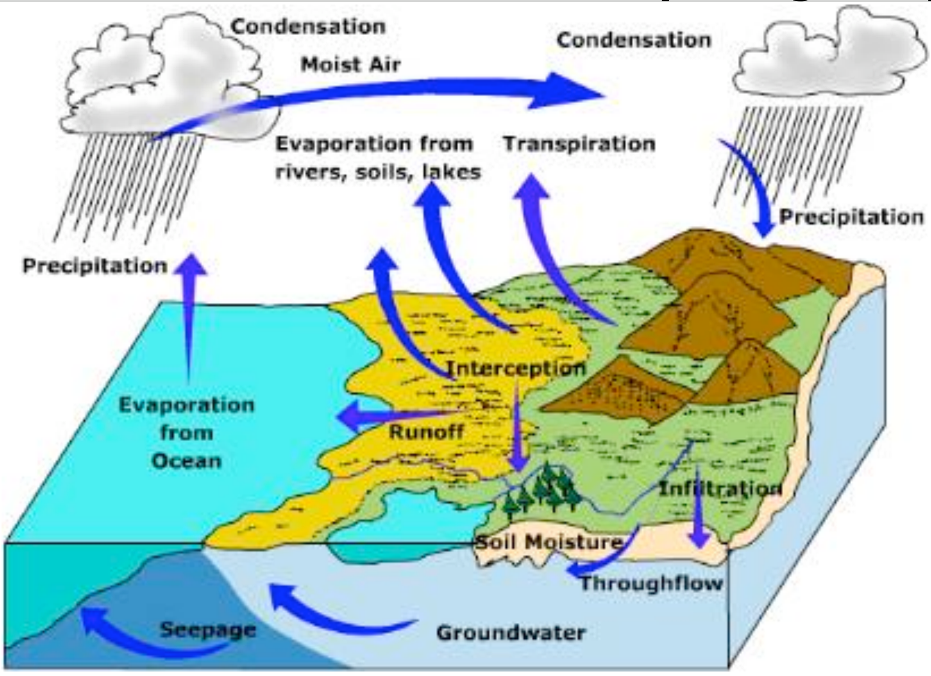

http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/hydrosphere/hydrologic_cycle.html

-TERMS & DEFINITIONS-

Hydrologic cycle	Models storage & movement of water across biosphere, atmosphere, lithosphere & hydrosphere
Drainage basin	Extent of land where rain / snowmelt drains into water body (marked by watershed boundaries)
Precipitation	Product of condensation of atmospheric water vapour
Infiltration	Where water on ground surface enters soil
Overland flow / Surface runoff	Flow of water, from rain / snowmelt, over land
Saturation overland flow (SOF)	When soil is saturated and rain continues to fall, rainfall immediately produces surface runoff
Infiltration excess flow (IEF)	When rate of rainfall exceed rate of infiltration and all storage has been filled
Throughflow	Movement of water horizontally beneath land surface
Percolation	Water draining through soil in the ground
Base flow	Groundwater seepage into stream channel, not attributable to runoff (rain / snowmelt)
Interception	Holding of raindrops by plant leaf / stem / branch
Throughfall	Raindrops penetrating through gaps in tree canopy
Soil moisture storage	Amount of water held in soil at any particular time
Channel storage	Volume of water at given time in channel
Groundwater	Water in ground in zone of saturation
Water table	Upper surface of zone of saturation
Aquifer	Underground layer of water-bearing permeable rock
Evapotranspiration	Water withdrawn from land by evaporation or transpiration
Channel flow	Runoff within confines of channel

http://en.wikipedia.org & http://water.usgs.gov/wsc/glossary.html

-INTRODUCTION-

1. Solar heating causes evaporation of water storage of oceans
2. Resultant water vapour condenses to form rain clouds
    a. Rain falls back to oceans
    b. Rain clouds transported by planetary winds over continental land masses
3. Evaporation & transpiration occurs over land surface
    a. Condensation in atmosphere lead to precipitation back onto land, increasing run-off, evaporating again or percolating into ground
4. Surface water returned to oceans by channel flow
    a. Losses meanwhile occur by percolation & evaporation
5. Water infiltrates into soil sinks into subsoil
    a. Water tapped by roots of plants contribute to evapotranspiration
    b. In highly permeable rock (limestone), water percolates more deeply to form zone of saturated rock (deep groundwater)
    c. Groundwater escapes onto surface when zone of saturation intersects land surface, forming springs & seepages that eventually contribute to rivers
6. Initial losses from ocean due to evaporation compensated for

-WATER BALANCE-

Precipitation = Evapotranspiration + Surface runoff (± Storage Δ)

