

2

Chapter

WATER SOURCES AND MANAGEMENT

Students' Learning Outcomes:

After completing this chapter, students will be able to:

- Identify the major sources of water on Earth in Pakistan.
- Explain different types of precipitation.
- Describe the process of Water Cycle in maintaining water supply of the Earth.
- Identify different uses of sewage waste.
- Identify bio-gas as a source of energy.
- Explore various water purification methods before supplying it to cities and villages.

Water is one of the most important commodities and basic need of life on Earth.

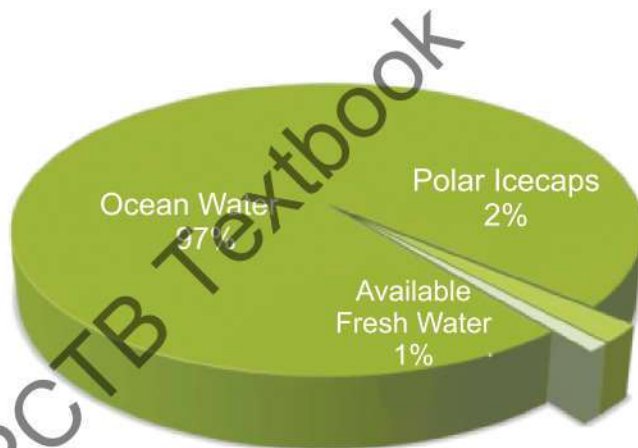
It is essential to human life. It is used in diverse areas such as farming, cooking, cleaning, construction and even for recreational purposes.

Major Sources of Water on Earth and in Pakistan

There are numerous sources of water ranging from underground sources to surface sources. Some of the main water sources on Earth and in Pakistan are discussed as under:

i- Oceans

Oceans are the largest sources of water on Earth. There are five oceans in the world. Ocean water is not suitable for human consumption in its raw form. It contains high salt levels and other impurities that make it unsuitable for household use. However, countries situated in dry regions such as Saudi Arabia, United Arab Emirates, Oman, and Australia use a technique known as desalination to purify ocean water. Desalination involves the stripping of salts and other components found in ocean water. The process is less in use due to huge cost. Oceans are the busiest trade routes in the world. Eighty percent trade of the world is doing through oceans.



Water on Earth

ii- Rivers

Rivers are natural paths through which water flows towards another river or a larger water body. There are several rivers flowing in different directions in the most parts of the world. Rivers provide water for farming, hydro-power generation, marine life industry and transportation, etc.

iii- Lakes

Lakes are an important source of livelihood for many people around the world. Lakes are classified into two categories: salt-water lakes and fresh water lakes. Lake water is used by the communities that live around the natural resource. Many people who live near lakes practice fishing. Farming communities also use lake water to irrigate their farms and boost their agricultural output.

iv- Glaciers and Icecaps

Glaciers and ice caps are natural sources of fresh water. Glaciers are formed when ice accumulate over several years. Most glaciers and ice caps are found in

Do You Know?

The World's largest lake is found in north America.

higher altitude and areas close to the north and south pole. Even the large quantities of useful fresh water contained in glaciers and ice caps. These huge natural bodies melt slowly and water flow into nearby rivers where people use it.

