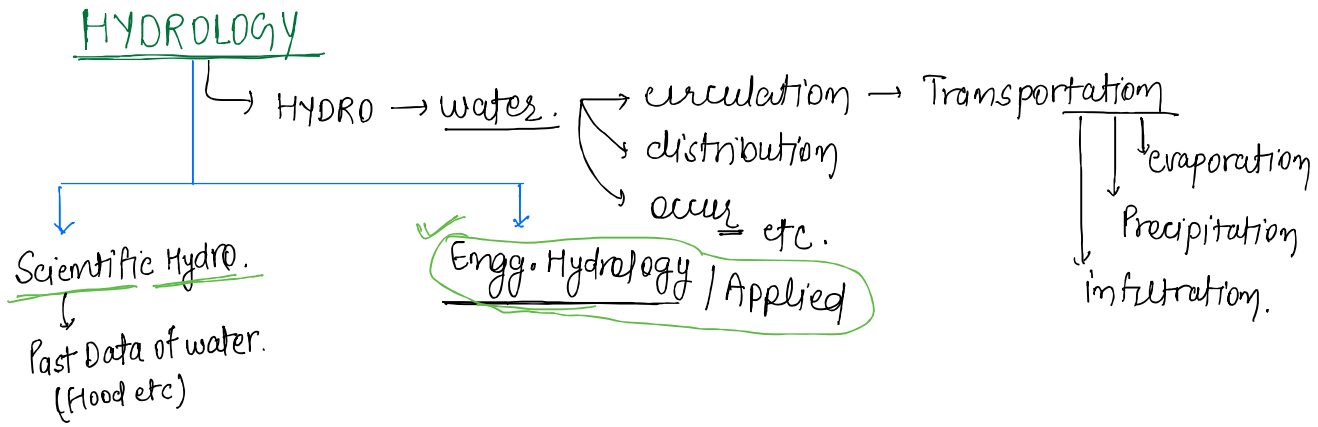
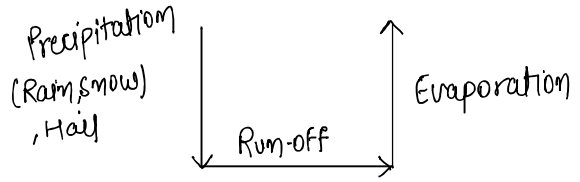
HYDROLOGY



⇒ It is a science of wates

→ It deals with occurance, circulation & distribution of wates of the earth and atmosphere.



⇒ Circulation.

→ It is further classified into two parts :-

(A) Scientific hydrology :- It is the study of wates concerned with acadmic aspects. i.e records of past data.

Ex:- Flood record.
Rainfall Data.

(B) Engineering Hydrology :- (Applied Hydrology)

It is the study of wates concerned with Engg. application of sources of wates, water processes.

i.e.-precipitation, evaporation, transportation, infiltration etc.

⇒ In order to understand occurance, circulation, storage of waters, hydrological cycle can be analysed :-

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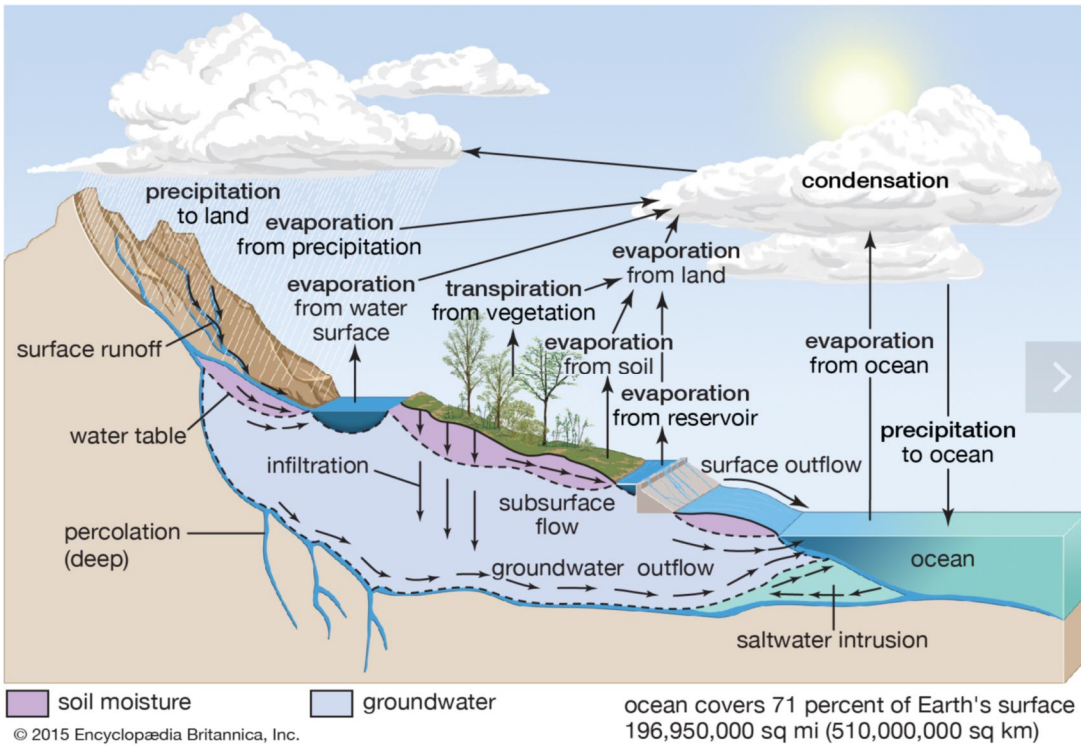
water cycle

