once.**

**astronomy** **meteorology** **geology** **oceanography**

_____ **1.** Physical and chemical properties of the oceans

_____ **2.** Objects beyond Earth's atmosphere

_____ **3.** Materials that make up Earth

_____ **4.** Forces and processes that produce weather

_____ **5.** Earth's neighbors, distant stars, and other cosmic bodies

_____ **6.** Rocks, glacial movements, and clues to Earth's history

_____ **7.** Creatures that inhabit salty water

_____ **8.** Blanket of air that surrounds Earth

**Circle the letter of the choice that best completes the statement or answers the question.**

**9.** What subspecialty of Earth science studies patterns of weather over a long period of time?
**a.** geochemistry **b.** climatology **c.** tectonics **d.** paleontology

**10.** Hydrology is the study of which of the following?
**a.** habitats of organisms
**b.** effects of internal processes on Earth's surface
**c.** water flow on and below Earth's surface
**d.** how the moon and stars affect people's lives

**11.** What subspecialty of Earth science studies ancient environments?
**a.** paleontology **b.** ecology **c.** tectonics **d.** hydrology

**12.** Which of the following might an ecologist study?
**a.** earthquakes and mountain building
**b.** the remains of organisms that once lived on Earth
**c.** the kinds of matter in the universe
**d.** how organisms interact with each other and their environments

**13.** In what field do scientists study the processes that change Earth's composition?
**a.** climatology **b.** hydrology **c.** geochemistry **d.** paleontology

## SECTION 1.1 *Earth Science, continued*

*In your textbook, read about Earth's systems and Earth science in your everyday life.*
**For each statement below, write *true* or *false*.**

_____ **14.** Earth's lithosphere is the rigid outer shell of the planet.

_____ **15.** The water in Earth's oceans, seas, lakes, rivers, and glaciers makes up the atmosphere.

_____ **16.** The blanket of gases that surround Earth is the atmosphere.

_____ **17.** The asthenosphere is the partially molten layer of Earth's core.

_____ **18.** The atmosphere contains about 78 percent oxygen.

_____ **19.** About three-fourths of all freshwater on Earth is contained in glaciers.

_____ **20.** The hemisphere includes all organisms on Earth as well as the environments in which they live.

_____ **21.** The atmosphere, biosphere, hydrosphere, and lithosphere are interdependent systems.

**Answer the following questions.**

**22.** How does continental crust differ from oceanic crust?

**23.** Describe three ways the atmosphere helps support life on Earth.

**24.** What is technology?

**25.** Name three products first developed for use in space that people now use in their everyday lives.

## SECTION 1.2 *Methods of Scientists*

*In your textbook, read about the nature of scientific investigations.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** Suggested explanation for an observation | **a.** independent variable |
| _____ | **2.** Organized procedure that involves making measurements and observations | **b.** constant |
| _____ | **3.** Factor in an experiment that can be manipulated by the experimenter | **c.** hypothesis |
| _____ | **4.** Factor in an experiment that can change if other factors are changed | **d.** dependent variable |
| _____ | **5.** Factor that does not change during an experiment | **e.** control |
| _____ | **6.** Standard for comparison that shows that the results of an experiment are actually due to the condition being tested | **f.** experiment |

**Use each of the terms below just once to complete the passage.**

**fire extinguisher** **laboratory glassware** **loose clothing** **safety goggles** **spill**

Wear **(7)** _____ and a safety apron during any activity or experiment in a science lab. Tie back long hair and **(8)** _____ before you begin any investigation. Never use **(9)** _____ as food or drink containers. Know the location and proper use of the **(10)** _____, safety shower, fire blanket, first aid kit, and fire alarm. Report any **(11)** _____, accident, or injury to your teacher immediately.

## SECTION 1.2 *Methods of Scientists, continued*

*In your textbook, read about measurement and scientific notation.*
**Complete the table by matching each SI unit with its measurement.**
**Some measurements will have more than one unit.**

**Celsius centimeter cubic centimeter cubic meter gram per cubic centimeter gram per millimeter Kelvin kilogram kilometer liter meter milliliter millimeter newton second square centimeter square meter**

| Measurement | Units |
|---|---|
| **12.** length | |
| **13.** area | |
| **14.** volume | |
| **15.** mass | |
| **16.** weight | |
| **17.** density | |
| **18.** time | |
| **19.** temperature | |

**Express each number in scientific notation.**

**20.** 1 000 000 _____ × _____

**21.** 0.01 _____ × _____

**22.** 325 _____ × _____

**23.** 0.000 25 _____ × _____

**24.** 6421 _____ × _____

**Convert each number expressed in scientific notation to a number with no exponent.**

**25.** $1 \times 10^3$ _____

**26.** $5 \times 10^2$ _____

**27.** $9.99 \times 10^8$ _____

**28.** $9.99 \times 10^{-8}$ _____

## SECTION 1.3 *Communicating in Science*

*In your textbook, read about communicating results.*
**Answer the following questions.**

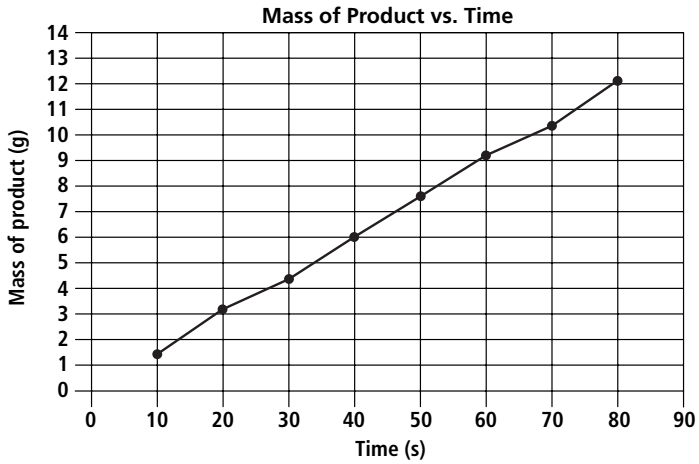
**1.** Give three reasons why communicating scientific data is important to others.

**2.** Describe two uses for the lab reports you write after doing an activity or experiment.

**The table below shows the results of an experiment. Use the data in the table to answer the following questions.**

| Time (s) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|
| Mass of product (g) | 1.5 | 3.2 | 4.3 | 6.0 | 7.7 | 9.2 | 10.4 | 12.1 |

**3.** On the grid below, plot the mass of product versus time. Connect the data points with a line.




**4.** What is the independent variable in this experiment?

**5.** What is the dependent variable in this experiment?

**6.** Describe the relationship between the dependent and independent variables in this experiment.

## SECTION 1.3 *Communicating in Science, continued*

*In your textbook, read about models, theories, and laws.*
**Use the following terms to complete the statements.**

**law** **model** **theory**

**7.** A scientific _____ is an idea, a system, or a mathematical expression that is similar to an idea being explained.

**8.** A scientific _____ is an explanation based on many observations during repeated experiments.

**9.** A scientific _____ is a basic fact that describes the behavior of a natural phenomenon.

**Answer the following questions.**

**10.** What was one model of the solar system developed by early astronomers?

_____

_____

**11.** What is the current model of our solar system?

_____

_____

**12.** What three conditions must be satisfied for a scientific theory to be valid?

_____

_____

**13.** Under what conditions can a scientific model or theory change?

_____

_____

Name Class Date

CHAPTER 2 STUDY GUIDE FOR CONTENT MASTERY

# Mapping Our World

## SECTION 2.1 *Latitude and Longitude*

*In your textbook, read about latitude and longitude.*
**Match the definition in Column A with the term in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** Science of mapmaking | **a.** prime meridian |
| _____ | **2.** Imaginary line that separates Earth into northern and southern hemispheres | **b.** longitude |
| _____ | **3.** Distance in degrees north or south of the equator | **c.** cartography |
| _____ | **4.** Distance in degrees east or west of the prime meridian | **d.** equator |
| _____ | **5.** Reference point for longitude that passes through Greenwich, England, and represents 0° | **e.** latitude |

**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **6.** The equator is located halfway between the north pole and the *prime meridian*.

_____ **7.** Lines of *latitude* run parallel to the equator.

_____ **8.** The equator is at *180°* latitude.

_____ **9.** The south pole is at 90° south *longitude*.

_____ **10.** *One degree* of latitude is equivalent to about 111 km on Earth's surface.

_____ **11.** Each degree of latitude is divided into *360 minutes*.

_____ **12.** Lines of longitude are also called *meridians*.

_____ **13.** The prime meridian is the reference line for *latitude*.

_____ **14.** Points east of the prime meridian are located between *0° and 180°* east longitude.

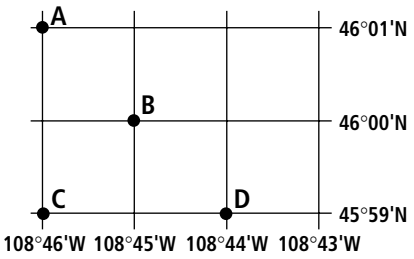
_____ **15.** Lines of longitude are *semicircles* that extend from the north pole to the south pole.

_____ **16.** Each degree of longitude corresponds to about 111 km at the *north pole*.

_____ **17.** All meridians converge at the *poles*.

## SECTION 2.1 *Latitude and Longitude, continued*

*In your textbook, read about locating places with coordinates.*
**Use the map grid to answer the following questions.**




**18.** What is the latitude of point A?

_____

**19.** Which two points have the same latitude? What is that latitude?

_____

_____

**20.** What is the longitude of point B?

_____

**21.** Which two points have the same longitude? What is that longitude?

_____

_____

**22.** What are the coordinates of point C?

_____

*In your textbook, read about time zones.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**23.** Into how many time zones is Earth divided?
**a.** 12 **b.** 24 **c.** 60 **d.** 360

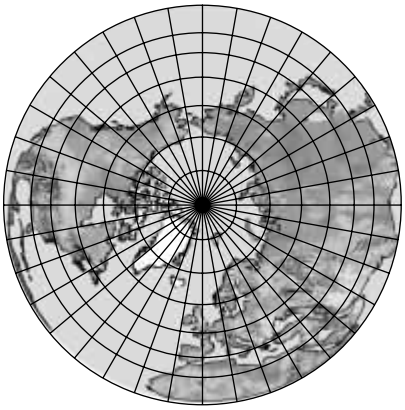
**24.** Approximately how wide is each time zone?
**a.** 15° **b.** 30° **c.** 60° **d.** 180°

**25.** The International Date Line is located at the
**a.** 0° line of latitude
**b.** 180° line of latitude
**c.** 0° meridian
**d.** 180° meridian

**26.** When you travel east across the International Date Line, you
**a.** advance your calendar one day
**b.** advance your calendar 12 hours
**c.** move your calendar back one day
**d.** move your calendar back 12 hours

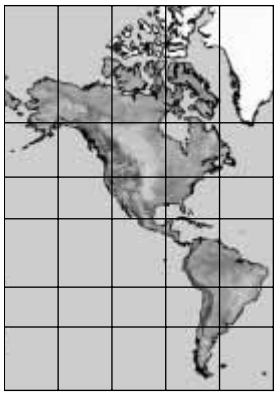
## SECTION 2.2 *Types of Maps*

*In your textbook, read about Mercator, conic, and gnomonic projections.*
**Label each map projection as *conic*, *gnomonic* or *Mercator*.**



**1.** _____

**2.** _____



**3.** _____

**Write the name of the map projection—*Mercator*, *conic*, or *gnomonic*—for each description.**

_____ **4.** Used as road and weather maps

_____ **5.** Has parallel lines of latitude and longitude

_____ **6.** Made by projecting points and lines from a globe onto a piece of paper that touches the globe at a single point

_____ **7.** Distorts direction and distance between landmasses

_____ **8.** Exaggerates the areas of landmasses near the poles, but correctly shows their shape

_____ **9.** Made by projecting points and lines from a globe onto a cone

_____ **10.** Has very little distortion in the areas or shapes of landmasses that fall along a certain line of latitude

_____ **11.** Used by navigators to plot great-circle routes

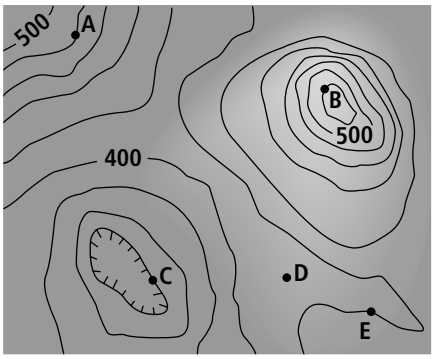
## SECTION 2.2 *Types of Maps, continued*

*In your textbook, read about topographic maps and contour lines.*
**Use each of the terms below just once to complete the passage.**

**contour interval** **contour lines** **hachures** **index contours** **topographic maps**

Maps that show changes in elevation of Earth's surface are called **(12)** _____. On this kind of map, points of equal elevation are connected by **(13)** _____. The difference in elevation between two side-by-side contour lines is called the **(14)** _____. Contour lines whose elevation is marked by a number on the map are known as **(15)** _____. Contour lines that indicate depressions have **(16)** _____, or short lines at right angles to the contour lines.

**The contour interval on the map below is 20 m.**
**Use the contour map to answer the following questions.**




**17.** Which of the labeled points on the map has the highest elevation?

_____

**18.** What is the elevation of the highest labeled point?

_____

**19.** Which of the labeled points on the map has the lowest elevation?

_____

**20.** What is the elevation of the lowest labeled point?

_____

## SECTION 2.2 *Types of Maps, continued*

*In your textbook, read about map legends and map scales.*
**Use each of the terms below to complete the following statements.**

**fractional scale** **graphic scale** **map legend** **map scale** **verbal scale**

**21.** A _____ explains what the symbols on a map represent.

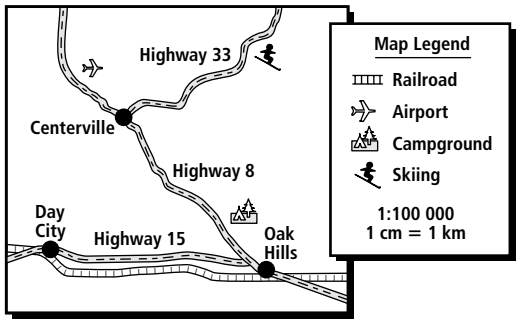
**22.** To measure distances on a map, you need to use the _____, of which there are three types.

**23.** A _____ expresses distance as a statement, such as one centimeter is equal to one kilometer.

**24.** A _____ consists of a line that represents a certain unit of distance, such as 5 km.

**25.** A _____ expresses distance as a ratio, such as 1:63 500.

**The map and map legend below have been reduced to fit this space. Use the map and the map legend to answer the following questions.**




**26.** Which city on the map is closest to a campground?

_____

**27.** Which highway leads to a skiing area?

_____

**28.** Which two cities are connected by a railroad?

_____

**29.** Look at the verbal scale. If the distance from Centerville to Oak Hills is 10 km, how far apart should these cities be on the map?

_____

## SECTION 2.3 *Remote Sensing*

*In your textbook, read about the electromagnetic spectrum.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**1.** The arrangement of electromagnetic radiation is called
**a.** remote sensing **c.** the radiation pattern
**b.** wave imaging **d.** the electromagnetic spectrum

**2.** Which term describes the number of waves that pass a particular point each second?
**a.** speed **b.** frequency **c.** wavelength **d.** wave height

**3.** Which of the following is NOT a type of electromagnetic radiation?
**a.** X rays **b.** ultraviolet waves **c.** ocean waves **d.** microwaves

**4.** The speed of light in a vacuum is
**a.** 300 000 km/s **b.** 300 km/s **c.** 300 m/s **d.** 3 m/s

**5.** Which form of electromagnetic radiation has the highest frequency?
**a.** visible light **b.** radio waves **c.** gamma rays **d.** infrared waves

**6.** Which form of electromagnetic radiation has the lowest frequency?
**a.** visible light **b.** radio waves **c.** gamma rays **d.** infrared waves

*In your textbook, read about Landsat satellites, the* Topex/Poseidon *satellite, and the Global Positioning System.*
**Write the name of the remote sensing device—Landsat, *Topex/Poseidon*, or GPS—for each description.**

_____ **7.** Uses a system of 24 satellites that transmit microwaves

_____ **8.** Uses radar to map features, such as mountains and valleys, that are on the ocean floor

_____ **9.** Uses a handheld receiver to help people determine their exact position on Earth

_____ **10.** Creates images that show surface features as different colors

_____ **11.** Used for ship and airplane navigation

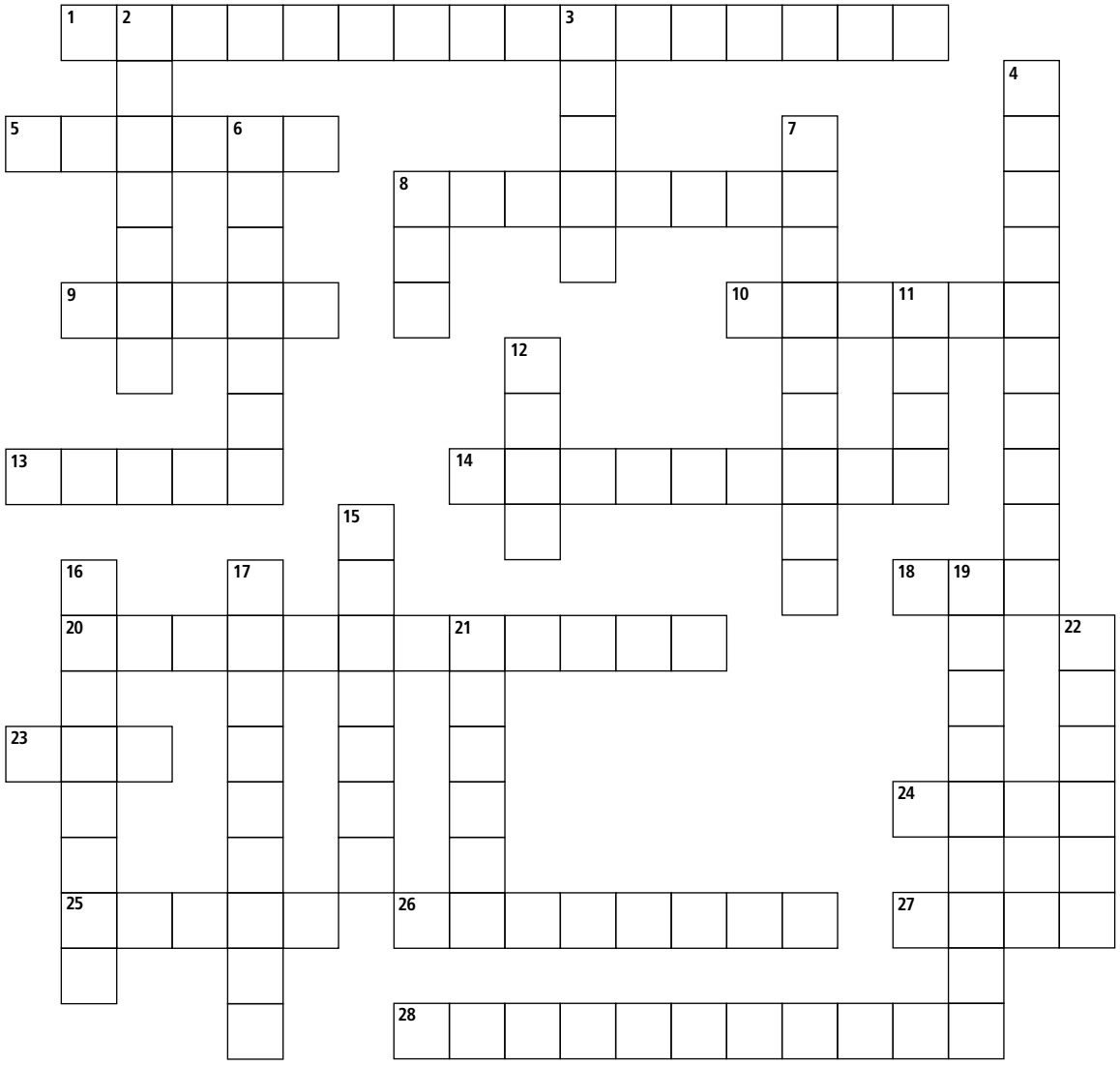
_____ **12.** Picks up bulges and depressions in ocean water

UNIT 1 STUDY GUIDE FOR CONTENT MASTERY

*GeoDigest*

# Earth Science

**Read the clues on the next page and use your answers to each clue to complete the crossword puzzle below.**



## ACROSS

**1.** Explanation based on observations from repeated experiments
**5.** Part of the lithosphere
**8.** Measurement of distance in degrees north or south of the equator
**9.** Satellite _____ *-Poseidon*
**10.** SI unit for weight
**13.** _____ make up the crust and upper mantle.
**14.** All the life and habitats on Earth
**18.** 24 hours equal one _____.
**20.** Study of Earth's oceans
**23.** Nitrogen is a _____ that makes up part of Earth's atmosphere.
**24.** Number of branches of Earth science
**25.** Part of Earth's hydrosphere
**26.** Map projection that shows true direction
**27.** Each time _____ on Earth represents a different hour.
**28.** Study of Earth's atmosphere

## DOWN

**2.** A standard for comparison in an experiment
**3.** Projection suitable for mapping a small area
**4.** Application of scientific discoveries
**6.** Parts of maps that explain the symbols
**7.** Type of variable that changes in response to the independent variable
**8.** The basic fact that describes the behavior of a natural phenomenon is called scientific _____.
**11.** Measured in hours, minutes, and seconds
**12.** Lines of latitude and longitude form this system used to locate exact positions on Earth.
**15.** Study of Earth's materials and the processes that form them
**16.** The system in which a number is expressed as a multiplier and a power of ten is called scientific _____.
**17.** Geology is the study of Earth _____.
**19.** Study of objects beyond Earth's atmosphere
**21.** Gathering data from far above Earth is called _____ sensing.
**22.** One _____ Celsius

Name Class Date

CHAPTER 3 STUDY GUIDE FOR CONTENT MASTERY

# Matter and Atomic Structure

## SECTION 3.1 *What are elements?*

*In your textbook, read about elements and atomic structure.*
**Use each of the terms below just once to complete the passage.**

**atom electrons element neutrons nucleus protons**

A(n) **(1)** _____ is a substance that cannot be broken down into simpler substances. A(n) **(2)** _____ is the smallest particle of matter having all that element's characteristics. It is made up of smaller particles. The **(3)** _____ is made up of protons and neutrons. Small particles that have mass and positive electrical charges are **(4)** _____. Particles that have about the same mass as protons, but that are electrically neutral are **(5)** _____. Surrounding the nucleus of an atom are tiny particles called **(6)** _____, which have little mass, but have negative electrical charges that are exactly the same magnitude as the positive charges of protons.

*In your textbook, read about atomic structure and isotopes.*
**Complete each statement.**

**7.** The number of protons in an atom's nucleus is the _____.

**8.** When atoms of the same element have different mass numbers, they are known as _____ of that element.

**9.** The spontaneous process through which unstable nuclei emit radiation is called _____.

**10.** A(n) _____ represents the area in an atom where an electron is most likely to be found.

**11.** The outermost electrons of an atom are called _____.

**12.** The combined number of protons and neutrons is the _____.

**13.** The _____ is the average of the mass numbers of the isotopes of an element.

## SECTION 3.1 *What are elements?, continued*

*In your textbook, read about electrons in energy levels and isotopes.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**14.** How many electrons can be held in the innermost energy level of atoms?
**a.** 2 **b.** 8 **c.** 18 **d.** 32

**15.** How many electrons can the fourth energy level hold?
**a.** 2 **b.** 8 **c.** 18 **d.** 32

**16.** Many elements are mixtures of
**a.** oxygen. **b.** electrons. **c.** neutrons. **d.** isotopes.

**17.** The chemical behavior of different elements is determined by the
**a.** number of electrons in the innermost energy level.
**b.** number of electrons in the middle energy level.
**c.** number of electrons in the outermost energy level.
**d.** total number of electrons in all of the energy levels.

**18.** How many electrons can an atom's third energy level hold?
**a.** 2 **b.** 8 **c.** 18 **d.** 32

**19.** Elements with a full outermost energy level are
**a.** unlikely to combine chemically with other elements.
**b.** likely to combine chemically with other elements.
**c.** likely to combine with inert elements.
**d.** likely to combine with many elements at one time.

**20.** The identity of an element is defined by its number of
**a.** electrons.
**b.** protons.
**c.** neutrons.
**d.** isotopes.

**21.** How many electrons can an atom's second energy level hold?
**a.** 2 **b.** 8 **c.** 18 **d.** 32

## SECTION 3.2 *How Atoms Combine*

*In your textbook, read about different types of bonds, chemical reactions, and mixtures.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** A combination of two or more components that retain their identity | **a.** acid |
| _____ | **2.** The attraction of two atoms for a shared pair of electrons that hold the atoms together | **b.** base |
| _____ | **3.** A substance that is composed of atoms of two or more different elements that are chemically combined | **c.** chemical bonds |
| _____ | **4.** A solution containing a substance that produces hydrogen ions ($H^+$) in water | **d.** chemical reaction |
| _____ | **5.** An atom that gains or loses an electron and is a charged particle | **e.** compound |
| _____ | **6.** Composed of two or more atoms held together by covalent bonds | **f.** covalent bond |
| _____ | **7.** A homogeneous mixture | **g.** ion |
| _____ | **8.** The attractive force between two ions of opposite charge | **h.** ionic bond |
| _____ | **9.** The forces that hold the elements together in a compound | **i.** mixture |
| _____ | **10.** A solid homogeneous mixture | **j.** molecule |
| _____ | **11.** A solution characterized by the formation of hydroxide ions ($OH^-$) | **k.** solid solution |
| _____ | **12.** The change of one or more substances into other substances | **l.** solution |

## SECTION 3.2 *How Atoms Combine, continued*

*In your textbook, read about chemical bonds.*
**Complete the table below by writing the type or types of chemical bond found in the type of matter on the left. Use the following types of chemical bonds: *covalent, ionic, metallic.***

| Matter | Type of Chemical Bond Present |
|---|---|
| **13.** Molecule | |
| **14.** Hydrogen gas ($H_2$) | |
| **15.** Magnesium oxide (MgO) | |
| **16.** Metal | |
| **17.** Table salt (NaCl) | |
| **18.** Sodium monoxide ($Na_2O$) | |
| **19.** Water | |

*In your textbook, read about chemical reactions and mixtures.*
**Examine equations A and B below. Then answer the questions.**

(A) $2H_2 + O_2 \Rightarrow 2H_2O$ (B) $H_2CO_3 \rightarrow H^+ + HCO_3^-$

_____ **20.** Which equation represents the formation of water?

_____ **21.** Which equation represents the formation of an acid solution?

_____ **22.** How many atoms of oxygen (O) are on both sides of equation A?

_____ **23.** How many atoms of hydrogen (H) are on both sides of equation A?

_____ **24.** How many atoms of hydrogen (H) are on both sides of equation B?

_____ **25.** In which equation are carbonic acid molecules broken apart into hydrogen ions and bicarbonate ions?

## SECTION 3.3 *States of Matter*

*In your textbook, read about the cycles of matter and the different states of matter.*
**For each statement below, write *true* or *false.***

_____ **1.** Most solids have a crystalline structure in which the particles are arranged in regular geometric patterns.

_____ **2.** Hot, highly ionized, electrically conducting gas is called plasma.

_____ **3.** The change of state from solid to gas without an intermediate liquid state is called evaporation.

_____ **4.** A glass is a solid that consists of densely packed atoms arranged at random.

_____ **5.** The change from a solid to a liquid is called condensation.

_____ **6.** The process of changing from a liquid to a gas is called sublimation.

_____ **7.** There are only three states of matter in the universe.

_____ **8.** Matter cannot be created or destroyed.

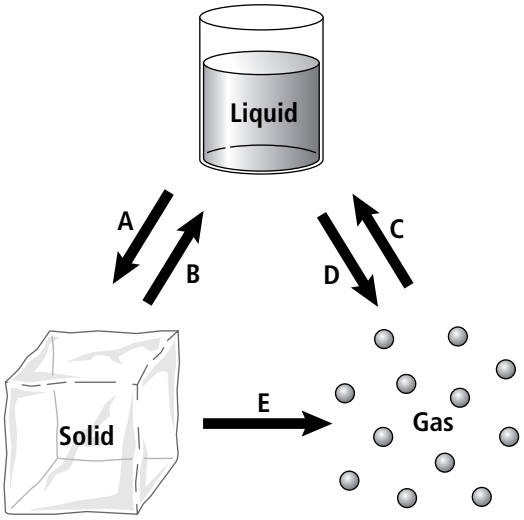
*In your textbook, read about the states of matter.*
**Complete the table by filling in the missing information.**

**The States of Matter**

| State of Matter | Definition of State | Example |
|---|---|---|
| **9.** | Hot, highly ionized, electrically conducting gases | Lightning, neon sign, the Sun, other stars |
| **10.** Liquid | | |
| **11.** | Made of densely packed particles arranged in a definite pattern; has both a definite shape and volume | |
| **12.** | | Helium |

## SECTION 3.3 *States of Matter, continued*

*In your textbook, read about changes of state.*
**Examine the diagram below. Then answer the questions.**




**13.** What change of state is represented by arrow A?

**14.** What change of state is represented by arrow B?

**15.** What change of state is represented by arrow C?

**16.** What change of state is represented by arrow D?

**17.** What change of state is represented by arrow E?

**18.** How is thermal energy involved in the processes of melting and evaporation?

**19.** How is thermal energy involved in the processes of freezing and condensation?

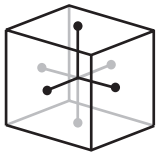
Name Class Date

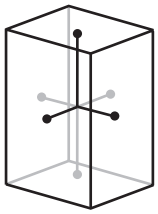
CHAPTER 4 STUDY GUIDE FOR CONTENT MASTERY

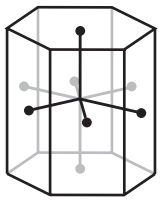
# Minerals

## SECTION 4.1 *What is a mineral?*

*In your textbook, read about mineral characteristics.*
**Label each diagram as *tetragonal*, *hexagonal*, or *cubic*.**







**1.** _____ **2.** _____ **3.** _____

**Answer the following questions.**

**4.** What is a mineral?

**5.** Why is salt classified as a mineral, but sugar is not?

**6.** Can minerals occur as liquids? Why or why not?

**7.** Can the chemical composition of a single mineral vary? Explain your answer.

**8.** What is a crystal?

**9.** How does forming in a restricted space affect the structure of a crystal?

## SECTION 4.1 *What Is a mineral?, continued*

*In your textbook, read about minerals that formed from magma and that formed from solution.*
**For each statement, write *true* or *false*.**

_____ **10.** Minerals can form from the cooling of magma.

_____ **11.** Density differences can force magma upward into cooler layers of Earth's interior.

_____ **12.** If magma cools slowly, atoms do not have time to arrange themselves into large crystals.

_____ **13.** Small crystals form from rapidly cooling magma.

_____ **14.** When liquid evaporates from a solution, the remaining elements cannot form crystals.

_____ **15.** Minerals can form from elements dissolved in a solution.

_____ **16.** If a solution remains unsaturated, mineral crystals may precipitate.

*In your textbook, read about mineral groups.*
**Complete the table by filling in the following terms: *silicates*, *carbonates*, *oxides*.**

| Mineral Group | Description |
|---|---|
| **17.** _____ | Calcite, dolomite, and rhodochrosite are examples. |
| **18.** _____ | Readily form silica tetrahedrons |
| **19.** _____ | Composed of one or more metallic elements with the carbonate compound $CO_3$ |
| **20.** _____ | Composed of silicon, oxygen, and another element |
| **21.** _____ | Compounds of oxygen and a metal |
| **22.** _____ | Magnetite and hematite, both sources of iron, are examples. |
| **23.** _____ | The most common minerals, feldspar and quartz, are examples. |
| **24.** _____ | Primary minerals in limestone and marble |

## SECTION 4.2 *Identifying Minerals*

*In your textbook, read about mineral identification.*
**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **cleavage** | **color** | **fracture** | **hardness** |
| **luster** | **specific gravity** | **streak** | **texture** |

Geologists use physical properties to identify minerals. For example, the **(1)** _____ of a mineral is caused by the presence of different trace elements. The way a mineral reflects light from its surface is called **(2)** _____, which is described as metallic or nonmetallic. How a mineral feels to the touch is called **(3)** _____. A mineral's **(4)** _____ is the color of a mineral when it is broken up and powdered. A measure of how easily a mineral can be scratched is called **(5)** _____.

Another property describes how a mineral will break. If a mineral splits easily and evenly along one or more planes, it has the property of **(6)** _____, while minerals that break along jagged edges are said to have **(7)** _____. The density of a mineral is usually expressed as **(8)** _____, which is the ratio of the weight of a substance to the weight of an equal volume of water at 4°C.

**Answer the following questions.**

**9.** Can all minerals produce a streak on a porcelain plate? Why or why not?

_____

_____

**10.** Can minerals with cleavage have more than one cleavage plane? If so, give an example.

_____

_____

**11.** What is the difference between density and specific gravity?

_____

_____

_____

**12.** How many minerals are represented on the Mohs scale of mineral hardness? What is the range of hardness of those minerals?

_____

_____

## SECTION 4.2 *Identifying Minerals, continued*

**Circle the letter of the choice that best completes the statement.**

**13.** Identification tests for minerals are based on their
- **a.** scientific names.
- **b.** physical and chemical properties.
- **c.** value as ores.
- **d.** value as gems.

**14.** The appearance of milky quartz is caused by
- **a.** its high density.
- **b.** its hardness.
- **c.** its magnetism.
- **d.** trapped bubbles of gas and liquid.

**15.** A mineral's hardness with respect to other minerals can be determined by
- **a.** its specific gravity.
- **b.** its cleavage planes.
- **c.** the Mohs scale of mineral hardness.
- **d.** its magnetic properties.

**16.** Minerals break along planes where atomic bonds are
- **a.** weak.
- **b.** strong.
- **c.** dense.
- **d.** magnetic.

**17.** Minerals, such as quartz, that break along jagged edges are said to have
- **a.** cleavage.
- **b.** density.
- **c.** fracture.
- **d.** special properties.

**18.** The ratio of the weight of a substance to the weight of an equal volume of water at 4°C is its
- **a.** chemical composition.
- **b.** weight.
- **c.** specific gravity.
- **d.** hardness.

*In your textbook, read about special properties of minerals.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**19.** In double refraction, light is
- **a.** bent in two directions.
- **b.** bent in one direction.
- **c.** obscured by gas bubbles in the crystal.
- **d.** changed to a magnetic field.

**20.** Calcite bubbles when it comes in contact with hydrochloric acid because the calcite releases
- **a.** tetrahedron crystals.
- **b.** $CO_2$ in the form of a gas.
- **c.** $H_2O$ in the form of a liquid.
- **d.** zircon.

**21.** Lodestone can pick up iron filings. What special property does lodestone have?
- **a.** a sticky texture
- **b.** extreme heaviness
- **c.** magnetism
- **d.** a rotten-egg smell

## SECTION 4.2 *Identifying Minerals, continued*

*In your textbook, read about mineral uses.*
**Answer the following questions.**

**22.** What makes a mineral an ore?

**23.** Is aluminum an ore? Explain your answer.

**24.** Can the classification of a mineral as an ore change? If so, how?

**25.** How are ores deep beneath Earth's surface removed?

**26.** How are ores near Earth's surface removed?

**27.** What two problems can result from removing waste material from ores?

## SECTION 4.2 *Identifying Minerals, continued*

*In your textbook, read about mineral uses.*
**Use each of the terms below to complete the statements.**

**open-pit mines** **ore** **underground mining** **waste material**

**28.** A(n) _____ is a mineral that contains a useful substance that can be mined at a profit.

**29.** An ore located deep within Earth's crust is removed by _____.

**30.** An ore near Earth's surface is obtained from large _____.

**31.** Unwanted rock and dirt, known as _____, are dug up along with valuable ore.

*In your textbook, read about gems.*
**Use each of the terms below to complete the statements.**

**abrasive** **emeralds** **gem** **trace elements**

**32.** A(n) _____ is a valuable mineral prized for its rarity and beauty.

**33.** Because of their relative rareness, rubies and _____ are more valuable than diamonds.

**34.** The presence of _____ can make one variety of a mineral more colorful and thus more prized than other varieties of the same mineral.

**35.** The mineral corundum, which is often used as a(n) _____, can also be found as rubies and sapphires.

CHAPTER 5 STUDY GUIDE FOR CONTENT MASTERY

# Igneous Rocks

## SECTION 5.1 *What are igneous rocks?*

*In your textbook, read about the nature of igneous rocks.*
**Use each of the terms below just once to complete the following statements.**

| | | |
|---|---|---|
| **extrusive** | **igneous rock** | **intrusive** |
| **lava** | **magma** | |

**1.** Molten rock inside Earth's crust is called _____.

**2.** A(n) _____ is formed from the crystallization of magma.

**3.** Magma that flows out onto Earth's surface is called _____.

**4.** Fine-grained igneous rocks that cool quickly on Earth's surface are called _____ igneous rocks.

**5.** Coarse-grained igneous rocks that cool slowly beneath Earth's surface are called _____ igneous rocks.

*In your textbook, read about the composition and origins of magma.*
**For each statement below, write *true* or *false.***

_____ **6.** Magma is often a slushy mix of molten rock, gases, and mineral crystals.

_____ **7.** The elements found in magma are quite different from those found in Earth's crust.

_____ **8.** Silica is the most abundant compound found in magma.

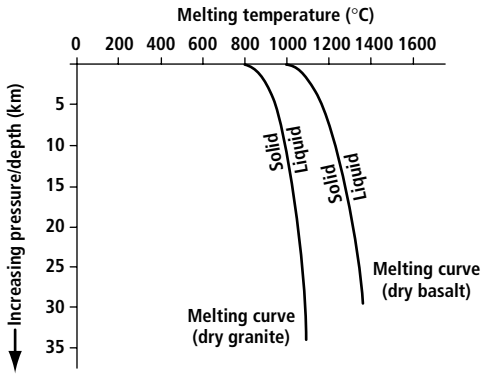
_____ **9.** Magmas are classified as intrusive or extrusive.

