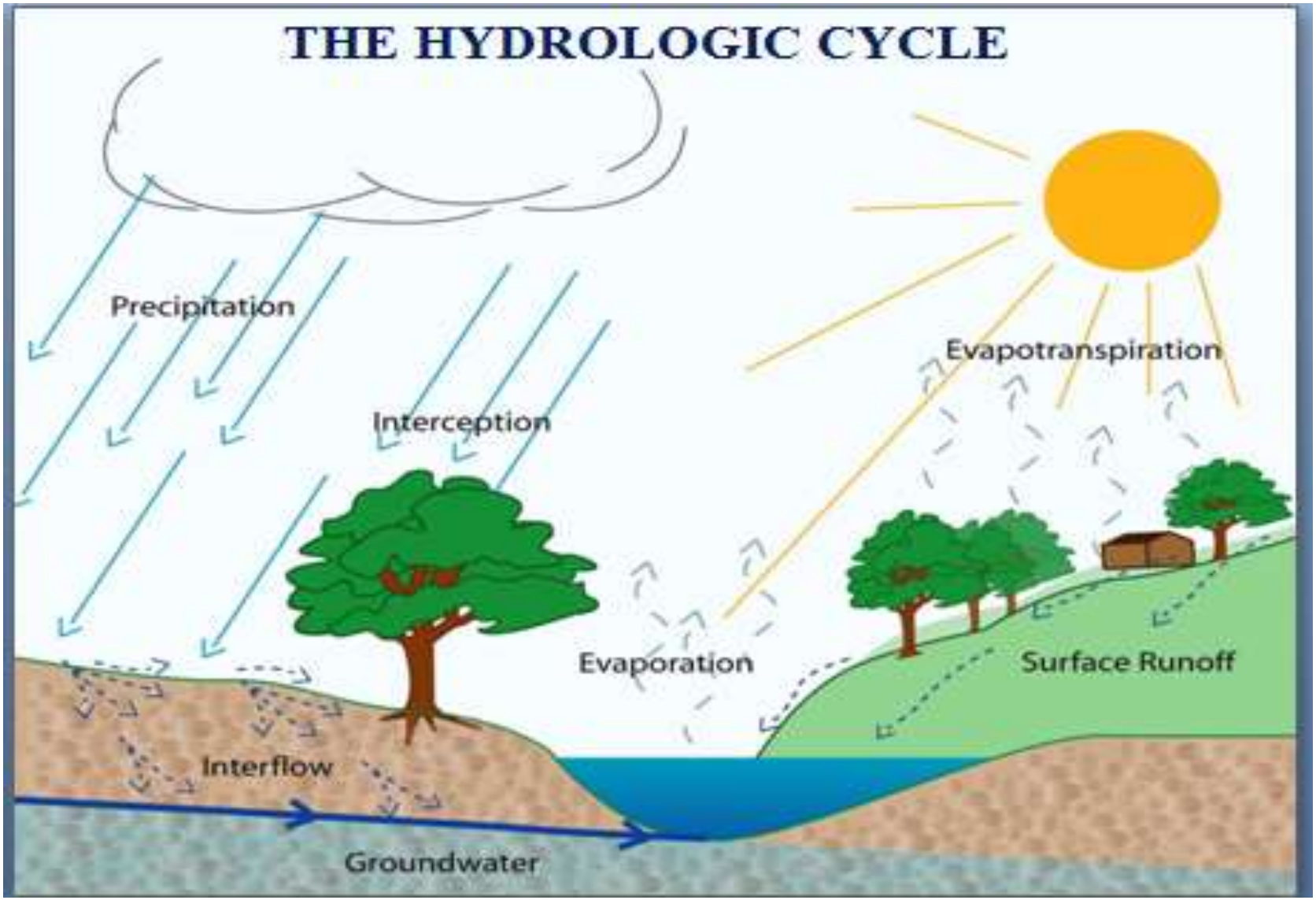
