

NATURE OF SEAWATER: SALINITY, TEMPERATURE, DENSITY, AND PRESSURE

- **surface salinities**
- **temperature profiles of the ocean; the thermocline**
- **seawater density dynamics**
- **deep ocean pressures**

Part A. Surface Salinities

The total quantity of dissolved inorganic solids in water is its salinity. The ocean's salinity varies from about 3.3% to about 3.7% by mass, depending on evaporation, precipitation, and freshwater runoff from the continents. The overall average salinity is about 3.5% or

35 ‰ (parts per thousand). This means that for every 1,000 grams of seawater, the solids left behind would have a mass of 35 grams.

The oceans get salt from the weathering and dissolution of minerals on land and from volcanic emissions. Salinity is a conservative property; it remains constant for the ocean as a whole for long periods of time, although local salinities may vary: High salinity is found in partially enclosed areas where there is high evaporation rates and little mixing with other waters, as in the Red Sea and the Mediterranean Sea. Dilute seawater is found in coastal waters where there is excessive runoff from the land.

An analytical method of determining the salinity of a solution is to measure the solution's ability to conduct an electrical current. Conductivity increases with increasing salt content.

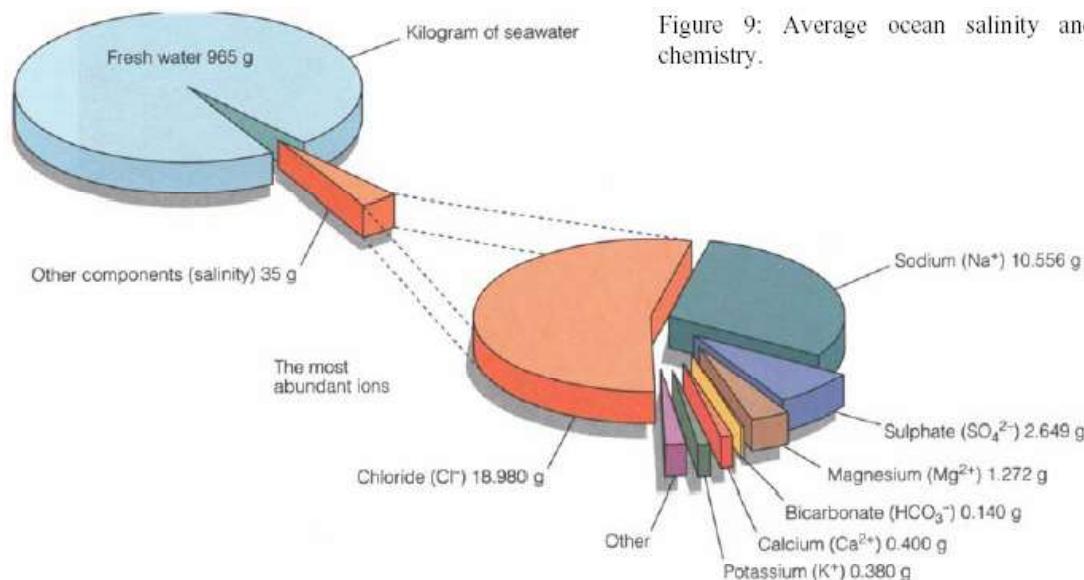


Figure 9: Average ocean salinity and chemistry.

- In the above figure what is the most abundant dissolved ion? _____
 The 2nd most abundant ion? _____ 3rd? _____ 4th? _____
 5th? _____ 6th? _____ 7th? _____
- The Gulf of Mexico has a higher salinity than the Atlantic Ocean, which means you can float in Florida's gulf coast waters noticeably easier. What holds you up?
 Hint: Archimedes Principle: "An object partially or wholly immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object."

1c. Thirst-crazed shipwrecked sailors in the Atlantic Ocean 100 miles off Brazil's east coast drank Atlantic water. They suffered no kidney damage, little dehydration, and remained lucid and seizure free because they were actually drinking fresh water and not seawater. Why? Hint: look at a map of Brazil.

