6. The Properties of Sea Water

Let's recall.

- Which is the largest water storage of the world?
- Why is the seawater salty?

In the earlier classes, we have studied the tides, ocean currents with reference to oceans. In this lesson, we will study the major properties of seawater.

Temperature:

Can you tell ?

- What is the difference in the temperatures of the land and the sea?
- What would be the difference in the temperature of the seawater from equatorial region to the polar areas?

Geographical explanation

Temperature is a major property of the seawater. The surface temperature of the seawater is not uniform everywhere. This is dependent on different factors.

Latitudinally speaking, the surface temperature of the seawater decreases from the equatorial areas towards the poles. The average temperature in equatorial areas is around 25° C, it is 16° C in mid-latitudes while it is about 2° C near the poles.

Besides this, cyclones, rainfall, sea waves, ocean currents, salinity, pollution, convectional currents, seasons, etc. also affect the surface temperature. Ocean currents also have similar effects on temperature of the sea water. In regions where cold ocean currents flow, the surface temperature of ocean water is less while the regions where the warm currents move, the temperatures increase.

Can you tell ?

The changes in the temperature of sea water with reference to depths in different latitudes is shown in fig 6.1.

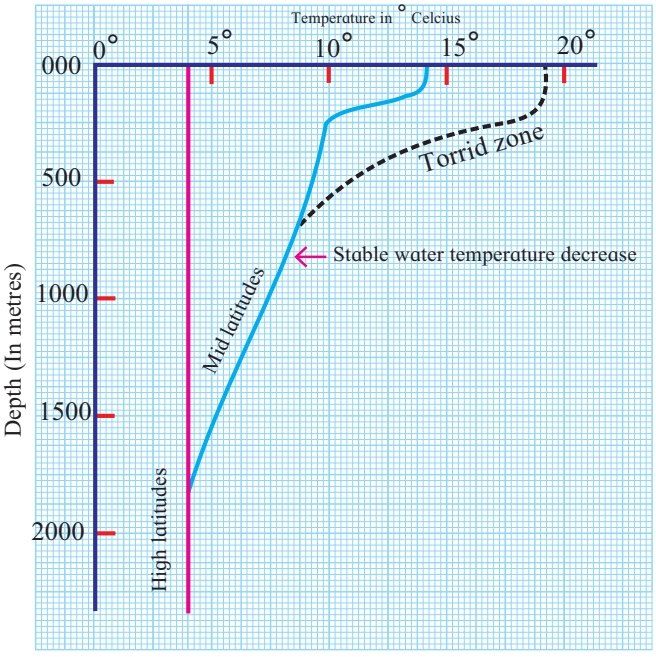


Figure 6.1 : Depth and temperature of seawater

Observe this graph and answer the following questions:

- What is the maximum temperature of seawater in equatorial areas? How much is this temperature at a depth of 500 m?
- What is the temperature of seawater at the sea level in the mid-latitudes?
- How much has this temperature changed at 1500m depth?
- What does the thermal graph for the high latitudes say? What is its temperature at 500, 1000 and 1500m depths?
- After what depth does the seawater temperature remain stable everywhere?

Geographical explanation

While most of the sunrays radiate back from the surface of the sea, some of them penetrate to certain depths in the water. As a result, the intensity of sunrays decreases with increasing depth. Temperature decreases up to 2000m depth. After 2000m, the temperature of the seawater is uniform everywhere. It is around 4 ^{0}C everywhere from the equatorial regions to the polar areas. Temperature reduces only up to 4 ^{0}C according to depth. And therefore, the water at greater depths does not freeze.

The temperature of the seawater changes rapidly with depth at the equatorial areas. The difference in temperature is lesser in polar areas.

There is also a difference in open seas and landlocked seas. As the salinity of the landlocked seas is more, the temperature of these landlocked seas is higher than the open seas. This is true for low latitudinal areas.

Think about it.

What would have happened if the temperature of the seawater near the seabed would have gone below the freezing point?

Salinity:

Let's recall.

- Why is the taste of seawater salty?
- What are the reasons for high salinity in the oceans?
- What is the use of the salts in the ocean to us?
- How can we obtain the salts from the ocean water?

Geographical explanation

Salt is used in the food we eat. Salt is also used for making various chemicals and medicines. Salt is also used to preserve things for longer periods. Salt is also used in ice factories. (Why did you use the salt in activity from lesson five?) We obtain salt from the salt-pans.

The buoyancy of the seawater increases because of salinity. This is useful for water transport.

But if the salinity is more than bearable limits, the life in the water gets destroyed.

Try this.

