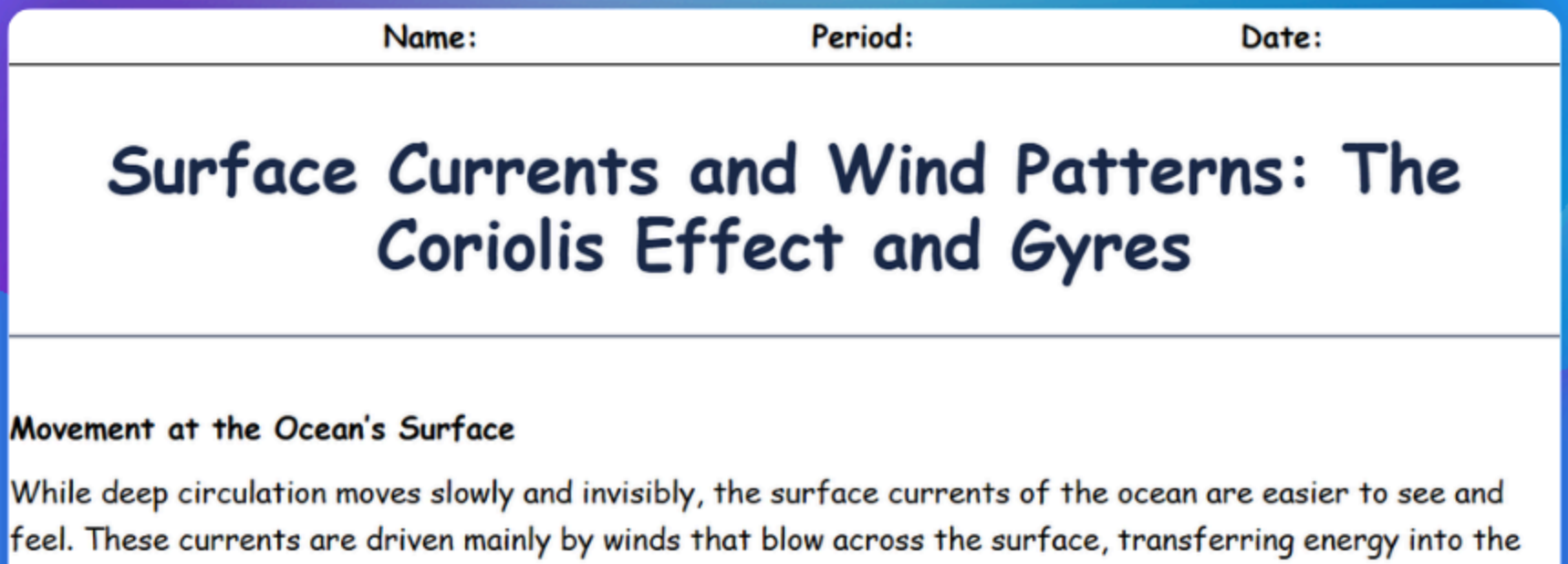
NO PREP

Surface Currents and Wind Patterns

The Coriolis Effect and Gyres

Includes: Student reading, case study, differentiated questions, teacher key



Name: Period: Date:

Surface Currents and Wind Patterns: The Coriolis Effect and Gyres

Movement at the Ocean's Surface

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Movement at the Ocean's Surface

While deep circulation moves slowly and invisibly, the surface currents of the ocean are easier to see and feel. These currents are driven mainly by winds that blow across the surface, transferring energy into the water. Surface currents move much faster than deep currents and are responsible for redistributing heat around the globe in a matter of weeks or months, rather than centuries. The most powerful surface currents form large, rotating systems called gyres. Each of the world's major ocean basins contains a gyre: the North and South Pacific, the North and South Atlantic, and the Indian Ocean. Within these gyres, warm water flows toward the poles on the western sides of basins, while cooler water flows back toward the equator on the eastern sides. This balance creates both climate stability and distinct regional weather patterns.

