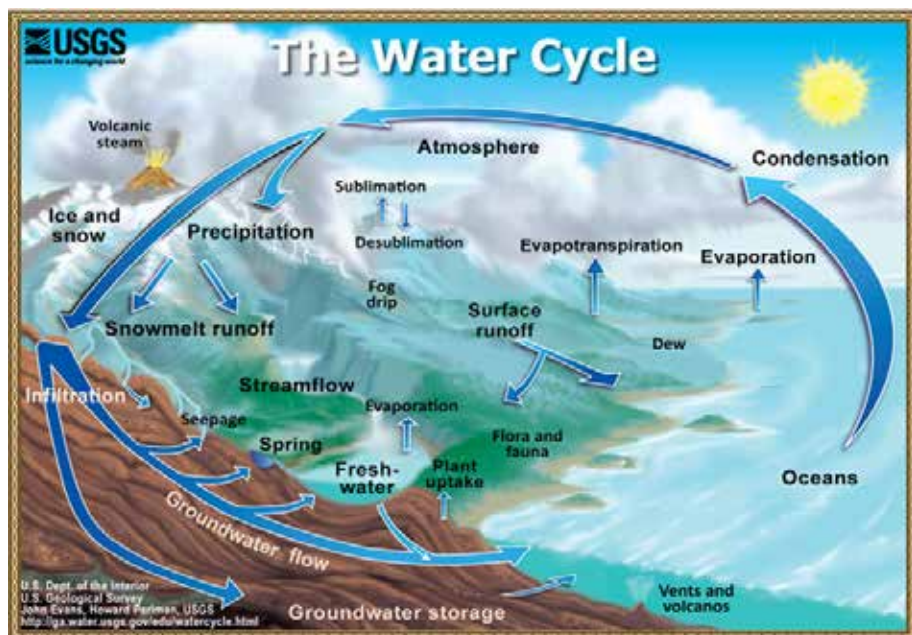


Like air, water is also essential for life. The same water that existed centuries ago still exists today. It only changes its states of solid, liquid and gaseous and its place. The Sun's heat causes melting of glaciers and evaporation of water into water vapour. When the water vapour rises up, it cools down. It condenses and forms clouds. The change of water vapour into droplets of water or snow crystals is called **condensation**. From there it may fall on the land or sea in the form of rain, snow, sleet or hails. The process by which water continually changes its form and circulates between oceans, atmosphere and land is known as the **water cycle** or **hydrological cycle**.