↳ continuous process. ⊢ start, end, Pause } ??? No idea.

↓

quantity same ⟶ only forms change

Diagram:-



⇒ The precipitation and evaporation continuous forever hence a balances maintained b/w the two. which can be understood from water cycle.

⇒ Since it is continuous process, it has no starting point, end point or point at which it pause.

⇒ Water in oceans vapourises upward and form clouds, which undergo condensation and forms precipitation,

that again falls over the ocean predominantly.

⇒ Some clouds moves over land due to wind and precipitates there.

⇒ The precipitations further undergoes following :-

(i) Evaporation from precipitation.

(ii) Intercepted by obstruction (Interception) which may be natural (plants or trees, mountains) or artificial (Building).

(iii) Certain portion of interception vapourises and remaining falls over surface.

(iv) During photosynthesis plant utilises water from soil and transpires certain portion back into the atmosphere.

(v) Reaches the surface water, which further undergoes —

(a) Evaporation.

(b) Fill the depression over the ground (Depression storage)

(c) Flow under gravity from surface into the soil through voids termed as infiltration.

(d) Flow over the surface (surface run-off) meets the stream after which it is termed as stream run-off.

NOTE :- Seepage :- certain portion of infiltration flow under head (energy) difference (Horizontally & vertically) and meet the stream termed as seepage.

Percolation :-

Flow of water through voids of soil under gravity

from unsaturated to saturated soil mass is termed as percolation.

Or

It is movement of water from one layer to another layer.

Deep-Percolation:-

If this percolation flow through voids, cracks, fissures of impermeable (stone, rock) strata it is termed as deep percolation.

Infiltration:-

It is movement of water into the soil from earth surface.

Base-flow:-

Certain portion of ground water also meets the stream over the period of time and termed as base-flow. (Prolonged interflow)

Precipitation:-

It is depositions of water on the earth-surface in the form of rain, snow, hail, sleet etc.

Transpiration:- → (occurs during photosynthesis)

It is the soil moisture taken up through roots of plant and discharge into the atmosphere through the vegetation by evaporation.

Storage:- Volume of water gets stored in natural depression at basin.

⇒ There are several paths of water cycle, each of which has one or more following aspects :-

* Transportation of water
* Temporary storage
* Change of phase/state.

* Transportation components of wates cycle are-
  - Precipitation
  - Evaporation
  - Run-off
  - Transpiration
  - Infiltration / seepage / percolation.

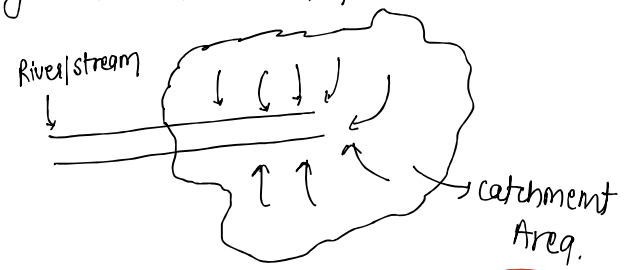
⇒ Storage Components Of Wates Cycle:-
  i) Ground wates storage
  ii) soil moisture storage
  iii) storage on surface (lake, pond, depression etc.)

⇒ Wates Budget Equation:-

→ For a given problem area (catchment area), In an interval of time Δt, the continuity eqⁿ for wates. i.e conservation of mass of wates in its various phases is applicable.