v - Ponds

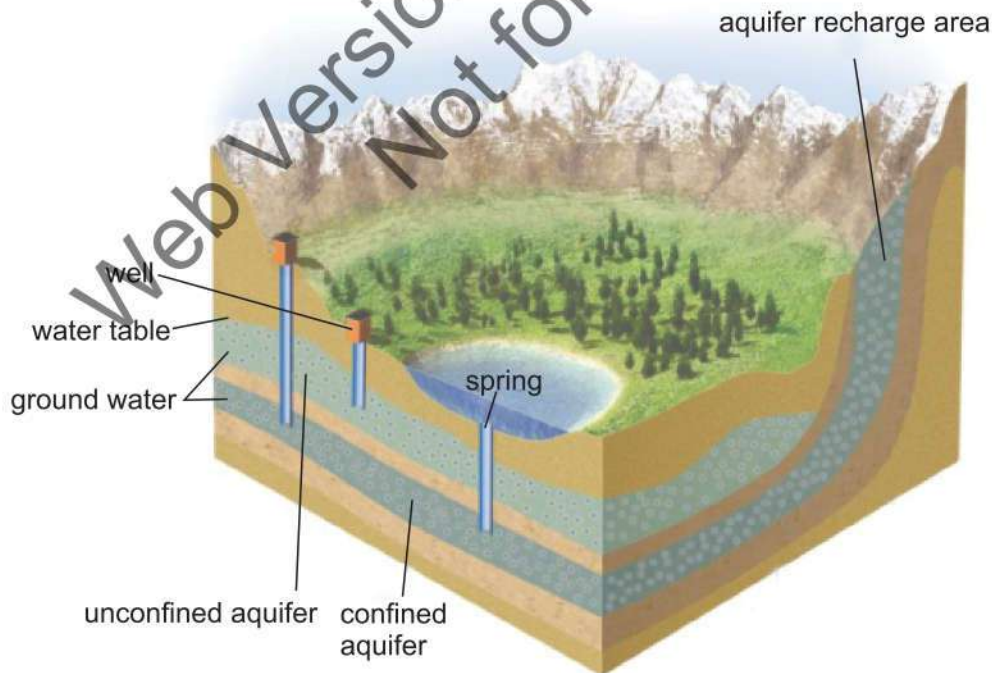
Ponds are shallow water sources usually smaller than a lake. Ponds are part of the many surface water sources. Some ponds occur naturally while others are man-made. Ponds may contain aquatic plants and animals. Water found in ponds is often used for support agriculture, fishing industry, landscaping ventures, and in rehabilitation of damaged land.



Glaciers and Icecaps

vi- Springs

Springs are natural freshwater sources found on the Earth's surface. They get their water from underground streams or aquifers. Some springs may produce hot water, while others produce cold water. Spring water is often used in commercial production of drinking water. Additionally, hot springs are popular tourist attractions, medical therapy, and recreational centres.



vii- Aquifers

Aquifers are water sources found below the surface of the Earth. They are underground porous rocks that contain water. It is estimated that 30% of the World's liquid water is found below ground. Water in underground aquifers may come to the surface through natural springs. In some cases, the water is pumped to the surface through specialized equipments. Aquifers are important water sources, especially in arid areas. Aquifers provide water for irrigation, industrial use and household needs.

viii- Rainwater

Rainwater is a common natural source of water. It is a seasonal source of water. The rainwater is collected in water tanks and dams in the rainy season for use in dry season. Most people in the developing world rely on rain water. Rain water is used for household needs, farming, replenishing ponds and hydro-power generation.



Skills

- Draw and label Water Cycle.
- Devise ways to solve the shortage of water in Pakistan.

Different Types of Precipitation

The fall of moisture on the surface of the Earth in liquid or solid form is known as precipitation. Rain, snow and hailstorm are the forms of precipitation. Their detail is given below:

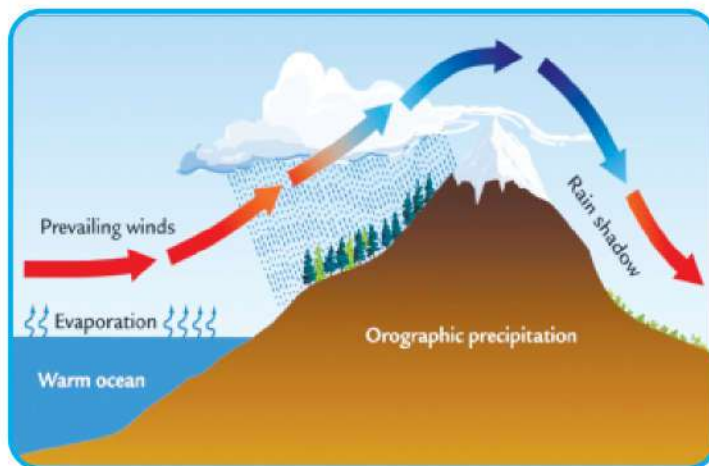
1. Rainfall

When moist air moves up from the Earth surface in the form of water vapours, condensation takes place and clouds are formed.