_____ **10.** In the laboratory, rocks must be heated from 8000°C to 12 000°C before they melt.

_____ **11.** Heat in the upper mantle and lower crust may come, in part, from the decay of radioactive elements.

## SECTION 5.1 *What are igneous rocks?, continued*

*In your textbook, read about factors that affect magma formation.*
**Use the diagram to answer the following questions.**




**12.** How does pressure affect the melting point of rock?

_____

**13.** Do all minerals have the same melting point?

_____

**14.** How does temperature change with depth in Earth's crust?

_____

**15.** How does pressure change with depth, and why?

_____

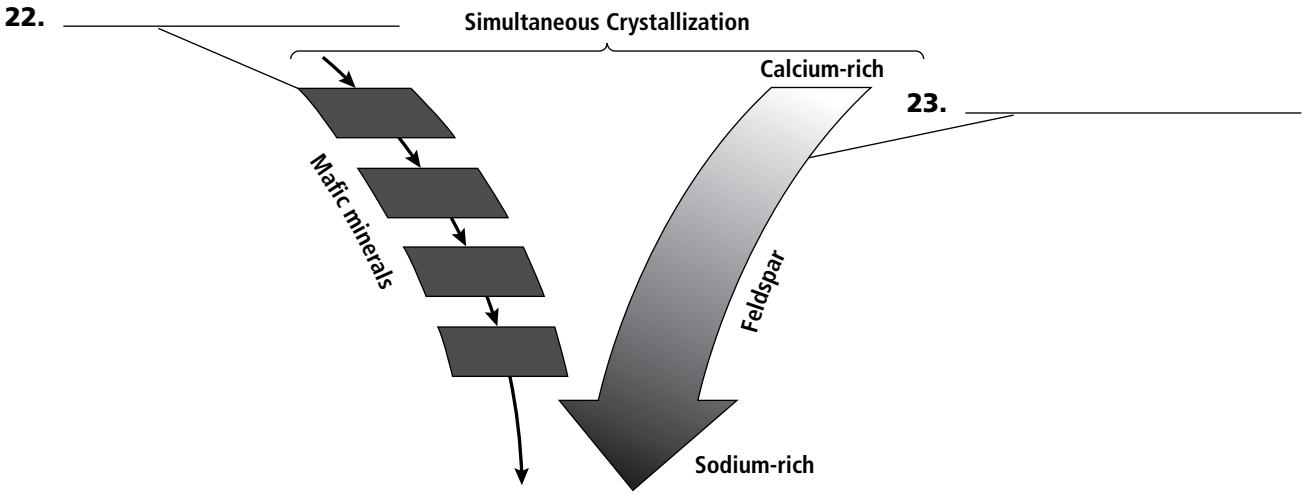
*In your textbook, read about how rocks melt.*
**Use each of the terms below just once to complete the passage.**

| | | |
|---|---|---|
| **elements** | **fractional crystallization** | **reverse** |
| **magma** | **melting points** | **partial melting** |

Because different minerals have different **(16)** _____, not all parts of a rock melt at the same time. The process whereby some minerals melt at low temperatures while other minerals remain solid is called **(17)** _____. As each group of minerals melts, different **(18)** _____ are added to the magma "stew," changing its composition. When the magma cools, it crystallizes in the **(19)** _____ order of partial melting. The process wherein different minerals form at different temperatures is called **(20)** _____. As each group of minerals crystallizes, it removes elements from the remaining **(21)** _____ instead of adding new elements.

## SECTION 5.1 *What are igneous rocks?, continued*

*In your textbook, read about Bowen's reaction series.*
**Label the diagram using either *continuous reaction series* or *discontinuous reaction series.***




**Answer the following questions. Use the diagram to answer questions 24 and 25.**

**24.** The first feldspars to form are rich in what mineral?

**25.** The second feldspars to form are rich in what mineral?

**26.** What causes a zoned crystal?

**27.** How is quartz formed?

## SECTION 5.1 *What are igneous rocks?, continued*

*In your textbook, read about the mineral composition of igneous rocks.*
**Complete the table by filling in one of the following terms: *felsic*, *mafic*, *intermediate*, or *ultramafic*.**

| Description | Type of Igneous Rock |
|---|---|
| **28.** May be formed by fractional crystallization of olivine and pyroxene | |
| **29.** Contains moderate amounts of biotite, amphibole, and pyroxene | |
| **30.** Light-colored, high silica content, contains quartz | |
| **31.** Contains plagioclase, biotite, amphibole, pyroxene, and olivine | |
| **32.** Peridotite and dunites are examples. | |
| **33.** Dark-colored, low silica content, rich in iron and magnesium | |
| **34.** Diorite in an example. | |
| **35.** Gabbro is an example. | |
| **36.** Granite is an example. | |
| **37.** Low silica content, very high iron and magnesium content | |

*In your textbook, read about the grain size of igneous rocks.*
**Answer the following questions.**

**38.** Does obsidian, a glassy rock, have a large grain size or a small grain size?

**39.** Is obsidian an intrusive or extrusive igneous rock? How do you know?

**40.** How does the texture of gabbro compare to that of obsidian?

**41.** Is gabbro an intrusive or extrusive igneous rock? How do you know?

## SECTION 5.2 *Classifying Igneous Rocks*

*In your textbook, read about classifying igneous rocks.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** Rock such as peridotite, which has low silica content and very high levels of iron and magnesium | **a.** felsic |
| _____ | **2.** Rock with two different-sized grains of the same mineral | **b.** mafic |
| _____ | **3.** Rock such as gabbro, which is dark-colored, has low silica content, and is rich in iron and magnesium. | **c.** ultramafic |
| _____ | **4.** Vein of extremely large-grained minerals | **d.** porphyritic |
| _____ | **5.** Rare type of ultramafic rock that can contain diamonds | **e.** pegmatite |
| _____ | **6.** Rock such as granite, which is light-colored and has high silica content | **f.** kimberlite |

*In your textbook, read about the texture of igneous rocks.*
**Answer the following questions.**

**7.** Why do geologists make thin sections?

**8.** How do interlocking edges form in mineral grains?

**9.** Why can minerals that form early in fractional crystallization grow distinct crystal shapes?

**10.** What does a rock with a porphyritic texture look like?

**11.** How do porphyritic textures form?

## SECTION 5.2 *Classifying Igneous Rocks, continued*

*In your textbook, read about igneous rocks as resources.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**12.** Igneous rocks are strong because of their
**a.** temperature.
**b.** color.
**c.** water content.
**d.** interlocking grain textures.

**13.** Which of the following is one of the most durable igneous rocks?
**a.** granite
**b.** sandstone
**c.** marble
**d.** limestone

**14.** Igneous rocks tend to be
**a.** radioactive.
**b.** full of gold.
**c.** resistant to weathering.
**d.** vulnerable to weathering.

**15.** Igneous intrusions often are associated with valuable
**a.** radioactive elements.
**b.** ore deposits.
**c.** oil reservoirs.
**d.** fossil deposits

**16.** Ore deposits sometimes are found as a(n)
**a.** layered intrusion.
**b.** extrusion.
**c.** obsidian deposit.
**d.** molten rock.

**17.** Metal-rich quartz veins are formed at the end of
**a.** volcanic eruptions.
**b.** radioactive decay.
**c.** magma crystallization
**d.** the cooling of Earth's crust.

**18.** What are pegmatites?
**a.** veins of extremely large-grained minerals
**b.** magmas of differing densities
**c.** microscopic, interlocking crystal grains
**d.** small volcanoes

**19.** What are kimberlites?
**a.** felsic rocks
**b.** mafic rocks
**c.** intermediate rocks
**d.** ultramafic rocks

**20.** Diamonds can form only
**a.** under very low pressure.
**b.** under very high pressure.
**c.** above ground.
**d.** near radioactive elements.

Name Class Date

CHAPTER 6 STUDY GUIDE FOR CONTENT MASTERY

# Sedimentary and Metamorphic Rocks

## SECTION 6.1 *Formation of Sedimentary Rocks*

*In your textbook, read about the processes that form sedimentary rocks.*
**Use each of the terms below to complete the following statements.**

| | | | |
|---|---|---|---|
| **cementation** | **chemical weathering** | **clastic sediments** | **deposition** |
| **lithification** | **physical weathering** | **sedimentary rock** | **sorted deposits** |
| **sediment** | **unsorted deposits** | | |

1. _____ consists of solid material that has been deposited on Earth's surface by wind, water, ice, gravity, or chemical precipitation.
2. Glaciers and landslides tend to create _____ in which sediments of different sizes are mixed together.
3. During _____, the minerals in a rock are dissolved or otherwise chemically changed.
4. The process by which mineral growth binds sediment grains together into solid rock is _____.
5. Weathering produces _____, which are rock and mineral fragments.
6. When sediments become cemented together, they form _____.
7. As a result of _____, sediments are laid down on the ground or on the bottom of bodies of water.
8. The physical and chemical process called _____ transforms sediments into sedimentary rocks.
9. During _____, minerals remain chemically unchanged, and rock fragments simply break off of the solid rock along fractures or grain boundaries.
10. Sediments tend to form _____ when transported by water and wind.

## SECTION 6.1 *Formation of Sedimentary Rocks, continued*

*In your textbook, read about lithification.*
**For each statement below, write *true* or *false*.**

_____ **11.** Lithification begins with erosion.

_____ **12.** Muds may contain up to 60 percent water and shrink as excess water is squeezed out.

_____ **13.** Sands are usually poorly compacted during deposition, and they tend to compact a great deal during burial.

_____ **14.** Groundwater, oil, and natural gas are commonly found within pore spaces in sedimentary rocks.

_____ **15.** The temperature in Earth's crust decreases with depth.

_____ **16.** Sediments buried 3 to 4 km deep experience temperatures that start the chemical and mineral changes that cause cementation.

_____ **17.** In one type of cementation, a new mineral grows between sediment grains.

_____ **18.** In one type of cementation, existing mineral grains grow larger as the same mineral precipitates and crystallizes around them.

*In your textbook, read about the features of sedimentary rocks.*
**Use each of the terms below to complete the passage.**

| | | | |
|---|---|---|---|
| **cross-bedding** | **fossils** | **graded bedding** | **lithification** |
| **ripple marks** | **sand dunes** | **transport** | **bedding** |

The primary feature of sedimentary rocks is **(19)** _____, or horizontal layering. The type of bedding that occurs depends upon the sediment's method of **(20)** _____. Bedding is called **(21)** _____ when the heaviest and coarsest material is on the bottom. A second type of bedding called **(22)** _____ forms as inclined layers of sediment migrate forward across a horizontal surface. Large-scale cross-bedding can be formed by migrating **(23)** _____. When sediment is moved into small ridges by wind or wave action, **(24)** _____ can form. Many sedimentary rocks contain **(25)** _____, the preserved remains, impressions, or any other evidence of once-living organisms. During **(26)** _____, parts of an organism can be replaced by minerals and turned into rock.

## SECTION 6.2 *Types of Sedimentary Rocks*

*In your textbook, read about the about different types of sedimentary rocks.*
**Complete the table by filling in the type of sedimentary rock described: *clastic*, *organic*, or *chemical*.**

| Description | Type of Sedimentary Rock |
|---|---|
| **1.** Breccias and conglomerates are examples. | |
| **2.** Classified by particle size | |
| **3.** Coal is an example. | |
| **4.** Formed from the remains of once-living things | |
| **5.** Formed from deposits of loose sediments | |
| **6.** Often contains calcite, halite, or gypsum | |
| **7.** Forms evaporites | |
| **8.** Sandstone is a medium-grained example. | |
| **9.** Formed from precipitation and growth of mineral crystals | |
| **10.** Formed from the shells of sea organisms | |

*In your textbook, read about how sedimentary rocks form and their importance to humans.*
**Answer the following questions.**

**11.** How does fossil-containing limestone form?

**12.** What is coal composed of, and how do humans use it?

**13.** What information can fossils provide?

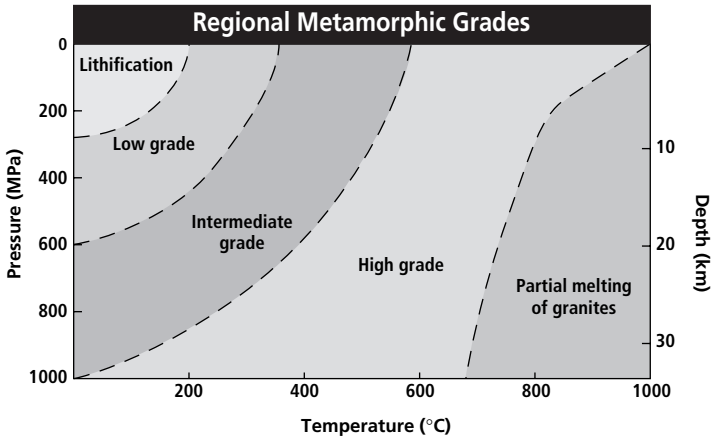
**14.** What do some of the features of sedimentary rocks indicate about ancient bodies of water?

## SECTION 6.3 *Metamorphic Rocks*

*In your textbook, read about metamorphic rocks.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **1.** Occurs when rocks come into contact with molten rock | **a.** contact metamorphism |
| _____ **2.** Rock whose texture, mineralogy, or chemical composition has been altered without melting it | **b.** foliated metamorphic rock |
| _____ **3.** Metamorphism resulting from high temperature and pressure that affects a large region | **c.** nonfoliated metamorphic rock |
| _____ **4.** Large crystals of new metamorphic minerals | **d.** metamorphic rock |
| _____ **5.** Occurs when very hot water reacts with rock | **e.** hydrothermal metamorphism |
| _____ **6.** Characterized by wavy layers and bands of light and dark minerals | **f.** porphyroblasts |
| _____ **7.** Composed mainly of minerals with blocky crystal shapes | **g.** regional metamorphism |

*In your textbook, read about types of metamorphism.*
**Use the diagram to answer the following questions.**




**8.** What grades of regional metamorphism are shown on the graph?

_____

**9.** Which grades represent the highest pressure conditions?

_____

**10.** Which grade generally occurs between 0 and 20 km below Earth's surface?

_____

## SECTION 6.3 *Metamorphic Rocks, continued*

*In your textbook, read about causes and types of metamorphism.*
**Circle the letter of the choice that best completes the statement.**

**11.** The pressure required for metamorphism can be generated by
- **a.** pressure from weight of overlying rock.
- **b.** heat from magma bodies in contact with surrounding rock.
- **c.** cementation and lithification.
- **d.** hydrothermal solutions.

**12.** A regional metamorphic belt is divided into zones based upon
- **a.** the number of volcanoes in the area.
- **b.** mineral groups found in the rocks.
- **c.** types of fossils found in the rocks.
- **d.** current underground temperatures.

**13.** Contact metamorphism occurs under conditions of
- **a.** high temperature and high pressure.
- **b.** high temperature and moderate-to-low pressure.
- **c.** low temperature and very high pressure.
- **d.** low temperature and moderate-to-low pressure.

**14.** Minerals that crystallize at higher temperatures as a result of contact metamorphism tend to be found near
- **a.** coal deposits.
- **b.** bodies of water.
- **c.** coral reefs.
- **d.** igneous intrusions.

**15.** The type of metamorphism that occurs when very hot water reacts with and alters the mineralogy of rock is
- **a.** contact.
- **b.** regional.
- **c.** hydrothermal.
- **d.** local.

**16.** Metamorphic rocks in which the long axes of their minerals are perpendicular to the pressure that altered them are described as
- **a.** marble-like.
- **b.** quartzite-like.
- **c.** foliated.
- **d.** nonfoliated.

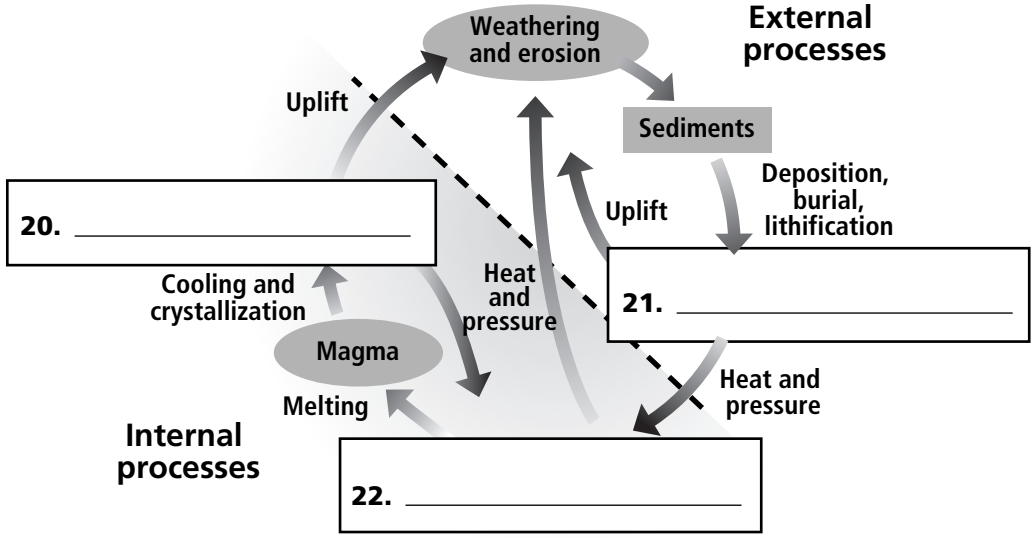
**17.** Metamorphic rocks that lack mineral grains with long axes oriented in one direction are described as
- **a.** marble-like.
- **b.** quartzite-like.
- **c.** foliated.
- **d.** nonfoliated.

**18.** Porphyroblasts differ from the minerals surrounding them in terms of
- **a.** size.
- **b.** color.
- **c.** axis of orientation.
- **d.** shape.

**19.** Hot fluids migrating into and out of a rock during metamorphism can change the rock's
- **a.** chemistry.
- **b.** energy.
- **c.** grade.
- **d.** fossil content.

## SECTION 6.3 *Metamorphic Rocks, continued*

*In your textbook, read about the rock cycle.*
**Label each blank below as *igneous rocks*, *sedimentary rocks*, or *metamorphic rocks*.**




**Answer the following questions.**

**23.** How are igneous rocks formed?

_____

**24.** What happens to igneous rocks that undergo weathering and erosion?

_____

**25.** How do sediments become sedimentary rock?

_____

_____

**26.** What forces cause sedimentary rocks to be transformed into metamorphic rocks?

_____

**27.** How can metamorphic rock be transformed into igneous rock?

_____

_____

**28.** How can sandstone be transformed into sediment without becoming metamorphic or igneous rock first?

_____

UNIT 2 STUDY GUIDE FOR CONTENT MASTERY

*GeoDigest*

# Composition of Earth

**Use the terms below to complete the following word "equations."**

**amethyst** **atom** **molecule** **metamorphism** **oxygen** **small crystals**

**1.** protons + electrons + neutrons = _____

**2.** atom of element A + atom of element B = _____

**3.** _____ + another element = silicate, carbonate, or oxide

**4.** quartz + manganese = _____

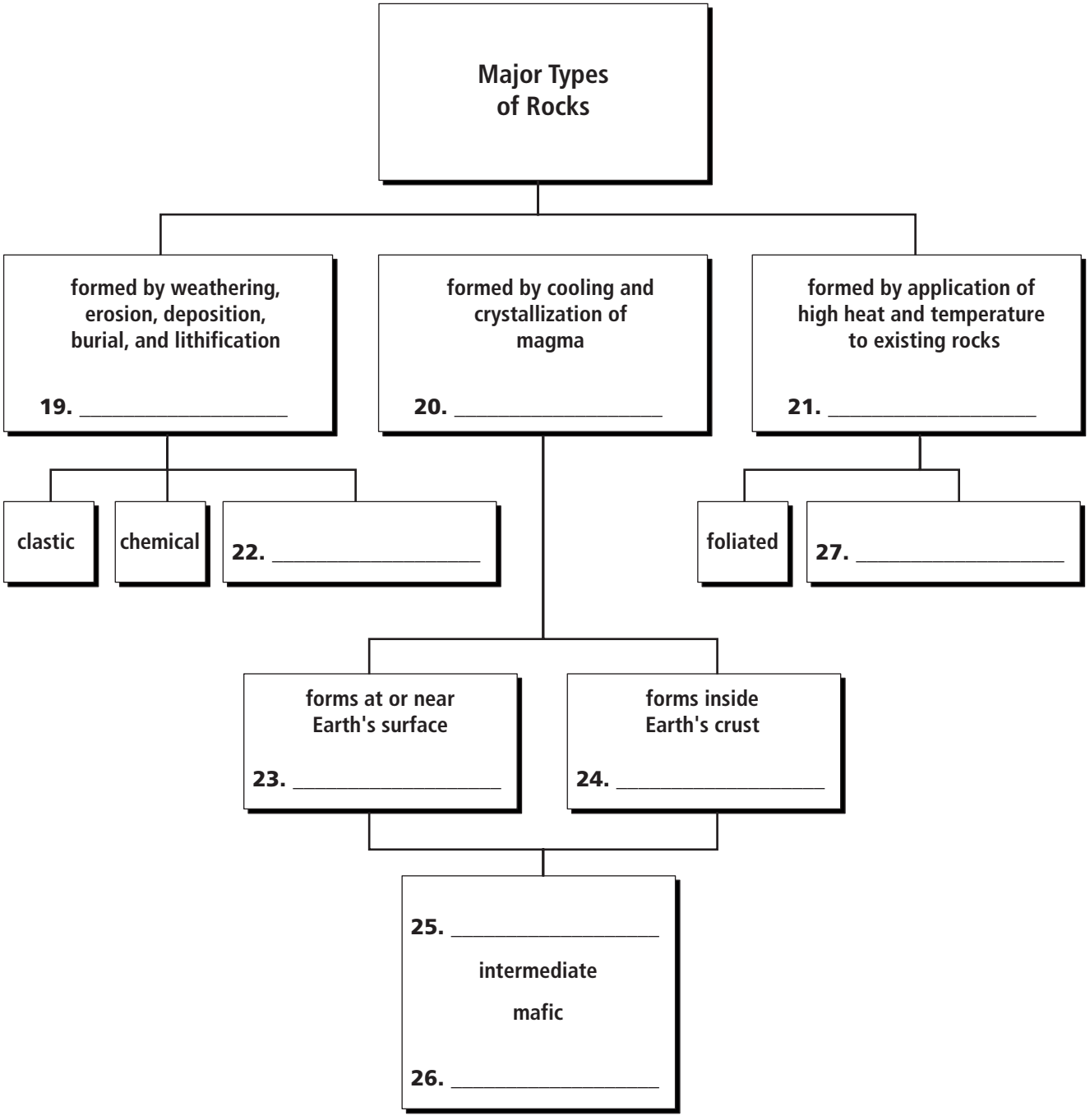
**5.** large crystals + _____ = porphyritic textures

**6.** rocks + high temperature + pressure = _____

**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **7.** Substance consisting of atoms with a specific number of protons in their nuclei | **a.** luster |
| _____ | **8.** Electrically charged atoms or groups of atoms | **b.** mixture |
| _____ | **9.** Solution containing hydrogen atoms | **c.** solid |
| _____ | **10.** Solution containing hydroxide atoms | **d.** mineral |
| _____ | **11.** Combination of components that retain their identities | **e.** element |
| _____ | **12.** Physical state of matter usually having a crystalline structure | **f.** acid |
| _____ | **13.** Physical state of densely packed mobile particles | **g.** ore |
| _____ | **14.** Physical state of widely separated individual particles | **h.** plasma |
| _____ | **15.** Fourth state of matter of hot, highly ionized, electrically conductive gas | **i.** liquid |
| _____ | **16.** Naturally occurring inorganic solid with a specific composition and structure | **j.** gas |
| _____ | **17.** Mineral containing a useful substance that can be mined at a profit | **k.** ions |
| _____ | **18.** Description of how a mineral reflects light | **l.** base |

**Complete the concept map by filling in the missing information.**



Name Class Date

CHAPTER 7 STUDY GUIDE FOR CONTENT MASTERY

# Weathering, Erosion, and Soil

## SECTION 7.1 *Weathering*

*In your textbook, read about weathering.*
**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **1.** *Weathering* is the process by which rocks on or near Earth's surface break down and change.

_____ **2.** The removal and transport of weathered materials from one location to another is called *erosion.*

_____ **3.** Weathering must take place *before* erosion.

_____ **4.** Acid precipitation has a pH value *above* 5.6.

_____ **5.** The repeated thawing and freezing of water in the cracks of rocks is called *frost wedging.*

_____ **6.** Water, oxygen, carbon dioxide, and acids are significant agents of *mechanical* weathering.

_____ **7.** Hydrolysis occurs in the decomposition of *iron ore.*

_____ **8.** The chemical reaction of *carbon dioxide* with other substances is called oxidation.

**Circle the letter of the choice that best completes the statement or answers the question.**

**9.** The reaction below is an example of which of the following processes?

$$2FeO_4 + \tfrac{1}{2}O_2 \rightarrow 3Fe_2O_3$$

**a.** oxidation **b.** erosion **c.** hydrolysis **d.** mechanical weathering

**10.** The pH scale is used to measurement which of the following?
**a.** oxidation **b.** erosion **c.** acidity **d.** precipitation

**11.** The process by which outer layers of rock are stripped away is called
**a.** chemical weathering. **b.** oxidation. **c.** exfoliation. **d.** frost wedging.

**12.** In which of the following climates would physical weathering most readily occur?
**a.** wet and warm **b.** dry and warm **c.** wet and hot **d.** dry and cool

**13.** Large amounts of carbonic acid are found in
**a.** the soil. **b.** acid precipitation. **c.** limestone. **d.** automobile exhaust.

**14.** Buildings and monuments that are made of limestone are greatly damaged by
**a.** hydrolysis. **b.** acid precipitation. **c.** oxidation. **d.** frost wedging.

**15.** Which of the following factors does NOT exert pressure on rocks that leads to physical weathering?
**a.** plant roots **b.** overlying rocks **c.** freezing water **d.** carbonic acid

## SECTION 7.1 *Weathering, continued*

*In your textbook, read about weathering and what affects the rate at which weathering occurs.*
**Use the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **water** | **acid precipitation** | **carbonic acid** | **carbon dioxide** |
| **temperature** | **mechanical** | **composition** | **pressure** |

The process by which rocks and minerals break down into smaller pieces is **(16)** _____ weathering, also called physical weathering. Two factors that play a significant role in this type of weathering are **(17)** _____ and **(18)** _____. To some extent, the **(19)** _____ of rocks determines the effects that chemical weathering will have on them. **(20)** _____ is an important agent in chemical weathering because it can dissolve many kinds of minerals. An atmospheric gas that contributes to the chemical weathering process is **(21)** _____, which is produced by living organisms. When this gas combines with water, it produces a weak acid called **(22)** _____. Another agent of chemical weathering is **(23)** _____, which is caused mainly by emissions of sulfur dioxide and nitrogen oxides.

**Answer the following questions.**

**24.** What climate conditions promote chemical weathering?

**25.** What rock type is most easily weathered? Why?

**26.** How is surface area related to weathering?

**27.** How does slope affect the rate of weathering?

## SECTION 7.2 *Erosion and Deposition*

*In your textbook, read about erosion and deposition.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** The final stage of the erosional process in which materials are dropped in another location | **a.** slope |
| _____ | **2.** The force that tends to pull all materials downhill | **b.** ocean waves |
| _____ | **3.** The steeper the _____, the greater the potential for flowing water to erode earth materials. | **c.** wind |
| _____ | **4.** Coastal areas undergo erosion by _____ and wind. | **d.** glaciers |
| _____ | **5.** Erode by scraping, gouging, and picking up large rocks and debris piles | **e.** gravity |
| _____ | **6.** A major erosional agent in areas with limited precipitation and high temperatures | **f.** deposition |

**Answer the following questions.**

**7.** Give two examples of how plants and animals move Earth's surface materials from one place to another as they carry on their life processes.

**8.** Explain rill erosion and how it differs from gully erosion.

**9.** Describe the formation of barrier islands.

## SECTION 7.2 *Erosion and Deposition, continued*

**The following statements list types of erosion. Using the numbers 1–4, label them by their ability to transport materials.**

_____ **1.** wind erosion

_____ **2.** water erosion

_____ **3.** glacial erosion

_____ **4.** plant and animal erosion

**For each statement below, write *true* or *false*.**

_____ **5.** When a river enters a large body of water, the water generally slows down and deposits large amounts of sediments.

_____ **6.** The Nile Delta was formed from ocean waves and currents.

_____ **7.** The constant movement of water and the availability of accumulated weathered material creates continuous erosion.

_____ **8.** Unlike water, glaciers do not move material over a long distance.

_____ **9.** Wind is a major erosional agent in areas on Earth that have both limited precipitation and high temperatures.

_____ **10.** Wind barriers are trees and other vegetation planted perpendicular to the wind direction.

_____ **11.** The movement of soil and other Earth materials by humans as they build highways and bridges, is not considered erosion.

_____ **12.** Barrier islands, which form from offshore sand deposits, can continue to be built up from sediments and form sandbars.

_____ **13.** The continued erosion of rill channels can develop into gully erosion.

_____ **14.** Winds cannot blow against the force of gravity.

_____ **15.** Wind can always move more material than water.

_____ **16.** A U-shaped valley indicate that glacial erosion has taken place.

_____ **17.** Waves, tides, and currents are responsible for erosion of islands.

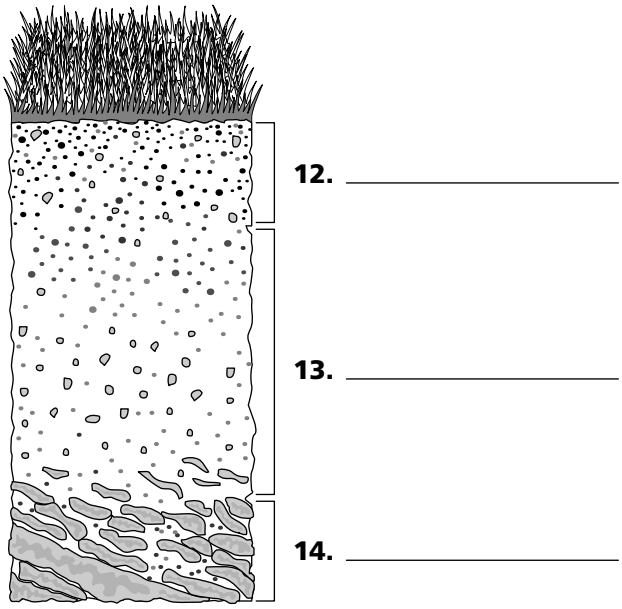
## SECTION 7.3 *Formation of Soil*

*In your textbook, read about soils and how they form.*
**Complete each statement.**

1. _____ is the loose covering of weathered rock particles and decaying organic matter overlying the bedrock of Earth's surface.
2. Soil that is located above its parent material is known as _____.
3. Soil that has been moved away from its parent bedrock is called _____.
4. When heavy machinery digs out soil in the process of building a road, a vertical sequence layers of soil, called a(n) _____, will often be exposed.
5. A distinct layer, or zone, located within a soil profile is known as a(n) _____.
6. Soils formed at high latitudes and high elevations that have good drainage but no distinct horizons are classified as _____.
7. A(n) _____ is any one of various types of soil that can support a forest, grassland, prairie, or other environments.
8. Soils found in areas with less than 25 cm of rainfall that often have a high accumulation of salts are called _____.
9. Soil forms as a result of _____ and biological activity that breaks down and changes soil materials over long periods of time.
10. The relative proportions of particle sizes make up a soil's _____.
11. Soil _____ is the measure of how well a soil can support the growth of plants.

## SECTION 7.3 *Formation of Soil, continued*

*In your textbook, read about soil profiles.*
**Complete the soil profile by filling in the horizons. Then answer the questions.**




**15.** Which horizon is the surface layer? Describe it.

**16.** Which horizon is the subsoil? Describe it.

**17.** Which horizon occurs directly above bedrock? Describe it.

Name Class Date

CHAPTER 8 STUDY GUIDE FOR CONTENT MASTERY

# Mass Movements, Wind, and Glaciers

## SECTION 8.1 *Mass Movement at Earth's Surface*

*In your textbook, read about mass movement.*
**Use each of the terms below just once to complete the passage.**

**avalanche** **creep** **landslide** **mass movement** **mudflow** **slump**

**(1)** _____ is downward movement that results from gravity acting on loose sediments and weathered rock. If the downward movement of loose material is slow, it is called **(2)** _____, whereas the rapid movement of a mud and water mixture is known as a(n) **(3)** _____. A rapid downslope slide of a thin sheet of earth materials is a(n) **(4)** _____. If these materials rotate and slide along a curved surface, it is called a(n) **(5)** _____. A(n) **(6)** _____ occurs in mountainous areas with thick accumulations of snow.

*In your textbook, read about the different types of mass movement.*
**Briefly describe the different types of mass movement.**

**7.** Creep _____

_____

**8.** Flows _____

_____

**9.** Slides _____

_____

**10.** Falls _____

_____

## SECTION 8.1 *Mass Movement at Earth's Surface, continued*

*In your textbook, read about mass movement and the factors that control it.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **11.** Determines how much material is available for mass movement | **a.** rockslide |
| _____ **12.** A force that works to pull material downslope | **b.** earthquake |
| _____ **13.** Acts as a lubricant to reduce friction between soil grains | **c.** gravity |
| _____ **14.** Occurs when a sheet of rock moves downhill on a sliding surface | **d.** slopes |
| _____ **15.** Can trigger a sudden mass movement | **e.** water |
| _____ **16.** Where all mass movements occur | **f.** climate |

*In your textbook, read about people and mass movement.*
**Answer the following questions.**

**17.** How does mass movement affect people?

_____

_____

_____

**18.** How do people contribute to mass movement?

_____

_____

_____

## SECTION 8.2 *Wind*

*In your textbook, read about wind erosion and deposition.*
**Use each of the terms below just once to complete the passage.**

**abrasion deflation dunes loess ventifacts**

The lowering of the land surface caused by the wind's removal of surface particles is called **(1)** _____. The process of erosion in which wind causes particles such as sand to rub against rocks is **(2)** _____. Rocks shaped by this process are called **(3)** _____. Over time, wind-blown sand accumulates to produce **(4)** _____. If the wind carries and drops finer particles such as silt, then deposits known as **(5)** _____ form.

**For each statement below, write *true* or *false*.**

_____ **6.** In suspension, strong winds cause particles to stay airborne for long distances.

_____ **7.** During the 1930s in the Great Plains, poor agricultural practices resulted in severe dust storms and the formation of deflation blowouts.

_____ **8.** Most sand carried by the wind moves by saltation.

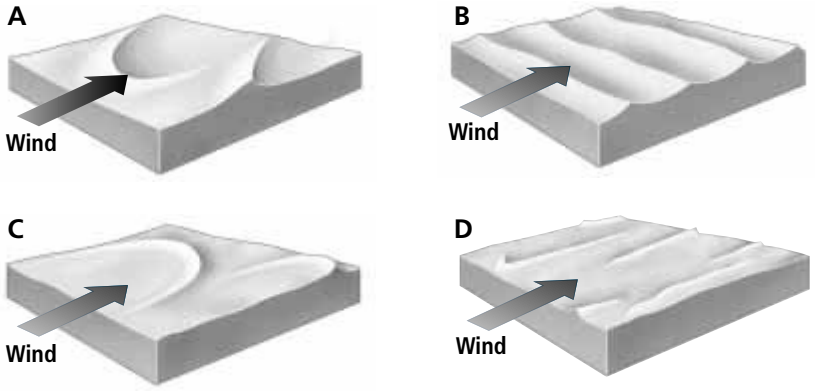
_____ **9.** The steeper slope of a sand dune is on the windward side, the side protected by the wind.

_____ **10.** Wind erosion tends to occur in areas of heavy vegetation cover.

_____ **11.** Dune migration is caused by prevailing winds continuing to move sand from the windward side of a dune to the leeward side.

## SECTION 8.2 *Wind, continued*

*In your textbook, read about the types of sand dunes.*




**Complete the table by filling in the missing information.**

| Diagram | Type of Dune | How and Where Formed |
|---|---|---|
| A | **12.** | |
| B | **13.** | |
| C | **14.** | |
| D | **15.** | |

*In your textbook, read about wind erosion and deposition.*
**Circle the letter of the choice that best answers the question.**

**16.** Which of the following results in the formation of desert pavement?
**a.** abrasion **b.** deflation **c.** deposition **d.** saltation

**17.** Which of the following is true of loess?
**a.** It consists of sand and gravel.
**b.** It is deposited by melting ice.
**c.** Its soils are some of the most fertile on Earth.
**d.** Its most common component is gypsum.

