

# Unit 1: Water Education

## Chapter 1: Water cycle

About 71 % of the earth's surface is covered by water. This mass of water is found in various forms such as glacial, freshwater, ocean salt water and atmospheric vapor. This water supply is constantly changing from one form to another. That is, it evaporates from rivers into the ocean and back into the atmosphere through the process of evaporation from the ocean. This cycle is indestructible and continues uninterrupted.

### Let us understand the water cycle.

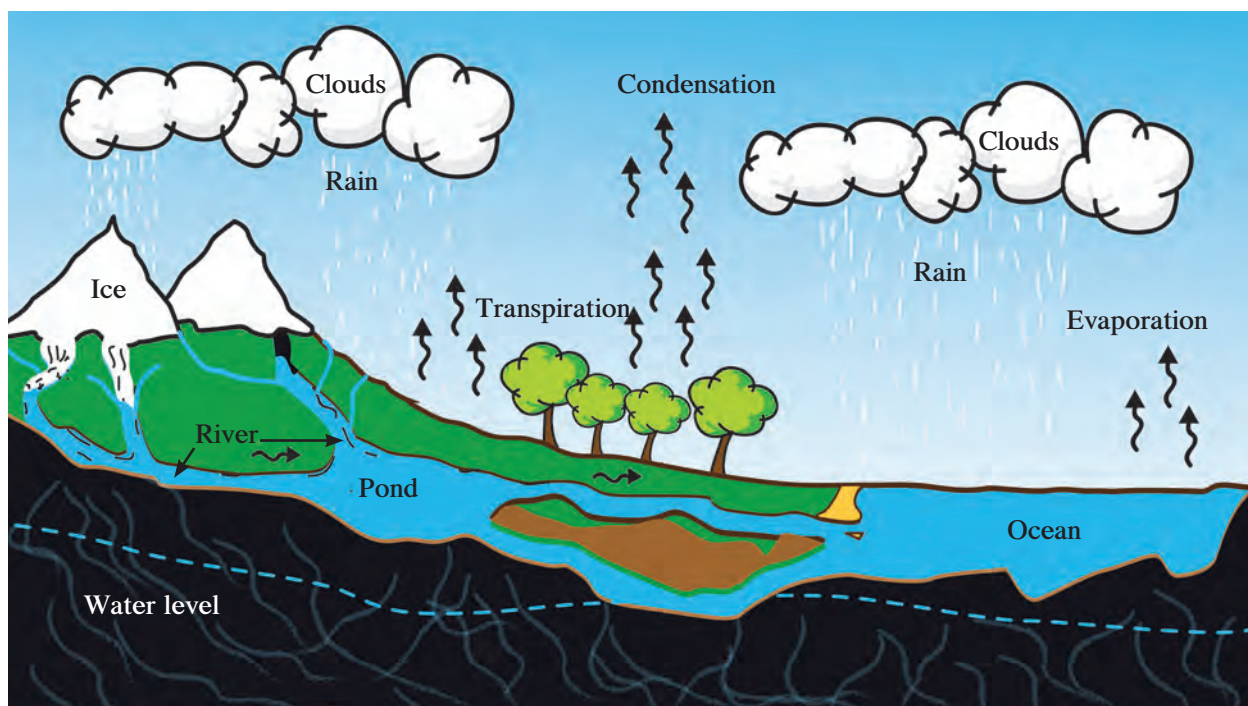
“Severe heat causes the water in the oceans to evaporate. As it is lighter, it rises to the sky, it forms clouds together, it becomes heavier because of the water in it. Due to cold air, water from clouds that falls on ground in the form of rain, this water flows through river brook and returns to the sea. In this way, the water travels through different conditions and returns to the sea. That is, a cycle is completed, this is called the water cycle.”

This journey from sea to sea is due to the constant movement of water in the earth's underground, evaporation, transpiration from the leaves of plants, liquefaction, precipitation, seepage from the soil, run-off water from the surface and subsoil, etc. While this is happening, water goes through various stages such as liquid, gaseous and solid.

The sun, which primarily evaporates ocean water, is the major component or driver of the water cycle. Evaporation in the water cycle is the process of purifying water and recharging it on the ground. The water cycle is essential for the survival of life on earth.

### Evaporation:

The process by which water gets converted into vapors due to heat is called evaporation. Evaporation is an essential part of the water cycle.



### 1.1.1 Water Cycle

The heat of the sun (solar energy) causes water to evaporate from the sea, lakes, soil moisture and other sources of water.

The higher the temperature, the higher the evaporation rate. At lower temperatures there is less evaporation. The larger the surface area of the liquid, the higher the rate of evaporation of the liquid. Water in the form of gas (water steam) is called vapor.

**Try this :**

Take water in a glass jar and cover it with a lid. Place jar in Sunlight. After 30 minutes, observe the inside of the jar. Record what you see.