* Catchment Area:-

The area of land draining into the stream is termed as catchment area.



>>> Continuity Equation:-

Mass inFlow − Mass outFlow = Change in Mass storage

$$V_i - V_f = \Delta S$$

$$P - R - G - E - T = \Delta S$$

Here $\boxed{P - R = \text{Losses (L)}}$

that portion of Rainfall which not converted to run off are losses.

$\Rightarrow \boxed{\frac{R}{P} = k}$ → Coeff. of Rainfall

↳ Portion of wates converted to rainfall.

let $k = 0.4$

↳ 40% Runoff

↳ loss 60

[R → Run-off
P → Precipitation.]

Q. A small catchment of Area 150 hec. recieved a rainfall of 10.5 cm in 90-minutes due to storm at the outlet of catchment, the stream draining the catchment was dry before the storm & experienced a run-off lasting for 10 hr. which an avg. discharge of 1.5 m^3/sec.

The stream was again due after the run-off event compute -

(A) what is the amount of wates that is not available to runoff.

(B) what is coeffitient of run-off.

Sol^n - Loss (L) $= P - R$

$= (150 \times 10^4) \times 10.5 \times 10^{-2} = 1.5 \times 10 \times 60 \times 60$

$= 103500\ m^3$

$k = \frac{R}{P} = \frac{1.5 \times 10 \times 60 \times 60}{150 \times 10^4 \times 10.5 \times 10^{-2}} = 0.34$

Q A lake had a water surface elevation of 103.2 m. above datum. at the beginning of a certain month. In that month the lake recieve an avg. inflow of 6 m^3/sec. from surface run-off sources. In the same period the outflow from lake had a value of 6.5 m^3/sec. Furthes in that month, the lake recieved rainfall of 145mm and Evaporation from the lake surface was 6.10cm.

(A) Mention the water budget eqn for this lake.

(B) Calculate water surface elevation of the lake at the end of the month.

(C) The avg. surface area of lake 5000 hec.

inflow = 6.3 m^3/sec.
outflow = 6.5 m^3/sec.
Evaporation = 6.10cm
Precipitation = 145mm.

Area = 5000 hec.
= 5000×10^4 m^2

water budget eqn $V_i - V_f = \Delta S$

$$\left[\frac{6 \times 30 \times 86400}{5000 \times 10^4} + 0.145\right] - \left[\frac{6.5 \times 30 \times 86400}{5000 \times 10^4} + 6.1 \times 10^{-2}\right] = \Delta S$$

$$\boxed{\Delta S = 0.058 \text{ m}}$$

water surface elevation = 103.2 + 0.058 = 103.258 m.

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Precipitation :-

↳ transport element

⇒ It represent all forms of water that reaches the earth surface from the atmosphere.

⇒ for precipitation to form, conditions required :-

a.) Presence of moisture in the atmosphere.

b.) Presence of suffitient nuclei (medium) particles to help condensation.

c.) Weather conditions, must be optimum for condensation to take over.

d.) The product of condensation must reach earth surface. (Rain, hail, sleet etc)

Precipitation Occurs in Following forms :-

i) Rain :-

The term is used generally when water droplets are of size 0.5 - 6 mm.

→ The rain can be classified on the basis of its intensity as follows :-

Intensity (mm/hr)	Types of Rain
< 2.5	Light
2.5 - 7.5	Moderate
> 7.5	Heavy

NOTE :-

i) In india avg. precipitation is about 120 cm/year. which is greater than world average of 100 cm/year.

ii) In order to find this annual average rainfall of a place a minimum of 30 years data is required.

iii) If total rain in a day is more than 2.5mm then that day is called "rainy day."

2.) Snow:-

→ It consist of ice crystals which combined to form ice flakes.

→ Initially flakes have density in rongle of 0.06 - 0.15 gm/cm³ (having average value of 0.1 gm/cm³)

→ It is also one of the mayes form of pricipitation in india that takes place in Himalyan Region.

3.) DRIZZLE:-

When water droplets are of size less than 0.5mm, then it is drizzle.

→ Its intensity should be less than 1mm/hr.

→ Here particles size are of such range, that they can be seen floating into the air.

4.) Glaze:-

When rain or drizzle comes in contact with cold ground 0°c, water is converted into ice coating, termed as glaze, also called freezing Rain.

5.) Sleet:-

It is frozen rain drop which formed when rain falls through air at sub-freezing temprature.

Diagram:-