Name _____ Date _____ Class _____

Directions. Annotate each passage and answer the questions on the back in complete sentences.

Due date: _____

Currents and Climate

Key Concepts

- What causes surface currents, and how do they affect climate?
- What causes deep currents, and what effects do they have?
- How does upwelling affect the distribution of nutrients in the ocean?

Currents are large streams of moving water that flow through the oceans. Unlike waves, currents carry water great distances. Some currents move water at the surface of the ocean. Other currents move water deep below the surface.

Surface currents, which affect water to a depth of several hundred meters, are driven mainly by winds. Therefore, surface currents follow the major wind patterns of the globe, moving in a circular pattern in the five major ocean basins. The **Coriolis effect,** which is the effect of Earth's rotation on the direction of winds and currents, is the reason for this circular pattern. The Coriolis effect causes currents to curve to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. The largest, most powerful surface current in the North Atlantic Ocean is the Gulf Stream.

Climate is the pattern of temperature and precipitation typical of an area over a long period of time. Currents affect climate by moving cold and warm water around the globe. **A surface current warms or cools the air above it, influencing the climate of the land near the coast.**

Deep currents are caused by differences in density of ocean water. Density, in turn, depends on temperature and salinity. When ice forms near the poles, the salinity of the remaining liquid water increases. This cold, salty water is dense and sinks, flowing along the ocean floor as a deep current. **Deep currents move and mix water around the world. They carry cold water from the poles toward the equator.** They flow much more slowly than surface currents.

Another type of water movement is **upwelling.** This is the upward movement of cold water from the ocean depths to replace warm surface water moved away by winds. **Upwelling brings up tiny ocean organisms, minerals, and other nutrients from the deeper layers of the water. Without this motion, the surface waters of the open ocean would be very scarce in nutrients.** Areas of upwelling usually attract huge schools of fish that feed on these nutrients.

El Niño is an abnormal climate event that occurs every 2 to 7 years in the Pacific Ocean. An unusual pattern of winds in the western Pacific pushes a vast sheet of water eastward toward the South American coast. This prevents upwelling off the western coast of South America and causes unusual weather patterns around the world. El Niño can cause rainstorms, floods, and mudslides in some areas and droughts in others.

Name _____ Date _____ Class _____

Currents and Climate

Understanding Main Ideas

Fill in the spaces in the table below.

Comparing Currents

Type of Current	Cause	Possible Temperatures
1. _____	Winds	2. warm / cold
Deep	3. _____	4. cold

Answer each of the following questions in the spaces provided.

5. How do surface currents affect climate?

_____

_____

_____

_____

6. Why does upwelling attract huge numbers of fish?

_____

_____

_____

Building Vocabulary

Fill in the space to complete each statement.

7. _____ are large streams of moving water that flow through the oceans.
8. The effect of Earth's rotation on the direction of winds and currents is called the _____.
9. _____ is the pattern of temperature and precipitation typical of an area over a long period of time.
10. _____ is an abnormal climate event that occurs every 2 to 7 years in the Pacific Ocean.

Name _____ Date _____ Class _____

SECTION 5-1 **SECTION SUMMARY**

Exploring the Ocean

Guide for Reading

- What factors make ocean-floor research difficult?
- What processes have shaped the ocean floor?

Studying the ocean floor is difficult for three reasons: First, the deep ocean is totally dark because sunlight does not penetrate far below the surface. Second, the water is very cold. And third, the water pressure is very high. **Because of the darkness, cold, and extreme pressure, scientists have had to develop technology to enable them to study the deep ocean floor.** That technology includes sonar, scuba, submersibles, satellites, remote underwater manipulators, and gravity mapping. **Sonar** is a system that uses sound waves to calculate the distance to an object.

Scientists have discovered many features on the ocean floor. Extending out from a continent's edge is a gently sloping, shallow area called the **continental shelf.** At the edge of the shelf, the ocean floor drops off in a steep incline called the **continental slope.** Beyond this slope is the **abyssal plain,** a smooth and nearly flat area of the ocean floor. In some places, deep, steep-sided canyons called **trenches** cut into the abyssal plain. A continuous range of mountains called the **mid-ocean ridge** winds around Earth. There are mountains on the abyssal plain, too. Some reach above the ocean surface to form volcanic islands. Others, called **seamounts,** are completely underwater.