## SECTION 8.3 *Glaciers*

*In your textbook, read about glaciers.*
**Use each of the terms below just once to complete the passage.**

**cirques** **continental glacier** **drumlins** **eskers** **glacier**
**moraines** **outwash plain** **valley glacier**

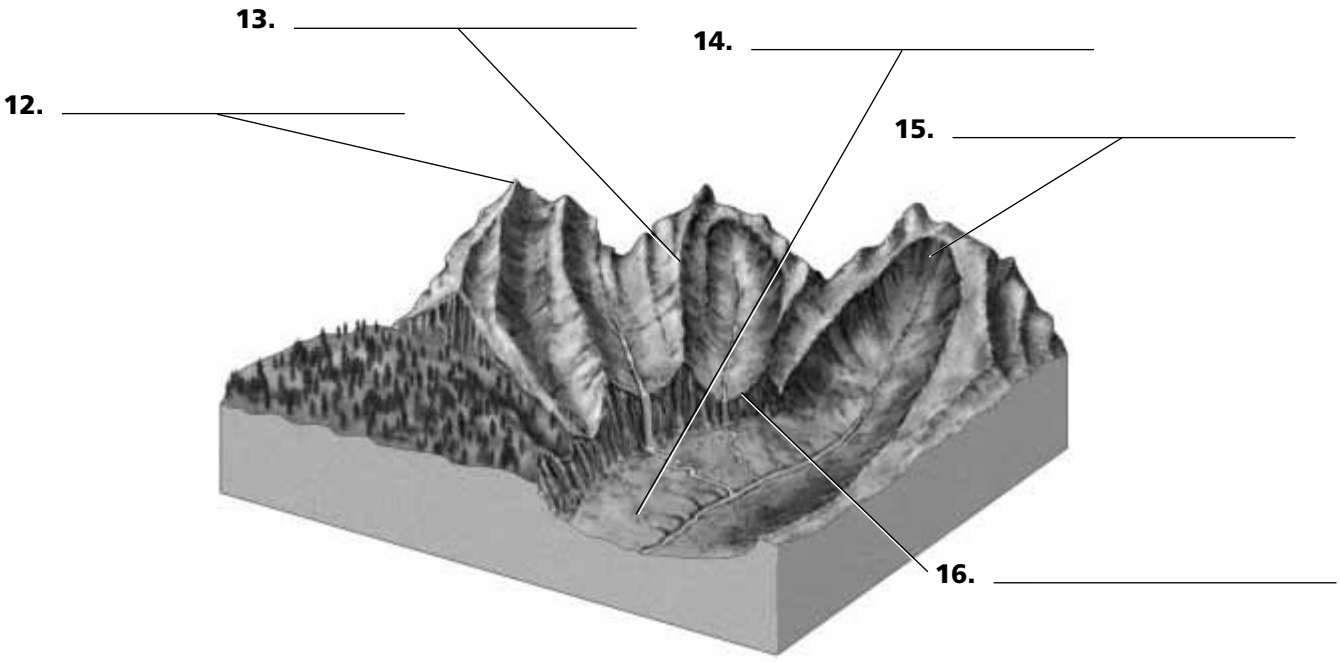
A large moving mass of ice is a(n) **(1)** _____. A moving mass of ice formed in a mountainous area is a(n) **(2)** _____, and one that covers a large continent-sized area is a(n) **(3)** _____. Deep depressions called **(4)** _____ are carved by mountain glaciers. When glaciers melt, they deposit **(5)** _____, which are ridges consisting of till. A melting glacier also forms a(n) **(6)** _____ composed of sorted gravel, sand, and fine silt. Glaciers that move over older moraines form **(7)** _____, which are elongated landforms. Sometimes glacier meltwater deposits long, winding piles of sediment called **(8)** _____.

*In your textbook, read about glacial erosion and deposition.*
**Complete the table by filling in the missing information.**

| Glacial Feature | Description |
|---|---|
| **9.** Groove | |
| **10.** Medial moraine | |
| **11.** | Ridge consisting of unsorted sediments deposited at the sides of a glacier |

## SECTION 8.3 *Glaciers, continued*

*In your textbook, read about glacial erosion.*
**Label the diagram below. Choose from the following: cirque, arête, horn, hanging valley, U-shaped valley.**




*In your textbook, read about glaciers.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**17.** Outwash is deposited by
- **a.** glacial ice.
- **b.** high winds
- **c.** glacial meltwater.
- **d.** gravity.

**18.** Continental glaciers form from
- **a.** sorted sediments deposited by meltwaters.
- **b.** snow that accumulates and recrystallizes.
- **c.** valley glaciers that flow downslope and meet.
- **d.** mixed debris dropped by ice.

**19.** Which of the following is true of striations?
- **a.** They are formed by plucking.
- **b.** They are formed by deposition.
- **c.** They occur only on glacial outwash plains.
- **d.** They indicate a glacier's direction of movement.

**20.** Sometimes ice breaks off a glacier, gets covered by sediment, and later melts. When the resulting depression fills with water, it forms
- **a.** a kettle lake.
- **b.** an esker lake.
- **c.** a moraine-dammed lake.
- **d.** a cirque lake.

Name Class Date

CHAPTER 9 STUDY GUIDE FOR CONTENT MASTERY

# Surface Water

## SECTION 9.1 *Surface Water Movement*

*In your textbook, read about surface water and the way in which it moves sediment.*
**Complete each statement.**

1. An excessive amount of water flowing downslope along Earth's surface is called _____.
2. A stream system's _____, or drainage basin, is all of the land area whose water drains into a stream system.
3. The watershed of the _____ is the largest in North America.
4. When water runs through or over rocks containing soluble minerals, it dissolves small amounts of the minerals and carries them away in _____.
5. A stream's _____ consists of sand, pebbles, and cobbles that the stream's water can roll or push along the bed of the stream.
6. _____ is the measure of the volume of stream water that flows over a particular location within a given period of time.

**For each statement below, write *true* or *false*.**

_____ **7.** Soils that contain grasses or other vegetation allow more water to enter the ground than do soils with no vegetation.

_____ **8.** Light, gentle precipitation is more likely than heavy rain to end up as runoff.

_____ **9.** The slope of the land has little influence on water's ability to enter the ground.

_____ **10.** A stream's slope affects its carrying capacity.

_____ **11.** Humus creates soil spaces, which increase the soil's ability to hold water.

_____ **12.** There is a greater potential for erosion and flooding on gradual slopes than on steep slopes.

_____ **13.** Carrying capacity increases as a stream's slope and discharge increase.

## SECTION 9.1 *Surface Water Movement, continued*

*In your textbook, read about water on Earth's surface.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**14.** The path of a stream can vary considerably, depending on the slope of the land and the
- **a.** amount of humus present in the soil.
- **b.** type of material through which the stream flows.
- **c.** amount of rainfall.
- **d.** bedload of the stream.

**15.** The amount of dissolved material that stream water carries is usually expressed in
- **a.** parts per million.
- **b.** grams per 1000 gallons.
- **c.** cubic feet per minute.
- **d.** cubic meters per second.

**16.** In a stream, how are particles such as silt, clay, and sand carried?
- **a.** in solution
- **b.** as bed load
- **c.** as dissolved load
- **d.** in suspension

**17.** The carrying capacity of a stream depends on both the velocity and the
- **a.** temperature of the water.
- **b.** type of material through which the stream flows.
- **c.** minerals dissolved in the stream.
- **d.** amount of water in the stream.

**18.** Potholes may form on the bottom of a stream because of
- **a.** changes in the stream's carrying capacity.
- **b.** an increase in the dissolved load.
- **c.** swirling pebbles.
- **d.** an increase in suspended materials.

**19.** Which of the following is true about watersheds?
- **a.** Each tributary in a stream system has its own watershed.
- **b.** Watersheds always cover extremely large areas.
- **c.** Some streams do not have a watershed.
- **d.** The size of a watershed depends upon its elevation.

**20.** Which of the following is NOT true about streams?
- **a.** All streams flow downslope.
- **b.** Brooks are small streams.
- **c.** All streams flow into the ocean.
- **d.** A large stream is called a river.

**21.** For water to enter the ground, there must be
- **a.** a sufficient amount of sand in the soil.
- **b.** heavy precipitation.
- **c.** large enough spaces in the ground's surface material.
- **d.** soil particles clumping together.

**22.** Which of the following statements is NOT part of the water cycle?
- **a.** Water falls as precipitation back to Earth.
- **b.** Water evaporates from bodies of water on Earth.
- **c.** Water soaks into the ground.
- **d.** Water dissolves minerals from rocks it flows over.

## SECTION 9.2 *Stream Development*

*In your textbook, read about stream development.*
**Answer the following questions.**

**1.** What are the stream channel and the stream banks?

**2.** How does a stream valley form and how deep will it be downcut?

**3.** Describe the formation of a meander.

**4.** What is a delta and how is it formed?

**5.** What is an alluvial fan and where are alluvial fans usually formed?

**6.** What is rejuvenation and under what circumstances does it occur?

## SECTION 9.2 *Stream Development, continued*

*In your textbook, read about stream development.*
**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **stream piracy** | **small** | **lengthening** | **gains** |
| **waterfalls** | **loses** | **headward erosion** | |

The process by which small streams erode their forward paths through rock is called **(7)** _____. This process involves **(8)** _____ the stream at the valley head. At this point in their development, streams are relatively **(9)**_____ . These streams flow swiftly over rough terrain and often form **(10)** _____ and rapids as they flow over steep inclines.

Sometimes, a stream erodes its way through the high area separating two drainage basins, joins another stream, and then draws away its water in a process known as **(11)** _____. The lower portion of the captured stream **(12)** _____ its water source, while the invading stream **(13)** _____ a source of water.

*In your textbook, read about deposition of sediment.*
**In the space at the left, write *true* of the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **14.** Streams that lose *headwaters* lose their ability to carry sediment.

_____ **15.** Alluvial fans are most common in *dry*, mountainous regions.

_____ **16.** Streams lose velocity when they join larger *streams.*

_____ **17.** Delta deposits usually consist of *sand* and clay particles.

_____ **18.** Streams that form to carry stream water through a developing delta are called *alluvial* streams.

_____ **19.** Alluvial fans are composed mostly of sand and *gravel.*

_____ **20.** As a delta develops, the flow of stream water *slows.*

## SECTION 9.3 *Lakes and Freshwater Wetlands*

*In your textbook, read about lakes and freshwater wetlands.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **1.** A depression in the landscape that collects and holds water | **a.** swamp |
| _____ **2.** The successional process that begins with the addition of nutrients and continues with the filling in of a lake | **b.** wetland |
| _____ **3.** A periodically saturated area that develops after a lake fills in with vegetation | **c.** lake |
| _____ **4.** Low-lying areas often located near streams that develop from filled-in marshes | **d.** oxbow |
| _____ **5.** A dominant bedrock in areas where lakes can be common | **e.** eutrophication |
| _____ **6.** A type of lake formed when meanders get cut off | **f.** limestone |

**Number the stages in the formation and eutrophication of lakes in the order in which they occur.**

_____ **7.** The decayed material falls to the bottom of the lake, filling it.

_____ **8.** Excessive algae growth occurs.

_____ **9.** Water slowly dissolves calcium carbonate, forming a cavern in limestone bedrock.

_____ **10.** Because of algae overpopulation, huge numbers of lake plants and animals perish.

_____ **11.** Agricultural fertilizers are picked up by runoff and flow into the lake.

_____ **12.** Groundwater percolates through limestone bedrock.

_____ **13.** The depression fills in with water from runoff and precipitation to become a lake.

_____ **14.** The ceiling of a limestone cavern collapses and leaves a depression.

## SECTION 9.3 *Lakes and Freshwater Wetlands, continued*

*In your textbook, read about the origins of lakes.*
**Circle the letter that best answers the question or completes the statement.**

**15.** Which of the following is NOT one of the ways that a lake can form?
- **a.** A stream cuts off a meander to leave an isolated channel of water.
- **b.** Ocean waters recede to lower-lying areas.
- **c.** Cirques high in the mountains fill with water.
- **d.** Eutrophication causes a bog to become flooded.

**16.** A lake created by people for storing water is a(n)
- **a.** kettle lake.
- **b.** reservoir.
- **c.** oxbow lake.
- **d.** runoff lake.

**17.** Which of the following determines where a lake can form?
- **a.** surface materials
- **b.** precipitation levels
- **c.** the presence of an outlet to the ocean
- **d.** the presence of a stream

**18.** The basins of glacial lakes formed
- **a.** as a result of tectonic activity.
- **b.** during the ice ages.
- **c.** where ocean water receded.
- **d.** along the edges of moraines.

**19.** Which of the following does NOT contribute to maintaining a lake's water supply?
- **a.** water from direct precipitation
- **b.** runoff
- **c.** underground sources
- **d.** deposition

**20.** Lakes usually fill in with sediment and cease to exist after
- **a.** several thousand years.
- **b.** hundreds of thousands of years.
- **c.** millions of years.
- **d.** tens of millions of years.

**21.** Many lakes are found in areas where the dominant bedrock is
- **a.** granite.
- **b.** sandstone.
- **c.** limestone.
- **d.** volcanic rock.

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CHAPTER 10 STUDY GUIDE FOR CONTENT MASTERY

# Groundwater

## SECTION 10.1 *Movement and Storage of Groundwater*

*In your textbook, read about the hydrosphere, precipitation and groundwater, and groundwater storage.*
**Use the following terms to complete the statements.**

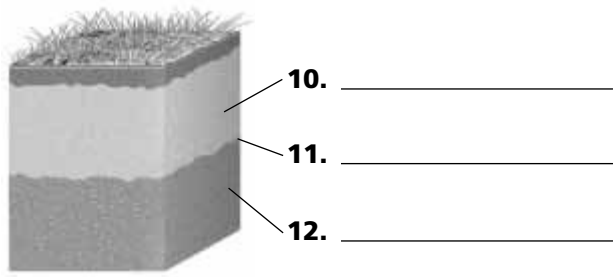
| | | | |
|---|---|---|---|
| **freshwater** | **hydrosphere** | **infiltration** | **polar ice caps** |
| **porosity** | **precipitation** | **water vapor** | **weather systems** |

1. About 97 percent of the _____ is contained in the oceans.
2. The _____ and glaciers hold about 90 percent of Earth's freshwater.
3. Only a very small amount of all of Earth's liquid _____ is contained in rivers, streams, and lakes.
4. Water evaporates from seawater and forms invisible _____ and visible clouds.
5. The winds and _____ move the atmospheric water all over Earth.
6. _____, mostly in the form of rain and snow, falls into the oceans and on the land.
7. Precipitation that falls on land enters the ground through the process of _____ and becomes groundwater.
8. Small openings in subsurface Earth materials are pores, and the percentage of pore space in a material is its _____.

## SECTION 10.1 *Movement and Storage of Groundwater, continued*

*In your textbook, read about the zone of saturation and groundwater movement.*
**Use the terms below to label the diagram.**

**zone of saturation** **zone of aeration** **water table**




**Match the definition in Column A with the term in Column B.**

| Column A | Column B |
|---|---|
| _____ **13.** Depth below Earth's surface at which groundwater completely fills all the pores of a material | **a.** aquifer |
| _____ **14.** Permeable layers through which groundwater flows | **b.** groundwater |
| _____ **15.** Upper boundary of the zone of saturation | **c.** permeability |
| _____ **16.** Ability of a material to let water pass through it | **d.** water table |
| _____ **17.** Water found in the zone of saturation | **e.** zone of aeration |
| _____ **18.** Zone below the surface, but above the zone of saturation, where materials are moist | **f.** zone of saturation |

**Answer the following questions.**

**19.** What is gravitational water?

_____

_____

**20.** What is capillary water?

_____

_____

**21.** How does the depth of the water table differ in stream valleys, swampy areas, and hilltops?

_____

_____

_____

_____

## SECTION 10.2 *Groundwater Erosion and Deposition*

*In your textbook, read about dissolution by groundwater.*

**Circle the letter of the choice that best completes the statement or answers the question.**

1. A major role in the formation of limestone is the
   - **a.** dissolution and precipitation of calcium carbonate.
   - **b.** reaction of carbon dioxide with calcium carbonate.
   - **c.** reaction of water with limestone.
   - **d.** flooding of sinkholes.

2. Carbon dioxide and water form
   - **a.** precipitated calcium carbonate.
   - **b.** carbonic acid.
   - **c.** underground limestone deposits.
   - **d.** calcium bicarbonate.

3. Which of the following statements is NOT true about groundwater?
   - **a.** Most groundwater contains some acid.
   - **b.** Groundwater is made up of mostly $H_2O$ ions, which is why it readily dissolves limestone.
   - **c.** Carbonic acid forms when groundwater percolates through decaying organic material.
   - **d.** Calcium carbonate precipitates out when groundwater evaporates.

4. In order for caves to form in limestone, there must be
   - **a.** runoff from surface streams.
   - **b.** no zone of saturation.
   - **c.** groundwater percolating through the cracks and joints of limestone.
   - **d.** sinkholes present.

**Complete each statement with the correct word or words.**

5. Some caves are _____, while others contain underground streams and lakes.

6. Most _____ of significant size are formed in limestone by the dissolving activity of groundwater.

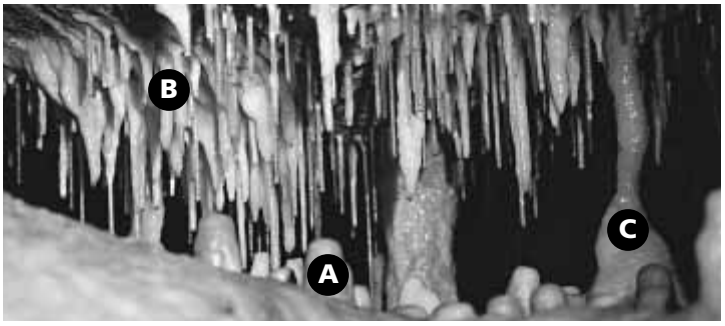
7. A depression in the ground caused by the collapse of a cave or by the direct dissolution of bedrock by acidic rain or moist soil is a(n) _____.

8. Limestone regions with sinkholes, sinks, and sinking streams are said to have _____.

## SECTION 10.2 *Groundwater Erosion and Deposition, continued*

*In your textbook, read about groundwater deposits.*
**Use the terms below to label the photograph.**

**stalactite** **stalagmite** **dripstone column**




**9.** A _____ B _____ C _____

**Answer the following questions.**

**10.** Explain how A on the photograph is formed.

_____

_____

_____

**11.** Explain how B on the photograph is formed.

_____

_____

_____

_____

**12.** Explain how C on the photograph is formed.

_____

_____

**13.** What kind of limestone is found in dripstone formations?

_____

**14.** What do we call water containing high concentrations of calcium, magnesium, or iron?

_____

**15.** How does a water softener change water?

_____

## SECTION 10.3 *Groundwater Systems*

*In your textbook, read about springs.*
**Use each of the terms below just once to complete the passage.**

**geysers** **hot springs** **springs**

Natural discharge sites for groundwater on Earth's surface are **(1)** _____. In contrast to air temperature, groundwater is colder in the summer and warmer in the winter. However, in some regions of the United States, **(2)** _____ will give off very warm or hot water. Explosive hot springs that erupt on a regular basis are **(3)** _____.

**For each statement below, write *true* or *false.***

_____ **4.** Some lakes are fed by karst springs, which are like underground rivers emerging from the ground.

_____ **5.** All springs have essentially the same temperature of water.

_____ **6.** Geysers are hot springs that erupt at regular intervals.

*In your textbook, read about wells and confined aquifers.*
**Use each of the terms below just once to complete the passage.**

**artesian well** **drawdown** **recharge** **well**

To obtain water, a(n) **(7)** _____ must tap into an aquifer. The difference between the original water-table level and the water level in the pumped well is called the **(8)** _____. In order for the water supply of the wells to be replenished, water from precipitation and run-off must **(9)** _____ the zone of saturation. A(n) **(10)** _____ contains water that is under pressure, which may cause the well water to spurt into the air.

**For each statement, write *true* or *false.***

_____ **11.** To produce water, a well must be drilled deep into aquicludes.

_____ **12.** It is very difficult to cause drawdown in an aquifer, no matter how many wells are tapped into the aquifer.

_____ **13.** An important artesian aquifer in the United States is the Ogallala Aquifer.

## SECTION 10.3 *Groundwater Systems, continued*

*In your textbook, read about threats to our water supply and protecting our water supply.*
**Answer the following questions.**

**14.** What are four common sources of groundwater pollution?

**15.** What are two natural pollutants?

**16.** How can salt get into freshwater supplies?

**17.** Where does radon originate?

**For each statement below, write *true* or *false*.**

_____ **18.** Subsidence is caused by flooding caves.

_____ **19.** Most pollution plumes spread extremely slowly, and time is available for alternate water supplies to be found.

_____ **20.** Most chemical contaminants can be removed easily from the groundwater and aquifers.

_____ **21.** If the recharge areas of confined aquifers are polluted, then the aquifer becomes polluted, too.

*GeoDigest*

# Surface Processes on Earth

**Use the terms below to write the name of the surface process or surface feature that causes each effect given.**

| | | | |
|---|---|---|---|
| **glacier** | **gravity** | **groundwater** | **hydrolysis** |
| **stream** | **temperature change** | **wind** | |

**1.** Chemical weathering caused by _____

**2.** Deflation blowout caused by _____

**3.** Cavern caused by action of _____

**4.** Alluvial fan caused by the flow of a _____

**5.** Mass movement caused by _____

**6.** Mechanical weathering of rock caused by _____

**7.** Drumlin caused by a _____

**Use *A B C* to order the steps in each process. Then use the following terms to write the name of the process above its three steps.**

| | | | |
|---|---|---|---|
| **cavern formation** | **eutrophication** | **stream development** | **glacier formation** |

**8.** _____

_____ Snow crystallizes into ice.

_____ Snow falls.

_____ Weight of snow exerts downward pressure.

**9.** _____

_____ Stream velocity slows.

_____ Load is deposited in triangle-shaped deposits.

_____ Precipitation flows in channels.

**10.** _____

_____ Nutrients, such as fertilizers, enter a lake.

_____ Oxygen is depleted.

_____ Certain organisms become overabundant.

**11.** _____

_____ Calcium carbonate dissolves and precipitates.

_____ Water infiltrates the ground.

_____ Carbonic acid in groundwater attacks limestone.

**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **12.** *Mechanical weathering* causes a change in the composition of rock.

_____ **13.** When the movement of transported Earth materials slows down, *deposition* occurs.

_____ **14.** Weathered rock and decayed organic matter called *silt* combine to form soil.

_____ **15.** A *horizon* is a cross section of soil layers.

_____ **16.** A slow, downslope mass movement of Earth materials is called *creep*.

_____ **17.** Barchan, transverse, longitudinal, and parabolic are classifications of *avalanches*.

_____ **18.** *Continental glaciers* form over broad regions and spread out from their centers.

_____ **19.** All the material carried by a stream is known as the stream's *watershed*.

_____ **20.** *Aquifers* emerge where the water table intersects Earth's surface.

Name Class Date

CHAPTER 11 STUDY GUIDE FOR CONTENT MASTERY

# Atmosphere

## SECTION 11.1 *Atmospheric Basics*

*In your textbook, read about the composition of the atmosphere.*
**Circle the letter of the choice that best completes the statement.**

**1.** Most of Earth's atmosphere is composed of
**a.** oxygen and hydrogen.
**b.** hydrogen and nitrogen.
**c.** nitrogen and oxygen.
**d.** carbon and ozone.

**2.** Water vapor in the atmosphere is the source of
**a.** clouds and rain.
**b.** pollution.
**c.** carbon dioxide.
**d.** wind.

**3.** The amount of energy the atmosphere absorbs depends in part on its level of
**a.** nitrogen.
**b.** argon.
**c.** nitrogen dioxide.
**d.** carbon dioxide.

**4.** Solid particles in the atmosphere include salt and
**a.** leaves.
**b.** ozone.
**c.** dust.
**d.** lightning.

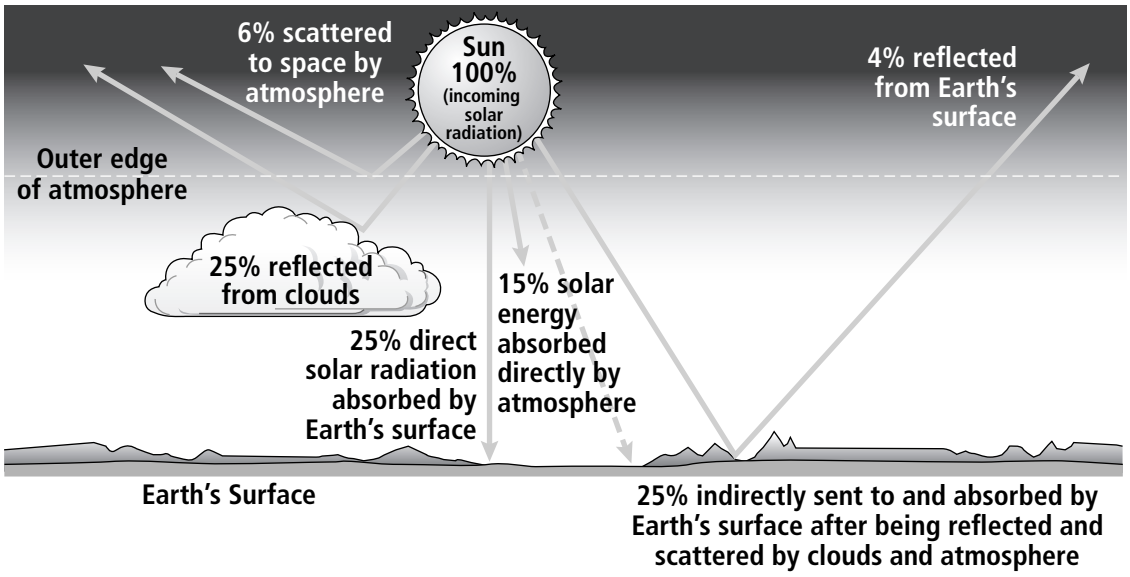
**5.** Ozone in Earth's atmosphere is important because it
**a.** causes rain to fall.
**b.** absorbs harmful radiation.
**c.** absorbs harmful pollution.
**d.** helps clouds form.

*In your textbook, read about the structure of the atmosphere.*
**Complete the table by writing the layer of the atmosphere that matches each description.**

| Characteristic | Layer |
|---|---|
| **6.** Contains concentrated ozone | |
| **7.** Layer just above the stratosphere | |
| **8.** Most weather occurs here. | |
| **9.** Outermost layer of the atmosphere | |
| **10.** Between mesosphere and exosphere | |

## SECTION 11.1 *Atmospheric Basics, continued*

*In your textbook, read about how the atmosphere is heated.*
**Examine the diagram below. Then answer the questions.**




**11.** What is the source of all energy that reaches Earth? _____

**12.** What percentage of the Sun's energy does Earth's surface absorb directly or indirectly? _____

**13.** What percentage of the Sun's energy is scattered or reflected back into space? What causes this loss of solar energy?

_____

_____

**14.** Earth's surface is heated by energy from the Sun. For the most part, the rereleased energy from the surface heats the atmosphere. Describe the method by which energy is transferred from Earth's surface to the air above it.

_____

_____

**15.** Describe convection.

_____

_____

_____

_____

## SECTION 11.2 *State of the Atmosphere*

*In your textbook, read about heat, temperature, and moisture in the atmosphere.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **water vapor** | **altitude** | **Fahrenheit** | **heat** | **condensation** |
| **dew point** | **temperature** | **lifted condensation level** | | |

Heat and temperature are not the same. **(1)** _____ is a measure of how rapidly or slowly molecules move. In contrast, **(2)** _____ is the transfer of energy that takes place because of temperature differences. Temperature can be measured in degrees Fahrenheit, degrees Celsius, or kelvins. The most commonly used temperature scale in the United States is **(3)** _____.

The atmosphere's temperature plays a role in the formation of rain. Rain drops form when **(4)** _____ in the atmosphere cools and turns from a gas to a liquid. This change in state is called **(5)** _____.

Air must be saturated before condensation can occur. Saturation is the point at which the air holds as much water vapor as it possibly can. The **(6)** _____ is the temperature to which air must be cooled at constant pressure to reach saturation. Until this temperature is reached, condensation cannot occur and rain cannot fall.

Temperature in the lower atmosphere generally decreases with increased **(7)** _____. As air rises, it cools and eventually reaches the temperature at which condensation occurs. The height above the surface at which condensation occurs is the **(8)** _____.

## SECTION 11.2 *State of the Atmosphere, continued*

*In your textbook, read about air pressure and wind.*
**For each statement below, write *true* or *false*.**

_____ **9.** Air is denser near Earth's surface than high in the atmosphere.

_____ **10.** Particles of air in the atmosphere exert pressure on Earth's surface.

_____ **11.** Air pressure is greater at the top of a mountain than at lower elevations.

_____ **12.** In the troposphere, as air temperature increases, generally air pressure increases, too.

_____ **13.** Wind is the movement of air from an area of low pressure to an area of high pressure.

_____ **14.** As you move upward from Earth's surface, wind speeds increase because the air meets with less friction from Earth's surface.

*In your textbook, read about temperature inversion and relative humidity.*
**Answer the following questions.**

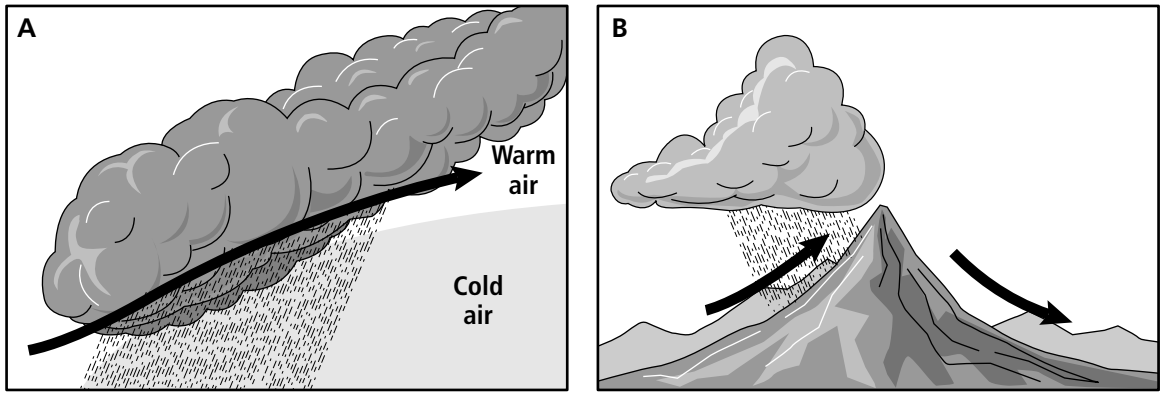
**15.** What is a temperature inversion? Explain how one can form.

**16.** What is relative humidity?

**17.** What is the relative humidity of fully saturated air?

## SECTION 11.3 *Moisture in the Atmosphere*

*In your textbook, read about the formation of clouds.*
**Examine the diagram below. Then answer the questions.**




**1.** What is happening to the air in both A and B that leads to the formation of clouds?

**2.** What is causing the air to rise in A?

**3.** What is causing the air to rise in B?

**4.** What type of cloud formation is shown in B?

**5.** Explain how condensation nuclei help clouds form.

## SECTION 11.3 *Moisture in the Atmosphere, continued*

*In your textbook, read about moisture in the atmosphere and clouds.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **6.** All forms of water that fall from clouds | **a.** stratus |
| _____ **7.** Low, layered clouds | **b.** cirrus |
| _____ **8.** Small cloud droplets join to form larger ones | **c.** precipitation |
| _____ **9.** Wispy, high clouds made of ice crystals | **d.** coalescence |

*In your textbook, read about the movement of water between the atmosphere and Earth's surface.*
**Circle the letter of the choice that best completes the statement.**

**10.** The constant movement of water between the atmosphere and Earth's surface is
**a.** cloud formation. **c.** precipitation.
**b.** the water cycle. **d.** temperature inversion.

**11.** The process of water changing from a liquid to a gas is
**a.** condensation. **c.** coalescence.
**b.** precipitation. **d.** evaporation.

**12.** As water vapor rises in the atmosphere, it cools and changes into liquid cloud droplets in a process called
**a.** evaporation. **c.** condensation.
**b.** precipitation. **d.** vaporization.

**13.** When cloud droplets combine to form larger drops, they fall to Earth as
**a.** ozone. **c.** precipitation.
**b.** condensation. **d.** water vapor.

**14.** The energy that drives the water cycle comes from the
**a.** Sun. **c.** ocean.
**b.** wind. **d.** stratosphere.

Name Class Date

CHAPTER 12 STUDY GUIDE FOR CONTENT MASTERY

# Meteorology

## SECTION 12.1 *The Causes of Weather*

*In your textbook, read about weather and climate.*
**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word to make it true.**

_____ **1.** *Meteorology* is the study of atmospheric phenomena.

_____ **2.** Weather is the current state of the *lithosphere*.

_____ **3.** Long-term variations in weather for a particular area make up the *climate* of the area.

_____ **4.** The tropics are hotter than the poles because the sun strikes this area of Earth more *indirectly*.

*In your textbook, read about air masses and source regions.*
**Circle the letter of the choice that best completes the statement.**

**5.** A large parcel of air that takes on the characteristics of the area over which it forms is a(n)
**a.** cloud. **c.** source region.
**b.** air mass. **d.** wind.

**6.** An air mass takes on its source region's
**a.** temperature and humidity. **c.** clouds and wind.
**b.** landforms. **d.** elevation.

**7.** Maritime air masses originate over
**a.** clouds. **c.** glaciers.
**b.** oceans. **d.** mountains.

**8.** When an air mass travels over land or water that has different characteristics than those of its source region, it undergoes
**a.** air source change. **c.** air pressure modification.
**b.** air mass modification. **d.** temperature inversion.

## SECTION 12.2 *Weather Systems*

*In your textbook, read about global winds and how Earth's rotation affects their movement.*
**Use each of the terms below just once to complete the passage.**

**intertropical convergence zone** **rotation** **North America** **jet streams**
**trade winds** **southwest** **polar jet streams** **Coriolis effect**
**low pressure** **prevailing westerlies** **polar easterlies** **northeast**

The **(1)** _____ deflects moving air to the right in the northern hemisphere and to the left in the southern hemisphere. The cause of this is Earth's **(2)** _____.

Each hemisphere has three basic wind systems. The first, at 30° latitude north and south, is known as the **(3)** _____. There, air sinks, warms, and moves toward the equator from northeast to southwest in the northern hemisphere and from southeast to northwest in the southern hemisphere. When the air reaches the equator, it rises, then moves back toward 30° to start the cycle again. These winds from both hemispheres converge at the equator. They are forced upward, creating an area of **(4)** _____. This area near the equator is called the **(5)** _____.

The second wind system, called the **(6)** _____, flows between 30° and 60° latitude north and south of the equator. Its circulation pattern is opposite that of the wind system discussed above. These winds are responsible for the movement of many weather systems across much of **(7)** _____.

The third wind system, the **(8)** _____, lies between the poles and 60° latitude. In the northern hemisphere, these winds flow from the **(9)** _____ to the **(10)** _____. They flow in the opposite direction in the southern hemisphere.

Narrow bands of fast, high-altitude, westerly winds called **(11)** _____ flow at the boundaries between wind zones in the middle latitudes. These bands of wind steer weather systems in the middle latitudes. The most important one, the **(12)** _____, separates the polar easterlies from the prevailing westerlies.

## SECTION 12.2 *Weather Systems, continued*

*In your textbook, read about fronts and wave cyclones.*
**Complete the table by filling in the type of weather system described. Use the following terms: *front, cold front, occluded front, stationary front, warm front, wave cyclone.***

| Description | Weather System |
|---|---|
| **13.** Cold, dense air that displaces warm air, forcing the warm air up | |
| **14.** Narrow region separating two air masses of different densities | |
| **15.** Advancing warm air that displaces cold air | |
| **16.** Low-pressure system that heavily influences weather in the middle latitudes | |
| **17.** Cold air mass that moves rapidly and overtakes a warm front | |
| **18.** Two air masses that meet and do not advance | |

*In your textbook, read about pressure systems.*
**Complete the table by checking the correct column for each statement.**

| Statement | High-Pressure System | Low-Pressure System |
|---|---|---|
| **19.** Characterized by sinking air | | |
| **20.** Characterized by rising air | | |
| **21.** Air flows toward center | | |
| **22.** Air flows away from center | | |
| **23.** Air moves clockwise in the northern hemisphere | | |
| **24.** Air moves counterclockwise in the northern hemisphere | | |
| **25.** Associated with fair weather | | |
| **26.** Associated with clouds and precipitation | | |

## SECTION 12.3 *Gathering Weather Data*

*In your textbook, read about weather instruments.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **1.** An instrument that measures the height of cloud layers and estimates cloud cover | **a.** thermometer |
| _____ **2.** An instrument that measures wind speed and direction | **b.** barometer |
| _____ **3.** An instrument that measures temperature | **c.** anemometer |
| _____ **4.** An instrument that measures air pressure | **d.** hygrometer |
| _____ **5.** A balloon-borne package of sensors that gathers upper-level weather data | **e.** ceilometer |
| _____ **6.** An instrument that measures relative humidity | **f.** radiosonde |

*In your textbook, read about radar and weather satellites.*
**Answer the following questions.**

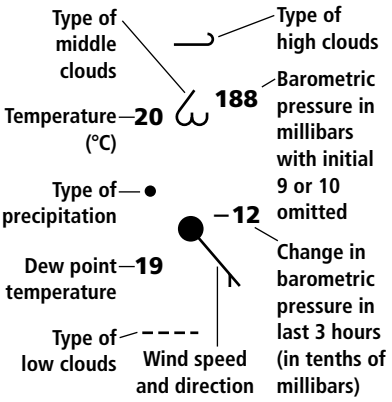
**7.** What is the Doppler effect? How do meteorologists use it to predict weather?

**8.** How do meteorologists combine data from weather radar and weather satellites to gather information about the atmosphere?

