

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Answer Key: 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.

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**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?**

**Answer:** A) Rapid melting of the Greenland Ice Sheet introducing a massive influx of freshwater.

Thermohaline circulation relies on the sinking of cold, salty, dense water in the North Atlantic. A massive influx of freshwater reduces salinity and density, preventing the water from sinking and potentially stalling the current.

**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.**

**Answer:** B) False

Water typically remains in the atmosphere for only about 9 days, whereas water in deep-ocean storage or glaciers can be sequestered for thousands of years.

**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.**

**Answer:** C) Evapotranspiration

Evapotranspiration is the combined process of evaporation from surfaces and transpiration from plants, representing a major flux in the terrestrial water cycle.

**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?**

**Answer:** A) The shifting of the Intertropical Convergence Zone (ITCZ) and the Indian Monsoon.

The seasonal reversal of the Indian Monsoon winds forces the Somali Current to change direction, flowing northeast in the summer and southwest in the winter.

**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.**

**Answer:** A) True

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In the Northern Hemisphere, Ekman Transport moves the net water column 90 degrees to the right of the wind, which is fundamental in creating gyres and upwelling zones.

**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.**

**Answer:** C) Thermocline

The thermocline is the distinct zone of temperature transition; the pycnocline refers to density, and the halocline refers specifically to salinity.

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

**Answer:** A) By moving carbon from the atmosphere to the deep ocean via sinking organic matter.

Phytoplankton fix carbon through photosynthesis; when they die or are eaten, that organic carbon sinks into the deep ocean, effectively removing it from the atmosphere for long periods.

**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.**

**Answer:** C) Left

Due to Earth's rotation, the Coriolis effect deflects moving water to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

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

**Answer:** B) False

High-pressure systems involve descending air, which inhibits cloud formation and precipitation, often leading to arid or desert climates (e.g., the Sahara).

**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?**

**Answer:** B) It has a higher salinity due to excessive evaporation in the Mediterranean basin.

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The Mediterranean Sea experiences high evaporation, creating very salty and dense water. When this water flows out into the less salty Atlantic, it sinks to an intermediate depth based on its density.