The vapours combine together and take the shape of water drops. When these drops become bigger, they fall down as rainfall. The following are the important types of rainfall:

(i) Orographic / Relief Rainfall

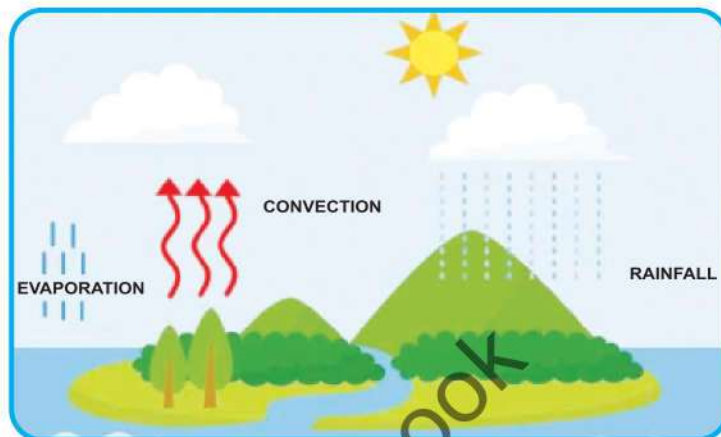
When the mountains block the moist air, it moves upwards and temperature drops. Vapours turn into drops and rainfall occurs. This is known as orographic rainfall.



Relief Rainfall

(ii) Convection Rainfall

The rain due to convectional currents is known as convectional rainfall. In hot areas, the air due to high temperature becomes light and moves upward on reaching at higher altitudes, condensation takes place which results in rainfall.



Convectional Rainfall

(iii) Cyclonic/Frontal Rainfall

Cyclones are spiral moving winds, having low pressure in its center. They are formed in the area where cold winds meet hot winds. Hot air moves upward being lighter in weight. Its temperature decreases gradually and condensation starts. Heavy clouds are formed and rainfall occurs. This type of rain occurs in the front of cyclone and its rear portion.

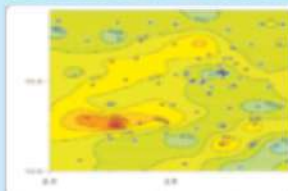
Rain Gauge

The instrument used to measure rain is Rain Gauge.



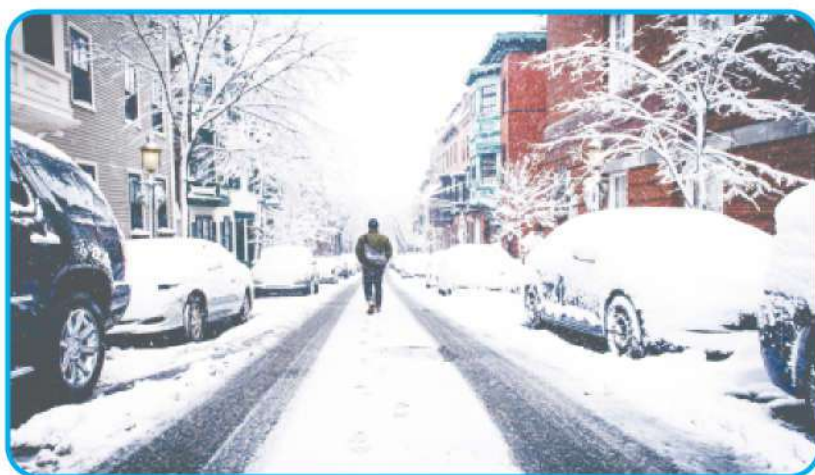
Isohyet

The lines on a map showing equal amount of rainfall are called isohyets.