**9.** What is infrared imagery? How is it used?

## SECTION 12.4 *Weather Analysis*

*In your textbook, read about station models.*
**Study the station model. Then answer the questions that follow.**




**1.** What is a station model?

**2.** What are the advantages of using station models?

**3.** List three types of information shown on a station model.

**4.** For the station shown, what is the temperature?

**5.** For the station shown, how has the barometric pressure changed in the last 3 hours?

## SECTION 12.4 *Weather Analysis, continued*

*In your textbook, read about isopleths.*
**For each statement below, write *true* or *false*.**

_____ **6.** An isopleth is a line that connects points of equal or constant values.

_____ **7.** Lines of equal pressure are called isobars.

_____ **8.** Isobars that are far apart indicate a small difference in pressure and light winds.

_____ **9.** Contour lines are lines of equal temperature.

_____ **10.** Isotherms are used to identify temperature gradients and, consequently, frontal systems.

*In your textbook, read about weather forecasting.*
**Use each of the terms below just once to complete the passage.**

**digital forecast** **short term** **long-term** **analog forecast**

There are two major types of weather forecasts. A(n) **(11)** _____ relies on numerical data. It is the main method used in modern weather forecasting. Another type of forecast, the **(12)** _____, involves comparing current weather patterns to patterns that took place in the past.

Regardless of the forecasting method, all forecasts are more reliable in the **(13)** _____. Forecasts become less reliable as they attempt to predict **(14)** _____ weather changes.

Name Class Date

CHAPTER 13 STUDY GUIDE FOR CONTENT MASTERY

# The Nature of Storms

## SECTION 13.1 *Thunderstorms*

*In your textbook, read about thunderstorm formation.*
**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **condensation** | **warmer** | **unstable** | **convection** |
| **cumulonimbus** | **moisture** | **stable** | |

At any moment, more than 2000 thunderstorms are occurring on Earth. Thunderstorms develop from cumulus clouds that grow into huge **(1)** _____ clouds.

Thunderstorms form when three conditions exist that cause cumulus clouds to grow by the energy transfer method of **(2)** _____. First, there must be sufficient **(3)** _____ in the lower atmosphere to condense and release latent heat. Second, some mechanism must make the air rise, causing the cloud to grow. Third, the portion of the atmosphere that the cloud grows through must be **(4)** _____. The rising cloud must stay **(5)** _____ than the air around it in order for the growth to continue.

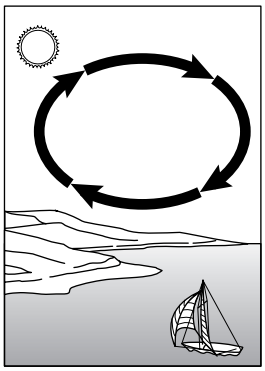
The cloud's growth stops when the rate of **(6)** _____ in the cloud, which diminishes with height, is insufficient to create enough heat to keep the cloud warmer than the air around it. Growth will also stop if the rising air meets a layer of **(7)** _____ air that it cannot overcome.

*In your textbook, read about different types of thunderstorms.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **8.** Forms when an air mass rises as a result of orographic lifting | **a.** frontal thunderstorm |
| _____ | **9.** Forms because of temperature differences between the air over land and the air over water | **b.** mountain thunderstorm |
| _____ | **10.** Forms as cold air pushes warm air up at a boundary between cold and warm air masses | **c.** sea-breeze thunderstorm |

## SECTION 13.1 *Thunderstorms, continued*

*In your textbook, read about air-mass thunderstorms.*
**Examine the diagram below. Then answer the questions.**



**11.** What phenomenon is pictured in the diagram?

_____

**12.** Describe how a sea breeze may lead to the formation of a thunderstorm.

_____

_____

_____

**13.** Why is a sea-breeze thunderstorm considered a type of air-mass thunderstorm?

_____

_____

_____

_____

*In your textbook, read about the stages of thunderstorm development.*
**Number the stages in the development of a thunderstorm in the order in which they occur.**

_____ **14.** Equal amounts of updrafts and downdrafts form convection cells.

_____ **15.** Warm, moist air rises quickly, and the moisture condenses into a visible cloud. Then updrafts form.

_____ **16.** Falling precipitation cools the air around it, forming downdrafts.

_____ **17.** Precipitation begins to fall.

_____ **18.** The updrafts cease and precipitation stops.

_____ **19.** The updrafts slow as downdrafts decrease the supply of warm, moist surface air.

## SECTION 13.2 *Severe Weather*

*In your textbook, read about thunderstorms and the dangerous conditions they cause.*
**Circle the letter of the choice that best completes the statement.**

**1.** Extremely powerful thunderstorms that develop intense, rotating updrafts are
**a.** downbursts.
**b.** supercells.
**c.** cumulus cells.
**d.** convection bursts.

**2.** Electricity caused by the rapid rush of air in a cumulonimbus cloud is
**a.** thunder.
**b.** hail.
**c.** friction.
**d.** lightning.

**3.** Violent downdrafts that are concentrated in one local area are
**a.** downdraft cells.
**b.** downstrokes.
**c.** downbursts.
**d.** return strokes.

**4.** Powerful downdrafts that affect an area of less than 3 km are
**a.** microbursts.
**b.** macrobursts.
**c.** supercells.
**d.** convection currents.

**5.** Precipitation in the form of balls or lumps of ice is
**a.** sleet.
**b.** drizzle.
**c.** snow.
**d.** hail.

**6.** The intense updrafts and downdrafts that characterize severe thunderstorms are the result of
**a.** unstable air caused by temperature differences between the upper and lower parts of a storm.
**b.** the contact between rising air and a layer of stable air.
**c.** the slowing of the rate of condensation within a cloud.
**d.** the cooling of the air inside a cumulonimbus cloud to a temperature lower than the surrounding air.

**7.** Flooding often occurs if rain falls faster than
**a.** snow.
**b.** rates of condensation.
**c.** the ground can absorb it.
**d.** clouds can form.

**8.** Hail forms in part because of the presence of
**a.** supercooled water droplets.
**b.** above-freezing temperatures.
**c.** high-pressure systems.
**d.** melting snow.

## SECTION 13.2 *Severe Weather, continued*

*In your textbook, read about tornado formation.*
**Answer the following questions.**

**9.** What is a tornado?

**10.** Describe how a tornado forms.

**11.** During which time of year do most violent tornadoes form? Explain why.

**12.** Where in the United States do many tornadoes occur? Explain why.

*In your textbook, read about tornado classification.*
**Examine the table below. Then answer the questions.**

**Fujita Tornado Intensity Scale**

| Rank | Category | Path of Destruction | Wind Speed (mph) | Duration |
|---|---|---|---|---|
| F0 and F1 | Weak | up to 3 miles | 60–115 | 1–10 minutes |
| F2 and F3 | Strong | 15+ miles | 110–205 | 20 minutes or longer |
| F4 and F5 | Violent | 50+ miles | more than 200 | 1 hour or longer |

**13.** The Fujita scale classifies tornadoes according to what criteria?

**14.** What is the wind speed of the most violent tornadoes on the scale?

**15.** How long would an average F3 tornado last?

## SECTION 13.3 *Tropical Storms*

*In your textbook, read about the life cycle of a hurricane.*
**Number the stages in the development of a hurricane in the order in which they occur.**

_____ **1.** tropical disturbance

_____ **2.** hurricane

_____ **3.** tropical storm

_____ **4.** tropical depression

*In your textbook, read about tropical cyclones and the damage they cause.*
**Determine if the statement is true. If it is not, rewrite the italicized part to make it true.**

_____ **5.** To people living near the Atlantic Ocean, tropical cyclones are known as *hurricanes.*

_____ **6.** Tropical cyclones are large, rotating, *high-pressure* storms.

_____ **7.** Tropical cyclones originate over the warm waters of most *tropical* oceans.

_____ **8.** Hurricanes are classified according to the *Fujita scale.*

_____ **9.** The minimum wind speed for a *Category 1* hurricane is 74 mph (120 kph).

_____ **10.** The eye of a hurricane is surrounded by a band of strong winds called the *eye current.*

_____ **11.** Hurricane winds can drive a mound of water toward the coast, where it washes over land. This is called a *storm surge.*

## SECTION 13.4 *Recurring Weather*

*In your textbook, read about weather patterns and problems they cause.*

**Complete the table by writing the result of each weather pattern. Choose from the following: *cold wave, drought, flood, heat wave.***

| Weather Pattern | Result |
|---|---|
| **1.** Thunderstorm remains over an area for many hours | |
| **2.** Extended period of well-below-normal rainfall | |
| **3.** Extended period of above-normal temperatures | |
| **4.** Extended period of below-normal temperatures | |

**Complete the table by writing the name of each weather pattern associated with each atmospheric event. Choose from the following: *cold wave, flood, heat wave, drought.***

| Atmospheric Event | Weather Pattern |
|---|---|
| **5.** Large pools of extremely cold air develop strong high-pressure systems over polar continental areas. Jet streams move systems. | |
| **6.** Large, warm, high-pressure system develops, remains over an area, and blocks cooler air masses from entering the area. | |
| **7.** Sinking air from a strong high-pressure system stops air from rising and condensation from occurring over a long period of time. | |
| **8.** A thunderstorm unleashes heavy precipitation. | |

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CHAPTER 14 STUDY GUIDE FOR CONTENT MASTERY

# Climate

## SECTION 14.1 *What is climate?*

*In your textbook, read about climate and different types of climate data.*
**Put a check (✓) next to the types of data that describe climate.**

_____ **1.** annual wind speed

_____ **2.** average ocean depth

_____ **3.** average precipitation

_____ **4.** average air temperature

_____ **5.** average thickness of atmosphere

_____ **6.** one day's temperature

*In your textbook, read about what causes climate variation.*
**Answer the following questions.**

**7.** How does latitude affect climate?

**8.** Explain how the presence of a large body of water can affect climate.

**9.** How do mountains affect climate?

**10.** Describe the effect that air masses can have on climate and give an example.

## SECTION 14.2 *Climate Classification*

*In your textbook, read about the Koeppen classification system.*
**Write the name of the types of climate in the Koeppen classification system described by each group of terms below. Choose from the following: *dry climate, polar climate, mild climate, continental climate, tropical climate.***

_____ **1.** Continental tropical air dominates, precipitation is low, vegetation is scarce, solar radiation is intense, and clouds are few

_____ **2.** Located between the polar zones and the tropics, violent weather changes occur, and summer and winter temperatures are extreme

_____ **3.** Prevails in the southeastern United States, summers are warm and muggy, and winters are dry and cool

_____ **4.** Mean temperature of warmest month is less than 10°C and precipitation is generally low

_____ **5.** Characterized by constant high temperatures, up to 600 cm of rain falls each year, and lush rain forests predominate

*In your textbook, read about microclimates.*
**Use each of the terms below just once to complete the passage.**

**heat island** **microclimate** **precipitation** **temperatures**

A localized climate that differs from the main regional climate is called a **(6)** _____. A **(7)** _____ is a place in a city where the climate is warmer than in the surrounding countryside. This added heat can cause strong convection currents, increased cloudiness, and more total **(8)** _____. Buildings can also change the surrounding climate by casting shadows that lower **(9)** _____.

## SECTION 14.3 *Climatic Changes*

*In your textbook, read about different types of climatic changes.*
**For each statement below, write *true* or *false*.**

_____ **1.** During ice ages, Earth's climate was colder and much of its surface was covered by vast sheets of ice.

_____ **2.** Earth is currently experiencing a warm period between ice ages, called an interglacial period.

_____ **3.** Seasons are short-term periods of climatic change caused by regular variations in daylight, temperature, and the curvature of Earth.

_____ **4.** During El Niño, cold ocean currents along the western coast of South America are replaced by warm waters from the western Pacific.

_____ **5.** El Niño can bring stormy weather to areas that are normally dry and drought conditions to areas that are normally wet.

_____ **6.** Some scientists think that changes in the angle of Earth's tilt caused ice ages.

_____ **7.** Europe's "Little Ice Age" of 1645 to 1716 is believed to have been the result of an elongation of Earth's orbit.

**Answer the following questions.**

**8.** How does the tilt of the Earth affect climate?

**9.** How will seasons on Earth change when Earth's axis points away from Polaris and toward Vega in 14 000 years?

## SECTION 14.3 *Climatic Changes, continued*

*In your textbook, read about why climatic changes occur.*
**Circle the letter of the choice that best completes the statement.**

**10.** English astronomer E. W. Maunder discovered that changes in Earth's climate have coincided with cycles of low activity for
**a.** tidal changes.
**b.** El Niño activity.
**c.** occurrence of tornadoes.
**d.** sunspot activity.

**11.** Each cycle of low activity referred to in question 10 is called the Maunder minimum and closely corresponds to an unusually
**a.** cold period. **b.** dry period. **c.** warm period. **d.** wet period.

**12.** Climatic changes may be triggered by changes in Earth's axis and
**a.** orbit. **b.** continents. **c.** circumference. **d.** density.

**13.** The shape of Earth's orbit changes over a 100 000-year cycle, becoming more circular, and then more
**a.** parabolic. **b.** elliptical. **c.** straight-lined. **d.** spiral-shaped.

**14.** When its orbit elongates, Earth passes closer to the Sun and climates become
**a.** colder. **b.** warmer. **c.** wetter. **d.** drier.

**15.** When its orbit is more circular, Earth is farther from the Sun and its climates become
**a.** drier. **b.** warmer. **c.** colder. **d.** wetter.

**16.** Some scientists hypothesize that changes in the angle of Earth's tilted axis cause
**a.** volcanic eruptions. **b.** ice ages. **c.** high winds. **d.** droughts.

**17.** Warmer summers and colder winters in the northern hemisphere could occur in several thousand years because
**a.** Earth's orbit reverses direction.
**b.** sunspot activity increases.
**c.** Earth's axis points to the Moon.
**d.** Earth wobbles on its axis.

**18.** A lowering of global temperatures caused by dust blocking solar radiation can be triggered by
**a.** blizzards. **b.** El Niño. **c.** hurricanes. **d.** volcanic eruptions.

## SECTION 14.4 *The Human Factor*

*In your textbook, read about the greenhouse effect and global warming.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **1.** One possible effect of global warming | **a.** greenhouse effect |
| _____ **2.** The main source of Earth's energy | **b.** carbon dioxide |
| _____ **3.** Natural heating of Earth's surface caused by certain atmospheric gases | **c.** global warming |
| _____ **4.** A rise in global temperatures | **d.** flooded coastal cities |
| _____ **5.** A major greenhouse gas | **e.** the Sun |

**Circle the letter of the choice that best completes the statement.**

**6.** Most scientists agree that global warming is occurring, but they mainly disagree about
- **a.** how much has occurred.
- **b.** whether there are greenhouse gases.
- **c.** what global warming really is.
- **d.** what is causing it.

**7.** Scientists hypothesize that an increase in atmospheric carbon dioxide leads to an increase in Earth's absorption of
- **a.** solar radiation.
- **b.** water vapor.
- **c.** gamma rays.
- **d.** volcanic ash.

**8.** If the global-warming trend continues, the effects on the planet could include
- **a.** a rise in sea level.
- **b.** a colder climate like that of Mars.
- **c.** the loss of Earth's atmosphere.
- **d.** increase in the size of polar ice caps.

## SECTION 14.4 *The Human Factor, continued*

*In your textbook, read about human impacts on climate.*
**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **9.** The burning of *fossils* releases the greenhouse gas carbon dioxide into the atmosphere.

_____ **10.** *Automobile exhaust* and industrial emissions are major sources of carbon dioxide.

_____ **11.** The mass removal of trees, or *desertification*, plays a role in increasing levels of atmospheric carbon dioxide.

_____ **12.** Trees decrease atmospheric levels of carbon dioxide by using the gas during *photosynthesis*.

_____ **13.** Because global warming is linked to human activities, *maintaining* those activities could work to reduce their impact.

_____ **14.** During the past 200 years, there has been a gradual increase in world air *pressure* levels.

**Describe three ways that individuals can combat global warming.**

**15.** _____

_____

_____

_____

**16.** _____

_____

_____

_____

**17.** _____

_____

_____

_____

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CHAPTER 15 STUDY GUIDE FOR CONTENT MASTERY

# Physical Oceanography

## SECTION 15.1 *The Oceans*

*In your textbook, read about modern oceanography.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** German research ship that studied the oceans during the 1920s | **a.** oceanography |
| _____ | **2.** Satellite used to monitor ocean surface temperatures | **b.** *Topex/Poseidon* |
| _____ | **3.** Device that uses echoes to map features of the ocean floor | **c.** sonar |
| _____ | **4.** First ship to use sophisticated measuring devices to study the ocean | **d.** *Challenger* |
| _____ | **5.** Scientific study of Earth's oceans | **e.** *Meteor* |

*In your textbook, read about the origin of the oceans.*
**Circle the letter of the choice that best completes the statement.**

**6.** Oceans on Earth have existed for
**a.** 4.6 million years.
**b.** almost 4.6 billion years.
**c.** 46 billion years.
**d.** half as long as Earth has existed.

**7.** One possible source of Earth's water is
**a.** asteroids. **b.** earthquakes. **c.** comet impacts. **d.** violent storms.

**8.** Gases emitted by volcanoes contain mostly
**a.** water vapor and ultraviolet radiation.
**b.** carbon dioxide and oxygen.
**c.** water vapor and carbon dioxide.
**d.** water vapor and nitrogen.

**9.** In Earth's early history, water vapor in the atmosphere condensed into the
**a.** crust. **b.** oceans. **c.** continents. **d.** mountains.

**10.** Water is still being added to Earth's hydrosphere by
**a.** volcanism.
**b.** ultraviolet radiation.
**c.** comet impacts.
**d.** earthquakes.

**11.** The total amount of water on Earth stays the same because water molecules in the atmosphere are destroyed by
**a.** ozone. **b.** meteors. **c.** evaporation. **d.** ultraviolet radiation.

## SECTION 15.1 *The Oceans, continued*

*In your textbook, read about the distribution of Earth's water.*
**Use the terms in the list to complete the statements.**

**sea level** **rising** **tectonic** **oceans** **frozen ice caps**

**12.** The _____ contain 97 percent of the water found on Earth.

**13.** Approximately 3 percent of Earth's water is located in the _____ of Greenland and Antarctica, and in rivers, lakes, and underground sources.

**14.** Global _____ has risen and fallen by hundreds of meters in response to warm periods and ice ages.

**15.** _____ forces that lift or lower portions of the seafloor also affect sea level.

**16.** Today average global sea level is slowly _____ at a rate of 1 to 2 mm per year.

**Answer the following questions.**

**17.** Why is Earth known as the blue planet?

_____

**18.** What is the average depth of the oceans?

_____

**19.** How much of the northern hemisphere is covered by oceans?

_____

**20.** How much of the southern hemisphere is covered by oceans?

_____

**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **21.** The three major oceans are the Atlantic, the Pacific, and the *Arctic*.

_____ **22.** The *Pacific* is Earth's largest ocean.

_____ **23.** The Atlantic Ocean extends for more than *20 000 km* from north to south.

_____ **24.** North of the *antarctic* circle, the Atlantic is known as the Arctic Ocean.

_____ **25.** The Indian Ocean is located mainly in the *northern* hemisphere.

## SECTION 15.2 *Seawater*

*In your textbook, read about the chemical properties of seawater.*
**Circle the letter of the choice that best answers the question.**

**1.** About what percentage of seawater is dissolved salts?
**a.** 96.5 percent **b.** 9.65 percent **c.** 3.5 percent **d.** 35 percent

**2.** Which of the following salts is most abundant in seawater?
**a.** sodium chloride
**b.** magnesium sulfate
**c.** potassium chloride
**d.** calcium chloride

**3.** What is salinity?
**a.** the amount of dissolved salts in seawater
**b.** the amount of water in the oceans
**c.** the amount of dissolved gases in seawater
**d.** another name for salt

**4.** What unit is commonly used to measure the salt content of water?
**a.** parts per liter
**b.** grams per liter
**c.** kilograms per cubic liter
**d.** parts per thousand

**5.** In addition to salts, which of these substances is dissolved in seawater?
**a.** sugars **b.** nutrients **c.** shells **d.** seaweed

**6.** Which of the following would cause surface ocean water to have a higher salt content?
**a.** a river flowing into the ocean
**b.** the melting of sea ice
**c.** high rates of evaporation and low rates of precipitation
**d.** low rates of evaporation and high rates of precipitation

**7.** What evidence indicates that the salt content of ancient oceans was about the same as it is today?
**a.** seafloor sediments
**b.** comparisons of modern seashells and fossil shells
**c.** ancient lava flows that formed in seawater
**d.** salt content in surface water versus the salt content in bottom water

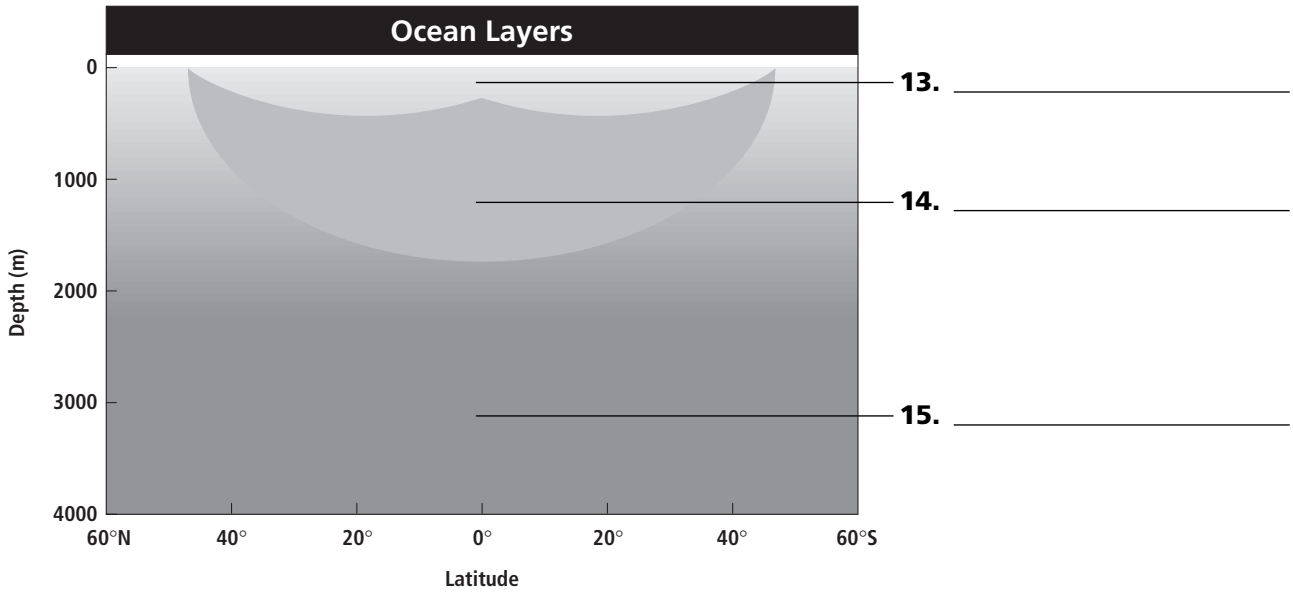
**8.** Which process does NOT add salts to seawater?
**a.** weathering of crustal rock
**b.** decay of hard-shelled sea creatures
**c.** volcanic gases
**d.** flow of rivers into the ocean

**9.** Which process removes salt from seawater?
**a.** ultraviolet radiation
**b.** weathering of feldspars
**c.** evaporation of elements near arid coastal regions
**d.** consumption of sediments by bottom-feeding organisms

## SECTION 15.2 *Seawater, continued*

*In your textbook, read about ocean layering.*
**Use the terms below to label the diagram of ocean temperatures.**

**surface layer** **bottom layer** **thermocline**




*In your textbook, read about water masses.*
**Use the letters A through D to sequence the stages of water-mass movement.**

_____ **16.** Cold, salty water sinks.

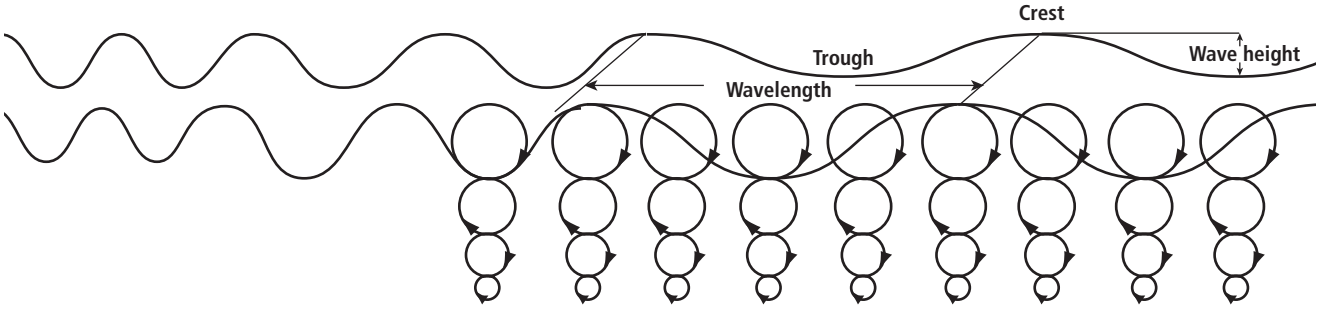
_____ **17.** Sea ice forms during the winter.

_____ **18.** Salty water migrates along the ocean floor toward the equator.

_____ **19.** Salt ions accumulate beneath the ice.

## SECTION 15.3 *Ocean Movements*

*In your textbook, read about wave characteristics.*
**Use the diagram to answer the following questions.**




**1.** Describe the rhythmic movement of a wave. What is the direction of its energy?

**2.** What is the highest point of a wave called?

**3.** What is the lowest point of a wave called?

**4.** What is the vertical distance between the highest and lowest points of a wave?

**5.** What is the horizontal distance between the top of one wave and the top of the next?

**6.** What is the relationship between the wave speed in deep water and wavelength?

**7.** How does an ocean wave become a breaker at the shoreline?

## SECTION 15.3 *Ocean Movements, continued*

*In your textbook, read about tides and the causes of tides.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **8.** Periodic rise and fall of sea level | **a.** gravitational and centrifugal forces |
| _____ **9.** Difference between high tide and low tide | **b.** spring tides |
| _____ **10.** Forces exerted by the Sun and the Moon that generate tidal bulges | **c.** neap tides |
| _____ **11.** Type of tide with the highest high tides and lowest low tides | **d.** tide |
| _____ **12.** Type of tide that occurs when the Sun, the Moon, and Earth form a right angle | **e.** tidal range |

*In your textbook, read about ocean currents.*
**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **13.** A current caused by differences in the temperature and salinity of ocean water is called a *gyre*.

_____ **14.** Surface currents are caused by *wind*.

_____ **15.** The gyres of the northern hemisphere circulate in a *counterclockwise* direction.

_____ **16.** Examples of warm, poleward-flowing currents are the Gulf Stream and the *Kuroshio Current*.

*In your textbook, read about upwelling.*
**Use each of the terms just once to complete the passage.**

**cold** **nutrients** **offshore** **trade-wind** **upwelling** **vertically**

In addition to moving horizontally, ocean water moves **(17)** _____. The upward motion of ocean water is called **(18)** _____. Upwelling waters originate from the bottom of the ocean and are **(19)** _____. Areas of upwelling exist mainly off the western coasts of continents in the **(20)** _____ belts. The trade winds blow surface water **(21)** _____, and the surface water is replaced by upwelling deep water. Upwelling waters are rich in **(22)** _____, which support abundant marine life populations.

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CHAPTER 16 STUDY GUIDE FOR CONTENT MASTERY

# The Marine Environment

## SECTION 16.1 *Shoreline Features*

*In your textbook, read about erosional landforms, beaches, estuaries, longshore currents, and rip currents.*
**For each statement below, write *true* or *false.***

_____ **1.** Waves move more slowly in deep water than in shallow water.

_____ **2.** Wave crests bend as they move into shallow water in a process called wave refraction.

_____ **3.** The force of breakers, along with rock fragments suspended in water, can erode solid rock.

_____ **4.** Rocky headlands, which are points of land reaching into the ocean, are eroded by waves.

_____ **5.** Most of a breaker's energy is concentrated along beaches.

_____ **6.** A wave-cut platform ends against a steep wave-cut cliff.

_____ **7.** Sea caves are formed by erosion from breakers.

_____ **8.** Wide, sandy beaches are the result of loose sediments carried away from the shore by waves.

_____ **9.** Beaches made of pebbles are usually found on rocky coasts.

_____ **10.** The water in an estuary is always salty.

_____ **11.** Estuaries are important because they are nurseries for the young of many species.

_____ **12.** The water current that flows parallel to the shore is called a longshore current.

_____ **13.** Fine-grained materials, such as clay, fall to the bottom of moving water and are pushed along the bottom by the current.

_____ **14.** Rip currents move large amounts of sediment along the shore.

_____ **15.** Rip currents flow through gaps of longshore bars and up onto beaches.

## SECTION 16.1 *Shoreline Features, continued*

*In your textbook, read about depositional features of seashores.*
**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **barrier islands** | **deposit** | **sand dunes** | **seashores** |
| **sediment** | **spit** | **storm waves** | **wave erosion** |

Most **(16)** _____ are constantly changing due to **(17)** _____, longshore transport, and **(18)** _____ deposition. Large storm waves pick up sediments and **(19)** _____ them wherever waves and currents move more slowly. Sometimes the transported sediments build a narrow bank of sand called a **(20)** _____ that projects into the water from a bend in the coastline. Longshore currents may also deposit long ridges of sediment to form a chain of **(21)** _____. Tides and **(22)** _____ can help currents build features that rise well above sea level. Also, winds blow dry, exposed sediment into **(23)** _____ along shorelines.

**Answer the following questions.**

**24.** How are a spit and a tombolo alike?

_____

_____

_____

**25.** Do you think the shore of a barrier island is a good or bad place to build a house? Why?

_____

_____

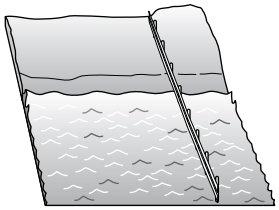
_____

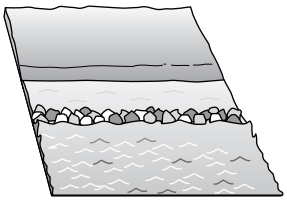
_____

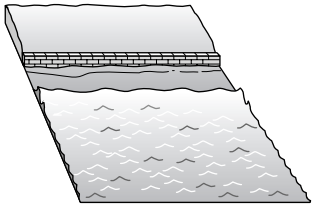
## SECTION 16.1 *Shoreline Features, continued*

*In your textbook, read about protective structures.*
**Use the terms below to label each drawing.**

**breakwater** **groin** **seawall**







**26.** _____ **27.** _____ **28.** _____

**29.** What happens to the beach in front of a seawall?

_____

_____

**30.** What happens to a beach located down the coast from a groin?

_____

_____

**31.** Why does the anchorage behind a breakwater have to be dredged?

_____

_____

*In your textbook, read about changes in sea level.*
**Underline the term in parenthesis that best completes the statement.**

**32.** About 10 000 years ago, Earth's seas were (higher, lower) than they are today.

**33.** The seas are still rising. Many researchers believe the cause is (global warming, lower temperatures on Earth's surface).

**34.** Coastal valleys scooped out by glaciers and later flooded produce (barrier islands, fjords).

**35.** Local sea levels can be affected by (tectonic movement, coastal cities).

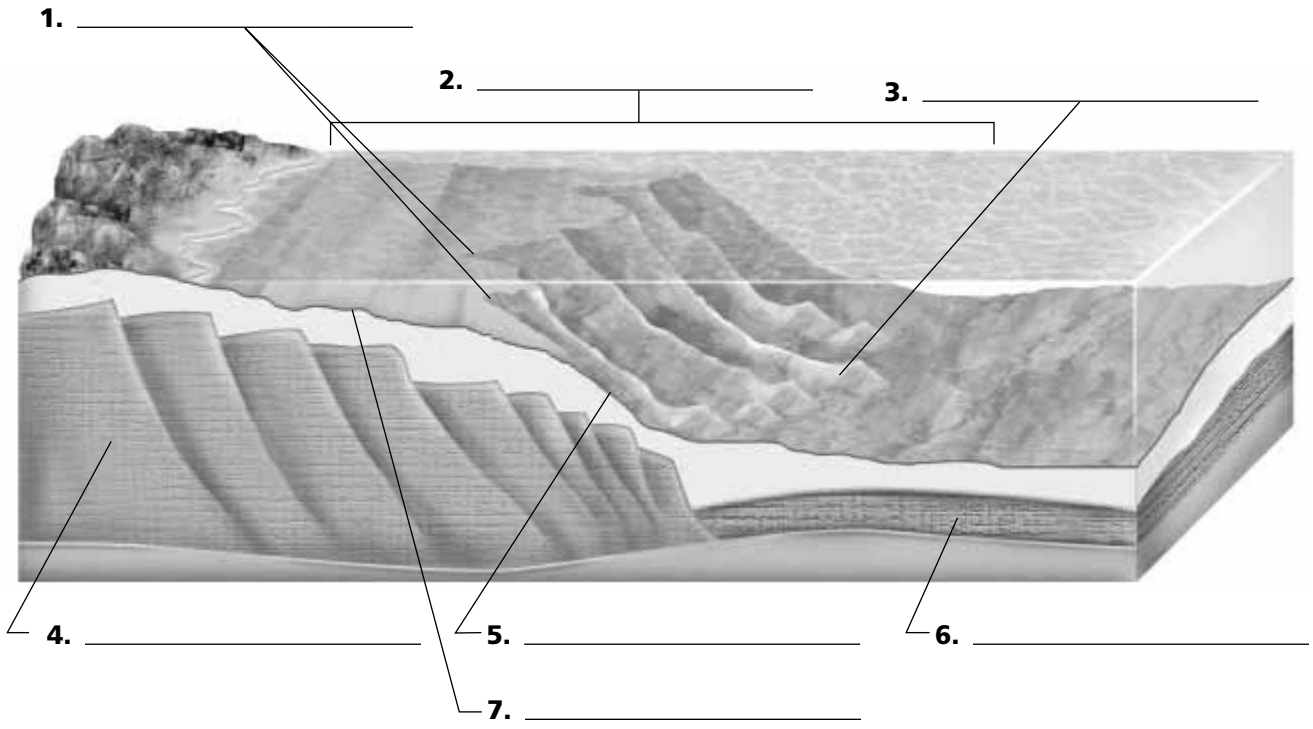
**36.** A rising coastline produces a relative (rise, drop) in sea level.

## SECTION 16.2 *The Seafloor*

*In your textbook, read about oceanic and continental crust, continental shelves, and continental slopes.*

**Use the terms below to label the diagram.**

**continental crust** **continental margin** **continental rise** **continental shelf**
**continental slope** **oceanic crust** **submarine canyons**




**Write the name of the topographic feature of the seafloor to the left of its description.**

_____ **8.** Thin crust associated with deep ocean basins

_____ **9.** Submerged parts of continents

_____ **10.** Shallowest part of a continental margin reaching seaward from shore

_____ **11.** Area beyond the continental shelf where the seafloor drops sharply

_____ **12.** Gentle slope at the base of the continental slope that is formed by sediments deposited by turbidity currents

_____ **13.** Feature cut into the continental slope by turbidity currents

_____ **14.** Crust associated with higher elevations on land

## SECTION 16.2 *The Seafloor, continued*

*In your textbook, read about ocean basins.*
**Answer the following questions.**

**15.** About what percent of Earth's surface is ocean floor?

**16.** What is an abyssal plain? What kind of sediment is found there?

**17.** What are six identifying features of deep-sea trenches?

**18.** What are four identifying characteristics of mid-ocean ridges?

**19.** What is a hydrothermal vent?

**20.** What are two types of hydrothermal vents?

## SECTION 16.2 *The Seafloor, continued*

*In your textbook, read about seafloor volcanoes and marine sediments.*
**Use each of the terms below just once to complete the passage.**

| | | |
|---|---|---|
| **continents** | **extinct volcanoes** | **guyots** |
| **nodules** | **ooze** | **seamounts** |

Thousands of solitary mountains on the seafloor are not near areas of active volcanism. Researchers believe that these mountains are **(21)** _____. There are two types of volcanoes on the seafloor. One type, submerged basaltic volcanoes more than 1 kilometer high, are called **(22)** _____. The other type is tablemounts, also called **(23)** _____, which are large, extinct basaltic volcanoes with flat, submerged tops.

Sedimentation is the only process that changes structures on the seafloor. Most of the sediments come from **(24)** _____ and other sources. These sediments include mud, sand, dust, and volcanic ash. **(25)** _____ is a source of sediment that is formed by the shells and hard parts of marine organisms. Another type of deep-sea sediment is manganese **(26)** _____, which are formed when metals precipitate from seawater.

**If the statement is true, write *true*. If it is not true, rewrite the italicized word or phrase to make it true.**

_____ **27.** Once they are formed, seafloor structures last *practically forever*.

_____ **28.** The deep ocean floor is covered with mud made of *silt, clay, and other fine-grained materials*.

_____ **29.** Sandy sediments sometimes reach the abyssal plains riding on *gentle* turbidity currents.

_____ **30.** Deep-sea mud has a reddish color because of *manganese* in the sediment.

_____ **31.** Sediments with a large percentage of particles from once-living organisms are called *oozes*.

_____ **32.** Oozes are found in the *deeper* parts of the ocean.

_____ **33.** Oozes and deep-sea muds accumulate grain by grain to reach the depth of only a few millimeters per *thousand years*.