River Flow = Precipitation – Evapotranspiration ± Changes in soil moisture & groundwater

- ✓ More realistic to calculate <u>annual water balance for particular regions / locations</u>
    - o Differs from global balance due to local influences (e.g. amount & type of precipitation, vegetation, temperatures, relief & rock type)
    - o Such balances best expressed in terms of water depth
- ✓ **Precipitation** provides initial input into hydrological cycle but also determines manner in which system operates
    - o Total annual precipitation: influences overall evapotranspiration & runoff losses
    - o Types of precipitation: controls amount & timing of runoff
    - o Intensity of precipitation: determines amount & rate of runoff
- ✓ Impact of rain on Earth's surface can be affected by presence of **vegetation**
    - o <u>Vegetation can reduce both rainfall intensity & proportion of total precipitation reaching ground level</u>
    - o Processes include interception, throughfall & stemflow
    - o Type of vegetation, size & nature of individual trees, density of tree cover & seasonal changes in forest are all factors
    - o <u>Vegetation cover facilitates infiltration</u> by reducing rainfall intensity at ground level & <u>provides plant root systems</u> opening up soil structure for percolation of rainfall
- ✓ **Evapotranspiration** depletes surface water

- Prevailing climate conditions can increase transpiration rates by high atmospheric temperatures, strong winds & low relative humidity
- Evapotranspiration = Precipitation – Run-off

-GROUNDWATER SYSTEM-

- ✓ **Infiltration** into soil through pores in soil that provide capillaries allowing pull of gravity to work on surface water
  - Infiltration capacity: ability of soil to allow water entry, expressed in depth of water infiltrating per unit time
  - Soil type influences infiltration (e.g. infiltration rate: sand > loam > clay)
- ✓ **Throughflow** occurs as water drains laterally downslope
  - Emerges as small springs & seepages on lower parts of slope or banks of streams, hence contributing to surface runoff
- ✓ Water flows through soil vertically / laterally until soil reaches saturation capacity
- ✓ Process of **percolation** of rainwater deeper down in soil forms **groundwater**
  - Zone of saturation where rock pores, joints & fractures are filled with groundwater
  - Border where saturated rock and unsaturated rock are divided known as water table
  - Rock stratum with abundance of underground water that can be tapped by wells & bore holes or escapes to Earth surface through springs known as aquifer
  - Perched water tables are pockets of groundwater stored above main water table, where downward percolation is impeded by relatively impermeable stratum
- ✓ Water table depleted by various means
  - During dry season, evapotranspiration depletes groundwater as plant extended root systems tap into deep groundwater
  - Extraction of water through wells & bore holes also deplete water table permanently
  - Irregular rainfall affects replenishment of water table
  - Greater losses of rainwater to accelerated run-off & evaporation from bare soil surfaces
  - E.g. Sahel: overuse + irregular rainfall + higher surface runoff = water table permanently declining
- ✓ Groundwater supplies especially plentiful in gently dipping sedimentary strata of alternate layers of permeable & impermeable rock
  - Springs appear along junctions of permeable & impermeable stratum and along fractures & joints through strata
  - Dip-slope springs form in dip-slope valleys and migrate up-dip & down-dip during wet or dry season respectively

-RUNOFF-

- ✓ Runoff consists of rainwater leaving drainage basin by surface routes as overland flow or channel flow
  - Initial direct product of rain / snowmelt but can be augmented by spring & seepage flow

- ✓ Overland flow (going downslope) comprises very thin layer of flowing water covering whole slope
    - Flows as sheet flow on upper slope, gradually concentrates into rills on lower slope that can cut into slope to form gullies
    - Overland flow is temporary, active only during & after rainfall
- ✓ **Horton Overland Flow / Infiltration Excess Flow** suggests that surface water cannot percolate fast enough hence excess water will accumulate and then overflow
    - When low / moderate rain, water will sink readily into ground
    - When high rainfall, infiltration capacity < rainfall intensity
    - Velocity of flow will also increase downslope
    - Limitations of model: works only in semi-arid areas, most other places infiltration capacity > rainfall intensity by a lot
- ✓ **Saturation Overland Flow** suggests that when rain falls on saturated soil surface water accumulates and overland flow begins
    - Build-up of water as rain falls causes throughflow and water will start accumulating from the slope base until saturation
- ✓ Channel flow, confined in rivers, can fluctuate seasonally based on climatic conditions (Mediterranean / tropical savanna climate especially)
    - Distinct rainy season and equally distinct dry season where runoff derives from subsurface water stores like springs & seepages (base flow)
    - Losses to evapotranspiration during dry season / summer can also be significant from channels