Earth consists of layers around its center, or core. The outer layer, or crust, is thin and rocky. The thick layer between the crust and the core is the mantle. It contains a hot liquid called **magma.** Magma flows out of the mantle and onto the surface through cracks in the crust. Magma on the surface is called lava, which hardens to form new crust.

Earth's crust is made up of large **plates** that float on the mantle. As these plates slowly move, they create different landforms. **The mountain ranges of the mid-ocean ridge, trenches, and underwater volcanoes are all formed by the interactions of Earth's plates.** At the mid-ocean ridge, plates are diverging, or moving apart. Magma squeezes up through cracks between the plates and hardens to form new rock. Newer eruptions push the older rock away from the ridge in a process called **sea-floor spreading.** Over millions of years, sea-floor spreading created the ocean floor.

Even though new ocean floor is created at the mid-ocean ridge, Earth stays the same size. Where two plates converge, or come together, one plate sinks under the other plate. The old rock sinks into a trench and back into Earth's mantle.

Name _____ Date _____ Class _____

SECTION 5-1 REVIEW AND REINFORCE

Exploring the Ocean

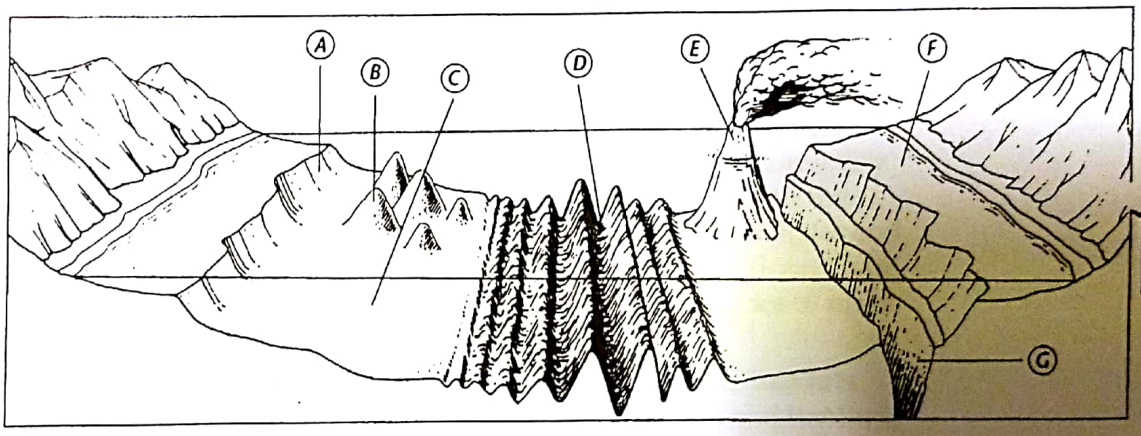
◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. What factors make it difficult to explore the ocean floor?
2. Describe the process of sea-floor spreading.
3. Why doesn't Earth get larger when new rock is added to the ocean floor at the mid-ocean ridge?

◆ Building Vocabulary

Match each letter on this diagram with one of the terms listed below. Write the letter on the line before each term. Then define each term in your own words in the spaces provided.



_____ 4. mid-ocean ridge _____

_____ 5. trench _____

_____ 6. continental slope _____

_____ 7. abyssal plain _____

_____ 8. seamount _____

_____ 9. continental shelf _____

_____ 10. volcanic island _____

Name _____ Date _____ Class _____

Ocean Habitats

Guide for Reading

- Into what zones do scientists divide the ocean?
- How are marine organisms classified?

Think of the ocean as a huge community that includes living and nonliving things. The ocean is divided into several zones. **Ocean zones include the intertidal zone, the neritic zone, and the open-ocean zone.** At the highest high tide line on land, the **intertidal zone** begins. From there, the zone stretches out to the point on the continental shelf exposed by the lowest low tide. The **neritic zone** extends from the low-tide line out to the edge of the continental shelf. Beyond the edge of the continental shelf lies the **open-ocean zone.** This zone includes the deepest, darkest part of the ocean.

On land, most organisms live on or near the surface. The ocean, on the other hand, is inhabited by organisms at every depth. **Scientists classify marine organisms according to where they live and how they move.** There are three categories of ocean organisms—plankton, nekton, and benthos. **Plankton** are tiny algae and animals that float in the water and are carried by waves and currents. Algae plankton include geometrically shaped diatoms. Animal plankton include microscopic crustaceans and some tiny fish. **Nekton** are free-swimming animals that can move throughout the water column. Squid, most fishes, and marine mammals, such as whales and seals, are nekton. **Benthos** are organisms that inhabit the ocean floor. Some benthos, like crab, sea stars, octopus, and lobsters, move from place to place. Others, like sponges and sea anemones, stay in one location.