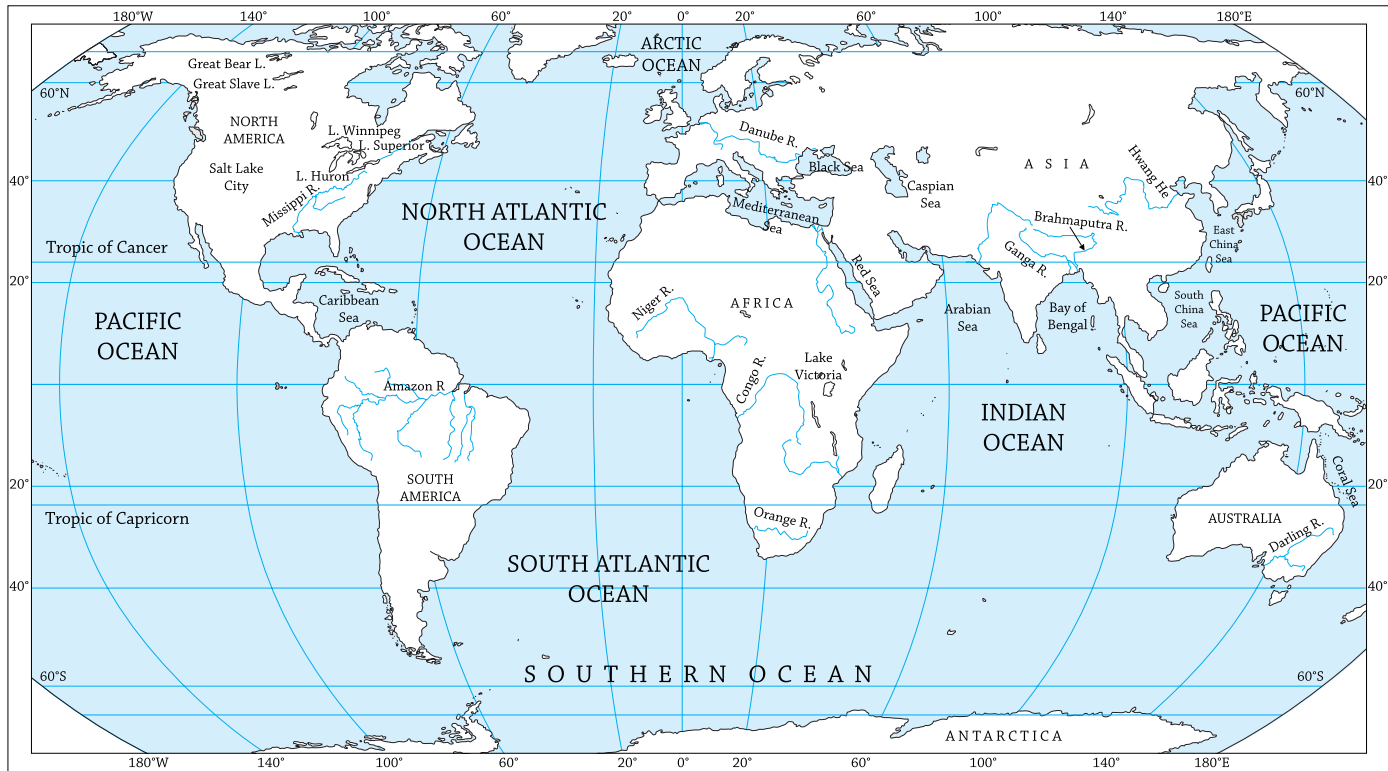
Water Cycle

Fresh and Saline Water

The water of the oceans is salty or saline as it contains large amount of dissolved salts. Most of the salt is sodium chloride or common salt that you eat. The oceans contain 97.3% of total water on Earth but it is saline, unfit for human use—drinking, irrigation, washing clothes, etc. The remaining 2.7% of water is fresh, that is, fit for human use. Out of it, 2% is found in the form of glaciers on mountain peaks and ice-caps over Polar regions. Only about 0.7% water is found underground or in fresh water lakes or flows in rivers, available for use.

Thus, though 71% of the total surface area of the Earth is covered with water, there is a scarcity of fresh water as 97.3% of the total water is salty. The water in the form of glaciers and ice-caps is out of reach.

We left with only ground water for our use. Only a part of rainfall or snowfall is stored under ground. That is why we should not use water carelessly. Every drop of water is precious. Preservation, protection and utilisation of water as a precious resource is known as **conservation of water**. To preserve water collect it direct from the rainfall or snowfall. 'To protect it' means not to pollute it. Efficient utilisation means not to waste water. March 22 is celebrated as World Water Day when the need to conserve water is preached in many ways.



Major Seas, Lakes and Rivers in the world

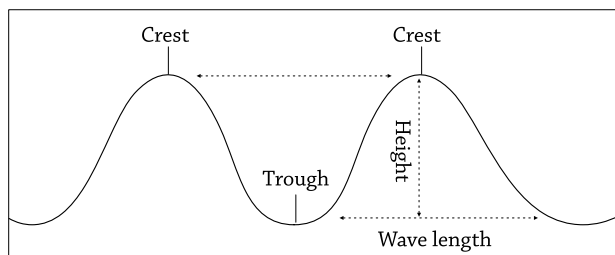


Fact File

On an average oceans contain 35 grams of salt dissolved per litre. Dead sea in Israel contains 245 grams of salt dissolved per litre. The increased salt content makes it so dense that the swimmers can just float in it.

Circulation of Water in Oceans


Unlike the calm waters of ponds and lakes, ocean water keeps moving continuously. Ocean water is always moving horizontally and vertically both ways. The horizontal movement of ocean water is in the form of waves and currents. The vertical movement of ocean water is in the form of tides. The movements may be due to (1) prevailing winds, (2) differences in temperature and salinity, variation in density of sea water and (3) attraction of the Moon and the Sun. The movements that occur in oceans can be broadly categorised as waves, currents and tides.



