

**ARULMIGU PALANIANDAVAR ARTS COLLEGE
FOR WOMEN, PALANI**

PG DEPARTMENT OF ZOOLOGY

Learning Resources

ENVIRONMENTAL BIOLOGY & BIODIVERSITY

TYPES OF BIOGEOCHEMICAL CYCLES

- There are two types of biogeochemical cycles, the gaseous and the sedimentary.
- In gaseous cycles the main reservoir of nutrients is the atmosphere and the ocean.
- In sedimentary cycles the main reservoir is the soil and the sedimentary and other rocks of the earth's crust.
- Both involve biotic and abiotic agents, both are driven by the flow of energy and both are tied to the water cycle.

WATER CYCLE

- Living organisms, atmosphere and earth maintain between them a circulation of water and moisture, which is referred to as **water cycle or hydrologic cycle**

- Water is important for an ecosystem for several reasons—

It is the medium by which nutrients are introduced into autotrophic plants;

It is an important part of living tissue, either as liquid water or as part of essential organic molecules;

It serves as a means of thermal regulation for both plants and animals;

It is the medium by which sediments—a prime source of mineral nutrients—are removed from or added to local ecosystems; it covers the great majority of the earth's surface, and is the dominant feature of all aquatic ecosystems.

- The hydrologic cycle is driven by solar energy and gravity.
- More than 80 per cent of the total insolation that is not lost immediately as electromagnetic radiation goes to evaporate water.
- The atmospheric water vapour produced by this means can then condense around particles of dust in the atmosphere, often called **nucleation particles**.
- The atmosphere possesses a limited capacity for holding water vapour, thus, the droplets formed by this means are heavy enough to fall as **precipitation**

under the influence of gravity.

- The hydrologic cycle can be defined as an alternation of evaporation and precipitation, with the energy used to evaporate the water being dissipated as heat in the atmosphere as the water condenses.

DISTRIBUTION OF WATER IN EARTH'S SURFACE:

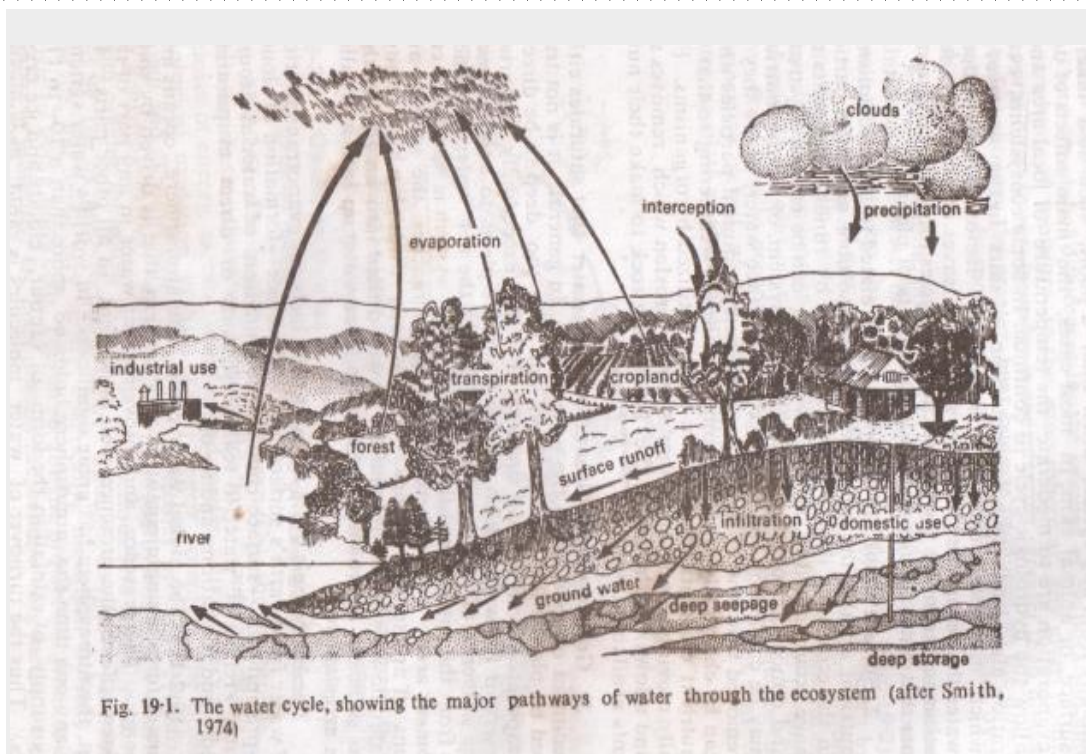
- Water is not evenly distributed throughout the earth.
- Almost 95 per cent of the total water on earth is chemically bound into rocks and does not cycle.
- Of the remainder about 97.3 per cent is in the ocean, about 2.1 percent exists as ice in the polar caps and permanent glaciers, and the rest is fresh water, present in the form of atmospheric water vapour, ground water, soil water, or inland surface water.