Plankton, nekton, and benthos are all found in most marine habitats. Photosynthetic plankton are called producers. Other plankton and benthos, as well as all nekton, eat either algae or other organisms. They are called consumers. Finally, some organisms, including many benthos, break down wastes and the remains of other organisms. They are called decomposers.

All of the feeding relationships that exist in a habitat make up a **food web.** In most marine food webs, each organism depends directly or indirectly on the algae plankton. Throughout the ocean, plankton are a source of food for other organisms of all sizes. Just think—Earth's largest animal—the blue whale—feeds only on tiny plankton.

Name _____ Date _____ Class _____

Ocean Zones · Review and Reinforce

Ocean Habitats

Understanding Main Ideas

Answer the following questions in the spaces provided.

1. What are three ways in which the ocean's zones differ from one another?

_____

_____

2. How do scientists classify marine organisms?

_____

_____

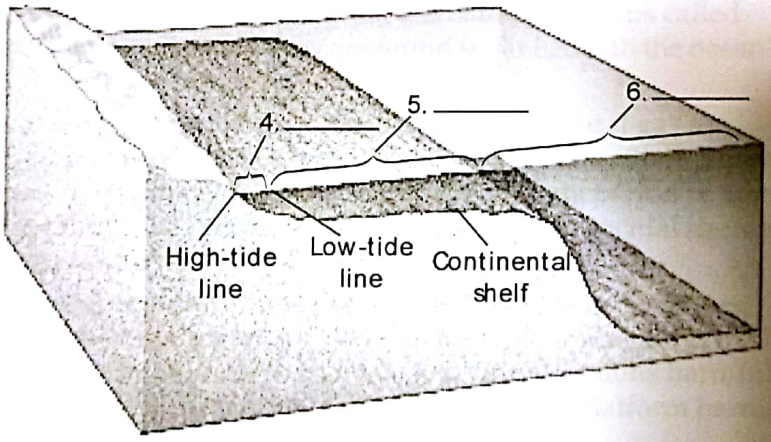
3. Are dolphins plankton, nekton, or benthos? Explain your answer.

_____

_____

Building Vocabulary

Fill in the blanks in the diagram below.



Match each term with its correct definition. Write the letter of the correct answer on the line.

____ 7. plankton

____ 8. nekton

____ 9. benthos

a. organisms that inhabit the ocean floor

b. tiny algae and animals that float in the water and are carried by waves and currents

c. free-swimming animals that can move throughout the water column

Write the correct answer on the space provided.

10. What is the combination of all of the feeding relationships in a habitat called?

_____

Name _____ Date _____ Class _____

Resources From the Ocean

Guide for Reading

- How do people use living resources from the ocean?
- What are some nonliving ocean resources?
- What are the sources of ocean pollution?

People depend heavily on fishes and other ocean organisms for food. Ocean organisms also provide materials that are used in products such as detergents and paints. As fish and other aquatic food organisms decline, aquaculture often becomes a good option. **Aquaculture** is the farming of saltwater and freshwater organisms. Ocean organisms are also important sources of other products besides foods. Many detergents, shampoos, and cosmetics are made from a base of algae, for example. Some sediments containing parts of diatoms are used in abrasives and polishes.

In addition to living organisms, the ocean contains valuable nonliving resources. **Some nonliving ocean resources include water, fuels, and minerals.** Sediments on the continental shelves are mined for gravel, sand, shells, diamonds, and gold. Some metals are obtained when ocean water is desalinated to produce fresh water. Other metals collect in lumps called **nodules** on the ocean floor. Because they are found so far beneath the ocean's surface, these nodules have not yet been mined.

Fuels are another important ocean resource. Oil and natural gas are formed when the remains of dead organisms sink to the ocean floor. There, the remains are covered with layers of sediments. Over a long period of time, heat and pressure change the remains to oil and gas. The continental shelves have the richest deposits of oil and gas.

Although some ocean pollution is the result of natural occurrences, most pollution is related to human activities. Sewage, chemicals, and trash are dumped into the ocean. Runoff from fields and roads contains harmful chemicals. An oil spill from a damaged oil tanker or drilling platform harms marine organisms.