Shape of Sea Waves

Waves

When the water on the surface of the ocean rises and falls alternately, they are called waves. Waves are caused in the open sea by the force of the wind pushing against the surface of the ocean water. The surface water rises and falls, in the crests and troughs. The highest point of the wave is called the



crest and lowest point is called the **trough**. Water in waves not only moves up and down but also to and fro. But it does not move forward along the wave, only the form of wave moves forward. Moreover, waves are confined only to the surface of the sea. The shape and size of the wave depends on the speed of the wind. On calm days the waves are small but on windy days they grow larger. During storms waves may rise to great heights and even become destructive. But as they reach the coast, their wavelength decreases as the depth of the water is very less near the coast but the height of the wave increases.

Tidal Waves or Tsunami

Tsunami is a Japanese Word—'tsu' means harbour and 'namis' means waves. They are called 'harbour waves' as the harbours get destroyed whenever there is tsunami. A **Tsunami** is movement of a large mass of sea water due to displacement of the sea floor. Tsunami waves can be generated by undersea earthquakes, volcanic eruptions or underwater landslides. The undersea earthquake displaces the sea floor which in turn causes a large mass of water on the surface to move and create huge waves which may be several hundred kilometres long. A violent submarine (undersea) volcanic eruption can uplift the water column and form huge waves. Submarine landslides occur when sediments and rocks slide downslope and are redistributed across the sea floor. It can disturb the overlying water column.

In the open sea the height of the Tsunami may be about one metre but its speed can be from 500 to 1000 km per hour. Speed of Tsunami reduces close to the shore but its height increases.

On 26 December 2004, a massive undersea earthquake measuring 9.0 on the Richter scale occurred near the Western boundary of Sumatra (Indonesia). As the Indian Plate went under the Burma Plate, there was a sudden movement of the sea floor causing the earthquake. The ocean floor was displaced by about 10-20 m and tilted in a downwardly direction. A huge mass of ocean water flowed to fill in the gap that was being created by the displacement. This marked the withdrawal of the water mass from the coastlines of the landmasses in the south and southeast Asia. After thrusting of the Indian plate below the Burma plate, the water mass rushed back towards the coastline. Tsunami travelled at a speed of about 800 km per hour.

The Tsunami comprised a succession of several destructive waves that occurred in retreat and rise cycles with a period of 30 minutes between each peak. The third was the most powerful wave and occurred about one and a half hours after the first wave. Smaller Tsunamis continued to occur throughout the day. The Indonesian island of Sumatra was hit very quickly within a few minutes, while Sri Lanka and East Coast of South India were attacked one and a half to two hours later. Thailand was struck about 2 hours later. It reached Somalia on the east coast of Africa (nearly 4500 km from the point of origin) 7 hours later.



Fact File

When a ball falls into the sea water, it is fun to watch how the ball gets washed back to the shore by the waves.

As the wave moved from earthquake epicentre from Sumatra towards the Andaman Islands and Sri Lanka, the wave length decreased with decreasing depth of water. The travel speed also declined from 700-900 km per hour to less than 70 km per hour. Tsunami waves which struck the coasts were as high as 30 m. The waves entered a distance of 3 km from the coast killing more than 10,000 people mostly in Tamil Nadu only. About three lakh people were killed in Indonesia and other countries. It destroyed structures and trees and crops and ruined fertile land with salty water. December 2004 Tsunami was the most devastating tsunami in the last several hundred years.

The large damage caused to life and property was a result of lack of monitoring, the early warning systems and knowledge among the coast dwellers of Indian Ocean.

Indications/Signs of an Approaching Tsunami : The first indication is the Rapid withdrawal of sea water from the coastal region. At once run to the high ground. Some other signs may be associated with a tsunami :