(Note to the teachers: 1. Keep the water safe for drinking with respect to health. 2. The water in the container is only for tasting not for drinking 3. After tasting, ask the students to rinse their mouth with clean water.)

- Take 1.5 litres of water in a big container. Put 100gm salt in it and stir.

Figure 6.2

- Now take 3 containers of same size. To identify them put three dots of different colours on them.

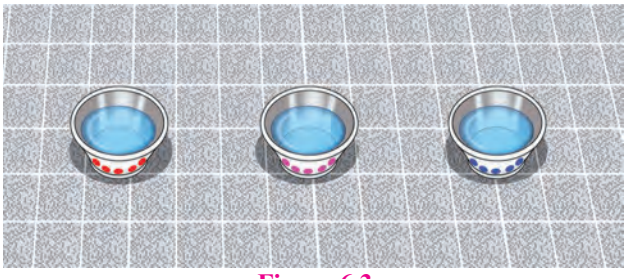


Figure 6.3

- Put the water containing salt equally in the three containers. Make sure the containers are half-empty after filling the water.

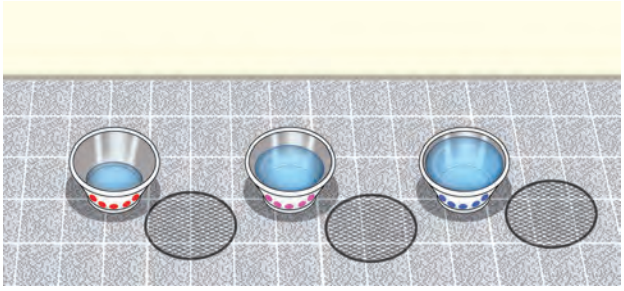


Figure 6.4

- Taste the water out of the three containers, keep one in the sun outside. Cover it with meshed lid.

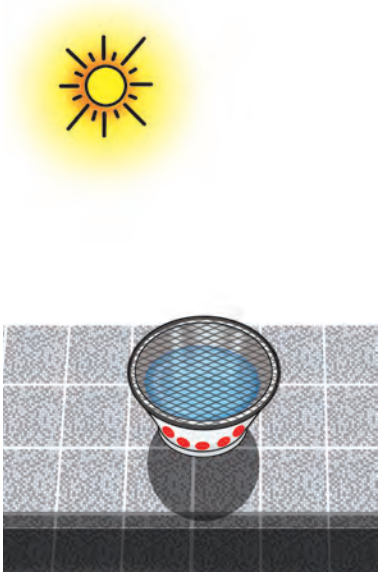


Figure 6.5

- Keep the remaining two in the classroom. (Cover them with net lids too.)
- Put half a glass of freshwater daily in one of the containers in the classroom.

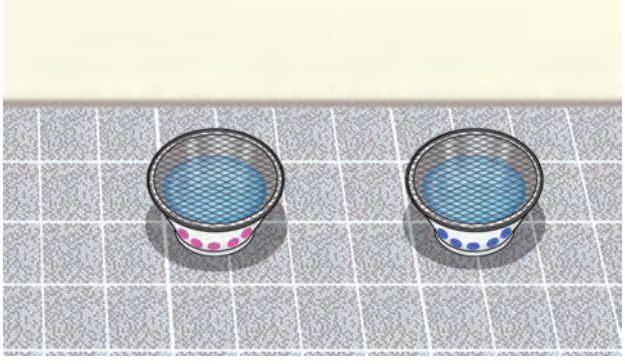


Figure 6.6

Figure 6.7

- After 3-4 days, bring all the containers together at one place. Observe the level of water in all the three containers.
- Taste the water in all the three containers. Experience the difference in the taste. Write about all the three tastes in one line each.

Figure 6.8

Answer the following questions:

- In which container has the water increased or decreased?
- What could be the reasons behind the decrease or increase?
- What could be the reason behind the low and high salinity of the water in the container?

Geographical explanation

You must have realised that because of the sun's heat, evaporation happens at a faster rate. Evaporated water turns into water vapour and reduces in quantity. But amount of salt remains the same in the remaining water and

therefore the salinity of the water increases.

- In seas where the rate of evaporation is high than the supply of freshwater salinity is high.
- In seas where the supply of freshwater exceeds the rate of evaporation, salinity is low.
- Salinity is not affected much in seas where both the supply of freshwater and evaporation of water is low.

Think about it.

If we collect all the salts in the ocean, its weight will be 120 million tonnes. If we spread it on the earth, it will form a 150m thick layer (almost equivalent to a 40-storeyed building). From where have these salts come in the sea?

Always remember –

How is the salinity of the seawater measured?

