NO PREP

Properties of Seawater

Salinity, Temperature, and Density

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

Name: Period: Date:

Properties of Seawater: Salinity, Temperature, and Density

Salinity: The Ocean's Salt Balance

The ocean may look like a uniform blue expanse, but its chemistry is complex and constantly changing. Salinity, the measure of dissolved salts in seawater, averages about 35 parts per thousand, but it varies depending on location. For example, tropical seas often have higher salinity due to strong evaporation, while polar regions may have lower salinity when melting ice adds fresh water. Salinity is more than just a number. It influences water density, ocean circulation, and marine ecosystems. Organisms from plankton to fish have adapted to specific salinity levels, and even slight changes can disrupt their survival. Estuaries, where rivers meet the sea, are particularly dynamic because salinity levels shift daily with tides and seasonally with

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Temperature: The Ocean's Heat Reservoir

Water has a high heat capacity, meaning it absorbs and stores large amounts of energy without changing temperature quickly. This property makes the ocean a global climate regulator. Coastal regions, for instance, experience milder winters and cooler summers because the nearby sea moderates air temperature. Ocean temperature is not uniform. Surface waters warm quickly in sunlight, while deeper waters remain cold and stable. This layering, called thermal stratification, creates boundaries such as the thermocline, where temperature drops rapidly with depth. Temperature affects not only climate but also biological productivity. Many species thrive only within narrow temperature ranges, and warming seas are already stressing coral reefs and polar ecosystems.

Density: Linking Salinity and Temperature

Density is the key to understanding how salinity and temperature interact. Cold, salty water is denser than warm, fresh water. This relationship drives much of the ocean's circulation. For example, in polar regions, sea ice formation leaves behind salty brine, causing dense water to sink and flow along the seafloor. This process is critical to the thermohaline circulation, often described as the "global conveyor belt," which redistributes heat and nutrients across the planet. Density differences also create barriers to mixing, trapping nutrients in deep water until upwelling brings them to the surface. In this way, density connects chemical, physical, and biological systems, shaping the very foundation of marine life.

Key Information: Key Concepts Table

Property	Definition	Impact on Ocean Systems
Salinity	Measure of dissolved salts	Affects density, ecosystems, and circulation
Temperature	Heat content of seawater	Regulates climate, controls stratification
Density	Mass per unit volume of seawater	Drives circulation, influences mixing and upwelling

Case Study: The Dead Zone in the Gulf of Mexico

Every summer, scientists monitor a massive low-oxygen region in the Gulf of Mexico, often called a "dead zone." This area forms where the Mississippi River delivers high levels of nutrients from agricultural runoff. The excess nutrients cause phytoplankton blooms, which eventually die and sink. As decomposition occurs, oxygen is consumed in the bottom waters. Warm summer temperatures and strong stratification prevent oxygen-rich surface water from mixing downward. As a result, marine life that cannot escape suffocates, leading to fish kills and economic losses for fisheries. Salinity also plays a role. Freshwater from the Mississippi forms a lighter layer over the denser seawater, strengthening stratification. With little vertical mixing, the oxygen crisis intensifies. This case shows how salinity, temperature, and density interact with human activities to produce real-world consequences. Solutions require reducing nutrient inputs, restoring wetlands to absorb runoff, and monitoring seasonal changes in stratification.

1. How do temperature and stratification contribute to the Gulf of Mexico dead zone?

_____

_____

2. Why does freshwater input from rivers worsen the problem?

_____

_____

Multiple Choice

1. What is the average salinity of the ocean?

    a) 45 parts per thousand

    b) 25 parts per thousand

    c) 35 parts per thousand

    d) 15 parts per thousand

2. Which layer of the ocean is marked by a rapid drop in temperature with depth?

a) Pycnocline

b) Halocline

c) Mixed layer

d) Thermocline

3. Why does cold, salty water sink in polar regions?

a) It is less dense than warm water

b) It is denser than surrounding water

c) It evaporates quickly

d) It freezes at higher temperatures than other seawater

Matching

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

Term	Definition
1. ___ Salinity	A) Drives global conveyor belt circulation
2. ___ Thermocline	B) Layering strengthened by freshwater input
3. ___ Density	C) Caused by nutrient input and low oxygen
4. ___ Dead Zone	D) Average of 35 ppt in seawater
5. ___ Stratification	E) Layer where temperature changes rapidly

Fill-in-the-Blank

1. The measure of dissolved salts in seawater is called _____.

2. The boundary layer where temperature drops quickly with depth is the _____.

3. Cold, salty water sinks because it has greater _____.

Short Answer

Answer each question in 2-4 complete sentences.

1. Explain how salinity and temperature together influence density.

2. Why is ocean temperature important for regulating climate in coastal regions?

3. How does the Gulf of Mexico dead zone illustrate the link between human activity and seawater properties?