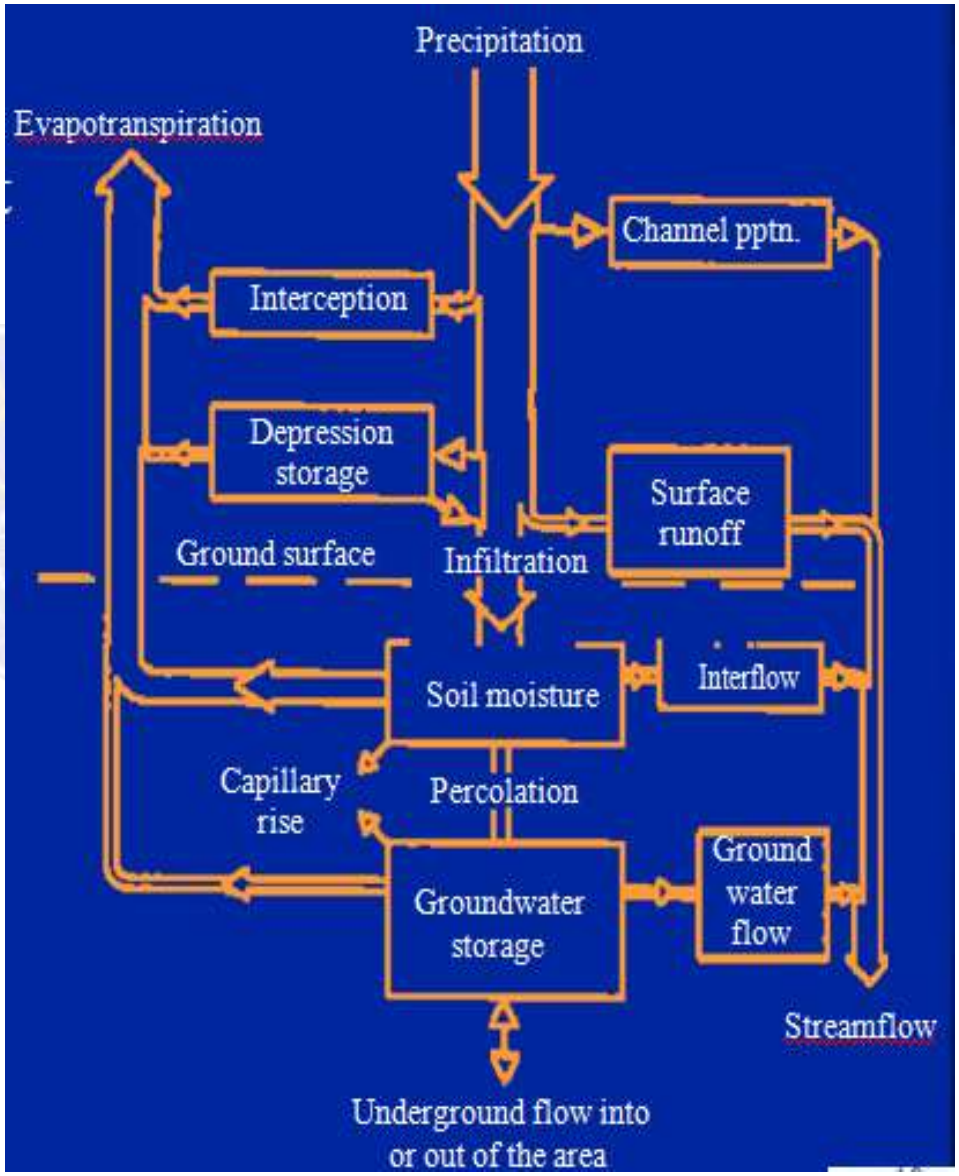
FACULTY OF ENGINEERING & TECHNOLOGY