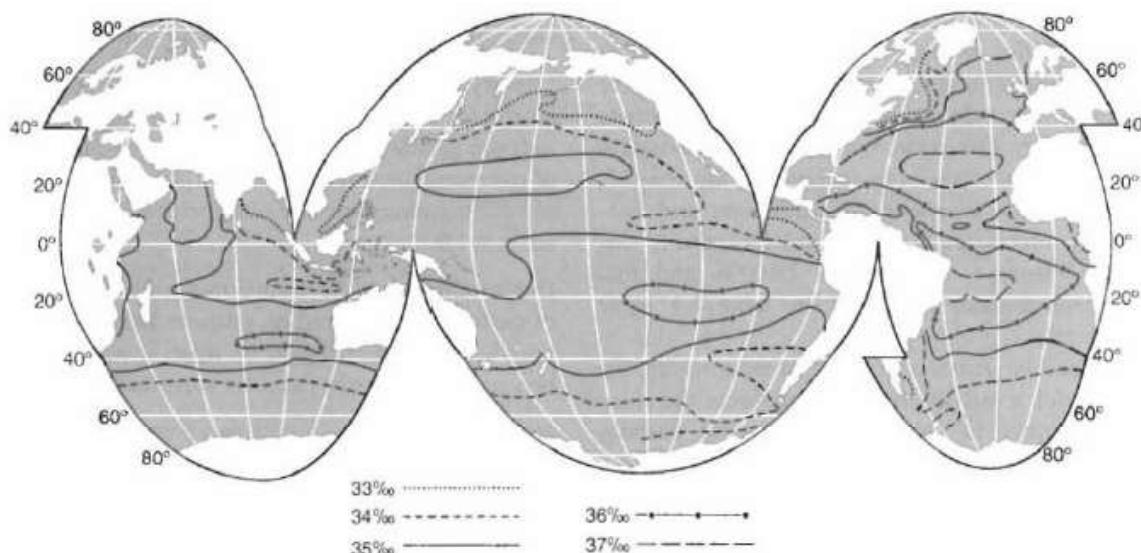
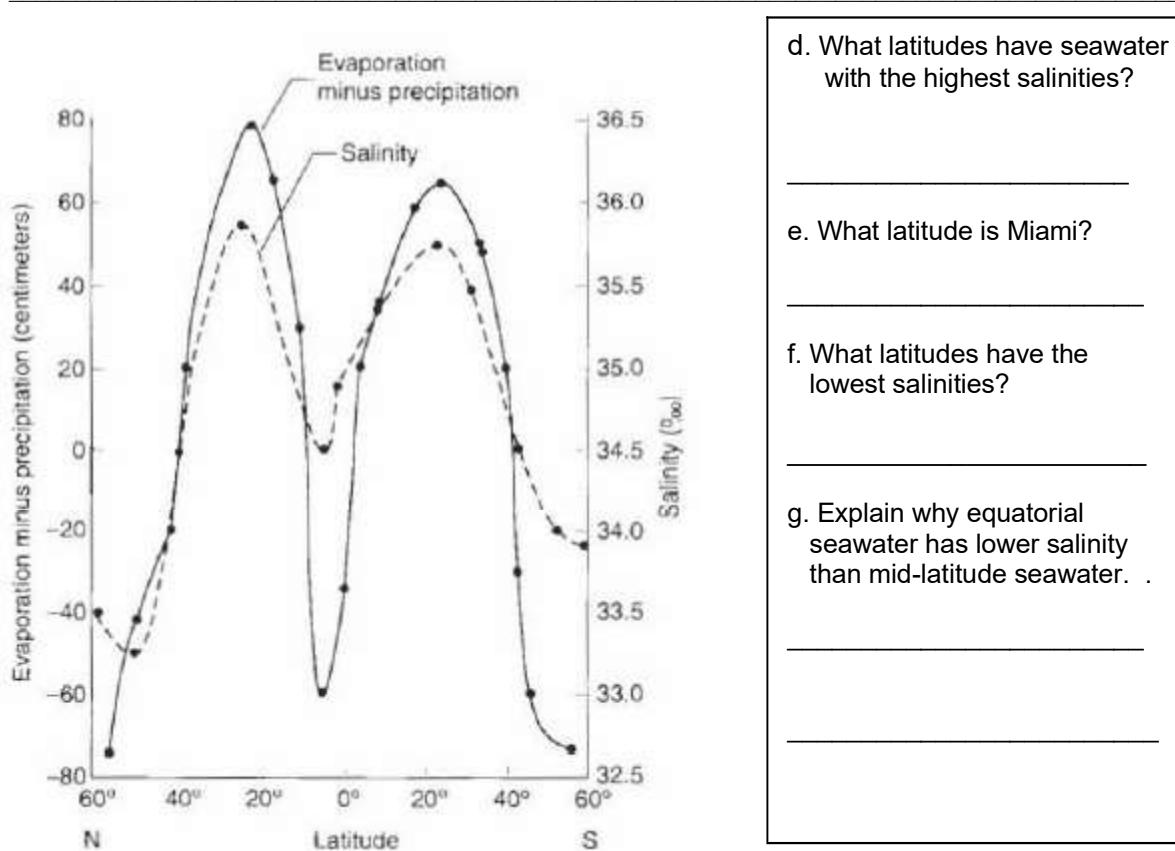


Figure 8: Salinity distribution in the surface waters of the oceans in August.