The Coriolis Effect

A key player in shaping currents is the Coriolis effect, which results from Earth's rotation. As winds push water, the Coriolis effect deflects movement to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. This deflection explains why currents do not simply move in straight lines but instead curve and help form circular gyres. For example, the North Atlantic Gyre includes the Gulf Stream, which carries warm water northward along the U.S. East Coast, before turning east toward Europe. This current contributes to Europe's relatively mild winters. In contrast, the Canary Current on the eastern side of the gyre brings cool water southward toward Africa. These differences shape regional climates and support unique ecosystems.

Gyres and Ocean Life

Gyres are not only physical systems; they also affect marine ecosystems. In the centers of gyres, where circulation traps water, floating debris and nutrients often accumulate. This is why regions such as the Great Pacific Garbage Patch exist, where plastic and waste collect in the calm center of the North Pacific Gyre. On the edges of gyres, however, nutrient cycling supports rich biodiversity. Western boundary currents like the Kuroshio and Gulf Stream are fast-moving and carry warm water north, while eastern boundary currents such as the California Current bring cold, nutrient-rich water south. These currents support fisheries, plankton growth, and diverse marine life.

Key Information: Key Concepts Table

Concept	Description	Example/Impact
Surface Currents	Movements driven mainly by winds	Gulf Stream, California Current
Coriolis Effect	Deflection of movement due to Earth's rotation	Right in Northern Hemisphere, left in Southern
Gyres	Large circular current systems	North Pacific Gyre, Indian Ocean Gyre
Western Boundary Currents	Fast, warm, poleward currents	Gulf Stream, Kuroshio
Eastern Boundary Currents	Slower, cold, equatorward currents	California Current, Canary Current

Case Study: The Great Pacific Garbage Patch

In the late 20th century, researchers began documenting large amounts of plastic debris floating in the Pacific Ocean. Today, this accumulation is known as the Great Pacific Garbage Patch, a region between Hawaii and California where ocean currents converge and trap floating material. The patch is not a solid island of trash, but a swirling zone of microplastics and larger debris, held in place by the North Pacific Gyre. Scientists estimate that millions of tons of plastic circulate here, harming marine organisms that ingest or become entangled in debris. This case shows how natural current systems like gyres can amplify human impacts. Cleanup efforts, such as The Ocean Cleanup project, now attempt to remove plastics from these waters, but the problem highlights the importance of reducing waste at its source.

1. How does the North Pacific Gyre contribute to the formation of the Great Pacific Garbage Patch?

_____

_____

2. What lesson does the Garbage Patch teach us about the interaction between natural systems and human activity?

_____

_____

Multiple Choice

1. What mainly drives surface ocean currents?

    a) Deepwater density differences

    b) Earth's gravity

    c) Wind patterns

    d) Tides from the Moon

2. In the Northern Hemisphere, the Coriolis effect deflects currents to the:

a) Right

b) Poles

c) Equator

d) Left

3. Why does the Great Pacific Garbage Patch exist?

a) Nutrients gather in upwelling zones

b) Earth's gravity pulls plastic toward the equator

c) Gyres trap floating debris in their centers

d) Winds concentrate trash in coastal bays

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ Coriolis Effect	A) Fast, warm current carrying water north along U.S. East Coast
2. ___ Gulf Stream	B) Deflection of movement caused by Earth's rotation
3. ___ Gyres	C) Area where plastics accumulate due to trapped circulation
4. ___ California Current	D) Large circular systems of currents in major ocean basins
5. ___ Great Pacific Garbage Patch	E) Slow, cold current moving south along western U.S. coast

Fill-in-the-Blank

1. The Coriolis effect deflects currents to the _____ in the Southern Hemisphere.

2. Large rotating current systems are called _____.

3. The _____ Current brings cool, nutrient-rich water south along North America's West Coast.

Short Answer

Answer each question in 2-4 complete sentences.

1. Explain how surface currents and gyres redistribute heat on Earth.

2. Why are western boundary currents faster and more powerful than eastern boundary currents?

3. What are two ways humans can reduce the problem of plastic accumulation in gyres?