THE RATE OF CYCLING OF WATER

The rate of cycling between surface and atmosphere is very rapid.

- The amount of water vapour in the atmosphere is sufficient, on the average, **turnover** the entire earth to a depth of 2.25 cm.
- But the average annual rainfall for the earth is about 81.1 cm and in some places it ranges up to 1.200cm.
- This means that the average turnover time for atmospheric water is about 11.4 days, or that the equivalent of all the water vapour in the entire atmosphere fall as precipitation and is re-evaporated more than 32 times per year.
- Further, the distribution of evaporation and rainfall is quite uneven.

If we compare the annual evaporation and precipitation over land and sea, we find that relatively more water precipitates on land than evaporates from land. This is fortunate from the point of view of terrestrial organisms. Even so, the amount of rainfall on the open ocean is proportionately greater than that on land, taking into account the relative percentages of the earth's surface covered by land and sea.



NATURE OF HYDROLOGIC CYCLE

- The hydrologic cycle over the oceans is extremely simple—the water is evaporated from the surface of the ocean and water vapours form the clouds which when cool down precipitate the water as rain fall.
- But several routes are open to precipitation that falls on land—direct evaporation, transpiration, entry of water into ground water system and runoff. (Fig. 19.1)
- The routes of hydrologic cycles on land can be divided into following three main categories—
 - the rapidly cycling portion or **evapotranspiration**, which includes the evaporation and transpiration,
 - the less rapidly cycling water, or surface runoff, and
 - very slowly cycling ground water that seeps into the soil can end up in any one of these three categories.

1. EVAPOTRANSPIRATION.

- Evapotranspiration includes evaporation and transpiration. **Evaporation** refers to water that is evaporated directly from any surface other than a plant, such as a lake, soil surface, or animal skin.

- In most cases, the main effects of direct evaporation are to moderate the temperature of local area and to allow the hydrologic cycle to continue. In some ecosystems, evaporation also leads to a concentration of salts in the water of soil which may be a critical environmental factor.
- **Transpiration** is water that evaporates from the surface of leaves of plants. Transpiration acts to move the biogeochemical cycles for all mineral nutrients that enter the food-chain via the roots of plants.

2. SURFACE RUNOFF.

- If transpiration is related to the mechanism of nutrient uptake, the gross movement of soluble and solid particles in the ecosystem is accomplished largely by runoff.
- Nutrients that have accumulated in sediments or soils can be eroded by streams and removed altogether from a local ecosystem, or soluble nutrients may be carried by soil.
- Seepage into surface water, where they are removed from the area. Streams may carry sediment particles which can be chemically altered through additional weathering so that the nutrient elements they contain may be utilized by organisms.
- Finally moving water acts as an agent of **erosion** removes soil and allows weathering of the underlying rock to make their nutrients available to plants.