Nations own the ocean resources near their land, but no nation owns the open ocean or the ocean floor below it. Because the world ocean is a continuous body of water that has no boundaries, it is difficult to determine who, if anyone, should control portions of it. Nations must cooperate to manage and protect the oceans.

Name _____ Date _____ Class _____

Resources From the Ocean

Understanding Main Ideas

Use the table below to answer Questions 1–3.

Total Catch (in metric tons)		
Fish Species	**1970**	**1993**
Haddock	829,300	226,500
Atlantic cod	2,817,500	1,028,700
Peruvian anchovy	11,845,300	7,464,600

1. How did the catches of these three fish change in the period shown?

_____

_____

2. Why do you think these changes might have occurred?

_____

_____

3. What can be done to protect fish populations?

_____

_____

Answer the following questions in the spaces provided.

4. What happens to the remains of dead marine organisms to transform them into oil and gas?

_____

_____

5. Why must nations cooperate to reduce ocean pollution?

_____

_____

Building Vocabulary

Answer the following questions in the spaces provided.

6. What is aquaculture?

_____

_____

7. What are nodules?

_____

_____

Name _____ Date _____ Class _____

Ocean Water Chemistry

Key Concepts

- How salty is ocean water?
- How do the temperature and gas content of ocean water vary?
- How do conditions in the ocean change with depth?

Ocean water contains dissolved salts. The salt that is most common in ocean water is sodium chloride, also known as table salt. Ocean water also contains smaller amounts of magnesium, calcium, potassium, and several other substances.

The total amount of dissolved salts in a sample of water is the **salinity** of that sample. **On average, one kilogram of ocean water contains about 35 grams of salts—that is, 35 parts per thousand.** Salinity is lower near the surface, where precipitation and melting ice add fresh water to the ocean. It is also lower near the mouths of large rivers that empty large amounts of fresh water into the ocean. Salinity is higher where evaporation is high, such as in hot, dry climates. It is also higher near the poles, where surface water freezes into ice and leaves the salt behind.

The dissolved salts in ocean water give it different properties from those of fresh water. Ocean water is more dense than fresh water. Because of its greater density, ocean water has more buoyancy than fresh water. This means that it lifts, or buoys up, less dense objects floating in it.

Like temperatures on land, temperatures at the surface of the ocean vary with location and the seasons. Gases in ocean water vary as well. Two gases found in ocean water that are necessary for living things are oxygen and carbon dioxide.

The surface of the ocean absorbs energy from the sun and heats up. Because warm water is less dense than cold water, the warm water stays on the surface. Surface water is warmest near the equator and becomes colder as you travel away from the equator. Since cold water can hold more dissolved oxygen than warm water, there is more oxygen in polar waters than in tropical waters.

If you could travel from the surface of the ocean to the ocean floor, you would pass through a vertical section of the ocean called the water column. Conditions change greatly as you travel down through the water column. **Temperature decreases as you descend through the ocean.** It drops to about 4°C at 1 kilometer below the surface. Below that, the temperature stays at about 3.5°C throughout most of the ocean. **Pressure increases continuously with depth in the ocean.** This is an obstacle to underwater exploration. A diver can descend safely to only about 40 meters. To go deeper, scientists must use a **submersible,** an underwater vehicle built of strong materials that resist water pressure.

Name _____ Date _____ Class _____

Ocean Water Chemistry

Understanding Main Ideas

Fill in the spaces in the table below.

The Water Column

Depth Zone	Depth Range	Average Temperature (°C)
Surface	1. _____	2. _____
3. _____	4. _____	4°C–10°C
5. _____	1 km to ocean floor	6. _____

Answer the following questions in the spaces provided or on the back of this sheet.

7. What is the average salinity of ocean water?

_____

8. Name three factors that affect how salty the ocean is.

_____

9. Which is more dense, ocean water or fresh water?

_____

10. What is the most abundant salt in seawater?

_____

11. Why is there more oxygen at the surface of the ocean than in deeper layers?

_____

_____

12. What prevents scuba divers from going deeper than about 40 meters below the surface?

_____

_____

Building Vocabulary

Fill in the space to complete each sentence.

13. A _____ is an underwater vehicle built of strong materials to resist pressure.
14. The total amount of dissolved salts in ocean water is called _____.
15. A vertical section of the ocean from the surface to the ocean floor is referred to as the _____.