The weight of all dissolved salts in water in ratio of parts per thousand of water is called the salinity of seawater. For example, if the weight of dissolved salts in 1000g (1 kg) of seawater is 40g, then the salinity is 40‰ i.e. 40 per thousand parts. Hydrometer, refractometer and salinometer are also used to measure salinity.

See fig. 6.9. Observe the map and answer the following questions:

- What is the salinity around the tropics?
- Which region has the least salinity?
- Which ocean has salinity more than 37‰?
- What are the reasons of differences in salinity on a global level? Discuss in the class.

Make friends with maps!

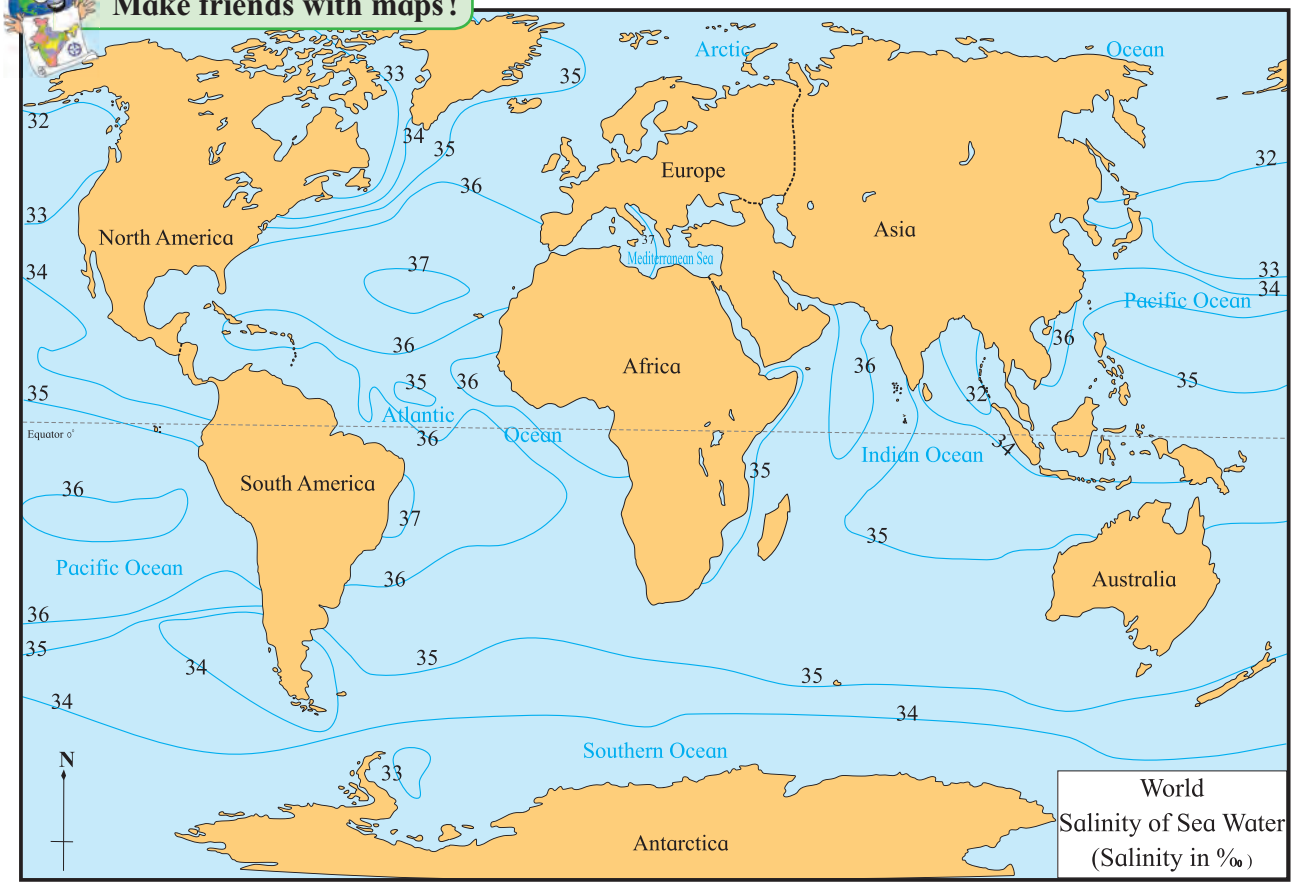


Figure 6.9 : Salinity of the sea water

Geographical explanation

- The uneven distribution of temperature on earth, uneven supply of freshwater, etc. affects the salinity of seawater. In tropical zone, temperature is higher and the rate of evaporation is also higher, therefore, salinity is higher. Around 5^0N and S of the equator, in the equatorial calm belt, the sky is cloudy for a long period of time and convectional rainfall occurs every day. Large rivers like Congo and Amazon in the equatorial regions meet the sea. Therefore the supply of freshwater is abundant. But because of higher temperatures, rate of evaporation is more and therefore, the seas in these areas are more saline.