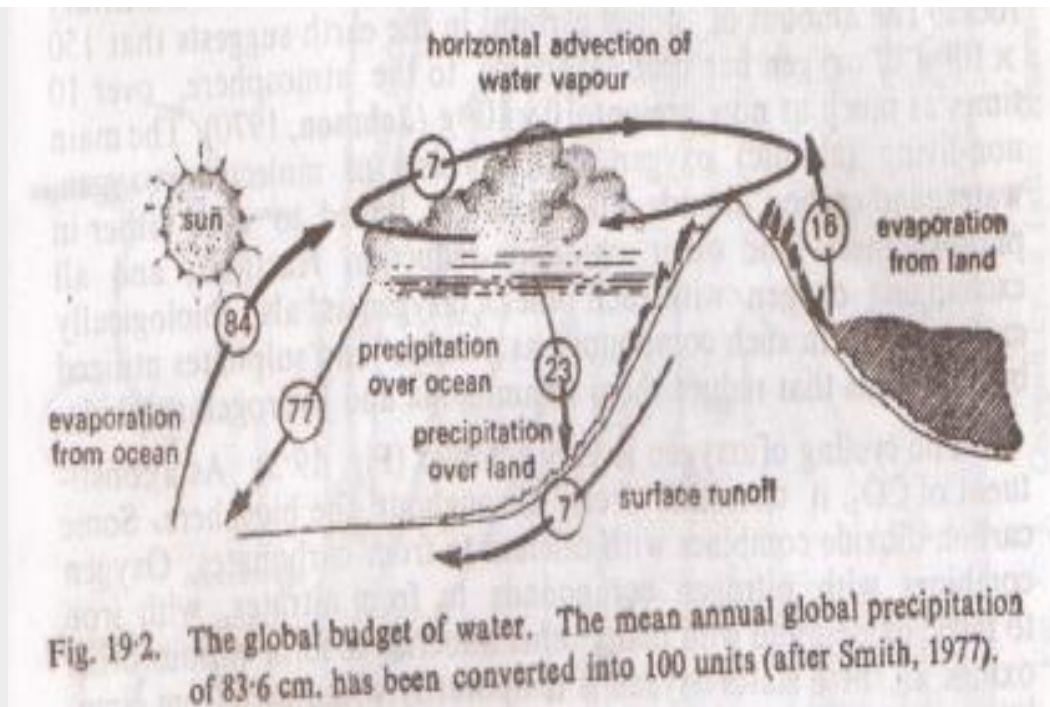
3. GROUND WATER.

- Ground water is water that saturates either sediment or rock below the water table.
- In general, it is not trapped by plants for transpiration and it is too deep to be directly evaporated from the soil surface.
- It is an exceedingly important reservoir for water which moves from one place to another under the influence of gravity.
- The area where the net water movement is from the surface into the ground water system is termed a **catchment area**; areas where ground water reaches the surface and runs off are termed **springs**.
- A rock body through which ground water flows is called an **aquifer**.
- A well drilled into an aquifer that has sufficient hydrostatic pressure to force water up into it is called an **artesian well**.
- The hydrologic cycle on land thus includes evapotranspiration of water from earth's surface and leaf surface—>formation of clouds
—>precipitation-» surface runoff + accumulation of water as ground water

—>return of water to sea via streams or direct evaporation
and cloud formation, and so on.

THE GLOBAL WATER CYCLE

- The atmosphere, oceans and masses form a single gigantic system that is driven by solar energy.
- The presence and movement of water in any part of the system affects the presence and movement in all other parts.
- The atmosphere has great significance in world's water system.
- At any one time the atmosphere holds no more than a 10— to 11—day supply of rainfall in the form of vapour, clouds and ice crystals. Thus the turnover of water molecules is rapid.
- Because the source of water in the atmosphere is evaporation from land and sea, there are global differences in the amount of evaporation and the amount of moisture in the atmosphere at any given point.
- Evaporation at lower latitudes is considerably greater than higher latitudes, showing the greater heat budgets produced by the direct rays of the sun.
- Evaporation is greater over ocean than over land.



- Thus, evaporation, precipitation, detention, and transportation maintain a stable water balance on the earth.
- Consider the amount of water that falls on the earth in terms of 100 units (Fig. 19•2). On the average, 84 per cent of water is lost from the ocean by evaporation, while only 77 per cent of water is gained by it from precipitation.
- Land areas loss 16 per cent of water by evaporation and gain 23 per cent of it by precipitation.
- Water runoff through rivers from land to oceans makes up 7 per cent, which balance the evaporative deficit of the ocean.
- The remaining 7 per cent of water circulate as atmospheric moisture.