UNIT 4 STUDY GUIDE FOR CONTENT MASTERY

*GeoDigest*

# The Atmosphere and the Oceans

**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** Flat part of the seafloor | **a.** precipitation |
| _____ | **2.** Deforestation and the burning of fossil fuels may contribute to this. | **b.** Doppler radar |
| _____ | **3.** Place on Earth where weather occurs | **c.** abyssal plain |
| _____ | **4.** Boundary between two air masses | **d.** global warming |
| _____ | **5.** Type of current that builds barrier islands | **e.** radiosonde |
| _____ | **6.** Result of abundant moisture in the lower atmosphere, the lifting of moisture, and unstable air | **f.** atmospheric pressure |
| _____ | **7.** Rain, snow, sleet, and hail | **g.** density current |
| _____ | **8.** Balloon-borne instrument that collects weather data | **h.** seawater |
| _____ | **9.** This generally decreases with increasing altitude in troposphere. | **i.** meteorology |
| _____ | **10.** Substance containing 3.5 percent dissolved salts | **j.** longshore current |
| _____ | **11.** Instrument that measures wind speed | **k.** upwelling |
| _____ | **12.** Differences in ocean's temperature and salinity cause this. | **l.** thunderstorm |
| _____ | **13.** The study of the atmosphere | **m.** front |
| _____ | **14.** Result of factors such as changes in solar activity, the tilt of Earth's axis, Earth's orbit, volcanic eruptions, and some human activities | **n.** troposphere |
| _____ | **15.** Occurrence resulting from winds pushing surface water aside and replacing it with cold, deep water | **o.** climatic change |

**Answer the following questions.**

**16.** What three processes transfer the Sun's energy through Earth's atmosphere?

**17.** What are the three stages of a thunderstorm?

**18.** How are a region's normals determined?

**19.** What are two possible sources of Earth's oceans?

**20.** What is the difference between weather and climate?

**21.** How do clouds form?

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CHAPTER 17 STUDY GUIDE FOR CONTENT MASTERY

# Plate Tectonics

## SECTION 17.1 *Drifting Continents*

*In your textbook, read about continental drift.*
**Circle the letter of the choice that best completes each statement.**

**1.** Early mapmakers thought continents might have moved based on their observations of
- **a.** Gondwanaland.
- **b.** rock and fossil evidence.
- **c.** matching coastlines.
- **d.** earthquakes and floods.

**2.** Pangaea was an ancient supercontinent made up of
- **a.** South Africa, India, Australia, and South America.
- **b.** the United States, Greenland, and Europe.
- **c.** Antarctica, India, and South America.
- **d.** all of Earth's continents.

**3.** To support his hypothesis of continental drift, Alfred Wegener did NOT use
- **a.** ancient climatic evidence.
- **b.** magnetic field data.
- **c.** data on ancient reptiles and ferns.
- **d.** evidence from rock formations.

**4.** Fossil evidence that supported Wegener's idea of continental drift included
- **a.** land-dwelling animals.
- **b.** ocean plants.
- **c.** ocean mammals.
- **d.** tropical flowers.

**5.** Fossils of aquatic reptiles found in freshwater rocks suggested to Wegener that these reptiles
- **a.** swam the great distances between continents.
- **b.** probably did not cross the oceans.
- **c.** ate *Glossopteris*.
- **d.** once lived in Earth's oceans.

**6.** Based on observations of fossils of *Glossopteris*, Wegener concluded that
- **a.** magnetic reversals had occurred in Earth's past.
- **b.** continental rocks containing these fossils had once been joined.
- **c.** Earth's continents were never joined.
- **d.** *Glossopteris* grew only in the tropics.

**7.** Coal beds in Antarctica indicated to Wegener that this continent was
- **a.** always cold.
- **b.** inhabited by penguins.
- **c.** once located closer to the equator.
- **d.** once beneath the ocean.

**8.** Based on the glacial deposits he observed, Wegener argued that
- **a.** glaciers form near the equator.
- **b.** Earth's axis of rotation had changed in the past.
- **c.** landmasses drifted away from the south pole.
- **d.** *Glossopteris* could not survive hot weather.

**9.** Most scientists at the time rejected Wegener's hypothesis of continental drift because he
- **a.** had collected little evidence to support his hypothesis.
- **b.** would not state his hypothesis publicly.
- **c.** insisted that Earth's axis of rotation had changed.
- **d.** couldn't explain how or why the continents moved.

## SECTION 17.2 *Seafloor Spreading*

*In your textbook, read about seafloor spreading.*
**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make the statement true.**

_____ **1.** *Sonar* uses sound waves to measure water depth.

_____ **2.** Maps made from sonar and magnetometer data led to the discovery of *ocean ridges and deep-sea trenches.*

_____ **3.** *Deep-sea trenches* are vast, underwater mountain chains.

_____ **4.** Rock samples taken near ocean ridges are *older* than rock samples taken near deep-sea trenches.

_____ **5.** The thickness of ocean-floor sediments *decreases* with distance from an ocean ridge.

_____ **6.** The oldest ocean floor rocks are about *3.8 billion* years old.

_____ **7.** The study of the magnetic record preserved in Earth's rocks is called *paleomagnetism.*

_____ **8.** *An isochron* is a change in Earth's magnetic field.

_____ **9.** Earthquake activity and volcanism are common along *ocean ridges.*

_____ **10.** The magnetic patterns on either side of *a deep-sea trench* are mirror images of each other.

_____ **11.** The theory of *continental drift* states that new ocean crust is formed at ocean ridges and destroyed at deep-sea trenches.

_____ **12.** As new seafloor is carried away from an ocean ridge, it *heats up, expands, and becomes less dense* than the material beneath it.

_____ **13.** The theory of seafloor spreading explains that Earth's continents move because they *ride atop ocean crust as it moves away from ocean ridges.*

**The statements below describe the steps involved in the process of seafloor spreading. Number these steps in the order in which they occur.**

_____ **14.** Magma fills the gap that is created.

_____ **15.** Magma hardens to form new ocean crust.

_____ **16.** Magma is forced upward toward the crust.

## SECTION 17.2 *Seafloor Spreading, continued*

*In your textbook, read about magnetism.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **combine** | **stronger** | **isochron** | **lower** | **magnetic field** |
| **normal polarity** | **older** | **cancel** | **reversed polarity** | **younger** |

Earth's **(17)** _____ has changed over time. A field with the same orientation as today's field is said to have **(18)** _____. A field that is opposite the present field has **(19)** _____. Magnetometers have been used to measure the ocean floor's magnetic field. When the ocean floor's magnetic readings match the present field, the two fields **(20)** _____. This produces a(n) **(21)** _____ than normal reading. When the magnetic readings of the ocean floor are reversed compared to today's field, the two fields partially **(22)** _____ to produce a(n) **(23)** _____ than normal reading. Magnetic data of the ocean floor has been used to generate **(24)** _____ maps, which have shown that the ocean floor is **(25)** _____ near ocean ridges and **(26)** _____ near deep-sea trenches.

*In your textbook, read about ocean rocks and sediments, magnetism, and seafloor spreading.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **27.** Device that can detect small changes in magnetic fields | **a.** isochron |
| _____ **28.** Minerals containing this act like small compass needles and record the orientation of Earth's magnetic field at the time of their formation | **b.** iron |
| _____ **29.** Was constructed from data gathered from continental basalt flows | **c.** geomagnetic time scale |
| _____ **30.** This type of line connects points on a map that have the same age | **d.** new ocean crust |
| _____ **31.** Each cycle of spreading and magma intrusion along an ocean ridge results in the formation of this | **e.** magnetometer |

## SECTION 17.3 *Theory of Plate Tectonics*

*In your textbook, read about plate tectonics and plate boundaries.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**1.** Which theory states that Earth's crust and rigid upper mantle move in different directions and at different rates over Earth's surface?
- **a.** ridge push and slab pull
- **b.** seafloor spreading
- **c.** continental drift
- **d.** plate tectonics

**2.** Tectonic plates interact at places called plate
- **a.** reversals.
- **b.** boundaries.
- **c.** regions.
- **d.** subductions.

**3.** Places where tectonic plates move apart are called
- **a.** convergent boundaries.
- **b.** transform boundaries.
- **c.** subduction zones.
- **d.** divergent boundaries.

**4.** Where are most divergent boundaries found?
- **a.** on the seafloor
- **b.** on continents
- **c.** along coastlines
- **d.** at subduction zones

**5.** What happens along a divergent boundary?
- **a.** Continental mountain ranges form.
- **b.** New ocean crust forms.
- **c.** Oceanic plates are subducted into the mantle.
- **d.** Ocean basins become smaller.

**6.** The Mid-Atlantic Ridge is an example of a
- **a.** divergent boundary.
- **b.** convergent boundary.
- **c.** subduction zone.
- **d.** transform boundary.

**7.** Places where tectonic plates come together are called
- **a.** convergent boundaries.
- **b.** divergent boundaries.
- **c.** transform boundaries.
- **d.** rift valleys.

**8.** Convergent boundaries are classified according to the
- **a.** types of fossils found at the boundaries.
- **b.** rate at which the plates collide.
- **c.** compass direction of movement of the plates.
- **d.** type of crust involved.

## SECTION 17.3 *Theory of Plate Tectonics, continued*

**9.** Oceanic crust is made mostly of
- **a.** granite.
- **b.** basalt.
- **c.** water.
- **d.** sediments.

**10.** Which of the following features forms when two oceanic plates converge?
- **a.** magnetic reversal patterns
- **b.** divergent boundaries
- **c.** subduction zones
- **d.** rift valleys

**11.** What can happen when two oceanic plates converge and one is subducted into the mantle?
- **a.** Melted magma erupts and forms an arc of islands.
- **b.** The colliding plate edges become crumpled to form a mountain range.
- **c.** The lithosphere splits to create a divergent plate boundary on land.
- **d.** A continent splits to form a new ocean basin.

**12.** Which of the following landforms results from divergence of continental crust?
- **a.** a mountain range
- **b.** a rift valley
- **c.** a deep-sea trench
- **d.** a long fault

**13.** Which of the following best describes what happens when an oceanic plate converges with a continental plate?
- **a.** A deep-sea trench and an island arc form.
- **b.** Both plates become fractured, and a series of long faults form on the surface.
- **c.** Both plates crumple and a folded mountain range forms.
- **d.** A trench and a mountain range with many volcanoes form.

**14.** Which feature is associated with a continental-continental plate boundary?
- **a.** a subduction zone
- **b.** a mountain range
- **c.** a deep-sea trench
- **d.** a volcano

**15.** At which tectonic plate boundary do plates slide horizontally past each other?
- **a.** transform boundary
- **b.** divergent boundary
- **c.** continental-continental boundary
- **d.** oceanic-oceanic boundary

**16.** Which of the following is NOT associated with transform boundaries?
- **a.** deformed and fractured crust
- **b.** shallow earthquakes
- **c.** long faults
- **d.** volcanoes

## SECTION 17.4 *Causes of Plate Motion*

*In your textbook, read about mantle convection, ridge push, and slab pull.*
**Answer the following questions.**

**1.** Explain the process of convection.

**2.** Describe the formation of convection currents in the mantle.

**3.** Explain how the parts of a convection current in the mantle are related to plate motions.

**4.** Compare and contrast ridge push and slab pull.

**5.** What is one hypothesis regarding the formation of a divergent boundary on a continent?

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CHAPTER 18 STUDY GUIDE FOR CONTENT MASTERY

# Volcanic Activity

## SECTION 18.1 *Magma*

*In your textbook, read how magma forms.*
**For each statement below, write *true* or *false*.**

_____ **1.** Magma is a mixture of molten rock, suspended minerals, and gases.

_____ **2.** Magma forms when rocks begin to melt.

_____ **3.** Pressure decreases with depth below Earth's surface.

_____ **4.** As pressure increases, the temperature at which a dry substance melts increases.

_____ **5.** Wet minerals and rocks melt at lower temperatures than do dry minerals and rocks.

**Answer the following questions.**

**6.** What three factors affect the formation of magma?

**7.** Why isn't Earth's entire mantle liquid?

**8.** How is water present in rocks and minerals?

## SECTION 18.1 *Magma, continued*

*In your textbook, read about the types of magma.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **andesitic** | **continental** | **extrusive** | **granite** | **rhyolitic** |
| **sediments** | **silica** | **slowly** | **upper mantle** | **viscosity** |

Magmas are named after **(9)** _____ rocks. Basaltic magma forms when rocks in the **(10)** _____ melt. This magma contains small amounts of silica and has a low **(11)** _____. Basaltic magma fuels relatively quiet volcanic eruptions.

Andesitic magma forms from oceanic crust and **(12)** _____. This magma contains about 60 percent silica and has an intermediate viscosity. **(13)** _____ magma fuels volcanoes with intermediate eruptions.

Rhyolitic magma forms deep beneath **(14)** _____ crust. This magma has the highest **(15)** _____ content of the three types of magma. It has the same composition as **(16)** _____, has a high viscosity, and flows **(17)** _____. **(18)** _____ magma produces very explosive volcanoes.

**Answer the following questions.**

**19.** How does the viscosity of magma change as magma cools?

_____

**20.** Does cooler magma flow more or less quickly than hotter magma?

_____

**21.** Is the viscosity of magma that is high in silica higher or lower than magma that is low in silica?

_____

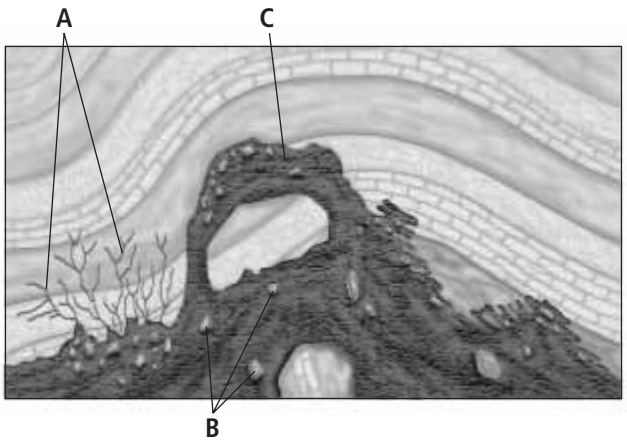
**22.** Which type of lava—basaltic lava or rhyolitic lava—flows faster? Explain.

_____

_____

## SECTION 18.2 *Intrusive Activity*

*In your textbook, read about how magma affects surrounding rocks.*
**Match each letter on the diagram with its description.**




_____ **1.** Magma can melt rocks with which it comes into contact.

_____ **2.** Magma can fracture apart overlying rocks and rise through cracks and fissures.

_____ **3.** Magma can cause blocks of rocks to break off, sink into the magma, and eventually melt.

*In your textbook, read about plutons and tectonics.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **4.** Intrusive igneous rock body | **a.** stock |
| _____ **5.** Largest pluton | **b.** sill |
| _____ **6.** Irregularly shaped pluton that is similar to a batholith, but smaller in size | **c.** laccolith |
| _____ **7.** Mushroom-shaped pluton | **d.** pluton |
| _____ **8.** Pluton that is parallel to the rocks it intrudes | **e.** batholith |
| _____ **9.** Pluton that cuts across preexisting rocks | **f.** dike |
| _____ **10.** Process responsible for the formation of many plutons | **g.** mountain-building |

## SECTION 18.3 *Volcanoes*

*In your textbook, read about the anatomy of a volcano and volcanic material.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**1.** Lava erupts through an opening in Earth's crust called a
**a.** vent. **b.** crater. **c.** caldera. **d.** volcano.

**2.** A bowl-shaped depression that forms around the vent of a volcano is a
**a.** magma chamber. **b.** vent. **c.** crater. **d.** sill.

**3.** Rock fragments thrown into the air during a volcanic eruption are called
**a.** dikes. **b.** sills. **c.** calderas. **d.** tephra.

**4.** The smallest tephra are
**a.** lapilli. **b.** dust. **c.** volcanic bombs. **d.** volcanic blocks.

**5.** Fast-moving clouds of gas, ash, and other tephra are
**a.** calderas. **c.** volcanic blocks.
**b.** pyroclastic flows. **d.** volcanic bombs.

**6.** Which of the following forms when the top or side of a volcano collapses into the magma chamber?
**a.** dike **c.** caldera
**b.** pyroclastic flow **d.** vent

**7.** Large, angular volcanic fragments are called
**a.** pyroclastic flows. **c.** vents.
**b.** volcanic blocks. **d.** volcanic bombs.

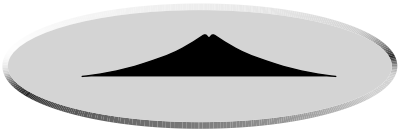
**8.** When magma reaches Earth's surface, it is called
**a.** a vent. **c.** lava.
**b.** a pyroclastic flow. **d.** calderas.

**9.** Large, rounded or streamlined tephra are called
**a.** pyroclastic flows. **c.** calderas.
**b.** volcanic blocks. **d.** volcanic bombs.

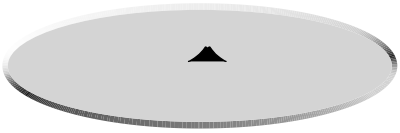
## SECTION 18.3 *Volcanoes, continued*

*In your textbook, read about types of volcanoes.*
**Label the diagrams as *composite volcano*, *cinder-cone volcano*, or *shield volcano*.**

**10.** _____



**11.** _____



**12.** _____

**Identify the type or types of volcano being described as *shield volcano*, *cinder-cone volcano*, or *composite volcano*.**

_____ **13.** Forms when tephra are ejected into the air then fall back to Earth and pile up around a vent

_____ **14.** Has broad, gently sloping sides and a nearly circular base

_____ **15.** Forms when layers of basaltic lava accumulate during a nonexplosive eruption

_____ **16.** Mauna Kea in Hawaii is an example.

_____ **17.** Small volcano with steep sides

_____ **18.** Forms when layers of tephra alternate with lava

_____ **19.** Forms from lava that contains relatively small amounts of gases and silica

_____ **20.** Forms from lava that is higher in water and silica content than lava that forms shield volcanoes
_____

_____ **21.** Fueled by magma that contains large amounts of silica, water, and gases

_____ **22.** Magma that fuels this type of volcano contains large volumes of gases but not silica and water.

_____ **23.** Potentially the most dangerous to humans and most destructive to the environment

_____ **24.** Mount St. Helens and Mount Rainier are examples.

## SECTION 18.3 *Volcanoes, continued*

*In your textbook, read about where volcanoes occur.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **Hawaiian Islands** | **crust** | **divergent** | **flood basalts** | **hot spots** |
| **Iceland** | **mantle** | **volcanoes** | **plateau** | **ocean ridges** |
| **Circum-Pacific Belt** | **western** | **convergent** | | |

Most of the world's volcanoes form along **(25)** _____ plate boundaries. Slabs of oceanic crust descend into the **(26)** _____ and melt. The magma that forms is forced upward through the overlying plate and forms **(27)** _____ when it reaches Earth's surface. The **(28)** _____ marks the locations of most convergent boundary volcanoes. It stretches along the **(29)** _____ coasts of North and South America and down the eastern coast of Asia.

At **(30)** _____ plate boundaries, magma is forced upward into fractures and faults that form as plates separate or spread apart. Most of the volcanoes that form along divergent boundaries are located underwater along **(31)** _____. This type of volcanic activity can be observed above sea level in **(32)** _____, which sits atop the Mid-Atlantic Ridge.

Some volcanoes that form far from plate boundaries form over **(33)** _____, which are unusually hot regions of Earth's mantle. At hot spots, high-temperature plumes melt rock. The magma that forms moves upward toward the **(34)** _____ and melts the crust to form a volcano. As a tectonic plate moves over a hot spot, a string of volcanoes forms. The **(35)** _____ are forming as the result of a hot spot. Hot spots can also result in the formation of **(36)** _____, which erupt from fissures to form a flat plain or a **(37)** _____ rather than volcanic mountains.

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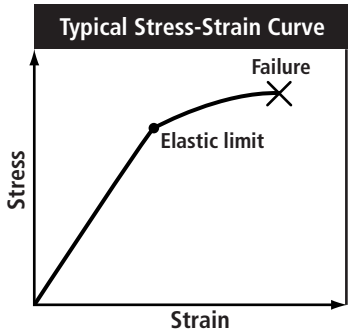
CHAPTER 19 STUDY GUIDE FOR CONTENT MASTERY

# Earthquakes

## SECTION 19.1 *Forces Within Earth*

*In your textbook, read about the effects of stress and strain on rocks.*
**Answer the following questions.**




**1.** What is stress?

**2.** What is strain?

**3.** What is compression?

**4.** What is tension?

**Use the graph to answer questions 5–7.**

**5.** What happens when stress exceeds the strength of a material?

**6.** On the stress-strain curve, what part of the curve represents the elastic deformation of a material? What part represents ductile deformation?

**7.** Which occurs at a lower stress value, ductile deformation or elastic deformation?

**8.** Are rocks near Earth's surface generally brittle or ductile? Rocks at great depths?

## SECTION 19.1 *Forces Within Earth, continued*

*In your textbook, read about the different types of faults.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **9.** Fracture that forms as a result of horizontal compression | **a.** fault |
| _____ **10.** Fracture caused by horizontal shear | **b.** fault plane |
| _____ **11.** Famous California strike-slip fault | **c.** normal fault |
| _____ **12.** Fracture caused by horizontal tension | **d.** reverse fault |
| _____ **13.** Fracture along which movement occurs | **e.** San Andreas |
| _____ **14.** Fault surface along which movement takes place | **f.** strike-slip fault |

*In your textbook, read about the different kinds of seismic waves.*
**Complete the table by filling in the type or types of seismic waves described.**

**Seismic Waves**

| Description | Type of Seismic Wave |
|---|---|
| **15.** Causes rock to move both up and down and from side to side | |
| **16.** Causes rock to move at right angles to the direction in which the wave travels | |
| **17.** Squeezes and pulls rock in the same direction as the wave travels | |
| **18.** Can pass through Earth's interior | |
| **19.** Travels only along Earth's surface | |

## SECTION 19.2 *Seismic Waves and Earth's Interior*

*In your textbook, read about seismometers and clues to Earth's interior.*
**Use each of the terms below to complete the following statements.**

**mass** **seismometer** **seismogram** **frame**

1. A _____ is an instrument that records earthquake vibrations.
2. All seismometers include a _____ suspended from a wire.
3. A paper or computer record of earthquake vibrations is called a _____.
4. All seismometers include a _____ that is anchored to the ground and vibrates during an earthquake.

**For each statement below, write *true* or *false*.**

_____ **5.** Seismic waves change speed and direction when they encounter different materials.

_____ **6.** P-waves travel through Earth's mantle.

_____ **7.** S-waves do not travel through Earth's mantle.

_____ **8.** Surface waves are the first to arrive at a seismic facility.

_____ **9.** P-waves are bent when they strike the core.

_____ **10.** On seismograms, seismic waves recorded from more distant facilities are closer together than those recorded from facilities close to the epicenter.

_____ **11.** S-waves do not enter the core because they cannot travel through solids.

_____ **12.** Seismologists have reasoned that Earth's outer core must be liquid based on the disappearance of S-waves.

_____ **13.** Studies of how waves reflect deep inside Earth show that Earth's inner core is solid.

_____ **14.** The P-wave shadow zone does not receive direct P-waves.

## SECTION 19.3 *Measuring and Locating Earthquakes*

*In your textbook, read about earthquake magnitude and intensity.*
**Circle the letter of the choice that best completes the statement.**

**1.** The amount of energy released by an earthquake is measured by its
**a.** amplitude. **b.** magnitude. **c.** focus. **d.** intensity.

**2.** The Richter scale is a numerical scale used to describe an earthquake's
**a.** intensity. **b.** amplitude. **c.** probability. **d.** magnitude.

**3.** Each whole-number increase on the Richter scale corresponds to a 32-fold increase in
**a.** seismic energy. **b.** magnitude. **c.** probability. **d.** intensity.

**4.** The moment magnitude scale takes into account the size of an earthquake's
**a.** epicenter. **b.** fault rupture. **c.** probability. **d.** intensity.

**5.** Moment-magnitude values can be estimated from the
**a.** P-wave arrival time. **c.** surface wave arrival time.
**b.** S-wave arrival time. **d.** seismic wave size.

**6.** The amount of damage done to structures by an earthquake is the earthquake's
**a.** intensity. **b.** amplitude. **c.** probability. **d.** seismic gap.

**7.** The modified-Mercalli scale measures an earthquake's
**a.** intensity. **b.** seismic gap. **c.** probability. **d.** magnitude.

**8.** The modified-Mercalli scale ranges from
**a.** 0 to 100. **b.** 1 to 10. **c.** I to XII. **d.** VI to XXI.

**9.** Earthquake intensity depends primarily on the height of
**a.** P-waves. **b.** S-waves. **c.** surface waves. **d.** the fault.

**10.** As the distance from a quake's epicenter increases,
**a.** intensity increases. **c.** magnitude increases.
**b.** intensity decreases. **d.** the focus decreases.

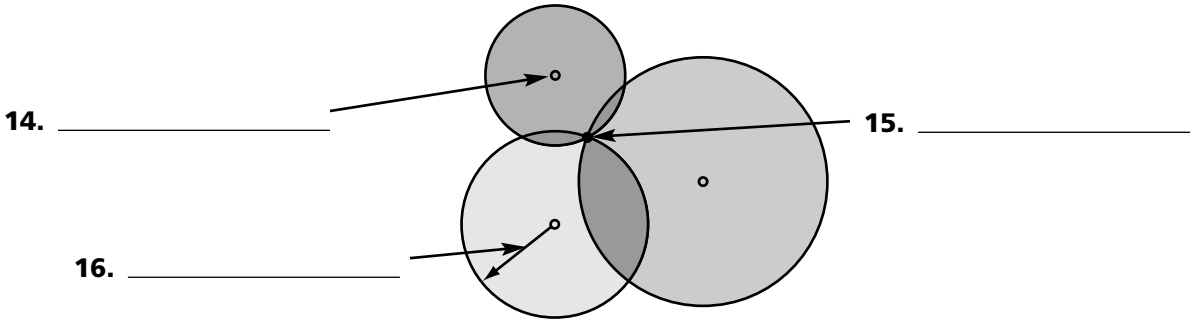
**11.** Maximum earthquake intensity is usually found at the earthquake's
**a.** epicenter. **c.** seismic gap.
**b.** shadow zone. **d.** focus.

**12.** One factor that determines the strength of an earthquake is the depth of its
**a.** epicenter. **c.** magnitude.
**b.** epicentral distance. **d.** focus.

**13.** The focus of a catastrophic earthquake with high intensity values is almost always
**a.** deep. **c.** difficult to determine.
**b.** shallow. **d.** below the point of initial rock failure.

## SECTION 19.3 *Measuring and Locating Earthquakes, continued*

*In your textbook, read about how scientists locate an earthquake's epicenter.*
**Label the diagram below. Choose from the following: *epicenter, epicentral distance, seismic station.***




**Answer the following questions.**

**17.** To determine an epicentral distance, scientists consider the arrival times of what wave types?

_____

**18.** Can the location of an epicenter be determined from the distance between one seismic station and the epicenter? If not, what information is needed?

_____

_____

*In your textbook, read about Earth's seismic belts.*
**Use each of the terms below just once to complete the passage.**

| | | |
|---|---|---|
| **Circum-Pacific Belt** | **boundaries** | **tectonic plates** |
| **Mediterranean-Asian Belt** | **ocean ridges** | **seismic belts** |

Most earthquakes occur in narrow **(19)** _____ that lie between large regions with little or no seismic activity. Seismic activity in seismic belts is a result of movements among Earth's **(20)** _____. Most earthquakes occur near the **(21)** _____ of tectonic plates. Nearly 80 percent of earthquakes occur in the seismic belt known as the **(22)** _____. About 15 percent of all earthquakes occur in the **(23)** _____, which stretches across Europe and Asia.

Most other earthquakes occur on the crests of **(24)** _____.

## SECTION 19.4 *Earthquakes and Society*

*In your textbook, read about how earthquakes are predicted and the factors that affect how damaging an earthquake is.*

**Answer the following questions.**

1. What kinds of structures suffer the most severe damage from an earthquake?

2. How does a rubber structure beneath a building prevent it from being damaged?

3. What takes place during the process called "pancaking"?

4. How is the height of a building related to damage caused during an earthquake?

5. What can happen during earthquakes in areas where the ground contains fluid-saturated sand?

6. How are seismic waves changed as they pass through soft soils?

7. What is a fault scarp?

8. Is an area that has already experienced past earthquakes more or less likely to experience a future earthquake than an area that has never had an earthquake?

9. Upon what two factors is the probability of earthquake occurrence based?

10. What is a seismic gap?

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CHAPTER 20 STUDY GUIDE FOR CONTENT MASTERY

# Mountain Building

## SECTION 20.1 *Crust–Mantle Relationships*

*In your textbook, read about Earth's topography and the relationships between the crust and the mantle.*

**Circle the letter of the choice that best completes the statement or answers the question.**

**1.** Approximately how much of Earth's surface is below sea level?
**a.** 10 percent **b.** 30 percent **c.** 70 percent **d.** 90 percent

**2.** Approximately how much of Earth's surface is above sea level?
**a.** 10 percent **b.** 30 percent **c.** 70 percent **d.** 90 percent

**3.** The largest percentage of Earth's surface above sea level ranges in elevation from 0 km to
**a.** 0.5 km. **b.** 0.8 km. **c.** 1 km. **d.** 2 km.

**4.** How far below sea level is the largest percentage of Earth's surface?
**a.** 0–1 km **b.** 1–2 km **c.** 3–4 km **d.** 4–5 km

**5.** Oceanic crust is made of
**a.** basalt and is denser than continental crust.
**b.** granite and is denser than continental crust.
**c.** basalt and is less dense than continental crust.
**d.** granite and is less dense than continental crust.

*In your textbook, read about isostasy and erosion.*

**Use each of the terms below just once to complete the passage.**

**equilibrium isostatic rebound mantle mountains roots seamounts smaller**

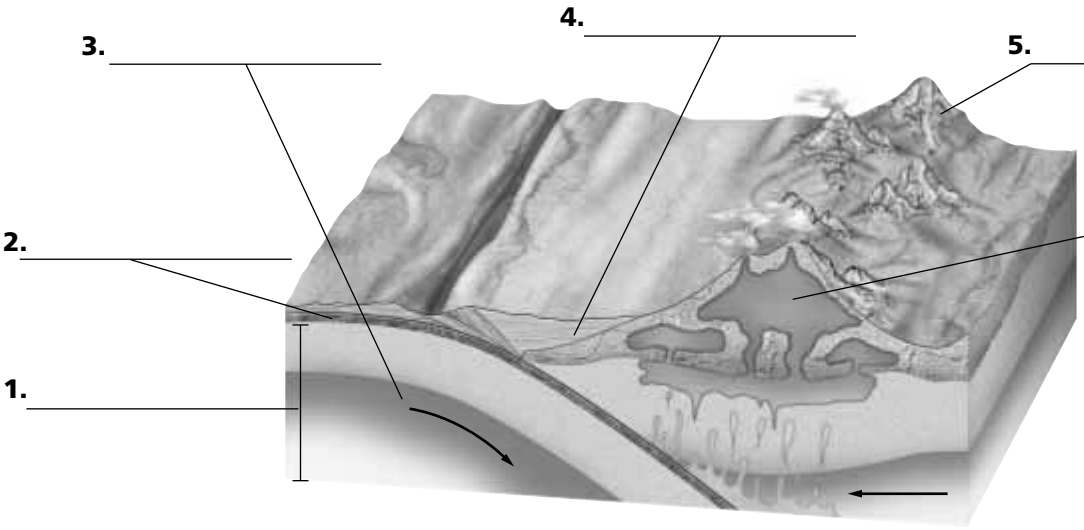
Isostasy is a condition of **(6)** _____ between the mass of Earth's crust and the buoyancy of the mantle. Topographic highs in the crust have deep **(7)** _____ that extend into the mantle and provide buoyant support. Continents are said to float on the denser **(8)** _____.

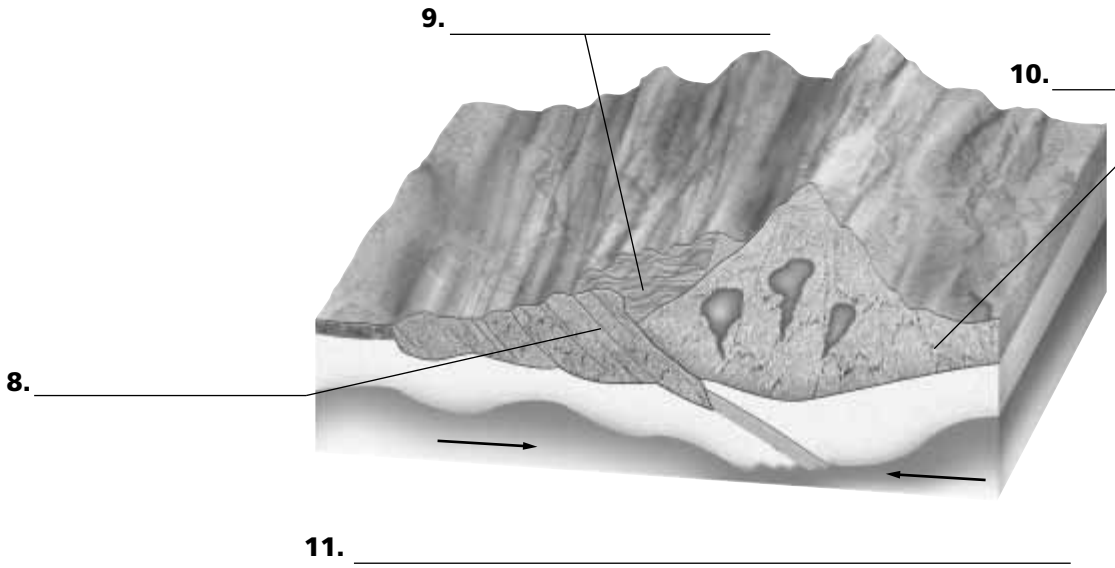
As **(9)** _____ rise, deep roots form. As mountains are eroded, their roots become **(10)** _____. As material is removed from mountains by erosion, the crust slowly rises. This process known as **(11)** _____. Such crustal movements resulting from isostasy are not restricted to continents, but also occur when volcanic mountains on the seafloor, called **(12)** _____, form.

## SECTION 20.2 *Convergent–Boundary Mountains*

*In your textbook, read about mountains that form as the result of convergence.*
**Use the terms below to label the diagrams. On the line below each diagram, write the name of the type of boundary pictured.**

| | | | | |
|---|---|---|---|---|
| **continental crust** | **deformed sediments** | **fault** | **basin sediments** | |
| **island arc complex** | **lava** | **mantle** | **oceanic crust** | **subducting plate** |

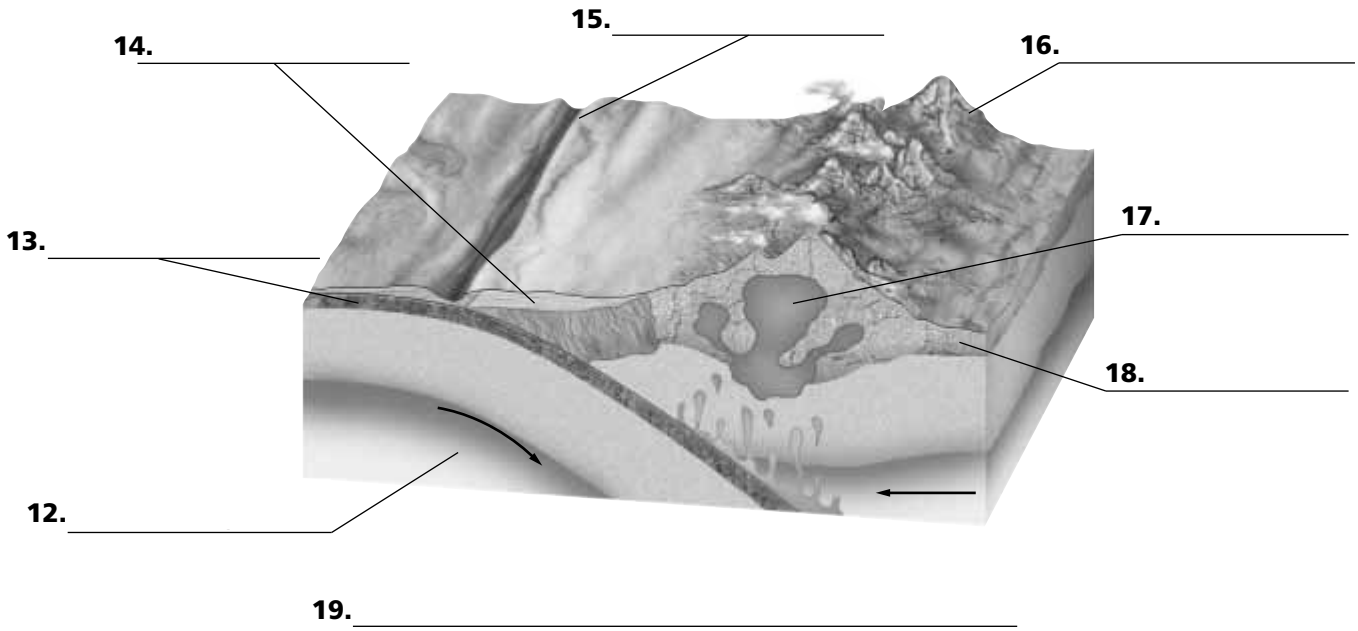


## SECTION 20.2 *Convergent–Boundary Mountains, continued*

**Use the terms below to label the diagram. On the line below the diagram, write the name of the type of boundary pictured.**

| | | | |
|---|---|---|---|
| **continental crust** | **trench** | **magma** | **oceanic crust** |
| **sediments** | **subducting plate** | **volcanic mountains** | |



## SECTION 20.2 *Convergent–Boundary Mountains, continued*

**Answer the following questions.**

**20.** Which convergent plate boundary does not include a subduction zone? Why?

**21.** How can oceanic sediments become part of continental mountains?

**22.** How do the mountains that form along an oceanic-oceanic convergent boundary differ from those associated with an oceanic-continental convergent boundary?