2 Study the isohalines (lines of equal salinity) above. Which ocean is saltiest? (circle)

Atlantic

Pacific

Part B. Taking the ocean's temperature: At most latitudes seawater has a layered temperature structure from the surface to the seafloor.
In our oceans seawater temperatures range from about **35 °C to -2 °C**.

3. Use the temperature profiles on Figure 1 (page 4) to answer the following:

a. Examine the seawater temperature profile for the low latitudes labeled "A". Is the warmer water found near the surface or the bottom?

b. Most of the sunlight entering the ocean is absorbed very near the surface. This sun-warmed surface water mixes with cooler, deeper waters as winds, breaking waves, and turbulent currents stir the water. One result of this mixing is a surface layer having nearly uniform temperature, or **isothermal**, conditions. On the low latitude profile, the mixed layer extends to a depth of _____.

c. The temperature of seawater immediately below the mixed layer changes rapidly with depth. This layer of rapid temperature change extends down to about 1000 meters. It is called the **main thermocline**. As depth increases within the main thermocline does seawater temperature increase or decrease?

d. Examine the seawater temperature profile for the mid-latitudes labeled "B". This profile resembles the low latitude profile but with some important differences. Compared to the low-latitude profile, the mixed layer temperature is cooler or warmer?

And shows seasonal variation or no seasonal variation? _____

e. Examine the temperature profile for the high latitudes labeled "C". Compared to the low and mid-latitude profiles, the surface temperature is cooler or warmer? _____

f. Now examine the ocean temperature north-south cross-section extending from about 70 degrees south latitude to 70 degrees north latitude. At the bottom of each vertical dashed line in this diagram circle the letter A, B, or C indicating which of the three temperature profiles you would expect to find at that particular latitude.

g. The accumulation of ocean temperature measurements from a variety of locations reveals that there is a three-layered thermal structure in most of the ocean. At what latitudes is there a main thermocline layer with rapidly changing vertical temperatures separating the warmer surface mixed layer from the colder deeper layer?

Although this colder deep layer is found at all three latitudes, it extends essentially to the surface only at _____

