SEAWATER MIXING AND SINKING

Two of the most important characteristics of ocean water are its temperature and salinity. Together they help govern the density of seawater, which is the major factor controlling the ocean's vertical movements and layered circulation.

The following activity investigates the role of temperature and salinity in determining seawater density. It does so by using a *Temperature-Salinity (T-S) Diagram* to examine the effect of mixing on density. Such mixing can be a significant factor in causing surface seawater to sink as part of vertical circulation. The *T-S Diagram* is a simple but powerful tool used in studies of seawater density, mixing, and circulation.

OBJECTIVES

After completing this investigation, you should be able to:

- Describe the use of a *Temperature-Salinity Diagram* in seawater density studies.
- Describe the role of mixing of seawater in density-driven vertical ocean circulation.

INVESTIGATIONS

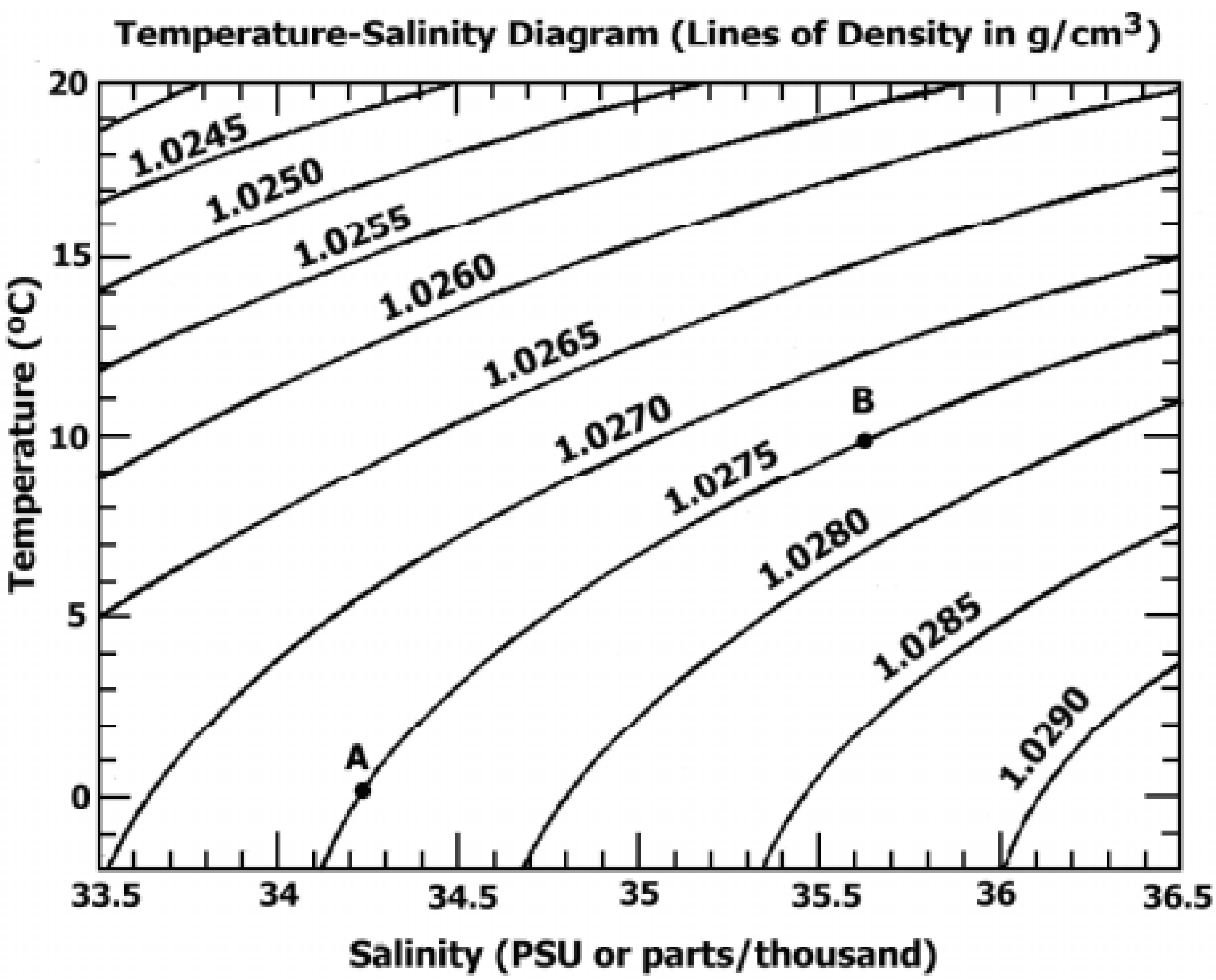
1. Examine the *Temperature-Salinity (T-S) Diagram*. Temperature is plotted along the vertical axis in degrees Celsius (°C). Salinity is measured along the horizontal axis in parts per thousand (‰) or numerically-equal Practical Salinity Units (PSU). Seawater density, in grams per cubic centimeter (g/cm^3), is shown on the diagram by curved lines of constant density. The value of each curved line appears immediately above each line. Note that temperature and salinity together govern the density of seawater.

   As shown by the *T-S Diagram*, the density of seawater increases with (increasing) (decreasing) temperature and with (increasing) (decreasing) salinity.
2. On the *T-S Diagram*, each seawater sample is plotted as a dot (•) at the point determined by its temperature and salinity. Find the temperature and salinity for the two surface seawater samples labeled "A" and "B" and record these values in the *Water Sample Table*.
3. The density of seawater samples must be determined to several decimal places in order to detect significant differences. Read from the *T-S Diagram* the densities for the two surface seawater samples labeled "A" and "B" to the fourth decimal place. Record these values in the table. Note that their densities are the same.
4. If surface waters of the same density are brought together, they tend to mix. The temperature and salinity of the resulting mixture are somewhere between the temperatures and salinities of the original waters prior to mixing. Record in the table, the temperature and salinity of a water sample "C" that would result if *equal volumes* of samples "A" and "B" were mixed together. (Hint: Mixing one liter of 10°C water with one liter of 30°C water produces two liters of water at 20°C.)
5. Plot the new sample "C" on the *T-S Diagram*. According to the diagram, the density of sample "C" is (1.0275) (1.0277) (1.0280) g/cm^3. Record this value in the table.

6. Comparison of the seawater densities recorded in the table shows that the density of sample "C" is (less than) (equal to) (greater than) the density of samples "A" and "B" prior to mixing.
7. On the *T-S Diagram*, draw a straight line between the points representing samples "A" and "B". Any possible mixture of these seawater samples, including sample "C," would be represented by a point falling somewhere on the straight line. Regardless of the relative volumes of seawater samples "A" and "B" mixed together, the *T-S Diagram* shows the resulting mixture will always be (denser) (less dense) than either "A" or "B."
8. Comparison of the density of surface seawater samples "A" and "B" with the density of any resulting mixture of these original samples indicate that the mixed water will (remain at the ocean surface) (sink). This can result in broad-scale motions that play significant roles in the layered circulation of the ocean.
9. This investigation shows that mixing surface seawaters of the same density, but different temperatures and salinities, produces seawater of (greater) (equal) (lesser) density.

Source

The Maury Project, American Meteorological Society



Water Sample Table

Sample	Temperature (°C)	Salinity (‰)	Density (g/cm_3)
A			
B			
C			