**23.** What happens when a continental plate converges with another continental plate?

**24.** Briefly describe the events that led to the formation of the Appalachian Mountains.

## SECTION 20.3 *Other Types of Mountains*

*In your textbook, read about divergent–boundary and nonboundary mountains.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **1.** Region of very broad uplift at a divergent plate boundary on the ocean floor | **a.** Adirondack Mountains |
| _____ **2.** Igneous rocks that form along ocean ridges | **b.** Basin and Range Province |
| _____ **3.** Forms when a large region of Earth's crust is uplifted as a unit | **c.** fault-block mountain |
| _____ **4.** Example of uplifted mountains | **d.** Mauna Kea |
| _____ **5.** Forms when large pieces of crust are tilted, uplifted, or dropped between large faults | **e.** ocean ridge |
| _____ **6.** Example of fault-block mountains | **f.** pillow basalts |
| _____ **7.** Form when plates move over hot spots in Earth's mantle | **g.** uplifted mountain |
| _____ **8.** Example of hot-spot volcanic peak | **h.** solitary volcanic peaks |

**Answer the following questions.**

**9.** What causes regional uplift?

**10.** How do mountains form over hot spots?

## SECTION 20.3 *Other Types of Mountains, continued*

*In your textbook, read about nonboundary mountains.*
**Answer the following questions.**

**11.** What makes uplifted mountains, fault-block mountains, and hot-spot volcanoes different from other mountains?

**12.** Describe the rocks that make up uplifted mountains. How are these rocks different from rocks associated with plate-boundary orogeny?

**13.** Describe how fault-block mountains form.

**14.** Describe and classify the mountains of the Basin and Range Province.

**15.** How did the mountains of Hawaii form?

UNIT 5 STUDY GUIDE FOR CONTENT MASTERY

*GeoDigest*

# The Dynamic Earth

**Match the geologic phenomenon or process below with the correct group of terms.**

**earthquake** **intrusive activity** **orogeny** **plate tectonics** **volcano**

_____ **1.** Seafloor spreading, ridge push, slab pull

_____ **2.** Batholiths, stocks, laccoliths

_____ **3.** Caldera, crater, hot spot

_____ **4.** Fault, seismic waves, epicenter

_____ **5.** Folding, faulting, uplift

**Use each of the terms below to complete the statements.**

| | | |
|---|---|---|
| **convection currents** | **faults** | **hot spot** |
| **magnetic patterns** | **modified-Mercalli scale** | **volcanoes** |

**6.** Evidence of seafloor spreading is provided by symmetric _____ of ocean-floor rocks.

**7.** Plate movements are related to _____ in Earth's mantle that cause warm matter to rise and cool matter to sink.

**8.** Cinder-cone, shield, and composite are three types of _____.

**9.** Earthquakes occur when stress in rock is released at breaks in Earth's crust called _____.

**10.** An earthquake's intensity, or the amount of damage it causes, is measured on the _____.

**11.** A solitary volcanic peak may form when a plate moves over a _____ in Earth's mantle.

**Compare and contrast each pair of related terms.**

**12.** continental drift, seafloor spreading

**13.** divergent boundary, convergent boundary

**14.** crater, caldera

**15.** P-waves, S-waves

**16.** uplifted, fault-block

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CHAPTER 21 STUDY GUIDE FOR CONTENT MASTERY

# Fossils and the Rock Record

## SECTION 21.1 *The Geologic Time Scale*

*In your textbook, read about the divisions of time in the geologic time scale.*
**Use each of the terms below just once to complete the passage.**

**epoch** **Mesozoic** **geologic time scale** **period** **eon** **era**

Geologists have organized the events of Earth's history and represented them on the **(1)** _____. This record of Earth's history is divided into units of time, the longest of which is the **(2)** _____, measured in billions of years. The next longest unit of time, the **(3)** _____, is measured in hundreds of millions to billions of years. The name of one such unit of time is the **(4)** _____, which means "middle life." The unit of geologic time defined by the abundance or extinction of life-forms during the time that certain rocks were deposited is the **(5)** _____. An even smaller unit of time, the **(6)** _____, is usually measured in terms of millions to tens of millions of years.

**Complete the table. Part of the table has been filled in for you.**

| Era | Meaning of Name | Description |
|---|---|---|
| | | end marked by the biggest extinction event in Earth's history |
| | middle life | |
| | | based on fossil records that are relatively complete and easily accessed |

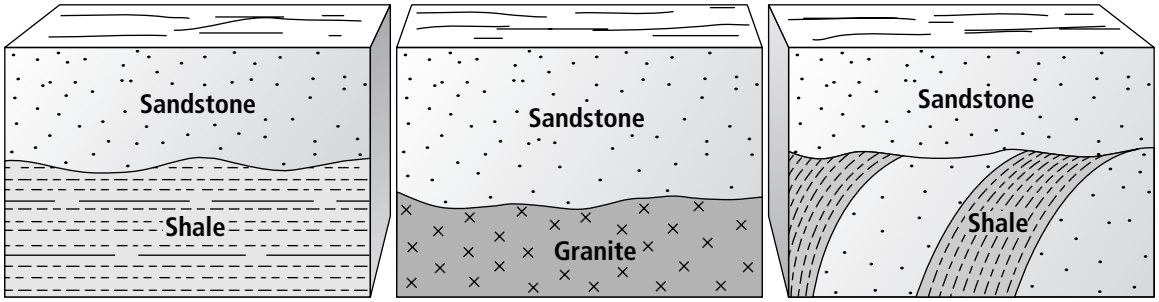
## SECTION 21.2 *Relative–Age Dating of Rocks*

*In your textbook, read about how the relative ages of rocks are determined.*
**Circle the letter of the choice that best completes the statement or answers the question.**

1. You can tell that the oldest rocks are at the bottom of an undisturbed rock sequence by using the principle of
   **a.** uniformitarianism. **c.** superposition.
   **b.** original horizontality. **d.** cross-cutting relationships.
2. The geologic principle that states that sedimentary rocks are deposited in horizontal layers is the principle of
   **a.** uniformitarianism. **c.** superposition.
   **b.** original horizontality. **d.** cross-cutting relationships.
3. You can tell that a fault is younger than the rock it cuts across by applying the principle of
   **a.** uniformitarianism. **c.** superposition.
   **b.** original horizontality. **d.** cross-cutting relationships.
4. The principle that states that the processes occurring today have occurred since Earth formed is known as the principle of
   **a.** uniformitarianism. **c.** superposition.
   **b.** original horizontality. **d.** cross-cutting relationships.
5. What is the matching of outcrops from one geographic region to another?
   **a.** correlation **c.** superposition
   **b.** unconformity **d.** uniformitarianism
6. A buried erosional surface in the rock record is a(n)
   **a.** correlation. **c.** inclusion.
   **b.** unconformity. **d.** principle.
7. In an undisturbed rock sequence, the youngest rock layer is located
   **a.** at the bottom of the sequence. **c.** below the sedimentary rock layer.
   **b.** at the top of the sequence. **d.** below the unconformity.
8. What are particles eroded from a layer of rock that become incorporated in an overlying rock layer?
   **a.** fossils **c.** sills
   **b**. unconformities **d.** inclusions
9. The rock layers beneath an eroded surface are at an angle to that surface in a(n)
   **a.** nonconformity. **c.** angular unconformity.
   **b.** disconformity. **d.** cross-cutting relationship.
10. The relative age of a rock layer that contains inclusions is
    **a.** older than the source of the inclusions. **c.** younger than the source of the inclusions.
    **b.** older than the layer below it. **d.** the same as the intrusion that cuts across it.

## SECTION 21.2 *Relative–Age Dating of Rocks, continued*

*In your textbook, read about the types of unconformities and how they form.*
**Match each diagram with the type of unconformity it shows. Write the letter of the matching diagram in the space provided. Then describe each unconformity and how it formed.**




_____ **11.** Nonconformity

_____ **12.** Angular unconformity

_____ **13.** Disconformity

## SECTION 21.3 *Absolute–Age Dating of Rocks*

*In your textbook, read about the methods scientists use to determine absolute age.*
**For each statement below, write *true* or *false*.**

_____ **1.** Absolute-age dating determines the relative age of a rock based on its observed position in the rock record.

_____ **2.** Formed by short-duration events, key beds contain distinctive and easy to recognize material that geologists use as time markers.

_____ **3.** The half-life of C-14 is longer than that of U-238.

_____ **4.** After one half-life, a pure sample of U-238 decays into a ratio of 25 percent U-238 atoms and 75 percent Pb-206 atoms.

_____ **5.** Varves are alternating light- and dark-colored sediment bands that indicate cycles of seasonal climate change.

_____ **6.** The emission of radioactive particles by isotopes as they change into other elements over time is known as dendrochronology.

_____ **7.** The width to which tree rings grow varies in spring and winter.

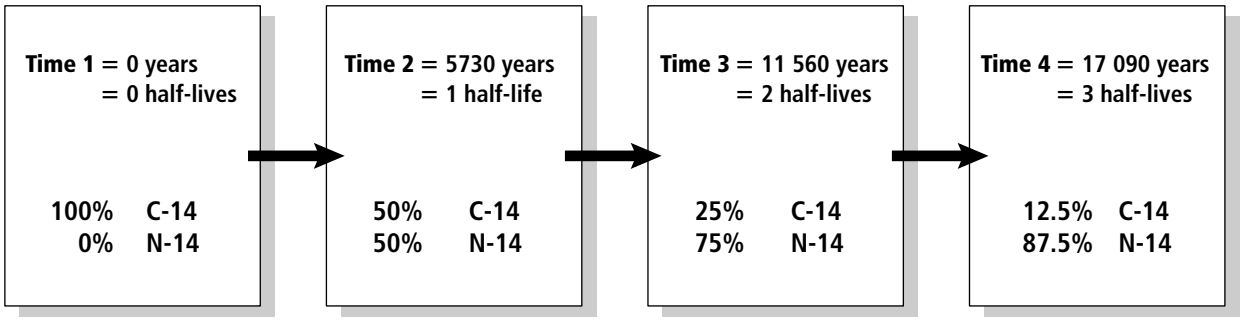
*In your textbook, read about the ways to determine the age of a rock or date an event.*
**Answer the following questions.**

**8.** What is radiometric dating and how is it used?

**9.** How are tree rings used to date geologic events?

## SECTION 21.3 *Absolute–Age Dating of Rocks, continued*

*In your textbook, read about radiometric dating using the radioactive isotope carbon-14.*
**Study the diagram. Then answer the questions that follow.**




**10.** Which element shown is the radioactive isotope?

_____

**11.** Which element shown is the stable nonradioactive element?

_____

**12.** What is the half-life of C-14?

_____

**13.** How many half-lives will it take for all but 25 percent of the original C-14 to decay? How many years?

_____

**14.** What percentage of C-14 remains after three half-lives?

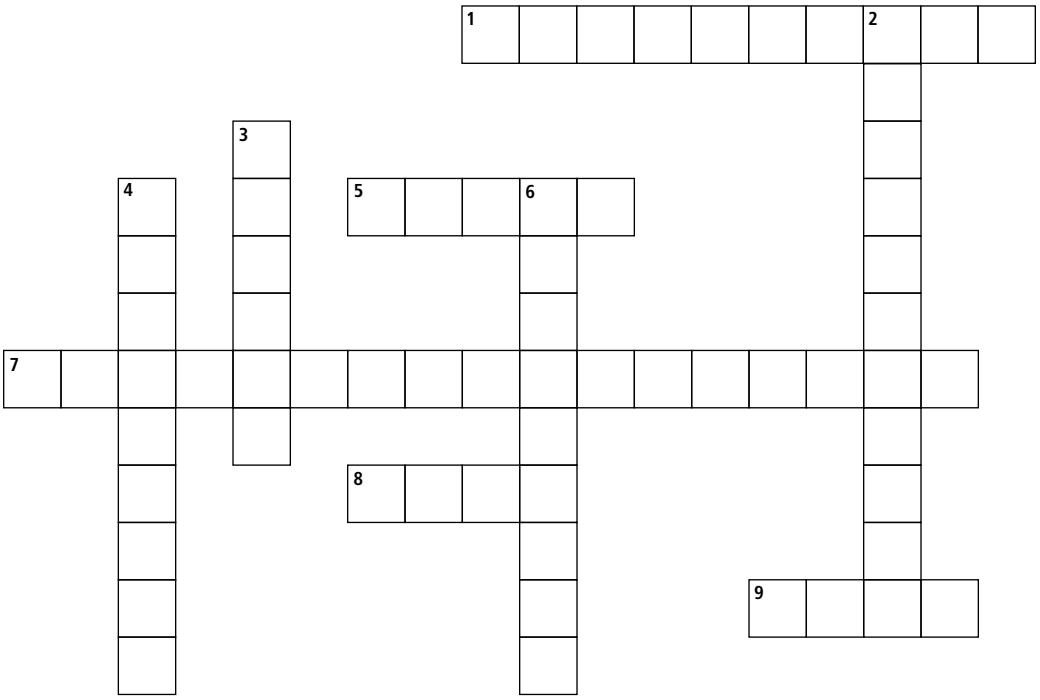
_____

**15.** What percentage of N-14 forms after 17 090 years?

_____

## SECTION 21.4 *Remains of Organisms in the Rock Record*

*In your textbook, read about fossils and how they form.*
**Use the vocabulary words to fill in the puzzle.**




### ACROSS

**1.** smooth, rounded rocks that helped dinosaurs digest and grind their food

**5.** hardened tree sap sometimes containing fossil insects

**7.** process of filling in pore spaces with mineral substances

**8.** fossil impression filled with minerals or sediments

**9.** a fossil impression

### DOWN

**2.** remains of plants or animals used to correlate rock layers over large geographic areas or to date a particular rock layer

**3.** remains or evidence of once-living plants or animals

**4.** remains of solid waste materials of animals

**6.** The adaptation of life-forms to environmental changes is known as _____.

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CHAPTER 22 STUDY GUIDE FOR CONTENT MASTERY

# The Precambrian Earth

## SECTION 22.1 *The Early Earth*

*In your textbook, read about the birth and age of Earth.*
**For each statement below, write *true* or *false.***

_____ **1.** The Precambrian is the oldest part of the geologic time scale.

_____ **2.** The Precambrian lasted for about 4 billion years.

_____ **3.** The first organisms to live on Earth were dinosaurs.

_____ **4.** Radiometric dating of zircon grains in metamorphosed sedimentary rocks in Australia indicate that Earth is about 3.1 billion years old.

_____ **5.** The oldest moon rocks collected are about 3.6 billion years old.

_____ **6.** Scientists think that Earth and meteorites are about the same age because they hypothesize that the solar system formed all at once.

*In your textbook, read about Earth's heat sources.*
**Answer the following questions.**

**7.** How do radioactive isotopes add to Earth's heat?

**8.** How has the amount of Earth's radioactive isotopes changed over time, and why has it changed?

**9.** What is a meteor? What is a meteorite?

**10.** How did continuous bombardment by meteorites and asteroids affect the temperature and size of Earth?

**11.** How did gravitational contraction affect Earth?

## SECTION 22.2 *Formation of the Crust and Continents*

*In your textbook, read about the formation of Earth's crust.*
**Use each of the terms below to complete the following statements.**

| | | | | |
|---|---|---|---|---|
| **crust** | **crystallize** | **differentiation** | **float** | **granite** |
| **lava** | **mantle** | **nickel** | **oceanic crust** | **subduction** |

1. When Earth formed, the dense minerals iron and _____ were concentrated in Earth's core.
2. Minerals with low densities tend to _____ at cooler temperatures than do denser minerals.
3. The common crustal rock _____ is mainly composed of feldspar, quartz, and mica, which are minerals with low densities.
4. Less-dense minerals became concentrated near Earth's surface by _____ flowing from the hot interior.
5. Denser minerals concentrated below Earth's surface and formed the rocks that make up Earth's _____.
6. The process by which a planet becomes internally zoned is called _____.
7. Earth's _____ probably formed as a result of the cooling of the uppermost mantle.
8. Sediment-covered slabs of Earth's earliest crust were recycled into the mantle at _____ zones.
9. Less-dense material such as crust has a tendency to _____ on more-dense material such as the mantle.
10. A difference in density causes the _____ to be lower in elevation than the less-dense granitic continental crust.

## SECTION 22.2 *Formation of the Crust and Continents, continued*

*In your textbook, read about the cores of the continents.*
**Complete the table by filling in one of the following terms: Precambrian shield, craton, Canadian Shield.**

**Continental Features**

| Description | Feature |
|---|---|
| **11.** General name for a core of Archean and Proterozoic rock | |
| **12.** North American core of Proterozoic rock | |
| **13.** Can be seen over a large part of Greenland | |
| **14.** Buried and exposed parts of a shield | |

*In your textbook, read about the growth of continents.*
**Answer the following questions.**

**15.** What is Laurentia?

**16.** What is a microcontinent?

**17.** What is the seam called that forms when two microcontinents join together?

**18.** What happened when volcanic islands collided with Laurentia between 1.8 and 1.6 billion years ago?

**19.** Describe the Grenville Orogeny.

**20.** What was the name of the first supercontinent, and when did it form?

## SECTION 22.3 *Formation of the Atmosphere and Oceans*

*In your textbook, read about the early atmosphere and oxygen in the atmosphere.*
**Answer the following questions.**

**1.** What two gases probably dominated Precambrian Earth's atmosphere?

_____

**2.** Why is Earth's atmosphere rich in nitrogen and oxygen today?

_____

_____

**3.** What occurs during the process of outgassing, and what role did this process play in the formation of the atmosphere?

_____

_____

_____

**4.** What is the likely source of oxygen in the early atmosphere?

_____

**5.** Did oxygen exist in the atmosphere during the Proterozoic? Explain your answer.

_____

_____

_____

**6.** What is a banded iron formation?

_____

*In your textbook, read about the formation of the oceans.*
**Use each of the terms below just once to complete the passage.**

**Archean** **liquid water** **minerals** **oceans** **outgassing** **water vapor**

Seawater probably originated largely from the same process of **(7)** _____ that formed the atmosphere. A major component of the gas that was vented from early Earth was **(8)** _____. As the early atmosphere and surface of Earth cooled, the water vapor in the atmosphere condensed to form **(9)** _____. During the **(10)** _____, rain slowly filled the low-lying areas on Earth. The low-lying areas were underlain by basalt, and as these basalt-floored basins filled, they formed the **(11)** _____. Rainwater reacted with the **(12)** _____ exposed at Earth's surface and dissolved them, making the oceans of the Precambrian salty.

## SECTION 22.4 *Early Life on Earth*

*In your textbook, read about experimental evidence of the beginning of life.*
**Answer the following questions about Miller and Urey's experiment.**

**1.** In Miller and Urey's experiment, what gases were contained in the atmospheric chamber, and what were these gases meant to simulate?

**2.** What was simulated by the sparks from the tungsten electrodes?

**3.** What was contained in the "primordial soup" created by this experiment?

**4.** How many of the amino acids known to occur in life could be created by using the Miller-Urey method?

**5.** What did Miller and Urey demonstrate about the basic building blocks of life?

*In your textbook, read about the beginnings of life and the role of RNA.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **6.** Have been found in waters of hydrothermal vents | **a.** enzymes |
| _____ **7.** Needed by RNA and DNA for reproduction in modern organisms | **b.** amino acids |
| _____ **8.** Sites where life may have originated | **c.** ribozyme |
| _____ **9.** A self-replicating, enzyme-like RNA molecule | **d.** RNA |
| _____ **10.** Essential characteristic of life | **e.** hydrothermal vents |
| _____ **11.** May have been first self-replicating molecules on Earth | **f.** ability to reproduce |

## SECTION 22.4 *Early Life on Earth, continued*

*In your textbook, read about Proterozoic life and the Ediacaran fauna.*
**Circle the letter of the choice that best completes the statement.**

**12.** An organism composed of a single cell, which does not contain a nucleus and is the simplest kind of cell, is
**a.** a eukaryote. **b.** a prokaryote. **c.** an acritarch. **d.** amino acid.

**13.** An organism composed of cells that contain nuclei is a(n)
**a.** eukaryote. **b.** prokaryote. **c.** amino. **d.** acritarch.

**14.** Eukaryotes differ from prokaryotes in that most eukaryotes are
**a.** smaller.
**b.** simpler.
**c.** larger.
**d.** found only in stromatolites.

**15.** The oldest known fossil eukaryotes are
**a.** related to cyanobacteria.
**b.** smaller than modern single-celled eukaryotes.
**c.** similar to jellyfish.
**d.** about 2.1 billion years old.

**16.** Scientists disagree on whether the Ediacaran fauna were
**a.** present at hydrothermal vents.
**b.** lacking a mouth, anus, or gut.
**c.** ancestors of modern fauna.
**d.** distributed throughout the world.

**17.** Near the end of the Proterozoic, a major extinction of acritarchs may have been linked to the
**a.** formation of the oceans.
**b.** oxygenation of the atmosphere.
**c.** formation of the ozone layer.
**d.** Varangian glaciation.

**18.** The Ediacaran fauna are generally believed to be
**a.** animals composed of eukaryotic cells.
**b.** animals composed of prokaryotic cells.
**c.** algae.
**d.** cyanobacteria.

**19.** Ediacaran fauna probably were widely distributed in the oceans of the
**a.** early Precambrian.
**b.** late Proterozoic.
**c.** early Cambrian.
**d.** last century.

**20.** The absence of tracks and trails leads scientists to speculate that the Ediacaran fauna were
**a.** already extinct by the late Proterozoic.
**b.** plants.
**c.** relatively immobile.
**d.** prokaryotes.

Name Class Date

CHAPTER 23 STUDY GUIDE FOR CONTENT MASTERY

# The Paleozoic Era

## SECTION 23.1 *The Early Paleozoic*

*In your textbook, read about the continental setting of the early Paleozoic.*
**For each statement below, write *true* or *false.***

_____ **1.** Paleogeography is the ancient geographic setting of an area.

_____ **2.** The ancient North American continent of Laurasia was once surrounded by ocean.

_____ **3.** Throughout the Cambrian Period, there was no plate tectonic activity on Laurasia.

_____ **4.** Over time, sand becomes limestone, clay-sized sediments become shale, and carbonate sediment becomes sandstone.

_____ **5.** At the end of the Proterozoic, the only part of Laurasia above sea level was the South American shield.

_____ **6.** Laurasia was surrounded by passive margins throughout the Cambrian Period.

_____ **7.** Large, sandy beaches formed on Laurasia as sand-sized fragments of quartz were weathered from Cretaceous rocks.

_____ **8.** Carbonate sediments tend to accumulate in deep water as the calcium carbonate shells of organisms fall to the seafloor.

*In your textbook, read about changes in sea level during the early Paleozoic.*
**Use each of the terms below to complete the following statements.**

**carbonate-rich sediment** **clay-rich sediment** **sandstone-shale-limestone**
**regression** **shoreline** **transgression** **vertical succession**

**9.** A transgression occurs when sea level rises and the _____ moves farther inland.

**10.** _____ is found deposited in water slightly deeper than the beach.

**11.** A _____ causes deep-water deposits to overlie shallow-water deposits.

**12.** A _____ occurs when sea level falls resulting in the shoreline moving seaward.

**13.** A stacked sequence of _____ deposits is evidence of a regression.

**14.** Sediments that are deposited adjacent to each other also end up in _____ when sea level changes.

## SECTION 23.1 *The Early Paleozoic, continued*

*In your textbook, read about early Paleozoic life.*
**Circle the letter of the choice that best answers the question.**

**15.** To what does the Cambrian "explosion" refer?
- **a.** the abrupt heating of Earth during the Cambrian
- **b.** the giant meteor that struck Earth during the Cambrian
- **c.** the great increase in the diversity and abundance of life-forms during the Cambrian
- **d.** the abrupt increase in volcanic activity during the Cambrian

**16.** What development in animals created fossils that mark the Cambrian explosion?
- **a.** hard, mineralized skeletons
- **b.** gills
- **c.** jaws
- **d.** lobed fins

**17.** What is preserved in the Burgess Shale?
- **a.** fossilized soft-bodied organisms from the Cambrian
- **b.** fossilized sharks
- **c.** modern echinoderms
- **d.** only fossilized shelled animals

**18.** What feature of Cambrian organisms greatly increased the likelihood that their remains would become fossilized?
- **a.** tough muscle fiber
- **b.** skeletons and hard parts
- **c.** amniote eggs
- **d.** feathery appendages

**19.** Which of the following statements is NOT true about the Burgess Shale fossils?
- **a.** They represent soft-bodied organisms.
- **b.** They include organisms unrelated to any living phylum.
- **c.** They have given paleontologists important insight into the Cambrian world.
- **d.** Fossils of these organisms are found nowhere else on Earth.

## SECTION 23.2 *The Middle Paleozoic*

*In your textbook, read about changes in sea levels during the middle Paleozoic.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **corals** | **evaporite** | **lagoon** | **latitudes** | **Laurentia** |
| **limestone** | **reef** | **sandstone** | **waves** | |

Sea level rose during the early Ordovician, and a beach environment covered the margins of **(1)** _____. The base of the rock layers that were deposited is marked throughout much of central North America by the St. Peter **(2)** _____. Overlying this is shale and extensive **(3)** _____ deposits. These deposits contain fossils of carbonate-secreting organisms, including those of the first reef-building **(4)** _____. Today corals require warm, clear water. For this reason, they are confined to low **(5)** _____. Reefs can form long, linear mounds parallel to the shoreline. These reefs absorb the energy of **(6)** _____ on their oceanward side. In the calm area behind a reef, called a(n) **(7)** _____, fragile organisms can survive. When a(n) **(8)** _____ restricts water flow from the lagoon to the ocean, water evaporates at a high rate. This can cause **(9)** _____ minerals, such as gypsum and halite, to precipitate out.

**Use the terms below to complete the table about tectonic collisions.**

| | | | |
|---|---|---|---|
| **Acadian** | **Antler** | **Caledonian** | **Taconic** |

**Mountain Building During the Middle Paleozoic**

| Orogeny | Evidence |
|---|---|
| **10.** | Older rocks in eastern New York tilt at an angle different from younger rocks |
| **11.** | Ancient lava flows and volcanic ash deposits in present-day eastern North America |
| **12.** | Collision of Laurentia with Baltica (northern Europe and western Russia) creating Laurasia |
| **13.** | Ocean that once separated Laurasia and Baltica is closed |
| **14.** | Added folds, faults, and igneous intrusions in area of Taconic Orogeny |
| **15.** | Collision of Avalonia (present-day Newfoundland) with Laurasia |
| **16.** | Microcontinent or island arc collision with present-day western North America |

## SECTION 23.2 *The Middle Paleozoic, continued*

*In your textbook, read about middle Paleozoic life.*
**Answer the following questions.**

**17.** What have paleontologists deduced about the lengths of days and years during the Devonian? How did they make this deduction?

**18.** What features did fishes develop during the Paleozoic?

**19.** What allows land plants to live outside of the water?

**20.** Why did the development of seeds change the surface of the continents?

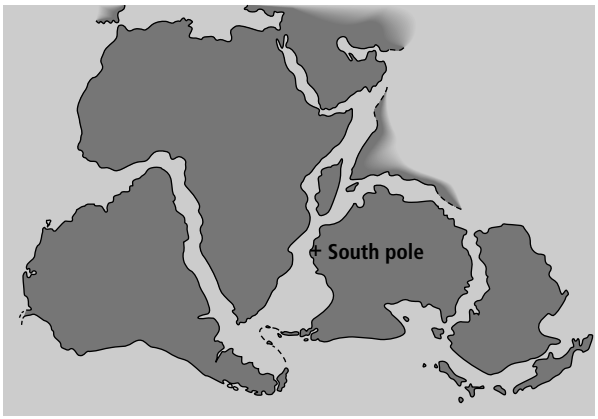
**21.** What is a mass extinction?

**22.** What evidence implies that overturning may have occurred during the late Devonian?

**23.** How might overturning contribute to the extinction of marine animals that live in surface water?

## SECTION 23.3 *The Late Paleozoic*

*In your textbook, read about sea level and deposition during the late Paleozoic.*
**Use information in your textbook and the diagram to answer the following questions.**




**1.** What late Paleozoic continent is shown in the diagram?

**2.** What modern continents or parts of continents joined to make this large continent?

**3.** What was the paleogeology of Laurasia like at the beginning of the late Paleozoic?

**4.** In what kind of surroundings did coal deposits accumulate?

**5.** Why are there few Mississippian-aged coal deposits in North America?

**6.** What is a cyclothem? How do cyclothems record changes in sea level?

## SECTION 23.3 *The Late Paleozoic, continued*

*In your textbook, read about reefs and evaporites of the late Paleozoic.*
**Answer the following questions.**

**7.** What organisms built the Great Permian Reef Complex in west Texas, southeast New Mexico, and north Mexico?

**8.** How did the formation of the Great Permian Reef Complex result in the formation of evaporites?

**9.** What is found in the pore spaces of the Permian reefs of West Texas?

**10.** What happened to Laurasia during the Ouachita Orogeny?

**11.** What mountain range in and near present-day Colorado was uplifted by the collision of Gondwana and Laurasia?

**12.** What mountain range resulted from the Alleghenian Orogeny?

*In your textbook, read about late Paleozoic life.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **13.** Animals attached to seafloor by stems consisting of small disks | **a.** amniote egg |
| _____ **14.** Group of Devonian fishes with club-shaped fins supported by bone | **b.** amphibians |
| _____ **15.** Lobe-finned fishes living today | **c.** lungfishes |
| _____ **16.** Large, slow, nonreptilian carnivores that thrived in coal swamps | **d.** crinoids |
| _____ **17.** Contains an embryo, a food sac, and a waste sac inside a shell | **e.** lobe-finned fishes |
| _____ **18.** Defines the end of the Paleozoic Era | **f.** Permo-Triassic Extinction Event |

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CHAPTER 24 STUDY GUIDE FOR CONTENT MASTERY

# The Mesozoic and Cenozoic Eras

## SECTION 24.1 *Mesozoic Paleogeography*

*In your textbook, read about the breakup of Pangaea and tectonism in western North America.*
**For each statement below, write *true* or *false.***

_____ **1.** The heat beneath Pangaea caused the continent to expand.

_____ **2.** The breakup of Pangaea resulted in the formation of the Atlantic Ocean.

_____ **3.** The Mid-Atlantic Ridge, formed by the breakup of Pangaea, has been dormant since the late Mesozoic.

_____ **4.** An active margin existed along eastern North America during the Mesozoic.

_____ **5.** Active subduction along the western coast of North America continued through the Middle Pleistocene.

_____ **6.** Deformation along the western margin of North America increased when Pangaea broke apart.

_____ **7.** Three major episodes of mountain building occurred along the western margin of North America during the Mesozoic.

_____ **8.** Half-Dome at Yosemite National Park is a result of igneous intrusions during the earliest episode of Mesozoic mountain building.

*In your textbook, read about western North American mountain building and seaways.*
**Answer the following questions.**

**9.** What kind of rocks characterize the oldest Mesozoic orogeny?

**10.** What kind of deformation characterizes the next orogeny that occurred?

**11.** What happened to the sea level during the Triassic?

**12.** What evidence shows that ancient western North America was dry and covered with sand?

**13.** What covered the interior of North America from Texas to Alaska?

## SECTION 24.2 *Mesozoic Life*

*In your textbook, read about life in the Mesozoic oceans.*
**Answer the following questions.**

**1.** What three groups of organisms first appeared during the Mesozoic?

**2.** How did the mass extinction at the end of the Paleozoic Era set the stage for the appearance of new organisms during the Mesozoic?

**3.** What is the modern fauna, and what are some examples?

**4.** What important function do phytoplankton perform?

**5.** What important function did rudists perform during the Cretaceous?

**6.** What is the economic importance of some Cretaceous reefs?

**7.** What were ammonites? Why are their fossils important today?

**8.** What were the top predators in the Mesozoic oceans?

## SECTION 24.2 *Mesozoic Life, continued*

*In your textbook, read about life on land during the Mesozoic.*
**Use each of the terms below to complete the following statements.**

| | | | | |
|---|---|---|---|---|
| **angiosperms** | ***Archaeopteryx*** | **cycads** | **endothermic** | **turtles** |
| **mammals** | **Ornithischia** | **reptiles** | **Saurischia** | **pterosaurs** |

**9.** The _____ are seed plants that do not have true flowers, such as the ginkgo, which is common today.

**10.** The _____, which evolved during the Cretaceous, are seed-bearing plants that have flowers.

**11.** Warm-blooded animals with hair or fur and mammary glands and that give birth to live young are _____.

**12.** Early mammals with one lower jawbone and three ear bones arose from mammal-like _____.

**13.** Flying vertebrates were called _____.

**14.** Two groups of reptiles, crocodiles and _____, survived the great extinction at the end of the Mesozoic.

**15.** Scientists hypothesize that birds are descended from the _____, or "lizard-hipped," dinosaurs.

**16.** There were five groups of plant-eating _____, or "bird-hipped," dinosaurs.

**17.** Fossils of feather impressions and wishbones provide clear evidence that _____ was a bird.

**18.** The fact that fossils of dinosaur bones show evidence of numerous passageways for blood flow supports the hypothesis that dinosaurs were _____.

## SECTION 24.2 *Mesozoic Life, continued*

*In your textbook, read about the mass extinction during the Mesozoic.*
**Circle the letter of the choice that best completes the statement.**

**19.** A major mass extinction ended the
**a.** Cenozoic. **b.** Cretaceous. **c.** Jurassic. **d.** Mesozoic.

**20.** Numerous Triassic black shale deposits suggest that the extinction was triggered by
**a.** climatic cooling.
**b.** volcanic eruptions.
**c.** a meteorite impact.
**d.** a rise in sea level.

**21.** The Mesozoic mass extinction devastated
**a.** few species overall.
**b.** all land species.
**c.** all marine species.
**d.** most major groups of organisms.

**22.** A very large meteorite striking Earth at the end of the Mesozoic would likely have caused
**a.** global cooling.
**b.** greenhouse warming.
**c.** little change in the conditions on Earth.
**d.** the destruction of Hiroshima, Japan.

**23.** Evidence that a very large meteorite struck Earth during the late Mesozoic includes
**a.** dinosaur fossils.
**b.** seed plant fossils.
**c.** iridium in rocks at Earth's surface.
**d.** a layer of coal.

**24.** The presence of iridium and soot are evidence of either a meteorite impact or
**a.** a massive volcanic event.
**b.** the greenhouse effect.
**c.** increased glaciation.
**d.** active continental margins.

**25.** One factor that may have contributed to the extinction of dinosaurs was
**a.** the predation of dinosaurs by mammals.
**b.** a reduction of dinosaur diversity and abundance.
**c.** transgression of seaways over North America.
**d.** a warmer climate.

**26.** Geological evidence that a large meteorite struck the Yucatan in the distant past includes
**a.** tsunamis that continued into modern times.
**b.** a crushed village called Chicxulub.
**c.** a large impact crater in the Gulf of Mexico.
**d.** shocked quartz found on the moon.

## SECTION 24.3 *Cenozoic Paleogeography*

*In your textbook, read about ice ages and glaciers during the Cenozoic.*
**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **Antarctica** | **Australia** | **Miocene** | **Ohio and Missouri rivers** |
| **North America** | **Pleistocene** | **Pliocene** | **south pole** |

During the Middle to Late Eocene, **(1)** _____ began to split apart from Antarctica. During the Oligocene, Antarctica was isolated over the **(2)** _____. A cold ocean current flowed around it, and glaciers began to form. The climate began to warm again during the Early **(3)** _____, and the glaciers began to melt. Glaciers returned to **(4)** _____ during the Middle and Late Miocene. Later, during the **(5)** _____, an arctic ice cap formed. During the Late Pliocene through the **(6)** _____, the northern hemisphere experienced an ice age. Arctic glaciers advanced and retreated in at least four stages over **(7)** _____. During the peak of Pleistocene glaciation, thick glaciers existed as far south as of the present day **(8)** _____.

*In your textbook, read about tectonic events during the Cenozoic.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **9.** Fossil-rich basin deposit in Wyoming | **a.** Alps |
| _____ **10.** Mountains in the Pacific Northwest that are the result of the subduction of an ocean plate beneath western North America | **b.** Basin and Range Province |
| _____ **11.** Series of north-to-northeast trending mountains from Nevada and Utah to Mexico | **c.** Cascades |
| _____ **12.** National park named for the the extrusive volcanic rock, rhyolite, that is abundant there | **d.** Green River Formation |
| _____ **13.** Mountains formed by collision of India and the south margin of Asia | **e.** Himalayan |
| _____ **14.** Mountains formed by continent-to-continent collision of Africa and Eurasia | **f.** Mount Everest |
| _____ **15.** Highest point on Earth, which is topped by Ordovician marine limestones | **g.** Yellowstone |

## SECTION 24.4 *Cenozoic Life*

*In your textbook, read about Cenozoic life on land.*
**Use the words below to complete the table. Each word may be used more than once.**

**Eocene** **Oligocene** **Pleistocene** **Pliocene**

| Life During the Cenozoic Era | |
|---|---|
| **Characteristic** | **Epoch** |
| Grasses appeared. | **1.** |
| Most of the currently living mammals appeared. | **2.** |
| Grassy savannas were common from Texas to South Dakota. | **3.** |
| An abundance of diverse mammals inspired the phrase Golden Age of Mammals. | **4.** |
| Great savannas were replaced by arid land as the ice age began. | **5.** |
| Many savanna mammals became extinct. | **6.** |
| Mammoths and saber-toothed cats evolved ability to survive cold conditions. | **7.** |

*In your textbook, read about primates and humans.*
**Use each of the terms below to complete the following statements.**

**fossils** **hominoids** ***Homo sapiens*** **Neanderthals**
**opposable thumb** **primates** **stereoscopic vision**

**8.** A group of mammals that possess specialized traits related to arboreal, or tree-living, ancestry are the _____.

**9.** The grasping hand with a(n) _____ is an easily recognizable primate trait.

**10.** Two forward-looking eyes give primates _____, which allows them to accurately judge distances.

**11.** Hominids are part of a larger primate group, the _____, which includes the great apes.

**12.** The modern human species is _____.

**13.** The _____ were hominid hunters that lived in Europe and Asia from 20 000 to 30 000 years ago.

**14.** Because there are few hominid _____, scientists do not yet have a complete understanding of the evolution of hominids.