TOPIC : HYDROLOGY (L-1)



TOPIC : HYDROLOGY (L-1)

- **HYDROLOGIC COMPONENT**
- Rainfall Or Snow
- Interception
- Depression Storage
- Evapo-transpiration
- Infiltration
- Surface Storage
- Runoff
- Interflow
- Groundwater Flow



WATER BALANCE

Water Balance Equation €

$$R = P - ET - IG - \Delta S$$

Whereas P = Precipitation

R = Runoff

ET = Evapotranspiration

IG = Deep/inactive groundwater

ΔS = Change in soil storage

Inter-relationships between components

Variation of components with time

consideration of soil condition, cover, antecedent conditions, land practices

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TOPIC : HYDROLOGY (L-1)

Water-Budget Equation

$P + Q_{in} = ET + \Delta S + Q_{out}$ (A1)

Whereas

P is precipitation,

Q_{in} is **water** flow into the watershed,

ET is evapotranspiration (the sum of evaporation from soils, surface-**water** bodies, and plants),

ΔS is change in **water** storage, and

Q_{out} is **water** flow out of the watershed.

Inter-relationships between components Variation of components with time

consideration of soil condition, cover, antecedent conditions, land practices

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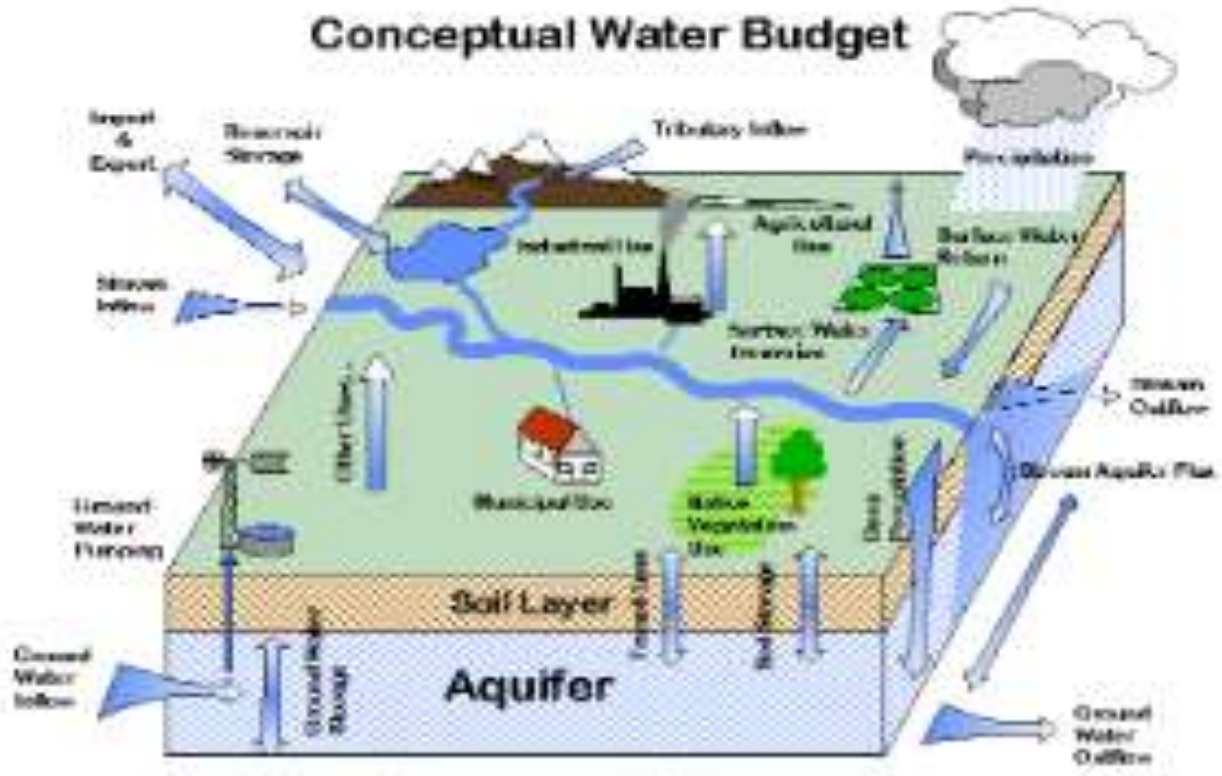

Hydrologic Budget

TOPIC : HYDROLOGY (L-1)

The hydrologic budget consists of inflows, outflows, and storage as shown in the following equation:

Inflow = Outflow +/- Changes in Storage

Inflows add water to the different parts of the hydrologic system, while outflows remove water. Storage is the retention of water by parts of the system. Because water movement is cyclical, an inflow for one part of the system is an outflow for another.

Precipitation = Evapotranspiration + Total Runoff,

Whereas, Total Runoff = Direct Runoff + Base flow (groundwater component of stream flow)

Looking at an aquifer as an example, percolation of water into the ground is an inflow to the aquifer. Discharge of groundwater from the aquifer to a stream is an outflow (also an inflow for the stream). Over time, if inflows to the aquifer are greater than its outflows, the amount of water stored in the aquifer will increase. Conversely, if the inflows to the aquifer are less than the outflows, the amount of water stored decreases. Inflows and outflows can occur naturally or result from human activity.

The earth's water supply remains constant, but man is capable of altering the cycle of that fixed supply. Population increases, rising living standards, and industrial and economic growth have placed greater demands on our natural environment. Our activities can create an imbalance in the hydrologic equation and can affect the quantity and quality of

natural water resources available to current and future generations.

Water use by households, industries, and farms have increased. People demand clean water at reasonable costs, yet the amount of fresh water is limited and the easily accessible sources have been developed. As the population increases, so will our need to withdraw more water from rivers, lakes and aquifers, threatening local resources and future water supplies.

A larger population will not only use more water but will discharge more wastewater. Domestic, agricultural, and industrial wastes, including the intensive use of pesticides, herbicides and fertilizers, often overload water supplies with hazardous chemicals and bacteria. Also, poor irrigation practices raise soil salinity and evaporation rates. These factors contribute to a reduction in the availability of potable water, putting even greater pressure on existing water resources.