2. Snowfall

Sometimes, humid air reaches the point in atmosphere where the temperature is even below freezing point. The water vapours instead of turning into droplets, turn into snow or into frozen crystals of snow. These crystals combine and make snow flakes. These flakes fall on the surface and form snowfall.



Snowfall

do You Know?

Precipitation is the source of fresh water storage in hilly, plain and desert areas.

3. Hailing

Air takes the water vapours to such cold areas in atmosphere where temperature is below freezing point. Here water vapours freeze and form hails which fall on the Earth. When these hails fall, the water vapours in their way join them and their size increases.

4. Sleet

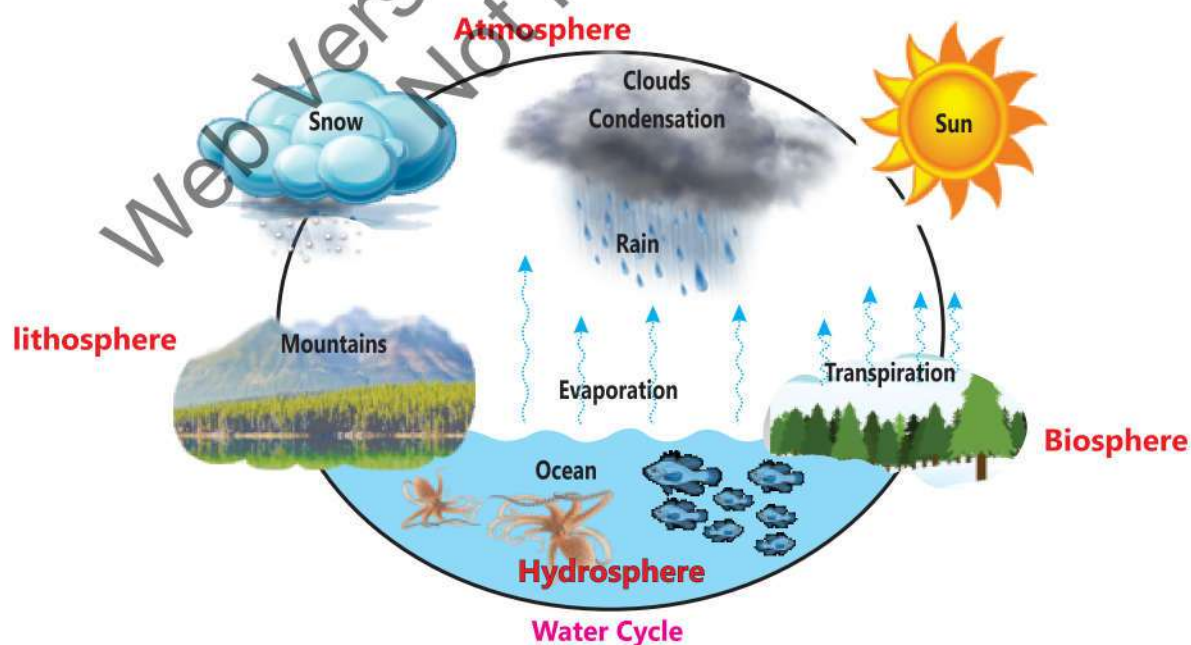
The combination of rainfall and snowfall is called sleet. When raindrops pass through the lower cold layers of atmosphere they freeze. These drops contain liquid water inside but their outer covering is hard.



Sleet

Process of Water Cycle

Water is the basic element of nature. It covers about 71% of the Earth surface. It provides life, eases out heat, drains harmful



substances and mediates many day-to-day activities. Water needs to be replenished, purified and circulated again and again so that it can perform its functions. Nature does this job through a process called the water cycle also known as hydrologic cycle. This is a phenomenon where water moves through the three phases (gas, liquid and solid) over the four spheres (atmosphere, lithosphere, hydrosphere and biosphere) and completes a full cycle.