**Condensation :**

As the vapor rises higher, the air pressure naturally decreases and the temperature begins to decrease. As the temperature drops, the vapor begins to liquify. As long as a tiny drop of water is light in weight, it is weighed in the air. As these tiny droplets come together to form larger droplets, they transform into clouds that appear over a large area of the sky. This vapor is also seen as a mist near the ground. This vapor is carried by the wind. The tiny droplets of water in the clouds increase in size and weight, collide with each other, and fall as rain on the earth under favorable conditions. There are different types of rainfall. Water, a mixture of water and hail, only hail and snow, depending on the situation.

**What exactly is a cloud?**

Clouds that form in the sky are also a form of water. The warmth of the sun causes water to evaporate from the surface of the earth as well as from the surface of the ocean. As it is light it goes up into the atmosphere. Cold air in high altitudes slows down the movement of vapor molecules. This slowdown causes these vapor molecules to come together and freeze. During this time, fine dust from the air begins to accumulate around it. These particles are called condensation nuclei.

Many such particles combine to form vapors that form droplets. That is, they transform into clouds.

**Cloud types:**

There are two types of clouds in the sky.

**1. A giant or huge cloud (Cumulonimbus)-**

As water vapor freezes, a large amount of energy is generated. It accumulates in these giant clouds. The result is thunder and lightning. Sometimes they fall on the earth in the form of large fireballs. Occasionally there may be a major storm or hurricane.

**2. Crazy black curved or gray black cloud (Nimbostratus) -**

This type of very large cloud can cause heavy rainfall at any time. Sometimes it can snowfall.

**How do clouds float in the air?**

The solar heat causes the earth's surface to heat up. As a result, the surface air becomes lighter and superficial. Due to the hot air going up, clouds keep the particles in the air without falling on the ground. Similarly, due to storms, the warm air on the ground helps to keep the clouds afloat.

As water vapor condenses on the dust in the air, a very fine nucleus is formed. These particles cannot be seen with the naked eye. But clouds are formed by the millions of vapor dust that live in such centers. While the vapor on the dust freezes, it helps to keep the clouds floating with itself.

**Condensation/compression:**

Condensation is the process by which the vapor in the air or atmosphere decreases and is converted back into water particles. Unsaturated air or air with a relative humidity of less than 100% , cools as the temperature decreases. As a result, its evaporation capacity decreases. Eventually this air becomes vaporized which means its relative humidity is 100%.

The temperature or temperature level at which unsaturated air evaporates at a certain temperature is called **the dew point**.

The action of condensation in the atmosphere depends on two factors. It is the relative humidity and temperature of the air. As the temperature of humid air decreases, it evaporates and a greater condensation occurs. During condensation, vapor is converted into water particles or ice. The dust that is required for the formation of these water particles or ice particles is called waterborne dust. If the temperature level (dew point) is above the freezing point during condensation, then the conversion of vapor (into water particles) is seen in different forms like dew, fog, clouds or rain. And if, during the condensation process, the dew point is below freezing point ( $0^{\circ}\text{C}$ ), then the vapor is converted into ice and there is dew, hail or snowfall.

The overall condensation action requires a lot of humidity in the air. And the temperature of that air also has to go down.

#### Do you know ?

1. When the ambient temperature is very cold, the vapor cools and comes together in the form of small droplets in the cloud. This temperature is called the hydrocephalus temperature.
2. Dust is required for clouds to form.
3. In the same way that hot water vapor freezes on a mirror glass in the bathroom, air vapor accumulates around the dust at cold temperatures.
4. There is only a difference in size between water droplets and raindrops in a cloud.
5. Not all raindrops falling from the clouds reach the ground. Such drops are called "Vibra".

#### Rain:

Due to the inability of large water particles to float in the air due to their big size, the water particles fall in the form of rain. Water falling from clouds to the ground in liquid or solid form is called rainfall.

The forms of rain are as follows.

**1. Snowfall:** When the air temperature goes below freezing point, the precipitation that takes place when steam is directly converted into snow is called snowfall.

**2. Hail:** Pallets of frozen rain which fall in showers are called hail.

#### How does it rain?

Rainfall in the Indian subcontinent is called 'Monsoon'. Monsoon is a slang of the Arabic word 'Mausam'. It means season.

When the clouds are joined by the wind, the clusters of clouds begin to come down in the form of drops due to the weight of the water. Some vanish in between, but most of the drops reach the earth from the atmosphere. This is what we call rain. During this time the size of the vapor dust increases. When they cannot carry their own weight, they separate from the clouds and fall to the ground in the form of rain.