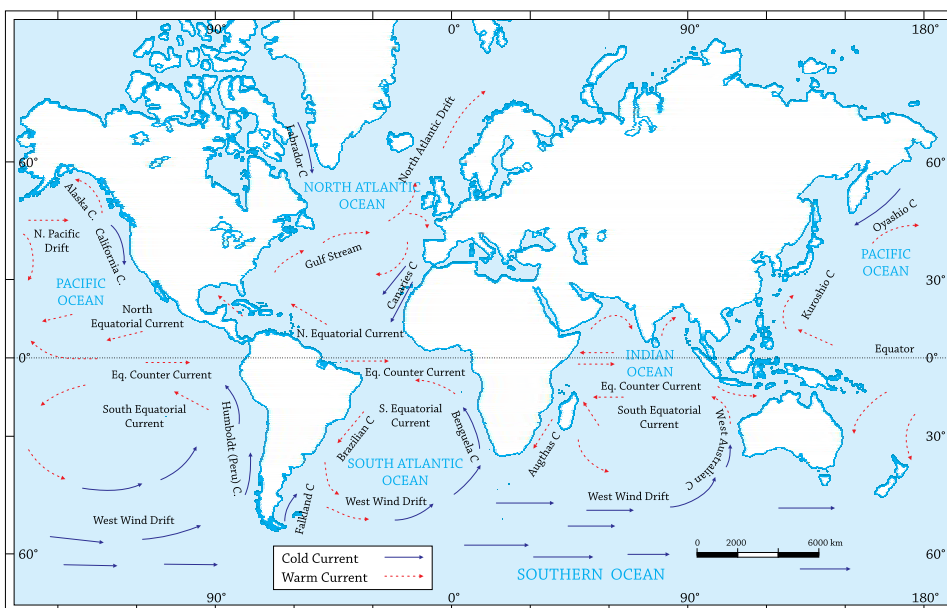
1. Large quantities of gas may bubble to the water surface and make the sea look as if it is boiling.
2. The water may smell of rotten eggs or of petrol or oil.
3. An earthquake may be felt.
4. A thunderous boom may be heard.
5. The water may sting the skin and may be unusually hot.

Ocean Currents


An ocean current is the movement of large bodies of ocean water in the form of streams flowing constantly on /under the ocean surface in a definite path and definite direction for a long distance. They are quite broad like a stream or river. The ocean currents have a regular pattern.

Ocean currents are normally swift, deep and narrow, ranging in speed from 2 to 10 km per hour. Broader and slower currents that are shallow in depth are called drifts. They move at a speed of 1 to 3 km per hour.

The ocean currents are caused by the permanent winds, the rotation of the Earth, difference in temperatures, difference in density of sea water and position and shape of the sea coasts.



Ocean Currents



The ocean currents may be warm or cold. Generally, the warm ocean currents originate near the equator and move towards the poles. The cold currents carry water from polar or higher latitudes to tropical or lower latitudes. The cold water is dense and heavy so it sinks down to the bottom of the sea. The warm water is light and rises to the surface. The cold water moves toward the equatorial regions along the bottom of the ocean or at a depth. The warm water moves toward the polar regions along the surface of the ocean. This is the general pattern of the ocean currents. You should also remember that **a current is named by the direction to which it flows. This is opposite of how winds are named.** The rotation of Earth reverses the direction of winds as well as ocean currents near equatorial region where this movement is felt most. The winds and ocean currents are deflected to the right in Northern Hemisphere and to the left in the Southern Hemisphere. Labrador Current is a cold current which flows south from Arctic region. Gulf Stream is a warm current in the Atlantic Ocean.

The ocean currents influence the temperature condition of the area. Warm currents bring about warm temperature over land surface. Warm currents generally pick up moisture and cause rainfall, cold currents are generally dry. Harbours of Norway, Russia and Great Britain would have remained closed for most parts of the year, but on account of warm Gulf Stream, they remain open even in winter. Ships sailing in the direction of the currents move faster.

The areas where a warm and cold current meet experience foggy weather making it difficult for navigation. But they provide best fishing regions of the world. For example, seas around Japan and the eastern coast of North America. Cold currents bring with them fish food called plankton from cold polar areas to support a large number of fish.

Tides

The rhythmic rise and fall of ocean water each twice in a day is called a **tide**. The rise of sea water and its movement towards the coast is called **high tide**. In this case water covers much of the shore by rising to its highest level. The fall of sea water and its movement towards the sea is called **low tide**. In this case water falls to its lowest level and recedes from the shore. The strong gravitational pull exerted by the Sun and the Moon on the Earth's surface causes the tides. The effect of the Moon is more pronounced because it is closer to the Earth than the Sun.