The water cycle has many effects:

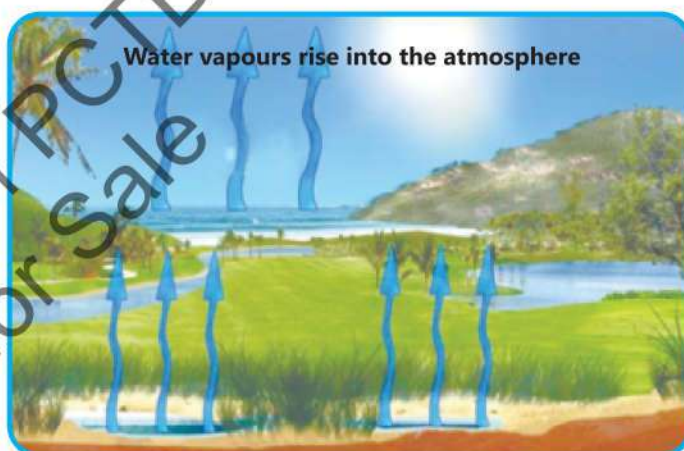
- It regulates the temperature of the surroundings.
- It changes weather and brings rain.
- It helps in conversion of rocks to soil.
- It circulates important minerals through the spheres.
- It also creates many geographical features present on earth like the ice caps of mountains, icebergs, rivers, valleys and lakes etc.

do You Know?

Plants also contribute to the process of evaporation through transpiration.

Step 1: Evaporation

The process of water cycle begins with evaporation. It is a process where water at the surface turns into water vapours. Water absorbs heat energy from the Sun and turns into vapours. Water bodies like oceans, seas, lakes and rivers, etc. are the main sources of evaporation.



Evaporation

Step 2: Condensation

When the vapours reach at higher altitude, their temperature decreases and the vapours turn into droplets. This conversion is called condensation.

Step 3: Sublimation

Sublimation is a process where ice directly converts into water vapours without converting into liquid water or vapours directly converts into ice without converting into liquid.

Let us Learn More!

- Global warming has impacted the Water Cycle causing wet places to become wetter and dry places drier.

Step 4: Precipitation

During condensation the water droplets join together and start falling on the earth surface, it is called precipitation. Rainfall is most common form of precipitation.

Step 5: Transpiration

Transpiration is a process similar to evaporation where liquid water is turned into water vapours by the plants.

Step 6: Runoff

Runoff is a process where water runs over the surface of the Earth. As water runs over the ground, it displaces the top soil with it and moves the minerals along with the stream.

Step 7: Infiltration

Some of the water that precipitates does not runoff into the rivers and is absorbed by the plants or gets evaporated. It moves deep into the soil. This is called infiltration. The water seeps down and increases the level of ground water table. It is called pure water and is drinkable.

Activity:

- Design a poster of various sources of water and display in the classroom.

Different Uses of Sewage Waste/Gray Water Uses

Sewage water or Municipal waste water means the water that has been used in urban and suburban area homes or businesses for washing, bathing and flushing toilets. Municipal wastewater may also include water from industrial sources.

The wastewater is conveyed via the sanitary sewerage system to a centralized wastewater treatment plant. The treated water is released to streams and rivers or may be sprayed over large areas of land.



Skill

- Evaluate ways of using wastewater.

Critical Thinking Questions:

- Explore different uses of sewage waste with the students.

Biogas as a Source of Energy

- Biogas is a renewable fuel produced by the breakdown of organic matter such as food scraps and animal waste.
- It can be used in a variety of ways including as vehicle fuel and for heating and electricity generation.
- Biogas has gained popularity in recent years as a “greener” fuel.
- Biogas is an environment-friendly and renewable energy source. For this, the waste material needs to be enclosed in an environment where there is no oxygen.
- After biogas is captured, it can produce heat and electricity for use in engines, microturbines and fuel cells.
- Biogas can also be upgraded into biomethane, and injected into natural gas pipelines or used as a vehicle fuel.