#### 1.1.2 Rain

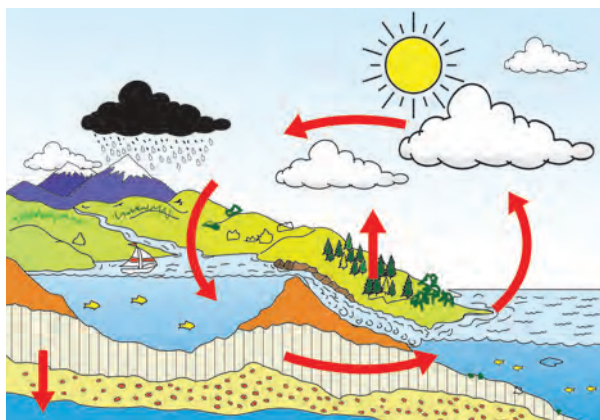
When large amounts of evaporated clusters come together, dense black or gray clouds form. Even the sun rays cannot penetrate them and reach the earth. At such times, there is no appearance of sun during the day. These black clouds together can go very high. Very large and black clouds can reach heights upto 15 km in the tropics. These types of clouds can cause very heavy or torrential rain. Sometimes there is cloudburst and the area becomes waterlogged.



**The journey of water :** Water is available everywhere on earth in the form of vapor, liquid or ice. Due to the heat of the sun, high temperatures, the transition of water to vapor continues uninterrupted. This process continues uninterrupted in any type of open water reservoirs such as lakes, rivers, seas. Similarly, the evaporation of water in animal and plant bodies continues. The vapor created by this evaporation becomes lighter and goes up in the air. All this vapor forms clouds, they rise up and up in the atmosphere.

Clouds formed by the mixture of fine dust particles freeze due to the cold air in the upper atmosphere, forming water droplets. When these clouds are blowing with the wind, they get blocked by mountains or high mountain ranges and move higher. The size of such clouds also increases. At the same time, water droplets made up of tiny particles become larger and heavier in size and eventually fall back to the ground in the form of rain.

This rainwater flows back down the hillside and takes the form of small streams, brook and then forms itself into a river or flows into the river. Sometimes it can accumulate in the form of lakes. Meanwhile, this water quenches the thirst of plants, other animals and human beings. All plants absorb ground water according to their needs and release it into the atmosphere through the leaves due to transpiration. This indestructible cycle continues year after year.



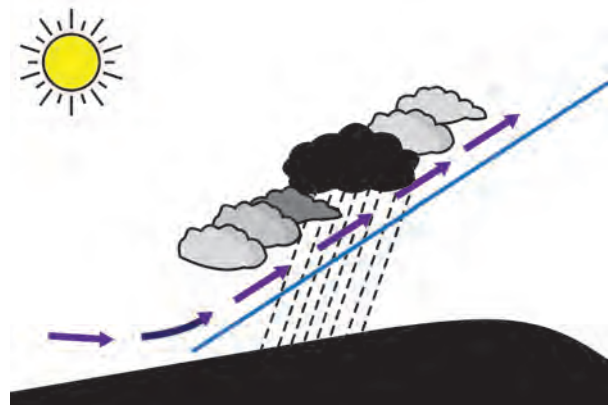
**1.1.3 Water Cycle**

The continuous circulation of water on the Earth, the convection of water from the oceans to the atmosphere, from the atmosphere to the land and from the land back to the ocean is called the water transition cycle or water cycle. Although the level of water on the Earth is almost constant, water molecules are coming in or out of the atmosphere. Water flows from one reservoir to another through physical processes such as evaporation, condensation, precipitation, run-off and groundwater flow. Like the water of rivers gets to the sea or the water of the sea mixes with the atmosphere in the form of vapor.

While this is happening, water is transformed into solid, liquid, and gaseous forms. One-third of the water that falls to the ground goes back to the ocean through surface or subsurface water flows. The remaining two-thirds of the water re-enters the atmosphere due to evaporation and transpiration of plants. Thus a gross water transition cycle is continued.

### **Types of rainfall**

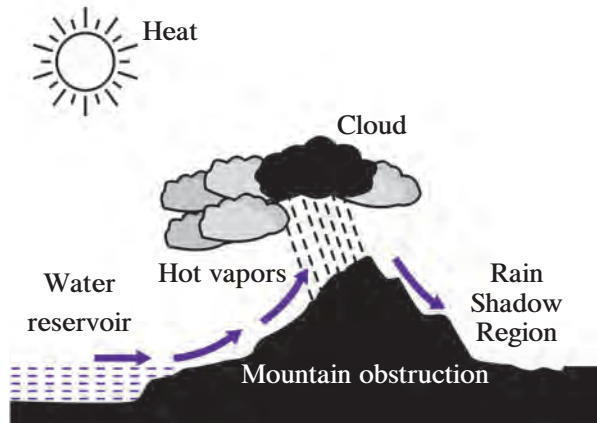
**1. Ascending or converging precipitation/ rainfall :** The air cools after reaching a certain height. The process by which air moves upwards is called 'ascent'. Cold air has low evaporation capacity, so it condenses and converts into water particles and rains. This type of rainfall occurs in regions where there is a large upward movement of air, as well as in areas where it is not much in the horizontal line. In the equatorial region, such rain usually falls every afternoon.