In mid-latitudinal zones (25° to 35° N and S), rainfall is less and the supply of freshwater from rivers is also low. This zone has the hot deserts of the world. Thus, the salinity of the seas is found to be higher here.

In temperate regions, the sunrays are slanting and therefore, the temperatures are lower. Because of the melting of the snow, the supply of water is also more, and therefore, in this zone, salinity decreases with increasing latitudes.

In the polar areas, temperatures are very low. Evaporation is also very less in polar areas. So salinity is low.

Landlocked seas have higher salinity than open seas as the rate of evaporation is more and there is a lack of supply of fresh water from large rivers. Thus, there is a difference in the salinities of open and enclosed seas. For example, the average salinity of the Mediterranean Sea is 39‰ while the salinity of the most saline ocean, the Atlantic Ocean, is 35‰.

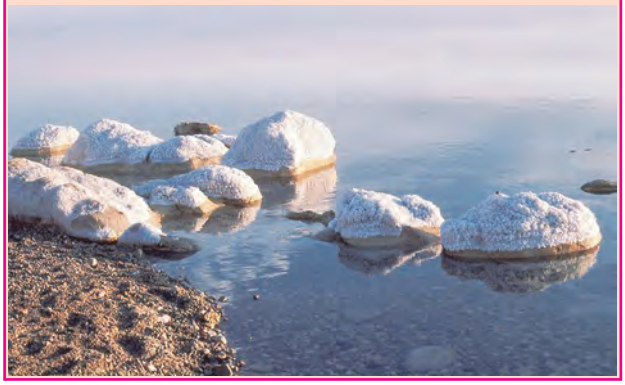
Think about it.

If you think about India, there is the Arabian Sea to the west and Bay of Bengal to the east. The salinity of the eastern coast is 34‰ while it is 35‰ in the Arabian Sea. What could be the reason of higher salinity in the western coastal region?

Do you know?

Dead Sea:

The name of the sea itself gives an idea of the conditions there. The sea lying on the border of Israel and Jordan has a salinity of 332‰. The average salinity of ocean is 35‰. Jordan is the only large river meeting this sea. Low rainfall, low supply of freshwater and high evaporation are the reason of high salinity. There is no life here except few unicellular organisms. The fish coming from the river Jordan die as soon as they come here. Because of high salinity, saline pillars have developed. Some of them come out on the surface. The density of water is also high because of higher salinity. Therefore, one can never drown in the sea. We can easily float when we go in the sea water. Another characteristic of the Dead Sea is that the land here is below the mean sea level. It is one of the places having the lowest elevations on the earth. In some areas, the altitude is -400m.



Density:

Temperature and salinity are the two properties of sea water that control the density of the sea water. If temperature reduces, density of water increases. Cold water is denser and so is saline water. As compared to salinity, temperature affects density more. Hence, sometimes, more saline water has lower temperature at the surface. But still, the density of such water is more than other water. On the contrary, seawater having higher temperature and low salinity can have lower density.

temperature and salinity. If you see the graph carefully, you will realise that after a certain depth, there is no change in these factors according to the depth. The change can be seen up to a depth of about 500m. The slopes of the curves of the graph are varying for all the three factors but below the depth of 1000m there is no change in all the three factors.

Generally, we can call the seawater up to the depth of 500m as surface water. This water gets affected by ocean currents and sunrays. We can see the movement of these