UNIT 6 STUDY GUIDE FOR CONTENT MASTERY

*GeoDigest*

# Geologic Time

**Complete the table by filling in the missing information.**

| Geologic Division | Chief Characteristics |
|---|---|
| **1.** _____ Eon | Granitic crust formed microcontinents. |
| **2.** _____ Eon | Atmosphere and oceans formed.<br>Core of today's continents formed.<br>Rodinia formed. |
| **3.** _____ Era | |
| EARLY | **4.** _____ covered with shallow sea<br>**5.** new organisms such as _____ and brachiopods |
| MIDDLE | **6.** _____ minerals deposited<br>Mountain building<br>Fishes evolved.<br>**7.** Mass _____ occurred. |
| LATE | **8.** Seeds and _____ developed.<br>**9.** Supercontinent _____ formed.<br>**10.** Plants and reptiles _____.<br>Mass extinctions occurred. |
| **11.** _____ Era | Pangaea broke up.<br>**12.** _____ were prevalent.<br>**13.** _____ were common land plants.<br>**14.** _____ were dominant land animals.<br>**15.** _____ struck Earth.<br>**16.** _____ became extinct. |
| **17.** _____ Era | Ice ages changed climates.<br>**18.** Large _____ evolved.<br>**19.** _____ emerged. |

**In the space at the left, write the term in parentheses that makes each statement correct.**

_____ **20.** The longest division on the geologic time scale is the (eon, era).

_____ **21.** Missing layers in the rock record are indicated by (fossils, unconformities).

_____ **22.** The time it takes for 50 percent of a radioactive mineral's original mass to decay into a nonradioactive element is known as the mineral's (random emission, half-life).

_____ **23.** The age of Earth has been dated at 4.6 billion years based upon the age of rocks from the Moon and (Sun, meteorites).

_____ **24.** Earth's first supercontinent, (Rodinia, Laurentia), formed during the Proterozoic Eon.

_____ **25.** Evidence that free oxygen was present in Earth's atmosphere during the Proterozoic is provided by the oxidized iron in (red beds, outgassing volcanoes).

_____ **26.** The first life-forms on Earth probably were small (prokaryotic, eukaryotic) cells.

_____ **27.** During the early Paleozoic, what is now North America was located near the (equator, north pole).

_____ **28.** The supercontinent of Pangaea formed during the (middle, late) Paleozoic.

_____ **29.** The development of (scales, the amniote egg) allowed reptiles to colonize dry land.

_____ **30.** At the end of the Cretaceous Period, dinosaurs became extinct, possibly as a result of an (meteorite impact, igneous intrusion).

_____ **31.** During the Cenozoic, much of Central North America was covered with (a shallow sea, grassy savannas).

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CHAPTER 25 STUDY GUIDE FOR CONTENT MASTERY

# Earth Resources

## SECTION 25.1 *What are resources?*

*In your textbook, read about natural resources and renewable and nonrenewable resources.*
**Answer the following questions.**

**1.** What is a renewable resource?

**2.** What is a nonrenewable resource?

**Put a check (✓) in the column to indicate whether a resource is renewable or nonrenewable.**

| Natural Resource | Renewable | Nonrenewable |
|---|---|---|
| **3.** Air | | |
| **4.** Aluminum | | |
| **5.** Chickens | | |
| **6.** Carbon | | |
| **7.** Coal | | |
| **8.** Copper | | |
| **9.** Diamond | | |
| **10.** Elephants | | |

| Natural Resource | Renewable | Nonrenewable |
|---|---|---|
| **11.** Trees | | |
| **12.** Freshwater | | |
| **13.** Gold | | |
| **14.** Petroleum | | |
| **15.** Phosphorus | | |
| **16.** Solar energy | | |
| **17.** Soil | | |

*In your textbook, read about the distribution of resources.*
**For each statement below, write *true* or *false*.**

_____ **18.** Natural resources are evenly distributed on Earth.

_____ **19.** Availability of natural resources helps determine a country's wealth and power.

_____ **20.** A country's standard of living has no relationship to its resource consumption.

_____ **21.** The United States has 6 percent of the world's population and annually consumes about 30 percent of the mineral and energy resources.

## SECTION 25.2 *Land Resources*

*In your textbook, read about protected land.*
**Answer the following questions.**

**1.** Name three types of public land in the United States.

_____

**2.** Name four responsibilities of the national park system.

_____

_____

_____

**3.** Name three things protected by a national wildlife refuge.

_____

*In your textbook, read about soil, bedrock, and aggregate.*
**Use the words below to complete the table. You may use each word more than once.**

**soil** **bedrock** **aggregate**

| Natural Resource | Description |
|---|---|
| **4.** _____ | Used in making concrete |
| **5.** _____ | Loss in arid areas can lead to desertification |
| **6.** _____ | Mixture of gravel, sand, and crushed stone that accumulates on or near Earth's surface |
| **7.** _____ | Large pieces used to build monuments and fireplaces |
| **8.** _____ | Takes up to 1000 years to produce just a few centimeters |
| **9.** _____ | Unweathered inorganic material that lies underneath soil |

*In your textbook, read about ores, other land resources, and using land resources.*
**Use each of the terms below to complete the statements.**

**igneous rocks** **hydrothermal fluids** **ore** **placer deposits**

**10.** A natural resource is considered to be a(n) _____ if it can be mined at a profit.

**11.** Chromium and platinum form in _____ when minerals crystallize and settle.

**12.** Copper and gold deposits are metallic ore deposits that come from _____.

**13.** Sand and gravel bars called _____ may contain gold nuggets and gold dust.

## SECTION 25.3 *Air Resources*

*In your textbook, read about the origin of oxygen and disrupting Earth's cycles.*
**Answer the following questions.**

**1.** What percentage of the atmosphere is oxygen?

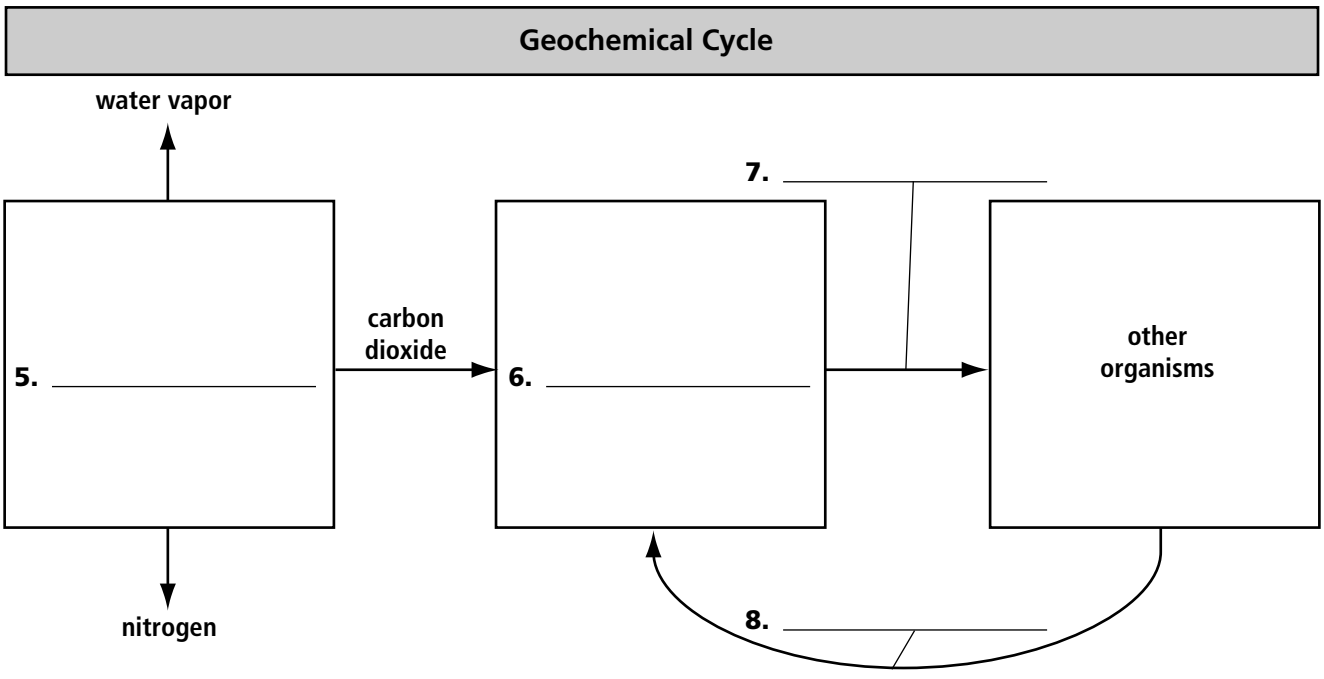
**2.** Why is oxygen so important to life on Earth?

**3.** What two human activities are thought to cause global warming?

**4.** What causes acid precipitation?

**Use the words below to complete the geochemical cycle.**

**oxygen** **carbon dioxide** **volcanic eruptions** **photosynthetic organisms**



## SECTION 25.3 *Air Resources, continued*

*In your textbook, read about sources of air pollution and outdoor and indoor air pollution.*
**Answer the following questions.**

**9.** What are two natural sources of air pollution?

**10.** What is one of the biggest sources of air pollution?

**11.** Why is carbon monoxide an air pollutant?

**12.** Name four ways pollutants are changed or affected in the atmosphere.

**13.** What is a "sick building"?

**14.** What is radon-222? Is it a potential outdoor or indoor pollutant?

## SECTION 25.4 *Water Resources*

*In your textbook, read about the importance of water.*
**For each statement below, write *true* or *false*.**

_____ **1.** About 27 percent of Earth's surface is covered with water.

_____ **2.** The oceans help regulate climate and clean up pollutants.

_____ **3.** Most animals are about 30 percent water by weight.

_____ **4.** Water can exist as a liquid over a wide range of temperatures because of the hydrogen bonds between its molecules.

_____ **5.** Polar bonds form when the positive ends of water molecules are attracted to the negative ends of other water molecules.

_____ **6.** Water boils at 200°C and freezes at 0°C.

_____ **7.** Liquid water can store a large amount of heat without a correspondingly high change in temperature.

_____ **8.** Perspiration from your skin is a heating mechanism that depends on water's properties.

_____ **9.** Living things depend on water to act as a solvent to carry nutrients into cells and wastes out of cells.

_____ **10.** Diffusion of water enables a cell to maintain internal pressure.

_____ **11.** Water concentrates water-soluble human waste products.

_____ **12.** Unlike most liquids, water shrinks when it freezes.

_____ **13.** Freezing water contributes to weathering of rocks.

_____ **14.** Ponds and streams freeze from the bottom up.

## SECTION 25.4 *Water Resources, continued*

*In your textbook, read about the location, use, and management of freshwater resources.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**15.** In the United States, freshwater is most likely to be scarce
- **a.** in rural areas in the East.
- **b.** in large cities in the West.
- **c.** along seacoasts.
- **d.** on the Great Plains.

**16.** On which continent has drought had serious effects on the most people?
- **a.** Australia
- **b.** North America
- **c.** Africa
- **d.** South America

**17.** For what is most freshwater used?
- **a.** irrigation
- **b.** household use
- **c.** power-plant cooling
- **d.** industrial processes

**18.** Which method of water control affects the most freshwater resources?
- **a.** dams and reservoirs
- **b.** aqueducts
- **c.** wells
- **d.** desalinization plants

**19.** A drawdown well may run dry when
- **a.** the withdrawal rate of the aquifer exceeds the recharge rate.
- **b.** saltwater intrudes.
- **c.** there is too much precipitation.
- **d.** the water is too hard.

**20.** How does desalination make freshwater out of salt water?
- **a.** by precipitating the salt from the water and skimming off the salt
- **b.** by heating the water until it evaporates, leaving the salts behind
- **c.** by pressurizing the water and filtering the salt out at high pressure
- **d.** by using solar energy to pump freshwater from the ocean bottom

**21.** What seems to be the most practical way to reduce the demand on freshwater?
- **a.** Get freshwater from icebergs.
- **b.** Stop irrigating crops.
- **c.** Ban ornamental lawns and gardens.
- **d.** Use water supplies more efficiently.

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CHAPTER 26 STUDY GUIDE FOR CONTENT MASTERY

# Energy Resources

## SECTION 26.1 *Conventional Energy Resources*

*In your textbook, read about energy resources on Earth.*
**For each statement below, write *true* or *false*.**

_____ **1.** The Sun is the ultimate source of most energy used by organisms on Earth.

_____ **2.** Materials that are burned to produce heat or power are known as energies.

_____ **3.** Probably the earliest fuels used by humans were fossil fuels.

_____ **4.** Humans can live in cold climates because they use energy to provide heat.

*In your textbook, read about traditional fuel sources.*
**Complete the table below. Write *yes* or *no* to indicate whether or not the fuel is renewable. Identify each fuel as a biomass fuel or a fossil fuel. Give one example of how the fuel is commonly used, such as to heat homes, to power vehicles, in cooking, or in power plants.**

| Fuel | Renewable? | Biomass or Fossil? | Common Use |
|---|---|---|---|
| **5.** charcoal | | | |
| **6.** coal | | | |
| **7.** fecal material | | | |
| **8.** field crops | | | |
| **9.** natural gas | | | |
| **10.** peat | | | |
| **11.** petroleum | | | |
| **12.** wood | | | |

## SECTION 26.1 *Conventional Energy Resources, continued*

*In your textbook, read about coal and how it forms.*
**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **anthracite** | **bituminous coal** | **carbon** | **hydrogen** |
| **lignite** | **oxygen** | **tropical swamps** | |

Scientists theorize that coal deposits developed from plants that grew in **(13)** _____ and then died, settled to the bottom, and were covered with subsequent generations of dead plants. The limited supply of **(14)** _____ was used up quickly, which resulted in a slow rate of decay. Over time, this same gas and **(15)** _____, were lost from the organic matter, and the concentration of **(16)** _____ increased. Eventually, this compressed organic matter became coal.

The softest coal is **(17)** _____. It changes into bituminous coal and may eventually become hard **(18)** _____. Most of the coal reserves in the United States are **(19)** _____.

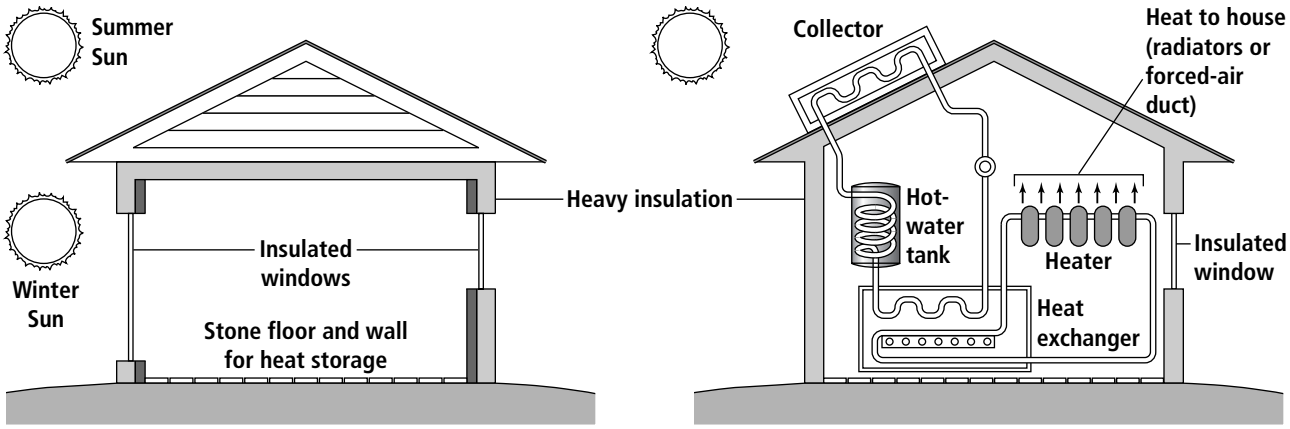
*In your textbook, read about petroleum and natural gas formation.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **bacteria** | **crude oil** | **methane** | **natural gas** | **organically** |
| **pressure** | **sediment load** | **sedimentary rocks** | **temperature** | |

Most geologists hypothesize that oil originated **(20)** _____, like coal. Organisms that died in or near water became part of the **(21)** _____ and fell to the bottom of the seas. As layers of sediment accumulated, they were pressed down by the weight of overlying layers and eventually became **(22)** _____. Little oxygen reached the layers of organic matter, and **(23)** _____ which do not require oxygen partially decomposed the accumulated organisms. As they broke down organic matter, these decomposers released a waste product called **(24)** _____, which is one of the components of natural gas. The remains of these organisms were subjected to increasing **(25)** _____, increasing **(26)** _____, and chemical changes as they were buried under the sediment of ancient seas. These changes resulted in the formation of **(27)** _____ and **(28)** _____.

## SECTION 26.2 *Alternative Energy Resources*

*In your textbook, read about solar energy and how we use it.*
**Examine the diagram below. Then answer the questions.**




A B

**1.** Which house uses active solar heating, and which uses passive solar heating?

**2.** What are some of the structural features used in a passive solar house for heating water and the air?

**3.** What are some of the features in an active solar house for heating water and the air?

**4.** Passive solar houses cost more to build than traditional houses. What is a reason to build one in spite of this extra expense?

**5.** What are the main advantages of solar energy?

## SECTION 26.2 *Alternative Energy Resources, continued*

*In your textbook, read about alternative forms of energy.*
**For each item in Column A, write the letter(s) of the matching item or items in Column B.**

| Column A | Column B |
|---|---|
| ***Advantages*** | |
| _____ **6.** Burns more cleanly than gasoline | **a.** biogas |
| _____ **7.** Mixes with gas to extend supplies | **b.** bitumen |
| _____ **8.** Inexpensive | **c.** ethanol |
| _____ **9.** Made from organic trash | **d.** geothermal energy |
| _____ **10.** More common than other fossil fuel sources in some areas | **e.** hydroelectric power |
| _____ **11.** Nonpolluting | **f.** kerogen (oil shale) |
| _____ **12.** Supplies water and recreation as well as energy | **g.** methane |
| _____ **13.** Renewable | **h.** nuclear energy |
| ***Disadvantages*** | **i.** tidal power |
| _____ **14.** Affects river flow | **j.** wind power |
| _____ **15.** Available only in favorable places | |
| _____ **16.** Not transportable | |
| _____ **17.** Destroys homes and habitats | |
| _____ **18.** Disrupts coastal ecosystems | |
| _____ **19.** Expensive to process | |
| _____ **20.** Hazardous to people and the environment | |
| _____ **21.** Interferes with bird migration | |
| _____ **22.** Can pollute air and water | |

## SECTION 26.2 *Alternative Energy Resources, continued*

*In your textbook, read about alternative forms of energy.*
**Use each of the terms below just once to complete the following statements.**

| | | | | |
|---|---|---|---|---|
| **photovoltaic cell** | **kinetic energy** | **kerogen** | **geothermal energy** | **gasohol** |
| **biogas** | **nuclear fission** | **solar cooker** | **hydroelectric power** | **bitumen** |

**23.** A simple _____ can be used to cook food by focusing the Sun's energy.

**24.** Transparent wafers of silicon in a(n) _____ convert solar energy into electrical energy.

**25.** Energy known as _____ is generated by harnessing the power of falling water.

**26.** The _____ in ocean waves, which are created primarily by the wind, can be used to generate electricity.

**27.** Tar sand is composed of _____, a heavy oil high in sulfur, as well as clay, sand, and water.

**28.** Burned in gasoline engines, the fuel _____ is a mixture of ethanol and gasoline.

**29.** Obtained by decomposing organic wastes, _____ is composed of a mixture of gases such as methane and carbon dioxide.

**30.** The energy known as _____ is contained in water and steam heated by Earth's internal heat.

**31.** In the process of _____, atomic particles are given off in radioactive decay.

**32.** Oil shale is a fine-grained rock that contains _____, a solid, waxy mixture of hydrocarbon compounds.

## SECTION 26.3 *Conservation of Energy Resources*

*In your textbook, read about conservation of energy resources.*
**Answer the following questions.**

**1.** What are the two best ways to meet energy needs, according to energy experts?

**2.** Describe three ways to make transportation more energy efficient.

**3.** How have industries used cogeneration and recycling to improve their energy efficiency?

**4.** What can you do to make an old home more energy efficient?

**5.** If you were building a new house, what could you do to make it an energy-efficient structure?

**6.** Why do you need a global perspective when planning for sustainable energy?

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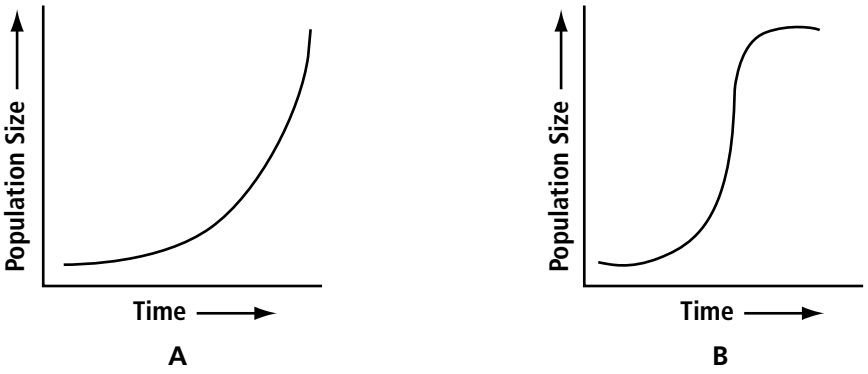
CHAPTER 27 STUDY GUIDE FOR CONTENT MASTERY

# Human Impact on Earth Resources

## SECTION 27.1 *Populations and the Use of Natural Resources*

*In your textbook, read about population growth and the use of resources by organisms.*
**Examine the graphs below. Then answer the questions.**




**1.** Why must organisms use natural resources?

**2.** Describe the pattern of population growth in graph A.

**3.** Describe the pattern of population growth in graph B.

**4.** What happens to a population that has not reached its carrying capacity?

**5.** What happens when a population exceeds its carrying capacity?

## SECTION 27.1 *Populations and the Use of Natural Resources, continued*

*In your textbook, read about environmental factors that affect population growth.*
**Identify each factor below that affects population growth as either a density-independent factor, or a density-dependent factor.**

_____ **6.** drought

_____ **7.** disease

_____ **8.** lack of food

_____ **9.** flood

_____ **10.** lack of water

_____ **11.** pollution

**Complete each statement.**

**12.** Eventually, the availability of such _____ as food, water, and clean air will cause a population to stop increasing.

**13.** The leveling off of population size results in a curve that is shaped like the letter _____.

**14.** When a population has not reached the _____ of its environment, there will continue to be more births than deaths.

**15.** A population that is at its carrying capacity for its environment is in _____.

**16.** Environmental limits that affect all populations that they touch, regardless of population size, are known as _____ factors.

**17.** A _____ factor increasingly affects a population as the population grows.

**18.** The human population is expected to continue growing for the next _____ years.

**19.** The human population reached 6 billion in the year _____.

## SECTION 27.2 *Human Impact on Land Resources*

*In your textbook, read about extraction of mineral resources.*
**Circle the letter of the choice that best completes the statement.**

**1.** One disadvantage of surface mining is that it
- **a.** does not provide iron or copper.
- **b.** disrupts the subsurface through tunneling.
- **c.** requires the building of holding ponds.
- **d.** completely changes the landscape.

**2.** A surface mining method that removes minerals in a circular pattern from the surface downward, leaving a big hole, is
- **a.** open-pit mining.
- **b.** strip mining.
- **c.** underground mining.
- **d.** shovel mining.

**3.** Underground mining can produce pollution as rainfall seeps through piles of
- **a.** coal nuggets.
- **b.** waste rock.
- **c.** logs.
- **d.** topsoil.

**4.** Responsible mining companies restore disturbed land and replant vegetation in a process called
- **a.** reclamation.
- **b.** restoration.
- **c.** relocation.
- **d.** reconstruction.

*In your textbook, read about environmental problems created by agriculture.*
**Write one positive and one negative statement about each of the practices below.**

**5.** Monoculture

Positive: _____

Negative: _____

_____

**6.** Pesticides

Positive: _____

Negative: _____

**7.** Clearing forests and grasslands for farming

Positive: _____

Negative: _____

## SECTION 27.2 *Human Impact on Land Resources, continued*

*In your textbook, read about environmental problems created by forestry.*
**Answer the following questions.**

**8.** What is deforestation?

**9.** Compare and contrast clear-cutting and selective logging in forestry.

**10.** What are two of the negative environmental impacts of clear-cutting?

*In your textbook, read about problems created by urban development.*
**For each statement below, write *true* or *false.***

_____ **11.** In cities, concrete and asphalt that cover large areas of soil can decrease the chance of flooding during heavy rains.

_____ **12.** Urbanization produces large volumes of solid waste that get buried in landfills that can leak chemicals into water supplies.

_____ **13.** Industrial processes, accidental spills, and illegal dumping can pollute the ground in urban areas.

_____ **14.** At construction sites, nothing can be done to prevent sediment erosion.

_____ **15.** Because wetlands are valuable ecosystems, developers must sometimes build new wetlands to replace those they destroy.

_____ **16.** Incinerators remain the most economical method of solid-waste disposal.

_____ **17.** Bioremediation uses organisms to clean up toxic wastes at industrial sites.

## SECTION 27.3 *Human Impact on Air Resources*

*In your textbook, read about air pollution.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **acid precipitation** | **carbon dioxide** | **gasoline** | **global warming** | |
| **greenhouse gases** | **nitrogen oxides** | **oil** | **ozone** | |
| **particulate matter** | **smog** | **ultraviolet** | **stratosphere** | **volcanic eruptions** |

Clean air is essential to life on Earth. But human activities put many types of pollution into the air we breathe. The reaction of sunlight on an atmosphere full of pollution causes a yellow-brown haze called **(1)** _____. The major chemical in this pollutant is a gas molecule with three oxygen atoms called **(2)** _____. Air pollutants also occur in the form of particles of materials such as ash and dust called **(3)** _____.

The largest source of air pollution in the United States is the exhaust from motor vehicles that burn the fossil fuel called **(4)** _____. Another large source of pollution is electric power plants that burn coal and **(5)** _____.

Air pollution does not come only from human activities. Natural phenomena such as forest fires and **(6)** _____ can also cause air pollution.

**(7)** _____ in Earth's atmosphere help it retain heat released from Earth's surface. However, the burning of fossil fuels has increased the concentration of the most important of these gases, **(8)** _____. Scientists hypothesize that the increase in this and other such gases has caused **(9)** _____, which is a rise in Earth's average surface temperature.

The use of chemicals called CFCs has also contributed to air pollution. CFCs rise into the atmosphere and break down ozone molecules in the **(10)** _____. The ozone layer protects Earth from the Sun's harmful **(11)** _____ radiation.

Precipitation with a pH of less than 5.0 is **(12)** _____. It forms when sulfur dioxide and **(13)** _____ from sources such as power plants and motor vehicles combine with moisture in the atmosphere.

## SECTION 27.4 *Human Impact on Water Resources*

*In your textbook, read about water pollution.*
**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **1.** Water pollution *nonpoint sources* generate pollution from widely spread areas.

_____ **2.** Leaking chemical-storage barrels, landfills, and underground gasoline storage tanks are major sources of *surface water* pollution.

_____ **3.** A pipe pouring out pollution from a factory into a river is a *point source* of water pollution.

_____ **4.** The *Endangered Species* Act is the main federal law that protects our nation's waters from pollution.

_____ **5.** The *Safe Drinking Water Act* was designed to ensure that every American has safe drinking water.

_____ **6.** Since 1960, freshwater use has nearly *doubled.*

_____ **7.** Nutrients present in sewage water can create blooms of cyanobacteria that deplete *nitrogen* in the water as they decompose.

*In your textbook, read about water conservation.*
**For each area below, list one way that people can conserve water.**

**8.** On farms

_____

_____

**9.** In industry

_____

_____

**10.** At home

_____

_____

UNIT 7 STUDY GUIDE FOR CONTENT MASTERY

*GeoDigest*

# Resources and the Environment

**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **Sun** | **geochemical cycles** | **resources** | **liquid** |
| **heat-storage capacity** | **nonrenewable** | **alternative** | **biomass** |
| **organisms** | **farming practices** | **renewable** | |

Air, water, land, organisms, rocks, minerals, and nutrients are among Earth's **(1)** _____. Living things, surface water, groundwater, fertile soil, air, solar energy, and elements that cycle, such as carbon and nitrogen, are **(2)** _____ resources. Fossil fuels and elements such as gold, copper, and silver are **(3)** _____ resources, replaceable only by processes that take hundreds of millions of years.

Land resources include topsoil, rocks, minerals, and space for humans to use. Land resources may be harmed by poor **(4)** _____. Air resources may be polluted as a result of human activities that disrupt the balance of **(5)** _____ in Earth's atmosphere. Water is an important resource because it has unique properties that allow life to exist on Earth. Water is a(n) **(6)** _____ over a wide range of temperatures, has high **(7)** _____, dissolves many substances, and expands when it freezes.

Energy resources are another type of resource. The **(8)** _____ is Earth's primary energy resource. Wood and field crops that can be burned and used as fuels are known as **(9)** _____ fuels. Coal, natural gas, and petroleum are energy resources that formed from **(10)** _____ that lived millions of years ago. Solar energy, hydroelectric power, geothermal energy, nuclear energy, and biomass energy are all **(11)** _____ energy resources.

**Use each word or phrase below to complete the word "equations."**

| | | | |
|---|---|---|---|
| **nutrients** | **carbon dioxide** | **high temperature and pressure** | **topsoil** |
| **peat** | **gasoline** | **decreased demand for resources** | **Earth's atmosphere** |

**12.** reducing + reusing + recycling = _____

**13.** methane + _____ = biogas

**14.** remains of organisms + swamp + anaerobic conditions = _____

**15.** alcohol + _____ = gasohol

**16.** peat + _____ = coal

**17.** decaying organic matter + eroded rock + minerals + _____ + oxygen + water = _____

**18.** nitrogen + oxygen + other gases = _____

**In the space at the left, write *true* of the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **19.** The oxygen in Earth's atmosphere was supplied slowly over time by *volcanic eruptions*.

_____ **20.** Materials such as sand, gravel, and crushed stone are known as *bedrock*.

_____ **21.** Natural resources are distributed *unevenly* on Earth.

_____ **22.** Burning fossil fuels releases *biogas*, a source of pollution, into the air.

_____ **23.** The energy of falling water, called *geothermal energy*, is commonly used in the production of electricity.

_____ **24.** Achieving *sustainable energy* use will help ensure that current and future energy needs are met.

_____ **25.** As populations grow, they first increase exponentially; then, eventually, the growth *slows down* when the population reaches the environment's carrying capacity.

_____ **26.** Ground level *acid precipitation* is a major component of smog.

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CHAPTER 28 STUDY GUIDE FOR CONTENT MASTERY

# The Sun-Earth-Moon System

## SECTION 28.1 *Tools of Astronomy*

*In your textbook, read about electromagnetic radiation and telescopes.*
**Use each of the terms below just once to complete the passage.**

**larger** **electromagnetic radiation** **visible light** **wavelength**
**reflecting telescope** **frequency** **telescopes** **refracting telescope**
**interferometry** **electromagnetic spectrum**

**(1)** _____ consists of electric and magnetic disturbances, or waves, that travel through space. Human eyes see one form of this energy, called **(2)** _____. All forms of electromagnetic radiation, including X rays and radio waves, make up the **(3)** _____. Each type of radiation can be classified in two ways. **(4)** _____ measures the distance between the peaks on a wave and **(5)** _____ is the number of waves that occurs each second. Scientists study radiation with **(6)** _____, which collect and focus light. The **(7)** _____ the opening that gathers light in a telescope, the more light that can be collected. A(n) **(8)** _____ uses lenses to bring light to a focus, and a(n) **(9)** _____ uses mirrors to do the same thing. The process of linking several telescopes together so that they can act as one is called **(10)** _____.

*In your textbook, read about satellites, probes, and space-based astronomy.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **11.** The first multi-country space habitat for long-term human occupation | **a.** *Hubble Space Telescope* |
| _____ **12.** Probe to Mars | **b.** *Sojourner/Pathfinder* |
| _____ **13.** Telescope launched in 1990 to carry out observations in visible light, infrared, and ultraviolet wavelengths | **c.** *Chandra X-Ray Observatory* |
| _____ **14.** Craft in which astronauts study weightlessness, growth of crystals, and other phenomena | **d.** Space Shuttle |
| _____ **15.** Telescope used to observe X rays blocked by Earth's atmosphere | **e.** *International Space Station* |

## SECTION 28.2 *The Moon*

*In your textbook, read about the characteristics and history of the Moon.*
**Circle the letter of the choice that best completes the statement.**

**1.** Temperatures on the Moon's surface are
**a.** always very hot.
**b.** either very hot or very cold.
**c.** always very cold.
**d.** moderate.

**2.** The light-colored, mountainous regions of the Moon are called
**a.** maria. **b.** impact craters. **c.** rilles. **d.** highlands.

**3.** The dark, smooth plains on the Moon are called
**a.** maria. **b.** impact craters. **c.** rilles. **d.** highlands.

**4.** The features on the Moon formed by objects crashing into its surface are
**a.** rilles. **b.** mountain ranges. **c.** impact craters. **d.** regolith.

**5.** The material that falls back to the Moon's surface after an impact blast is
**a.** regolith. **b.** feldspar. **c.** ejecta. **d.** lava.

**6.** Long trails of ejecta on the Moon's surface are called
**a.** rilles. **b.** rays. **c.** plains. **d.** highlands.

**7.** Meandering valleylike features on the Moon's surface are called
**a.** rays. **b.** ejecta. **c.** rilles. **d.** craters.

**8.** There is no erosion, other than surface creep and erosion due to impacts, on the Moon because there is no
**a.** lava or flowing water.
**b.** atmosphere or flowing water.
**c.** ejecta or lava.
**d.** ejecta or atmosphere.

**9.** After a long period of impacts, the Moon's impact basins filled with
**a.** water. **b.** lava. **c.** feldspar. **d.** breccia.

**10.** Scientists hypothesize that the Moon's crust is twice as thick
**a.** in the highlands.
**b.** in the maria.
**c.** on the side seen from Earth.
**d.** on the far side.

**11.** The layers of the Moon, from the surface inward, are the
**a.** upper mantle, lower mantle, crust, and core.
**b.** crust, core, upper mantle, and lower mantle.
**c.** core, crust, upper mantle, and lower mantle.
**d.** crust, upper mantle, lower mantle, and core.

**12.** According to the most commonly accepted theory of the Moon's formation, the Moon is made from
**a.** materials from asteroids and comets.
**b.** materials from Earth only.
**c.** materials from Mars.
**d.** materials from Earth and the body that hit it.

**13.** The most commonly accepted theory about the origin of the Moon explains why the
**a.** the Moon and Earth have similar compositions.
**b.** the Moon is so far away from Earth.
**c.** the same side of the Moon is always seen from Earth.
**d.** the Moon has very little regolith.

## SECTION 28.2 *The Moon, continued*

*In your textbook, read about explorations of the Moon.*
**Number the following events in chronological order from 1 to 6.**

_____ **14.** Project *Gemini* launches two-person crews into space.

_____ **15.** *Sputnik 1* is launched into space by the Soviet Union.

_____ **16.** *Apollo 11* lands on the Moon.

_____ **17.** Cosmonaut Yuri A. Gagarin becomes the first human in space.

_____ **18.** American Alan B. Shepard, Jr., is launched into space.

*In your textbook, read about the theories of the Moon's formation.*
**Answer the following questions.**

**19.** Explain the capture theory of the origin of the Moon. Then describe the problems with this theory.

**20.** Explain the simultaneous formation theory of the Moon's origin. Then describe the problem with this theory.

**21.** Explain the most commonly accepted theory of the origin of the Moon. Then describe why this theory is currently the accepted theory.

## SECTION 28.3 *The Sun-Earth-Moon System*

*In your textbook, read about the motions of Earth, the Sun, and the Moon.*
**In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.**

_____ **1.** All societies base their calendars and timekeeping systems on the *apparent motion of the Sun* and Moon.

_____ **2.** The Sun, Moon, and stars appear to rise in the east and set in the west because of the rotation of *the Moon*.

_____ **3.** You can demonstrate that Earth rotates through the use of a *Foucault pendulum*.

_____ **4.** The period from one sunrise or sunset to the next is called the *solar day*.

_____ **5.** The length of time it takes for the Moon to go through a complete cycle of phases is called the *lunar month*.

_____ **6.** Annual variations in the length of the day and in temperatures are dependent on the *longitude* where you live.

