

Name: _____ Date: _____

Salty Seas and Surface Systems: Smash 9th Grade Science

How does density dictate deep-sea patterns? Analyze thermohaline circulation and isotopic signatures through high-stakes inquiry and analytical reasoning.

1. Deep-ocean circulation, often called the 'Great Ocean Conveyor Belt,' is primarily driven by thermohaline gradients. Which scenario would most likely cause a significant slowing of this global system?

- A. Rapid melting of the Greenland Ice Sheet introducing a massive influx of freshwater.
- B. A localized increase in solar radiation over the equatorial Pacific region.
- C. An intensification of Trade Winds causing more frequent upwelling events.
- D. The seasonal expansion of sea ice in the Southern Ocean surrounding Antarctica.

2. The residence time of a water molecule in the atmosphere is significantly longer than the residence time of a water molecule in the deep ocean sequestered within the cryosphere.

- A. True
- B. False

3. In the context of the global water cycle, _____ refers to the total volume of water lost to the atmosphere from both the soil surface and the stomata of vegetation.

- A. Sublimation
- B. Advection
- C. Evapotranspiration
- D. Infiltration

4. The Somali Current is unique among major western boundary currents because it reverses its direction seasonally. What is the primary meteorological driver of this phenomenon?

- A. The shifting of the Intertropical Convergence Zone (ITCZ) and the Indian Monsoon.
- B. The Coriolis effect becoming negligible near the geographic equator.
- C. Large-scale hydrothermal vent activity in the Indian Ocean basin.
- D. The periodic occurrence of the El Niño-Southern Oscillation (ENSO).

5. Ekman Transport describes how surface water moves at a 90-degree angle to the wind direction due to the balance between wind stress and the Coriolis effect.

- A. True
- B. False

6. The _____ is the ocean layer where a rapid change in temperature occurs with depth, acting as a barrier to the vertical mixing of nutrients and dissolved gases.

- A. Halocline
- B. Pycnocline
- C. Thermocline

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D. Bathypelagic

7. How does the 'biological pump' contribute to the carbon cycle within the ocean-atmosphere interface?

- A. By moving carbon from the atmosphere to the deep ocean via sinking organic matter.
- B. By increasing the outgassing of CO₂ through the warming of tropical surface waters.
- C. By converting methane into dissolved inorganic carbon via aerobic respiration.
- D. By physically shifting carbon isotopes toward the poles via the Kuroshio Current.

8. In the Southern Hemisphere, the Coriolis effect causes moving objects, including large-scale ocean currents, to be deflected toward the _____ of their path of motion.

- A. Right
- B. Equator
- C. Left
- D. West

9. High-pressure systems typically associated with descending air in the atmospheric water cycle result in high precipitation and the formation of rainforests.

- A. True
- B. False

10. Analyze the relationship between the Mediterranean Sea and the Atlantic Ocean. Why does the Mediterranean Outflow Water (MOW) sink below the surface when it enters the Atlantic through the Strait of Gibraltar?

- A. It is significantly colder than the Atlantic surface waters.
- B. It has a higher salinity due to excessive evaporation in the Mediterranean basin.
- C. It is pushed downward by the prevailing Westerly winds.
- D. The Atlantic water is more acidic, making it less dense than the alkaline MOW.