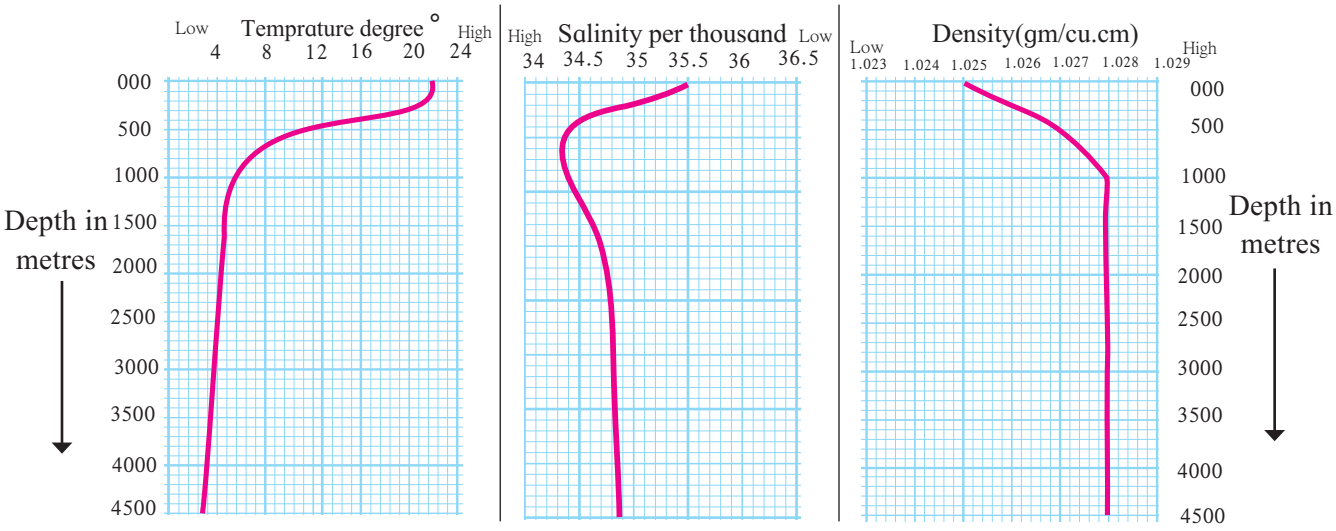


Figure 6.10 : Distribution of temperature, salinity and density of seawater according to depth.

Give it a try.

Study the fig 6.10 and answer the following questions:

- With increasing depth, what decreases: temperature, salinity or density?
- After what depth does the change in these factors become almost zero?
- Till what depth is the change in this factor higher?
- Explain the correlation between all the three factors.

Geographical explanation

See fig 6.10. The graph shows salinity, temperature and density with reference to the depth of the seawater. You know that the density of the water is dependent on waters in the form of ocean currents. At greater depths, winds, sunrays and currents do not affect these properties. Therefore, after around 1000m depth, there is no change in these three factors.

The ocean currents are generated because of difference in the properties of seawater. They act as temperature controllers at the global level. The distribution of temperature gets controlled due to the ocean currents. Thus, the climate of the earth gets affected by ocean currents.

Give it a try.

Calculate the salinity of the water used in your experiment mathematically.

Exercise

Q1. Tick the correct box according to the salinity of the ocean water ✓

	Salinity		
	High	Medium	Low
(a) Slanting sunrays, melting snow	☐	☐	☐
(b) Cloudy sky, rainfall throughout the year	☐	☐	☐
(c) Clear skies for the most part, perpendicular sunrays	☐	☐	☐
(d) Less supply of freshwater, desert area around	☐	☐	☐
(e) Low temperatures, ample supply of river water	☐	☐	☐
(f) Continental location, desert around, low rainfall	☐	☐	☐

Q2. Give reasons.

(a) Salinity is low in the land-locked Baltic Sea.

(b) There is higher salinity in the northern Red Sea while lower in the southern.

(c) Oceans located at the same latitude do not have same salinity.

(d) With increasing depth, the temperature of sea water decreases to a certain limit.

(e) There are more salt-pans on the Western coast of India than its eastern coast.

(f) Salinity increases in the mid-latitudinal zones.

Q3. Answer the following questions.

(a) What are the factors affecting the salinity of the sea water?

(b) Explain the distribution of salinity around the Tropic of Cancer and tropic of Capricorn.

(c) What are the factors affecting the temperature of the sea water?

(d) Explain the changes occurring in the temperature of sea water according to the depth.

(e) Name the factors affecting salinity.

Q4. Explain how temperature affects the following.

(a) the density of sea water

(b) the salinity of sea water

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Activity:

Complete the table showing the salinity of open and land-locked seas.

Evaporation of water			Supply of freshwater			
Region	**Latitude**	**Solar Energy**	**Rainfall**	**River water**	**Snow water**	**Average salinity**
Equatorial	0° to 15°	High	Perennial	High	-----	34‰
Tropical	15° to 35°	--------	Seasonal	--------	-----	37‰
Temperate	35° to 65°	Low	--------	--------	-----	33‰
Polar	65° to 90°	--------	--------	low	ample	31‰
Landlocked Sea		**Solar Energy**	**Rainfall**	**River water**	**Snow water**	**Average salinity**
Mediterranean Sea		High	low	low	-------	39‰
Red Sea		-------	------	---------	-------	41‰
Baltic Sea		low	------	Medium	-------	7‰
Dead Sea		-------	Very less	Very less	-------	332‰
Caspian Sea		-------	------	-------	-------	155‰
Great Salt lake		medium	------	-------	-------	220‰