Large cities and urban sprawl particularly affect local climate and hydrology. Urbanization is accompanied by accelerated drainage of water through road drains and city sewer systems, which even increases the magnitude of urban flood events. This alters the rates of infiltration, evaporation, and transpiration that would otherwise occur in a natural setting. The replenishing of ground water aquifers does not occur or occurs at a slower rate.

Together, these various effects determine the amount of water in the system and can result in extremely negative consequences for river watersheds, lake levels, aquifers, and the environment as a whole. Therefore, it is vital to learn about and protect our water resources.

TOPIC : HYDROLOGY (L-1)

❖ MAIN FORMS OF PRECIPITATION

- ❑ Drizzle,
- ❑ Rain,
- ❑ Sleet,
- ❑ Snow,
- ❑ Ice Pellets,
- ❑ Graupel
- ❑ Hail.

❖ **Precipitation** occurs when a portion of the atmosphere becomes saturated with water vapor (reaching 100% relative humidity), so that the water condenses and "**precipitates**".

TOPIC : HYDROLOGY (L-1)

Precipitation is any type of water that forms in the Earth's atmosphere and then drops onto the surface of the Earth. Water vapor, droplets of water suspended in the air, builds up in the Earth's atmosphere. Water vapor in the atmosphere is visible as clouds and fog. Water vapor collects with other materials, such as dust, in clouds.

Precipitation condenses, or forms, around these tiny pieces of material, called cloud condensation nuclei (CCN).

Clouds eventually get too full of water vapor, and the precipitation turns into a liquid (rain) or a solid (snow).

Precipitation is part of the water cycle. Precipitation falls to the ground as snow and rain. It eventually evaporates and rises back into the atmosphere as a gas. In clouds, it turns back into liquid or solid water, and it falls to Earth again. People rely on precipitation for fresh water to drink, bathe, and irrigate crops for food.

The most common types of precipitation are rain, hail, and snow.

Precipitation forms in the clouds when water vapor condenses into bigger and bigger droplets of water. When the drops are heavy enough, they **fall** to the Earth. ... These ice crystals then **fall** to the Earth as snow, hail, or rain, depending on the temperature within the cloud and at the Earth's surface

Rain

Rain is precipitation that falls to the surface of the Earth as water droplets. Raindrops form around microscopic cloud condensation nuclei, such as a particle of dust or a molecule of pollution.

Rain that falls from clouds but freezes before it reaches the ground is called sleet or ice pellets. Even though cartoon pictures of raindrops look like tears, real raindrops are actually spherical.

Hail

Hail forms in cold storm clouds. It forms when very cold water droplets freeze, or turn solid, as soon as they touch things like dust or dirt. The storm blows the hailstones into the upper part of the cloud. More frozen water droplets are added to the hailstone before it falls.

Unlike sleet, which is liquid when it forms and freezes as it falls to Earth, hail falls as a stone of solid ice.

Hailstones are usually the size of small rocks, but they can get as large as 15 centimeters (6 inches) across and weigh more than a pound.

Snow

Snow is precipitation that falls in the form of ice crystals. Hail is also ice, but hailstones are just collections of frozen water droplets. Snow has a complex structure. The ice crystals are formed individually in clouds, but when they fall, they stick together in clusters of snowflakes. Snowfall happens when many individual snowflakes fall from the clouds. Unlike a hail storm, snowfall is usually calm. Hailstones are hard, while snowflakes are soft. Snowflakes develop different patterns, depending on the temperature and humidity of the air.

When snow falls in the form of a ball instead of soft flakes, it is called **Graupel.** This happens when snow is melted and precipitation forms around the snow crystal. Snow requires temperatures at the ground to be near or below freezing—less than 0 degrees Celsius (32-degrees Fahrenheit). Snow that falls on warmer ground melts on contact.

Other Types of Precipitation

Sometimes, different types of precipitation fall at the same time. During harsh winter storms, for instance, it is not unusual for sleet and rain to fall at the same time. Other times, precipitation doesn't fall at all. Virga is a type of precipitation that begins to fall from a cloud, but evaporates before it reaches the surface of the Earth. Human activity can create precipitation. Urban heat islands, which are areas around major cities that are much warmer than their surroundings, lead to increased and more intense rainfall near cities.

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Global Warming also causes changes in global precipitation. When the planet is hotter, more ice evaporates in the atmosphere. That eventually leads to more rainy precipitation. It usually means wetter weather in parts of North America, for example, and drier conditions in tropical areas that are usually humid.

Thank You