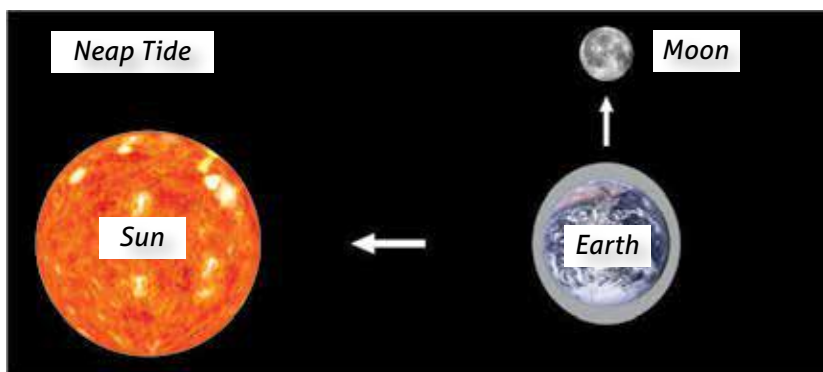
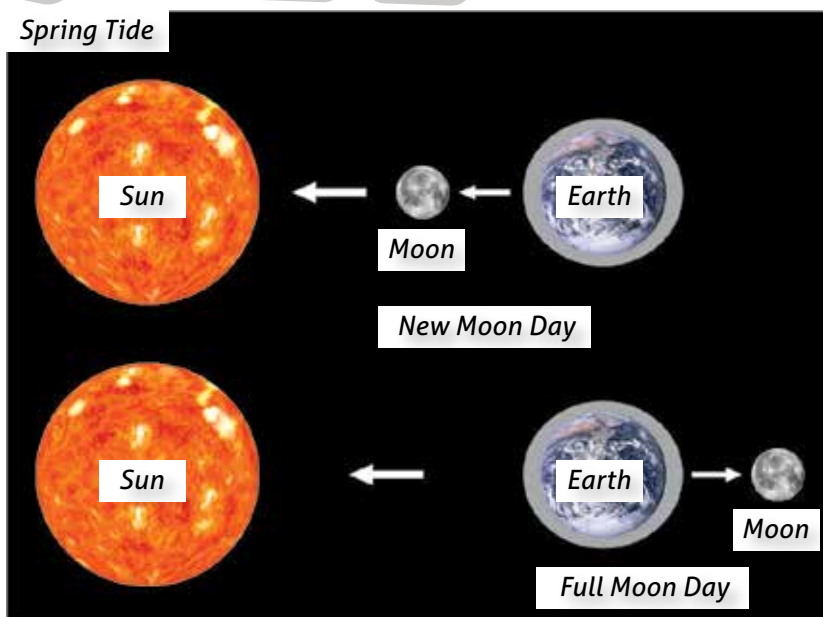
The water of the Earth closer to the Moon gets pulled under the influence of the Moon's gravitational force and causes high tide. Due to Moon's attraction when high tide occurs on one side of the Earth, the low tide occurs on the opposite side of the Earth simultaneously. Therefore, two tides are experienced twice at every place on Earth's water surface within 24 hours. We have two high tides and two low tides in a day. Thus, alternate rise and fall in the level of sea water every six hours is called a **tide** (6 hours x 4 = 24 hours).



Fact File

When a warm current meet cold current, they produce fog. Fogs reduce visibility and often cause major accidents in navigation. That is why the area near Newfoundland where Gulf Stream and Labrador Current meet is called the 'Graveyard of a Thousand Ships'.

Spring Tide



During the full moon and new moon days, the Sun, the Moon and the Earth are in the same line. Thus, the gravitational pulls of the Sun and the Moon are added to pull water to the highest. And the tides are highest. These tides are called **spring tides**. But when the Moon is in its first and last quarter, the ocean waters get drawn diagonally opposite directions by the gravitational pulls of the Sun and the Moon resulting in low tides. These tides are called **neap tides**.

High tides help in navigation. They raise the water level close to the shores. The water level also increases at the river mouths. It facilitates the movement of ships into the river harbours which otherwise cannot enter the rivers. The importance of Diamond Harbour near Kolkata on the Hoogli river and that of London port on river Thames is due to the high water that enters these rivers from the sea during high tides. Tidal water clears away a lot of mud, silt

and garbage brought down by rivers from the land into the depths of the sea. Some countries like Canada, United Kingdom, France and Japan has started to produce electricity using the energy of the tides. The high tides also help in fishing as many more fish come closer to the shore during the high tide.