Biogas

Various Water Purification Methods

It is extremely important to confirm the water has been purified or treated before drinking. If water is contaminated that there are various water purification methods that are used today Each method has its own merits and demerits. Filtering is good for basic water tasks such as sediment and chlorine removal, but in the long run reverse osmosis is the best option. There are four water purification methods that we can use to make our water safe for drinking.

1 Boiling

Boiling Water is the cheapest and safest method of water purification. Sometimes the water contains parasites and germs that we may not see with naked eyes, but they badly affect our health. So, clean water should be brought to boil and left at rolling-boil for 1-3 minutes.



Boiling of water

2 Filtration

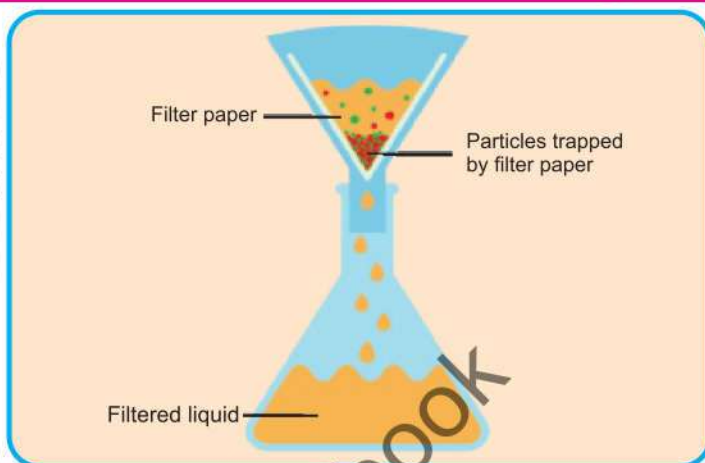
Filtration is one of the effective ways of purifying water. This method uses chemical and physical processes to purify water and make it

safe for human consumption. Filtration eliminates both large and small compounds, dangerous contaminants that cause diseases with a simple and quick filtration process. It is cost effective method of purification as it involves less energy and very little water is lost during this method.

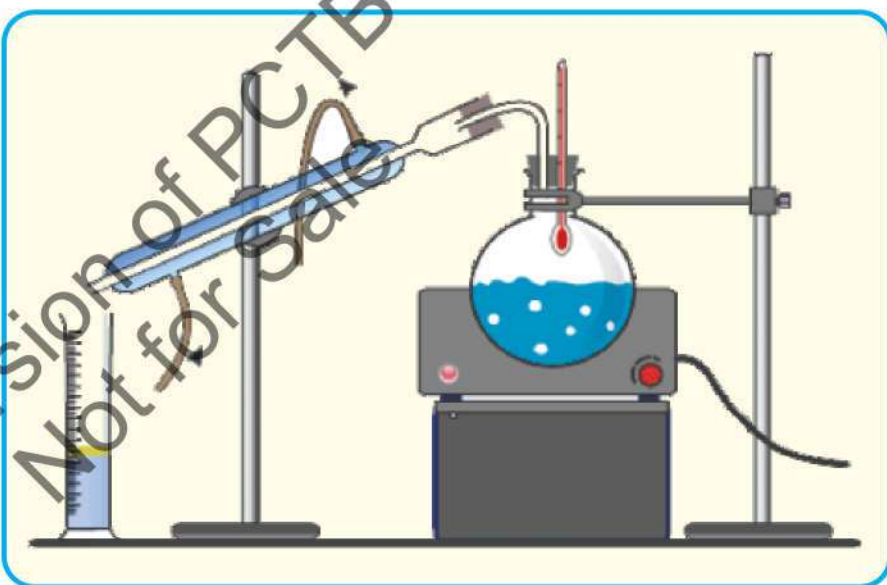
3 Distillation

Distillation is a water purification method that utilizes heat to collect pure water in the form of vapours. This method is effective as proven by the scientific fact that water has a lower boiling point than other contaminants and disease-causing elements and organisms found in water. Water is subjected to a heat source until it attains its boiling point. It is then left at the boiling point until it vaporizes. These vapours are directed into a condenser to cool. Upon cooling, vapours are turned into liquid water that is clean and safe for drinking. Other substances that have a higher boiling points are left as sediments in the container.

