

Sea Water

This text is from the U.S. National Oceanic and Atmospheric Administration.

If there is one thing that just about everyone knows about the ocean is that it is salty. The two most common elements in sea water, after oxygen and hydrogen, are sodium and chloride. Sodium and chloride combine to form what we know as table salt.

Sea water salinity is expressed as a ratio of salt (in grams) to liter of water. In sea water there is typically close to 35 grams of dissolved salts in each liter. It is written as 35. The normal range of ocean salinity ranges between 33-37 grams per liter (33 - 37).

But as in weather, where there are areas of high and low pressure, there are areas of high and low salinity. Of the five ocean basins, the Atlantic Ocean is the saltiest. On average, there is a distinct decrease of salinity near the equator and at both poles, although for different reasons.

Near the equator, the tropics receive the most rain on a consistent basis. As a result, the fresh water falling into the ocean helps decrease the salinity of the surface water in that region. As one move toward the poles, the region of rain decreases and with less rain and more sunshine, evaporation increases.

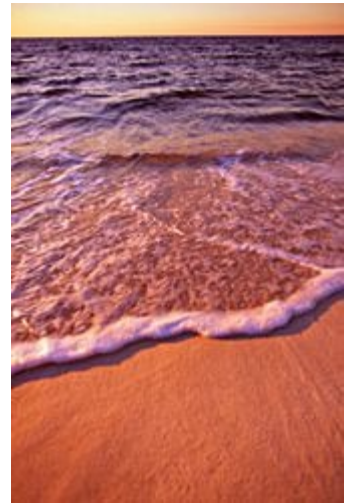
Fresh water, in the form of water vapor, moves from the ocean to the atmosphere through evaporation causing the higher salinity. Toward the poles, fresh water from melting ice decreases the surface salinity once again.

The saltiest locations in the ocean are the regions where evaporation is highest or in large bodies of water where there is no outlet into the ocean. The saltiest ocean water is in the Red Sea and in the Persian Gulf region (around 40) due to very high evaporation and little fresh water inflow.

Water has a unique property. As the temperature decreases to 40°F (4°C) the molecules slow, water contracts and the density increases. Below 40°F (4°C) the molecules begin to bond to each other and as they do, the water begins to expand again, *decreasing* the density. At 32°F (0°C) all molecules are locked into a crystalline structure with a resulting nine percent expansion in size. This expansion, and corresponding decrease in density, is the reason ice floats.

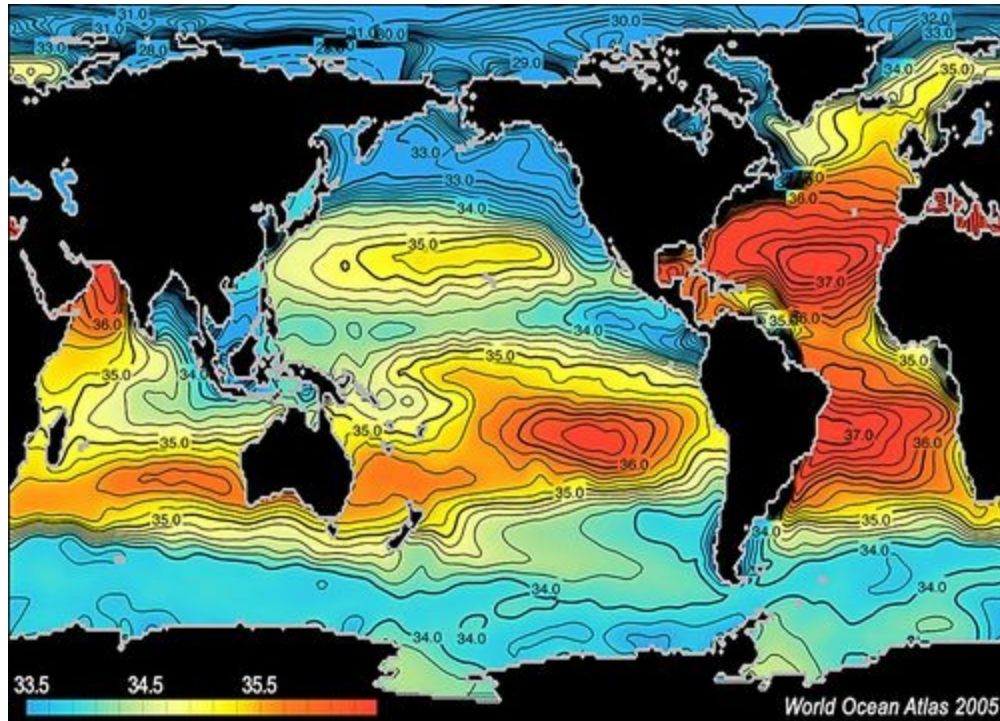
The amount of salt in sea water also determines the temperature at which sea water freezes. Adding salt to water lowers the freezing temperature. Water with a salinity of 17 freezes at about 30°F (-1°C) and 35 water freezes at about 28.5°F (-2°C). Yet, despite the saltiness of the ocean, sea ice contains very little salt, about a tenth of the amount of salt that sea water has. This is because ice will not incorporate sea salt into its crystal structure. Therefore, sea ice is actually drinkable.

The temperature and salinity of the sea water also help determine its density. As the temperature of sea water *decreases* the density also *increases*. Also, as the salt content of sea water *increases*, so does its density. This makes the density of sea water, unlike fresh water, below the freezing point. So in situations of sea ice formation, the salinity, and therefore the density of the underlying water



continues to increase well after an area is iced over.

In the "Average Salinity" map, it shows the lowest salinity in the polar regions. Bear in mind, this image depicts surface salinity only. The surface salinity is lower in the polar regions than in the tropical regions due to melting each summer. However, each winter below the ocean surface, the increased salinity in the water due to ice formation, causes the water below the ice to sink and that sinking motion governs the motion of the ocean's deep water currents.



Average ocean salinity

Name: _____ Date: _____

1. What is one thing that just about everyone knows about the ocean?

- A. The ocean is cold.
- B. The ocean is salty.
- C. The ocean is dense.
- D. The ocean is icy.

2. The text describes sea water salinity in different places. Where has lower surface salinity?

- A. the Atlantic Ocean
- B. near the equator and the poles
- C. the Red Sea
- D. in the Persian Gulf region

3. The salinity, temperature, and density of sea water are connected. What evidence from the text supports this conclusion?

- A. "On average, there is a distinct decrease of salinity near the equator and at both poles, although for different reasons."
- B. "The amount of salt in sea water also determines the temperature at which sea water freezes."
- C. "The temperature and salinity of the sea water also help determine its density."
- D. "The surface salinity is lower in the polar regions than in the tropical regions due to melting each summer."

4. Read these sentences from the text.

Near the equator, the tropics receive the most rain on a consistent basis. As a result, the fresh water falling into the ocean helps decrease the salinity of the surface water in that region.

[. . .]

. . . as the salt content of sea water increases, so does its density.

What can you infer about how rain affects the density of surface water near the equator?

- A. Rain near the equator helps decrease the density of surface water there.
- B. Rain near the equator helps increase the density of surface water there.
- C. Rain near the equator does not help affect the density of surface water there.
- D. Rain near the equator helps to remove the density of surface water there.

5. What is the main idea of this text?

- A. Sea water is salty, with different salinity, temperature, and density in different places, sea depths, and forms of water.
- B. Sea water near the equator and poles have lower surface salinity because of the addition of fresh water from rain or melting ice.
- C. Sea water density increases when sea water temperature decreases or when sea water salinity increases.
- D. Water expands as it changes from liquid to ice, which decreases its density, and this is why ice floats.