_____ **7.** The plane of Earth's orbit about the Sun is called the *solstice*.

_____ **8.** The seasons are caused by Earth's orbit around the Sun in combination with the *tilt of Earth's axis*.

_____ **9.** The hemisphere that is tilted toward the Sun experiences *winter*.

_____ **10.** A *solar eclipse* occurs when the Moon passes through Earth's shadow.

_____ **11.** On the *summer solstice*, the number of daylight hours for the northern hemisphere is at a maximum.

_____ **12.** During the northern hemisphere's summer, the sun appears *lower* in the sky than it does in winter.

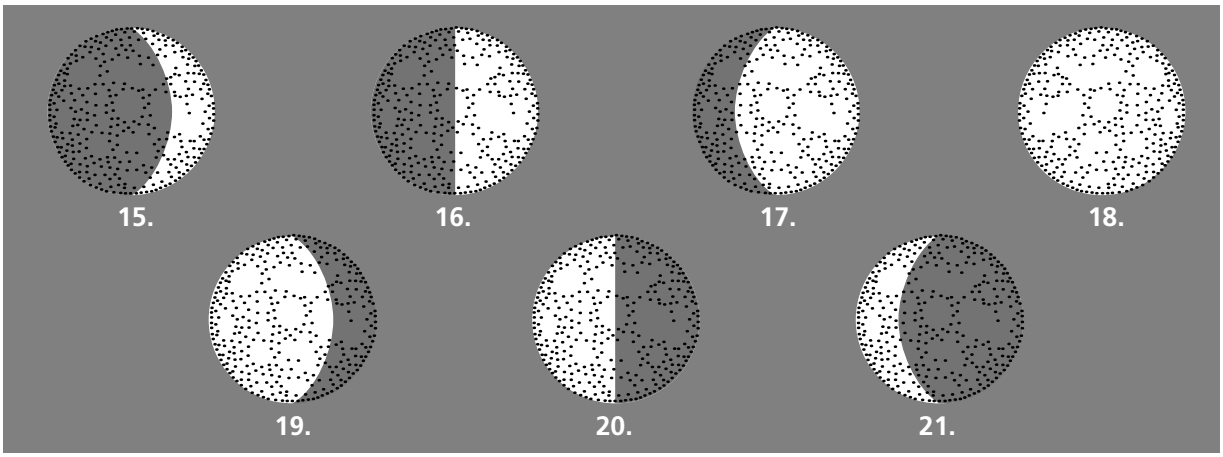
_____ **13.** On the winter solstice, the number of daylight hours is at its *minimum*.

_____ **14.** The lengths of day and night are equal for *both the northern and southern hemispheres* on the vernal equinox.

## SECTION 28.3 *The Sun-Earth-Moon System, continued*

*In your textbook, read about the phases of the Moon.*

**Label each phase of the Moon below. Choose from the following phases: *waning gibbous, waxing crescent, third quarter, first quarter, waxing gibbous, waning crescent, full moon.***




**15.** _____

**16.** _____

**17.** _____

**18.** _____

**19.** _____

**20.** _____

**21.** _____

**Answer the question.**

**22.** Why is the Moon invisible from Earth during a new moon?

_____

_____

## SECTION 28.3 *The Sun-Earth-Moon System, continued*

*In your textbook, read about the phases and motions of the Moon and about eclipses.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **23.** The closest point to Earth in the Moon's orbit | **a.** synchronous rotation |
| _____ **24.** The inner portion of the shadow cast on Earth by the Moon | **b.** lunar month |
| _____ **25.** Blocking of the Sun's light by the Moon passing between Earth and the Sun | **c.** tides |
| _____ **26.** Farthest point from Earth in the Moon's orbit | **d.** solar eclipse |
| _____ **27.** State at which the Moon's orbital and rotational periods are equal | **e.** umbra |
| _____ **28.** Occurs when the Moon passes through Earth's shadow | **f.** penumbra |
| _____ **29.** Length of time it takes for the Moon to go through a complete cycle of phases | **g.** perigee |
| _____ **30.** The daily rise and fall of Earth's oceans caused by the gravitational pull of the Moon and the Sun | **h.** apogee |
| _____ **31.** Outer portion of the shadow cast on Earth by the Moon | **i.** lunar eclipse |

**Circle the letter of the choice that best completes the statement.**

**32.** The fact that Earth observers always see the same side of the Moon is explained by the Moon's
- **a.** eclipse.
- **b.** penumbra.
- **c.** gravity.
- **d.** synchronous rotation.

**33.** The tides on Earth are caused by the gravitational pull of the
- **a.** the Moon only.
- **b.** the Sun only.
- **c.** both the Moon and the Sun.
- **d.** neither the Moon nor the Sun.

**34.** During an annular solar eclipse, the Moon
- **a.** is near perigee.
- **b.** does not completely block the Sun.
- **c.** passes through Earth's shadow.
- **d.** always appears reddish in color.

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CHAPTER 29 STUDY GUIDE FOR CONTENT MASTERY

# Our Solar System

## SECTION 29.1 *Overview of Our Solar System*

*In your textbook, read about early ideas.*
**Write the letter of the term from Column B next to its matching item in Column A.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** Motion of a planet moving in the opposite direction of the normal direction of planetary motion as observed from Earth | **a.** aphelion |
| _____ | **2.** Point in a planet's orbit when it is farthest from the Sun | **b.** astronomical unit |
| _____ | **3.** Nicolaus Copernicus's model of the solar system in which the planets orbit the Sun | **c.** eccentricity |
| _____ | **4.** Oval shape centered on two points instead of one point | **d.** ellipse |
| _____ | **5.** Point in a planet's orbit when it is closest to the Sun | **e.** heliocentric |
| _____ | **6.** Defines a planet's elliptical orbit as the ratio of the distance between the foci and the length of the major axis | **f.** perihelion |
| _____ | **7.** Unit of measure that is the average distance between the Sun and Earth ($1.4960 \times 10^8$ km) | **g.** retrograde |

*In your textbook, read about gravity and orbits.*
**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **acceleration** | **center of mass** | **distance** | **force** |
| **Isaac Newton** | **masses** | **Moon** | **universal gravitation** |

English scientist **(8)** _____ developed an understanding of gravity by observing the motion of the **(9)** _____, the orbits of the planets, and the **(10)** _____ of falling objects on Earth. He learned that two bodies attract each other with a **(11)** _____ that depends on their **(12)** _____ and the **(13)** _____ between the bodies. This is called the law of **(14)** _____. He also determined that each planet orbits a point between itself and the Sun. That point is called the **(15)** _____.

## SECTION 29.2 *The Terrestrial Planets*

*In your textbook, read about Mercury and Venus.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**1.** The four inner planets of our solar system are
**a.** gas giant planets. **c.** terrestrial planets.
**b.** interplanetary asteroids. **d.** meteorites.

**2.** The closest planet to the Sun is
**a.** Venus. **b.** Mercury. **c.** Mars. **d.** Earth.

**3.** How many times bigger than Mercury is Earth?
**a.** two times **b.** three times **c.** four times **d.** five times

**4.** The surface of Mercury is similar to the surface of
**a.** Earth. **b.** the Moon. **c.** Venus. **d.** Mars.

**5.** Observations of Mercury suggest that it was originally much larger, with a mantle and crust similar to that of
**a.** Earth. **b.** the Moon. **c.** Venus. **d.** Mars.

**6.** The brightest planet in Earth's nighttime sky is
**a.** Mercury. **b.** the Moon. **c.** Venus. **d.** Mars.

**7.** One day on Venus is equal to how many days on Earth?
**a.** 243 days **b.** 43 days **c.** 143 days **d.** 4 days

**8.** In the 1960s, radar measurements showed that the surface of Venus is very hot and that it is
**a.** rotating quickly. **b.** orbiting quickly. **c.** rotating slowly. **d.** orbiting slowly.

**9.** Venus's spin is an example of
**a.** retrograde motion. **b.** backward rotation. **c.** retrograde rotation. **d.** backward motion.

**10.** The atmosphere of Venus is mostly
**a.** nitrogen and oxygen. **c.** oxygen.
**b.** sodium. **d.** carbon dioxide and nitrogen.

*In your textbook, read about Earth and Mars.*
**For each statement below, write *true* or *false.***

_____ **11.** Earth's distance from the Sun and its nearly circular orbit allow water to exist on its surface as a solid, liquid, and gas.

_____ **12.** Earth's atmosphere is moderately dense and is composed of 78 percent oxygen and 21 percent nitrogen.

_____ **13.** The wobble in Earth's rotational axis is called precession.

_____ **14.** Mars is referred to as the red planet as a result of its high iron content and reddish appearance.

_____ **15.** Mars's atmosphere is similar to that of Venus, and it has a strong greenhouse effect.

_____ **16.** The southern hemisphere of Mars is dominated by sparsely cratered plains.

## SECTION 29.3 *The Gas Giant Planets*

*In your textbook, read about Jupiter and Saturn.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**1.** What percentage of all planetary matter in the solar system is in Jupiter's mass?
**a.** 40% **b.** 60% **c.** 50% **d.** 70%

**2.** Galileo discovered Jupiter's
**a.** rings.
**b.** 12 smaller satellites.
**c.** four major satellites.
**d.** Great Red Spot

**3.** Elements in the Jovian atmosphere remain in
**a.** only liquid form.
**b.** both gas and liquid forms.
**c.** only gas form.
**d.** gas, liquid, and solid forms.

**4.** The form of hydrogen that has properties of both a liquid and a metal is
**a.** liquid metallic hydrogen.
**b.** magnetic hydrogen.
**c.** liquid hydrogen.
**d.** electric hydrogen.

**5.** Jupiter spins once on its axis in a little less than
**a.** 5 hours. **b.** 12 hours. **c.** 10 hours. **d.** 2 hours.

**6.** Low, warm, dark-colored, sinking clouds in Jupiter's atmosphere are known as
**a.** belts.
**b.** the Great Red Spot.
**c.** zones.
**d.** rings.

**7.** Jupiter's four moons are composed of
**a.** clouds. **b.** ice and rock. **c.** hydrogen and oxygen. **d.** ice.

**8.** What is Jupiter's Great Red Spot?
**a.** a surface ocean
**b.** a large moon
**c.** an atmospheric storm
**d.** an ice cap

**9.** Which of Jupiter's moons is almost completely molten inside?
**a.** Io **b.** Europa **c.** Ganymede **d.** Callisto

**10.** Saturn's average density is lower than that of
**a.** helium. **b.** hydrogen. **c.** water. **d.** methane.

**11.** The ringlets and open gaps in Saturn's rings are caused by the gravitational effects of
**a.** Saturn.
**b.** Jupiter.
**c.** Saturn's moons.
**d.** the Sun.

**12.** Many astronomers hypothesize that Saturn's rings were formed from
**a.** debris left over from the formation of Saturn and its moons.
**b.** debris left over when a moon was destroyed by a collision.
**c.** debris that escaped from Jupiter's gravitational pull.
**d.** asteroids attracted by Saturn's gravitational pull.

**13.** Saturn's largest moon is named
**a.** Io. **b.** Titan. **c.** Europa. **d.** Ganymede.

## SECTION 29.3 *The Gas Giant Planets, continued*

*In your textbook, read about Uranus, Neptune, and Pluto.*
**For each statement, write *true* or *false*.**

_____ **14.** Uranus was discovered accidentally in 1781.

_____ **15.** Today, we are certain that Uranus has no moons and 15 rings.

_____ **16.** Most of Uranus's atmosphere is composed of helium and hydrogen, which causes its atmosphere to reflect blue light back into space.

_____ **17.** Uranus has a large, solid core that extends almost to the planet's surface.

_____ **18.** The rotational axis of Uranus is tipped over so far that the north pole almost lies in its orbital plane.

_____ **19.** The existence of Neptune was predicted before it was discovered based on small deviations in the motion of Saturn.

_____ **20.** Uranus's tilt and its great distance from the Sun result in seasons on Uranus that last about 21 Earth years.

_____ **21.** Until 1994, Neptune had a persistent storm, the Great Dark Spot, with characteristics similar to Jupiter's Great Red Spot.

_____ **22.** Neptune's largest moon, Triton, has a retrograde orbit, which means it orbits like every other satellite in the solar system.

_____ **23.** Triton has nitrogen geysers and a thin atmosphere.

_____ **24.** Neptune's six rings are composed of microscopic dust particles, and parts of its outermost rings appear much brighter than other parts.

_____ **25.** Scientists hypothesize that the clumps in Neptune's rings do not spread evenly because of Neptune's gravitational effect.

_____ **26.** Pluto is not classified as a terrestrial planet because of its low density and small size.

_____ **27.** Pluto is larger than Earth and is made of ice.

_____ **28.** Like Earth's Moon, Pluto has no atmosphere.

_____ **29.** The orbit of Pluto is a perfect circle.

_____ **30.** Pluto and its moon Charon are in a synchronous rotation with each other.

_____ **31.** Pluto's properties more closely resemble those of the gas giants' large moons than of the other planets.

## SECTION 29.4 *Formation of Our Solar System*

*In your textbook, read about collapsing interstellar clouds and Sun and planet formation.*
**Write the letter of the item in Column B next to its matching item in Column A.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** Gas and dust from which stars and planets form | **a.** inner planets |
| _____ | **2.** Rotating disk of dust and gas that formed the Sun and planets | **b.** tungsten |
| _____ | **3.** Solid bodies hundreds of kilometers in diameter that merged to form the planets | **c.** planetesimals |
| _____ | **4.** Believed to be the first large planet to develop | **d.** solar nebula |
| _____ | **5.** One of the first elements to condense in the early solar system | **e.** interstellar cloud |
| _____ | **6.** Lacking in satellites because of proximity to the Sun | **f.** Jupiter |

*In your textbook, read about asteroids.*
**For each statement, write *true* or *false*.**

_____ **7.** Asteroids orbit the Sun and range from a few kilometers to about 100 kilometers in diameter.

_____ **8.** Most asteroids are located between the orbits of Mars and Jupiter in the asteroid belt.

_____ **9.** Asteroids are thought to be planetesimals that never formed planets.

_____ **10.** A meteoroid is a broken fragment of an asteroid or other interplanetary material.

_____ **11.** A meteor is a meteoroid that bypasses Earth's atmosphere.

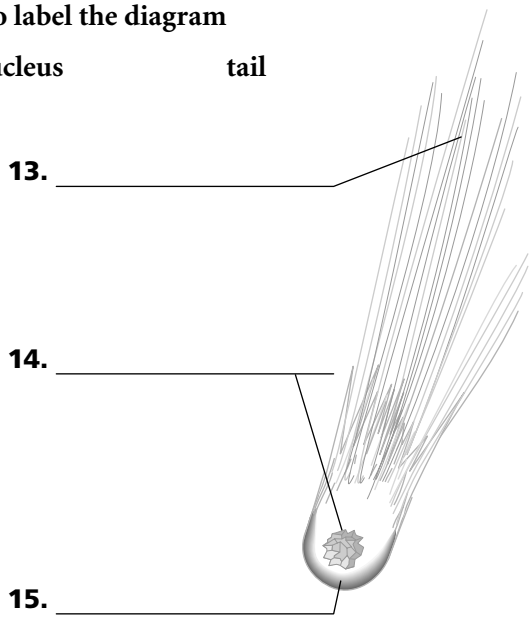
_____ **12.** A large meteorite will cause an impact crater when it collides with Earth.

## SECTION 29.4 *Formation of Our Solar System, continued*

*In your textbook, read about comets.*

**Use the words below to label the diagram**

**coma** **nucleus** **tail**



**13.** _____

**14.** _____

**15.** _____

**Answer the following questions.**

**16.** What type of orbit does a comet have? Describe a typical comet's perihelion and aphelion.

**17.** What happens when a comet comes within 3 AU of the Sun?

**18.** What is a periodic comet? Give an example.

**19.** What is a meteor shower?

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CHAPTER 30 STUDY GUIDE FOR CONTENT MASTERY

# Stars

## SECTION 30.1 *The Sun*

*In your textbook, read about the properties of the Sun and the Sun's atmosphere.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **chromosphere** | **corona** | **gaseous** | **ions** | **mass** |
| **photosphere** | **solar eclipse** | **solar system** | **solar wind** | |

The Sun is the largest object in our **(1)** _____. Its **(2)** _____ controls the motions of the planets. The center of the Sun is very dense. The high temperature at its center causes the solar interior to be **(3)** _____ throughout.

The visible surface of the Sun is called the **(4)** _____. It is the lowest layer of the Sun and is approximately 400 km in thickness. The average temperature is 5800 K.

Above the visible layer is the **(5)** _____. It is approximately 2500 km in thickness and has a temperature of nearly 30 000 K at the top. Without special filters, this layer is visible only during a **(6)** _____.

The top layer of the Sun's atmosphere is the **(7)** _____. It has a temperature range of 1 million to 2 million K. Gas flows outward from this layer at high speeds and forms the **(8)** _____. It is made up of charged particles, or **(9)** _____, which flow outward through the entire solar system.

*In your textbook, read about solar activity.*
**For each term in Column A, write the letter of the matching item in Column B.**

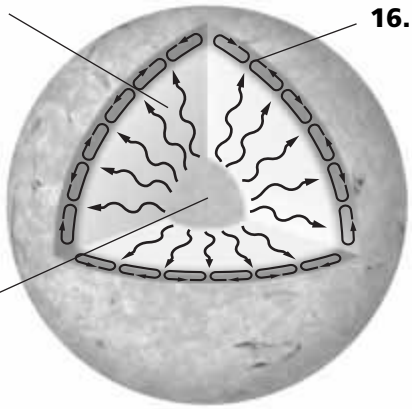
| Column A | Column B |
|---|---|
| _____ **10.** Cooler areas on the surface of the photosphere that appear darker than the surrounding areas on the Sun | **a.** prominence |
| _____ **11.** A period of 22.4 years in which the number of sunspots on the Sun changes regularly and the Sun's magnetic field reverses | **b.** solar flares |
| _____ **12.** Areas of low density in the gas of the corona from which particles escape | **c.** sunspots |
| _____ **13.** Violent eruptions of particles and radiation from the surface of the Sun | **d.** coronal holes |
| _____ **14.** Arc of gas ejected from the photosphere | **e.** solar activity cycle |

## SECTION 30.1 *The Sun, continued*

*In your textbook, read about the solar interior.*
**Use the terms below to label the diagram.**

**convective zone** **radiative zone** **core**

**15.** _____ **16.** _____



**17.** _____

**Answer the following questions.**

**18.** What is fusion? Where does it take place in the Sun?

_____

_____

**19.** What is fission?

_____

_____

**20.** How is Einstein's theory of special relativity expressed? What does each letter stand for?

_____

_____

_____

**21.** What is the process that transfers the Sun's energy from particle to particle? Where does this process take place?

_____

**22.** What is the process that carries the Sun's energy the rest of the way to the Sun's surface? What carries the energy?

_____

**23.** How far, as a percentage, does the radiative zone extend to the photosphere?

_____

_____

## SECTION 30.2 *Measuring the Stars*

*In your textbook, read about groups of stars and stellar positions and distances.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**1.** Constellations are
- **a.** the brightest stars.
- **b.** stars over Greece.
- **c.** groups of stars named after animals, mythological characters, or everyday objects.
- **d.** found only in the northern hemisphere.

**2.** Ursa Major, or the big dipper, is an example of a
- **a.** circumpolar constellation.
- **b.** constellation that can be seen only in winter.
- **c.** constellation that can be seen only in summer.
- **d.** constellation that can be seen only in the fall.

**3.** Scientists measure distances to stars and observe how stars interact with one another to
- **a.** determine if stars are right next to each other.
- **b.** determine if stars are touching.
- **c.** determine the names of constellations.
- **d.** determine which stars are gravitationally bound to each other.

**4.** Astronomers can identify binary stars by
- **a.** comparing the colors of the stars.
- **b.** measuring the parallax of the stars.
- **c.** measuring the position of the visible star in the pair and noting shifts as it orbits the center of mass between it and the unseen companion star.
- **d.** examining the stars' absorption spectra.

**5.** When estimating the distance of stars from Earth, astronomers use the fact that nearby stars shift in position as observed from Earth, which is called
**a.** parsec. **b.** parallax. **c.** precision. **d.** shafting.

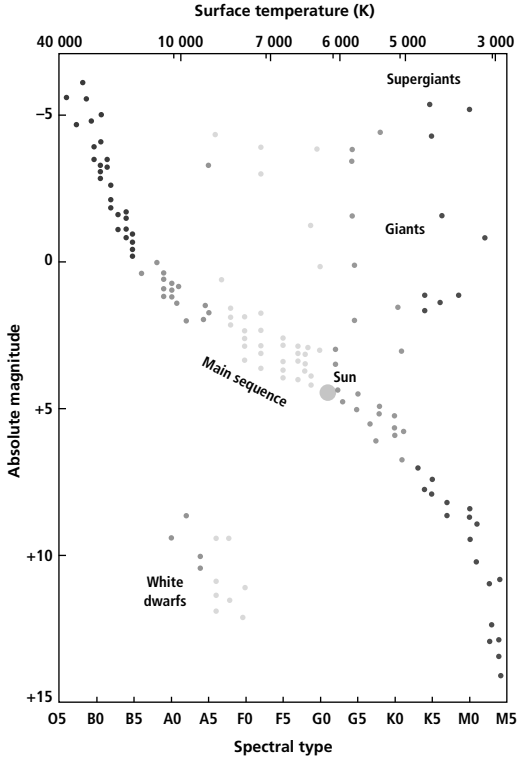
*In your textbook, read about the basic properties of stars.*

**For each term in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **6.** Ancient Greek classification system based on how bright a star appears to be | **a.** luminosity |
| _____ | **7.** Brightness of an object if it was placed at a distance of 10 pc | **b.** absolute magnitude |
| _____ | **8.** Energy output from the surface of a star per second | **c.** watt |
| _____ | **9.** Unit of measurement used to express the energy emitted per second | **d.** apparent magnitude |

## SECTION 30.2 *Measuring the Stars, continued*

*In your textbook, read about the spectra of stars.*
**Use the diagram below to answer the questions.**




**10.** The spectral types—O, B, A, F, G, K, M—were originally based on the pattern of spectral lines. What else did astronomers discover that the classes corresponded to? What is the difference from O to M?

**11.** What type of star is the Sun? What is its surface temperature? What is its absolute magnitude?

**12.** What is the typical composition of a star?

**13.** What makes a star's spectrum appear to be different from another star's?

## SECTION 30.3 *Stellar Evolution*

*In your textbook, read about the basic structure of stars.*
**Use each of the terms below just once to complete the passage.**

| | | | |
|---|---|---|---|
| **carbon** | **helium** | **hydrostatic equilibrium** | **iron** |
| **luminosity** | **magnesium** | **mass** | **neon** |
| **nuclear fusion** | **oxygen** | **silicon** | **temperature** |

For a star to be stable, it must have **(1)** _____, which is the balance between gravity squeezing inward and pressure from **(2)** _____ and radiation pushing outward. This balance is governed by the **(3)** _____ of the star. The **(4)** _____ inside a star determines the star's energy output, or **(5)** _____.

Stars on the main sequence produce energy by fusing hydrogen into **(6)** _____. Once a star's core has been converted into helium, it may react if the temperature is high enough. If the temperature is high enough, **(7)** _____ can react with helium to form **(8)** _____, then **(9)** _____, then **(10)** _____, and then **(11)** _____. Other types of reactions can produce even heavier elements, the heaviest being **(12)** _____.

*In your text, read about stellar evolution and life cycles.*
**For each statement below, write *true* or *false.***

_____ **13.** As a star ages, its internal composition changes as a result of rising temperature.

_____ **14.** As nuclear fuel runs out, a star's internal structure and its mechanism for producing pressure change to counteract gravity.

_____ **15.** The formation of a star begins with a cloud of interstellar gas and dust called nebula.

_____ **16.** A nebula collapses on itself as a result of its high temperature.

_____ **17.** As a nebula contracts, its rotation forces it into a disk shape with a hot condensed object at the center, which will become a new star.

_____ **18.** A new star often illuminates the gas and dust surrounding it.

## SECTION 30.3 *Stellar Evolution, continued*

*In your textbook, read about the Sun's life cycle.*
**Answer the following questions.**

**19.** How many years does it take a star with the mass of the Sun to convert all the hydrogen in its core? To what is the hydrogen converted?

**20.** What happens to a star when it becomes a red giant?

**21.** A star of the Sun's mass never becomes hot enough for carbon to react, and the star's energy production is at an end. What happens to the outer layers? What is this star called?

*In your textbook, read about life cycles of massive stars.*
**Circle the letter of the choice that best completes the statement.**

**22.** A star that begins with a mass 8 to 20 times that of the Sun's mass will
- **a.** undergo the same evolution as the Sun.
- **b.** become a white dwarf.
- **c.** end up with a core too massive to be supported by pressure and come to a violent end.
- **d.** remain at the same stage and not evolve.

**23.** The resistance of a star's core to being squeezed halts the collapse of the core and the core becomes a
**a.** supernova. **b.** neutron star. **c.** red dwarf. **d.** protostar.

**24.** During a supernova,
- **a.** infalling gas remains trapped in the core.
- **b.** the core continues to fuse helium.
- **c.** the resistance of electrons being squeezed counteracts gravity and supports the core.
- **d.** the entire outer portion of the star is blown off in a massive explosion.

**25.** A star that starts with more than about 20 times the Sun's mass will
- **a.** become a neutron star.
- **b.** continue to fuse iron in its core.
- **c.** end up with a smaller mass.
- **d.** collapse forever and become a black hole.

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CHAPTER 31 STUDY GUIDE FOR CONTENT MASTERY

# Galaxies and the Universe

## SECTION 31.1 *The Milky Way Galaxy*

*In your textbook, read about discovering the Milky Way.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | | Column B |
|---|---|---|
| _____ | **1.** Stars in the giant branch of the H-R diagram that pulsate in brightness because of the expansion and contraction of their layers | **a.** Cepheid variables |
| _____ | **2.** Stars that have periods of pulsations between 1.5 hours and 1 day, and on average, have the same luminosity | **b.** luminosity |
| _____ | **3.** Stars with pulsation periods between 1 day and more than 100 days | **c.** RR Lyrae variables |
| _____ | **4.** By measuring a star's period of pulsation, astronomers can determine this. | **d.** Sagittarius |
| _____ | **5.** Direction of the center of the Milky Way is toward this constellation. | **e.** variable stars |

*In your textbook, read about the shape of the Milky Way.*
**For each statement below, write *true* or *false.***

_____ **6.** Radio waves are used to map the Milky Way because they can penetrate the interstellar gas and dust without being scattered or absorbed.

_____ **7.** The Milky Way's galactic nucleus is surrounded by a nuclear bulge that sticks out of the galactic disk.

_____ **8.** Measurements of star luminosity at different distances provide a hint of the Milky Way's spiral arms.

_____ **9.** Around the Milky Way's nuclear bulge and disk is the halo, where the globular clusters are located.

_____ **10.** Astronomers mapped the emission wavelength of nitrogen gas in space to conclusively determine the existence of spiral arms in the Milky Way.

_____ **11.** Five major spiral arms and a few minor arms were identified in the Milky Way.

_____ **12.** The Sun is located in the Milky Way's minor arm Orion at a distance of 28 000 ly from the galactic center.

_____ **13.** In its 4.5-billion-year life, the Sun has orbited the galaxy approximately 100 times.

## SECTION 31.1 *The Milky Way Galaxy, continued*

*In your textbook, read about the mass of the Milky Way.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **2.6 million** | **100 billion** | **center** | **dark matter** | **galaxy** |
| **gas clouds** | **stellar remnants** | **halo** | **supermassive black hole** | |

The mass located within the circle of the Sun's orbit through the galaxy is about **(14)** _____ times the mass of the Sun. Because the Sun is of average mass, astronomers have concluded there are about 100 billion stars within the disk of the **(15)** _____.

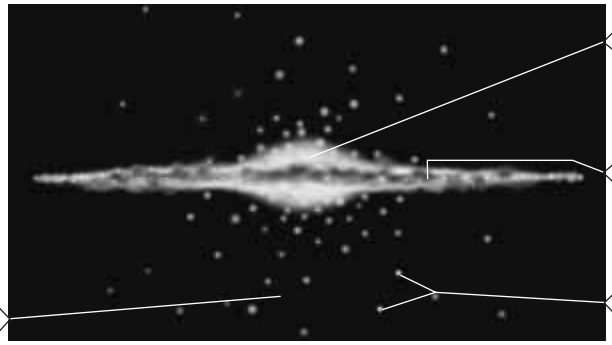
Astronomers have found evidence that much more mass exists in the outer galaxy. The stars and **(16)** _____ that orbit in the outer disk are moving faster than they would if the galaxy's mass were concentrated near the **(17)** _____ of the disk. Evidence indicates that as much as 90 percent of the galaxy's mass is contained in the **(18)** _____. This mass is not observed in the form of normal stars, and astronomers hypothesize that some of this unseen matter is in the form of dim **(19)** _____, such as white dwarfs, neutron stars, and black holes. The remainder of this mass, usually called **(20)** _____, is a mystery.

Studies of the motion of stars that orbit close to Sagittarius A* indicate that this area has about **(21)** _____ times the mass of the Sun, but is smaller than our solar system. Astronomers believe that Sagittarius A* is a **(22)** _____ that glows brightly because of the hot gas surrounding it and spiraling into it.

## SECTION 31.1 *The Milky Way Galaxy, continued*

*In your text, read about stellar distribution in the Milky Way.*
**Use the terms below to label the diagram. Each term may be used more than once.**

| | | |
|---|---|---|
| **disk** | **globular cluster** | **halo** |
| **nuclear bulge** | **Population I** | **Population II** |




**Answer the following questions.**

**31.** What are Population I stars? How do they differ from Population II stars?

**32.** Where does most star formation take place?

*In your textbook, read about the formation and evolution of the Milky Way and maintaining spiral arms.*
**Answer the following questions.**

**33.** What does the type of stars found in the halo and bulge indicate?

**34.** What two theories explain how the spiral arms are maintained?

## SECTION 31.2 *Other Galaxies in the Universe*

*In your textbook, read about discovering other galaxies.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**1.** The question about other objects existing in the sky was answered by Edwin Hubble in 1924. What did he discover in the Great Nebula in the Andromeda constellation?
**a.** Cepheid variable stars **c.** RR Lyrae variables
**b.** a supernova **d.** a black hole

**2.** Disklike galaxies with spiral arms are divided into which of the following two subclasses?
**a.** normal spirals and flat spirals **c.** flat spirals and barred spirals
**b.** normal spirals and barred spirals **d.** loose spirals and flat spirals

**3.** Galaxies that are not flattened into disks and do not have spiral arms are called
**a.** dwarf galaxies. **c.** elliptical galaxies.
**b.** barred elliptical galaxies. **d.** nebular galaxies.

**4.** Galaxies that do not fit into the spiral or elliptical classifications are called
**a.** dwarf galaxies. **b.** Hubble galaxies. **c.** barred galaxies. **d.** irregular galaxies.

*In your textbook, read about groups and clusters of galaxies.*
**For each statement, write *true* or *false*.**

_____ **5.** Most galaxies are spread evenly throughout the universe.

_____ **6.** The Milky Way belongs to a small cluster of galaxies called the Local Group.

_____ **7.** The Milky Way and the Andromeda Galaxy are two of the smallest members of the Local Group.

_____ **8.** When galaxies move away from each other, they form strangely shaped galaxies or galaxies with more than one nucleus.

_____ **9.** Studies of clusters of galaxies provide astronomers with the strongest evidence that most of the matter in the universe is visible and accounted for.

*In your textbook, read about the expanding universe, active galaxies, and quasars.*
**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **10.** Feature in the spectra of galaxies that indicates that they are moving away from Earth | **a.** active galactic nuclei |
| _____ **11.** About 70 km per second per megaparsec | **b.** Hubble constant |
| _____ **12.** Extremely bright galaxies that are often giant elliptical galaxies emitting as much or more energy in radio wavelengths than in wavelengths of visible light | **c.** quasars |
| _____ **13.** Starlike objects with emission lines in their spectra | **d.** radio galaxies |
| _____ **14.** Provide important clues for astronomers to study the origin and evolution of the universe | **e.** redshift |

## SECTION 31.3 *Cosmology*

*In your textbook, read about models of the universe.*
**Use each of the terms below just once to complete the passage.**

| | | | | |
|---|---|---|---|---|
| **2.735 K** | **background noise** | **Big Bang** | ***Cosmic Background Explorer*** | |
| **compressed** | **radiation** | **Doppler** | **cosmic background radiation** | |
| **cosmology** | **density** | **expanding** | **matter** | **steady-state** |

The study of the universe, including its current nature, its origin, and its evolution is called **(1)** _____. The fact that the universe is **(2)** _____ implies that it had a beginning. The theory that the universe began as a point and has been expanding ever since is called the **(3)** _____ theory. Not all astronomers agree that the universe had a beginning. The **(4)** _____ theory proposes that the universe looks the same on large scales to all observers and that it has always looked that way. Supporters of this theory propose that new **(5)** _____ is created and added to the universe. Therefore, the overall **(6)** _____ of the universe doesn't change.

According to the more accepted theory, the Big Bang Theory, if the universe began in a highly **(7)** _____ state, it would have been very hot, and the high temperatures would have filled it with **(8)** _____. As the universe expanded and cooled, the radiation would have been shifted by the **(9)** _____ effect to lower energies and longer wavelengths. In 1965, scientists discovered a persistent **(10)** _____ in their radio antenna. The noise was caused by weak radiation called the **(11)** _____. It appeared to come from all directions in space and corresponded to an emitting object having a temperature of about **(12)** _____, which is close to the temperature predicted by the Big Bang theory. An orbiting observatory called the **(13)** _____, launched in 1989, mapped the radiation in detail.

## SECTION 31.3 *Cosmology, continued*

*In your textbook, read about the Big Bang model.*
**Circle the letter of the choice that best completes the statement or answers the question.**

**14.** What are the three possible outcomes for the universe?
- **a.** open universe, closed universe, and flat universe
- **b.** expanding universe, closed universe, and flat universe
- **c.** open universe, closed universe, and static universe
- **d.** open universe, barred universe, and flat universe

**15.** All three possible outcomes for the universe are based on the premise that the rate of expansion has
- **a.** remained the same since the beginning of the universe.
- **b.** slowed down since the beginning of the universe.
- **c.** increased since the beginning of the universe.
- **d.** doubled since the beginning of the universe.

**16.** The total amount of matter in the universe is expressed in terms of the
- **a.** critical density of matter.
- **b.** average critical density of matter.
- **c.** average density of matter.
- **d.** absolute density of matter.

**17.** Observations of visible galaxies reveal a(n)
- **a.** average density equal to critical density.
- **b.** average density much less than critical density.
- **c.** absolute density greater than average critical density.
- **d.** critical density much less than average density.

**18.** Evidence suggests that the universe contains a great amount of
- **a.** visible matter.
- **b.** invisible matter.
- **c.** mystery matter.
- **d.** dark matter.

**19.** By measuring redshifts of the most remote galaxies, it is possible for astronomers to determine the
- **a.** Doppler shifts.
- **b.** absolute magnitudes.
- **c.** expansion rate of long ago.
- **d.** apparent magnitudes.

**20.** The universe began as a fluctuation in a vacuum and expanded very rapidly for a fraction of a second, according to the
- **a.** inflationary universe model.
- **b.** steady-state model.
- **c.** deceleration model.
- **d.** flat universe model.

**21.** When the rate of expansion of the universe is known, it is possible to calculate the
- **a.** date the universe will end.
- **b.** date the universe began.
- **c.** distance to each galaxy.
- **d.** age of the universe.

**22.** Based on the best value for $H$ that has been calculated, the age of the universe is hypothesized to be about
- **a.** 1.3 billion years.
- **b.** 13 million years.
- **c.** 13 billion years.
- **d.** 13 trillion years.

UNIT 8 STUDY GUIDE FOR CONTENT MASTERY

*GeoDigest*

# Beyond Earth

**Complete the table below by filling in the missing information. Choose from the words and phrases below. One choice will be used twice.**

| | | | | |
|---|---|---|---|---|
| **interior** | **corona** | **Earth** | **ring system** | **Sun** |
| **gas giant planet** | **chromosphere** | **tectonics** | **highlands and maria** | **Venus** |
| **Jupiter** | **photosphere** | **the Moon** | **terrestrial planet** | |

| Planet or Body | Characteristics | Group |
|---|---|---|
| Moon | • no atmosphere or erosion<br>• **1.** _____ | planetary satellite |
| **2.** _____ | • mostly made up of hydrogen and helium<br>• atmosphere has three layers:<br>**3.** _____<br>**4.** _____<br>**5.** _____<br>• **6.** _____ consists of radiative and convective zones<br>• fusion takes place within the core | star |
| Mercury | • surface similar to surface of<br>**7.** _____ | terrestrial planet |
| **8.** _____ | • extremely hot surface as a result of greenhouse effect | **9.** _____ |
| **10.** _____ | • has liquid water and life | terrestrial planet |
| Mars | • may once have had active<br>**11.** _____ | **12.** _____ |
| **13.** _____ | • largest and most massive planet | gas giant planet |
| Saturn | • extensive **14.** _____ | **15.** _____ |

**For each item in Column A, write the letter of the matching item in Column B.**

| Column A | Column B |
|---|---|
| _____ **16.** Visible light, radio waves, infrared radiation, ultraviolet radiation, X rays, and gamma rays | **a.** parallax |
| _____ **17.** Result of Earth's tilt on its axis and its changing position in its orbit | **b.** steady-state theory |
| _____ **18.** A surface feature of the Sun | **c.** active galactic nucleus |
| _____ **19.** Apparent shift in a star's position | **d.** electromagnetic radiation |
| _____ **20.** A star's internal structure is determined by this. | **e.** mass |
| _____ **21.** A nuclear bulge, a disk, and a halo are among its characteristics. | **f.** seasons |
| _____ **22.** Energetic objects or activities at the core of a galaxy | **g.** the Milky Way |
| _____ **23.** Explanation proposing that the universe will always be the same | **h.** prominence |

**Use the terms below to complete the analogies so that the terms in the second part of the sentence have the same relationship to each other as do the terms in the first part of the sentence.**

**volatile** **Earth** **refracting** **solar eclipse** **white dwarfs**

**24.** A lunar eclipse is to the Earth's shadow as a _____ is to the Moon's shadow.

**25.** A mirror is to a reflecting telescope as a lens is to a _____ telescope.

**26.** A comet is to the Sun as the Moon is to _____.

**27.** Refractory elements are to terrestrial planets as _____ elements are to gas-giant planets.

**28.** Stars more than 20 times the Sun's mass are to black holes as sunlike stars are to _____.