This method is effective in removing bacteria, germs, salts and other heavy metals such as lead, mercury and arsenic.



Filtration



Distillation

4. Chlorination

Chlorine is an effective water purification method that kills germs, parasites and other disease-causing organisms found in ground or tap water. Water can be purified using chlorine tablets or liquid chlorine. Chlorine is cheaper and effective. However, caution should be taken when using chlorine liquid or tablets to treat drinking water. For example, people suffering from thyroid problems should talk to a medical practitioner before using this product. Chlorine tablets kill all bacteria leaving water clean and safe.



Skills

- Organize information about water purification methods into flow charts.
- Analyze the reasons for the scarcity of drinking water in cities.

Note For Teacher:

- Divide the class into groups and assign one method of water purification to each group. Each group to make mini-projects/presentations and share their findings with other groups.

What We Have Learnt!

1. Water is one of the most important commodities on Earth and it is essential for life.
2. Oceans are the largest sources of water on the planet. There are five oceans in the entire world.
3. Lakes are an important source of livelihood for many people around the world.
4. Rivers are natural paths through which water flows towards another river or a larger water body.
5. Glaciers are formed when large pieces of ice accumulate over several years.
6. Aquifers are water sources found below the surface of the Earth.
7. The fall of water drops on the surface of Earth in liquid or solid form is known as precipitation.
8. Water is the basic element of nature. It covers about 71% of the Earth's surface.
9. Biogas is a renewable fuel produced by the breakdown of organic matter such as food scraps and animal waste.
10. While using chlorine tablets, it is important to apply them in heated water.

EXERCISE

Q.1: Tick (✓) the correct answer.

- i. The cheapest naturally occurring water source:
(a) river (b) glacier
(c) ocean (d) rainwater
- ii. The Water Cycle begins with:
(a) evaporation (b) condensation
(a) transpiration (d) infiltration
- iii. Water covers of the Earth's surface:
(a) about 69% (b) about 71%
(c) about 73% (d) about 75%
- iv. Water purification methods are :
(a) 2 (b) 3
(c) 4 (d) 5
- v. The river is estimated to carry 20% of all the fresh water found on the Earth:
(a) Indus (b) Amazon
(c) Nile (d) Tigris

Q. 2: Give the short answers of the following:

- i. What is orographic rainfall?
- ii. Write two uses of biogas.
- iii. Define the term Chlorination.
- iv. What are aquifers?
- v. Which instrument is used to measure rain?

Q. 3: Write the answer of the following in detail:

- i. Explain the major sources of water on Earth and Pakistan? Explain
- ii. Describe the different types of precipitation.
- iii. Explain the process of Water Cycle in maintaining water supply of the Earth.
- iv. Describe different uses of sewage waste.
- v. Discuss the biogas as a source of energy.

Learning Activities:

The Teacher will:

- i. Show students photographs/ videos of areas affected by scarcity of water. Ask them to discuss its impacts on life in general (lifestyle, economy, weather, environment, flora, and fauna) in pairs/ groups.
- ii. Show videos or arrange Student Study Tours to biogas plants and water treatment units.
- iii. Use diagrams or presentations to explain different aspects of the unit like water sources, Water Cycle, and water treatment to develop their understanding.

Critical Thinking Questions:

- What will happen if there is no Water Cycle?
- Can biogas reduce climate change?
- How does sewage affect water quality and aquatic life
- Which regions received the highest rate of precipitation and why?

Projects For Students:

- Make a project on conservation of water purification methods.