**1.1.4 Ascending or converging precipitation/ rainfall**

## 2. Resistance Rainfall:

Winds containing vapor from the sea or large reservoirs are blocked by high mountain ranges in the path and begin to follow the mountains. Due to the low temperature at the altitude, the vapor in this air condenses and it rains. This rain is called resistance rain as it falls due to obstruction.

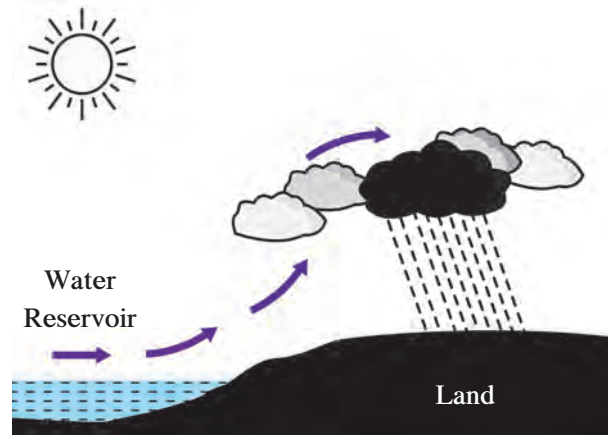


### 1.1.5 Resistance Rainfall

Rainfall is heavier on the slopes in the direction in which the winds follow the mountains, while in the areas where the winds cross the mountain, the amount of rainfall decreases as the amount of air vapor decreases and the vapor holding capacity of the air increases. Such a region with low rainfall is called a 'rain shadow region'.

## 3. Periodic Rainfall:

A low pressure belt is formed at a specific place in the air, so that the winds from the adjacent region are attracted in that direction. These winds move in a circular direction and at a tremendous speed. This is called a cyclone or periodic. When a cyclone is formed in a region, the air in the cyclone starts to go up. As the air rises, its temperature decreases and the vapor in the air condenses and rain falls. Such precipitation is called cyclonic precipitation or cyclone precipitation. The cyclones move from one place to another and rain falls wherever they pass. This type of rain falls more in temperate belts. Also in the tropics there is some cyclonic/periodic rainfall which is stormy.



### 1.1.6 Periodic Rainfall

Out of all the above three types of rainfall, resistance type rain falls in most parts of the world. There is such certainty in ascending type rains but there is also uncertainty in resistance and periodic precipitation. Therefore, in these cases, sometimes we have to face disasters like heavy rains, floods and sometimes droughts. Considering Maharashtra, there is resistance rainfall in the Western Ghats, drought prone areas in the Marathwada region as a rain shadow region and a lot of certainty in Vidarbha.

Rainwater seeps into groundwater or it is carried to the ocean in the form of runoff.

### Seepage :

Not all surface water flows into rivers. Some water seeps into the soil. Groundwater is the water that seeps into the soil. The period of surface water flow depends on the porosity of the soil, the type of soil, the slope of the groundwater, etc. Depending on the factors, water seeps first into the subsoil and then deeper into the ground. Groundwater recharge occurs. To some extent this water can come to the surface as a source of living water. Deep-seated water can be stored in the soil for a long time.

### Run-off :

A watershed is an area of land on which all the rainwater that falls is collected in a specific source of water. Watershed size, length, width, rainfall, soil texture and other properties are related to each other. They

determine the limit of water accumulation or stagnation of the catchment area. Run-off is an integral part of the water cycle. Its regulation and management is intended for watershed development. This water flows from the surface to the ocean through brooklets (Odhe), runnels (Nale), rivulets (Ohol) and rivers.

Surface water and groundwater are also stored in lakes naturally created due to topography. In the river basins, surface water and groundwater are constantly circulating. Over time, water enters the ocean and changes its position in the water cycle.

### Exercise

1. What is the water cycle?
2. What are the main components of the water cycle?
3. Write the names of different steps in the water cycle.
4. Find out the information about places in India regarding heavy rainfall.  
i) Mawsynram ii) Cherrapunji iii) Agumbe iv) Amboli v) Tamhini
5. Describe the main processes in the water cycle.
6. Make a model of the water cycle and present it to the class.
7. Briefly describe the journey of rain.
8. What are the factors that affect seepage and run-off ?
9. State the types of rainfall.
10. Visit an organization that keeps track of rainfall and other factors in the water cycle.
11. Observe landforms related with runoff and groundwater.