Key Words

- » Salinity : the amount of salt dissolved in water.
- » Waves : alternate rise and fall of water on the surface of the ocean.
- » Tsunami : huge waves in the sea caused by an undersea earthquake, undersea volcanic eruption or underwater landslide.
- » Ocean Current : streams of water flowing constantly on/under the ocean surface in definite directions.
- » Tide : rise and fall of the sea water each twice a day near the shore.
- » High Tide : rising of the sea water twice a day near the shore.

SUMMARY

- ▶ Water continually changes its form and circulates between oceans, atmosphere and land.
- ▶ Though 71% of the total surface area of the Earth is covered with water, there is a scarcity of fresh water as 97.3% of the total water is salty.

- ▶ Ocean water is always moving horizontally and vertically both.
- ▶ A Tsunami is movement of a large mass of sea water due to displacement of the sea floor.
- ▶ Tsunami can be generated by undersea earthquakes, undersea volcanic eruptions or underwater landslide.

Exercise Time

A. Tick (✓) the only correct choice amongst the following :

1. The rhythmic rise and fall of ocean water each twice a day is called
 - a. Ocean current
 - b. Wave
 - c. Tide
 - d. Water cycle
2. Generally the warm ocean currents originate near
 - a. Poles
 - b. Equator
 - c. N. America
 - d. None of these
3. Continually changing of form by water and its circulation between oceans, atmosphere and land is called
 - a. Waves
 - b. Tides
 - c. Ocean Currents
 - d. Water cycle
4. Spring Tide occurs on
 - a. First quarter of the moon
 - b. Third quarter of the moon
 - c. Full moon day
 - d. None of these
5. At the place where the warm and cold currents meet, occurs
 - a. clear sky
 - b. dense fog
 - c. snow fall
 - d. Tsunami

B. Fill in the blanks :

1. The huge ocean waves caused by undersea earthquakes are called _____.
2. Rise and fall of water in crests and troughs is called a _____.
3. Difference in _____ and _____ of ocean water causes currents.
4. The tide caused on the full moon is called _____ tide.
5. Very broad ocean currents are called _____.

C. Match the Following :

- | | |
|-------------------|--|
| 1. Ocean currents | a. Cyclic movement of water between oceans, atmosphere and land |
| 2. Tide | b. Streams of water moving in definite paths in the oceans |
| 3. Water Cycle | c. Rise and fall of water caused by the wind blowing over the seas |
| 4. Wave | d. Periodic rise and fall of water towards sea coasts |

D. Write true (T) or False (F) against the following statements in given brackets :

1. Salinity of ocean waters is highest at the Equator. □
2. Ocean currents transfer heat from lower latitudes to the higher latitudes □
3. Currents are caused by the gravitational pull of the Sun and Moon. □
4. One high tide and one low tide is seen in the coastal areas daily. □
5. Warm ocean currents move from tropics towards poles. □



E. Define the following terms :

1. Water cycle
2. Waves
3. Tsunami
4. Ocean current
5. Tide
6. Spring Tide
7. Neap Tide

F. Identify the following :

1. The change of water vapour into droplets of water
2. The main source of fresh water
3. Rise and fall of ocean water caused by pushing action of the wind
4. Vertical rise of sea water by gravitational pull of the Moon
5. The currents moving towards the polar regions

G. Answer in one word or one phrase :

1. Due to what are the waves caused ?
2. When is the spring tide caused ?
3. In which direction do the cold currents flow ?
4. Where are warm currents generated ?
5. What is the first indication of an approaching Tsunami ?

H. Answer these questions briefly :

1. What is water cycle ?
2. What are the factors affecting the height of the waves ?
3. Which factors affect the movement of ocean water ?
4. What are tides and how are they caused ?
5. What are ocean currents ? Which factors cause them ?

I. Differentiate between :

1. Fresh water and Saline water
2. Waves and Ocean Currents
3. Spring Tide and Neap Tide
4. Waves and Tides

J. Answer these questions in detail :

1. How are Tsunami (tidal waves) caused ? Describe their propagation and way of destruction.
2. What are ocean currents ? How are warm and cold currents caused ? Give the effects of ocean currents.

PROJECT WORK

1. Draw a sketch to show water-cycle.
2. Show some important ocean currents on an outline map of the world.
3. Diagrammatically show how tides are caused.