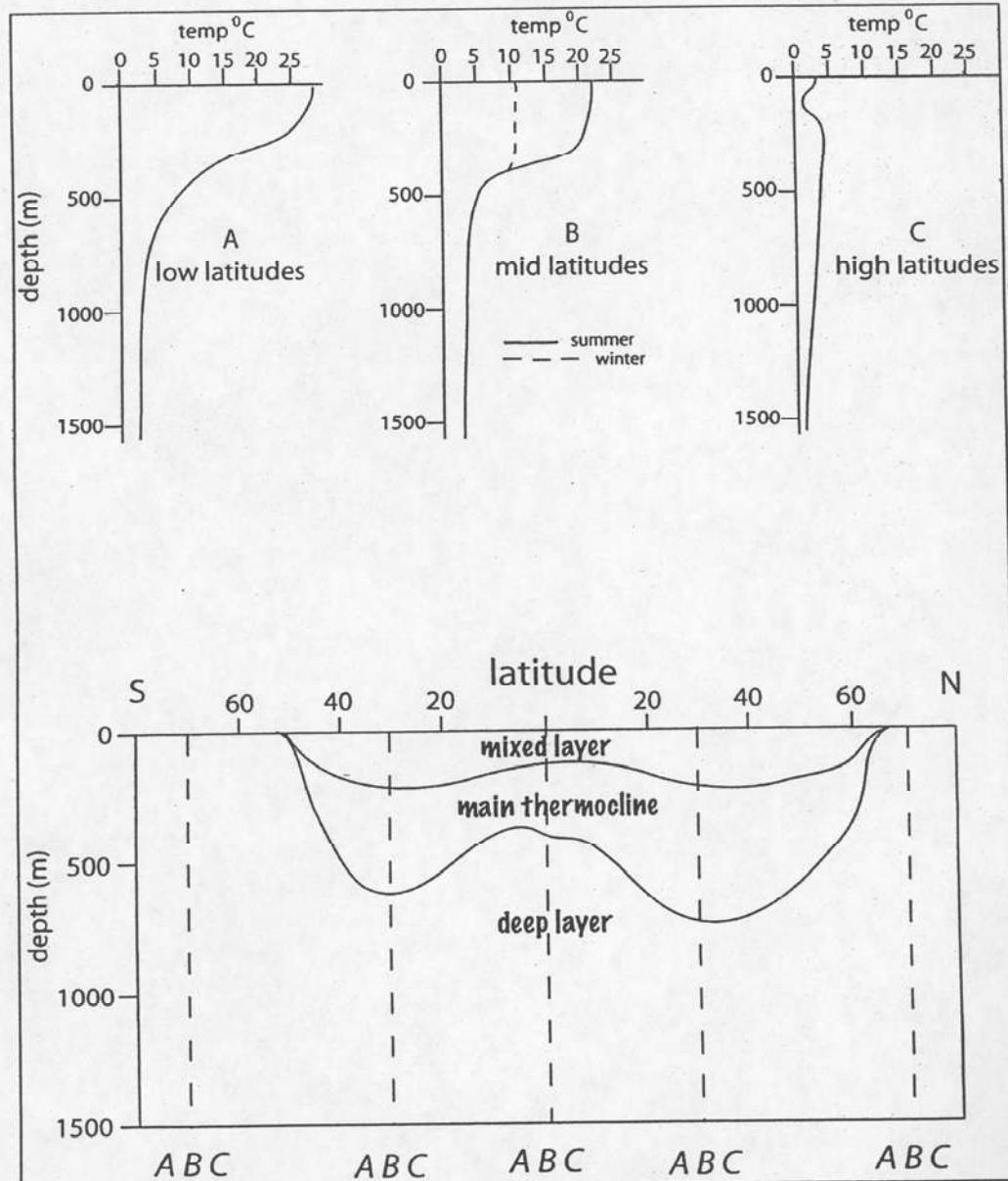
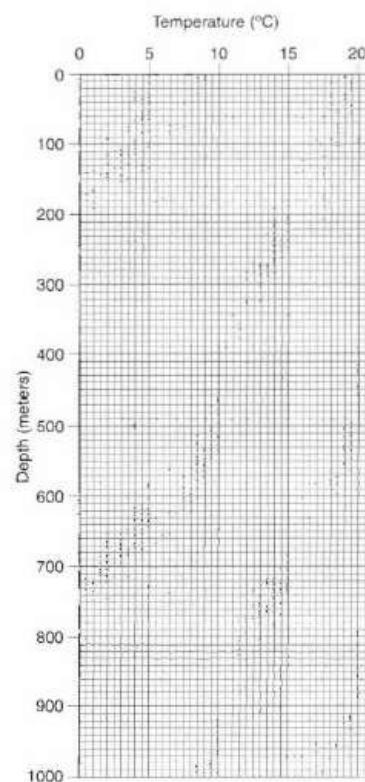


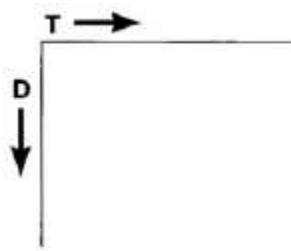
FIGURE 1. TEMPERATURE PROFILES
modified from: Visit to an Ocean Planet
<http://topex-www.jpl.nasa.gov/education>

The table below lists temperature and salinity data for an oceanographic station off Point Conception, Southern California.

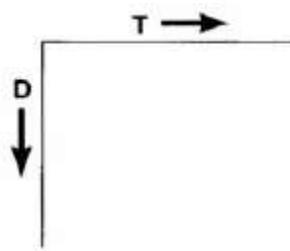
Depth (meters)	Temperature (°C)	Salinity (‰)	Depth (meters)	Temperature (°C)	Salinity (‰)
0	14.56	31.22	260	6.57	33.98
10	14.50	31.40	300	6.15	34.01
20	14.48	31.56	400	5.49	34.07
30	12.72	31.88	500	4.01	34.14
50	10.86	32.40	600	4.65	34.20
75	9.20	33.24	700	4.36	34.26
100	8.82	33.60	800	4.10	34.31
150	7.77	33.88	1000	3.51	34.41
200	7.10	33.94			



- 4 a. Using the tabulated data, plot temperature against depth on the above graph.
- b. Label the thermocline on your temperature plot.
- c. With depth does salinity increase or decrease? _____
- d. How would a depth-temperature curve from the Arctic differ from an Equatorial depth-temperature curve. Sketch each below.



Arctic



Equatorial