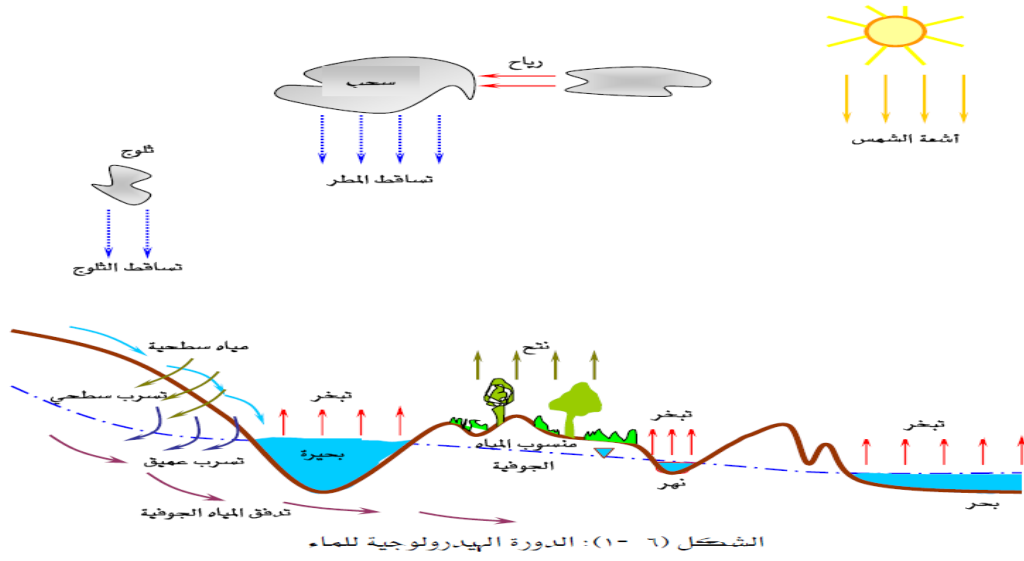


الدورة الهيدرولوجية Hydrology cycle

يهتم علم الهيدرولوجيا بدورة المياه على الكرة الأرضية سواء كانت هذه المياه في باطنها أو على سطحها أو بالغلاف الجوي من حيث توزيعها وخواصها الكيميائية والفيزيائية وتفاعلها مع مكونات البيئة وعلاقتها بالحياة.

يغطي الماء مايقارب ثلاثة أرباع الكرة الأرضية ويمر بحركة طبيعية مستمرة كما يوضحها الشكل (1). فدورة الهيدرولوجيا أو الدورة المائية تتكون من سلسلة من الأحداث التي تصف مسارات الماء من الغلاف الجوي إلى الأرض وبالعكس، ويمكن تلخيص أو تقديم صورة مبسطة للدورة الهيدرولوجيا من خلال جملة من الأحداث المتتالية:



- 1- يتبخر الماء من الأنهار والبحيرات والبرك والبحار تحت تأثير الإشعاع الشمسي مكوناً تجمعات لبخار الماء والتي تسمى الغيوم.
- 2- تتحرك الغيوم فوق مساحات اليابسة ويحصل السقوط ثم يبدأ الماء بالرجوع إلى البحر.
- 3- إن بعض الماء يترشح إلى داخل التربة ويسير إلى الأسفل أو ينفذ إلى الطبقة المشبعة (تحت مستوى الماء الأرضي) ويجري ببطء في الطبقات الحاملة للمياه إلى الجداول والأنهار وفي بعض الأحيان إلى البحر مباشرة.
- 4- الماء المترشح يمتص من قبل النبات ويلفظ إلى الجو بطريقة النتح (Transpiration).
- 5- قسماً من المياه المتبقية على سطح التربة تعود إلى الجو عن طريق التبخر المباشر، أما القسم الآخر فيجري سطحياً إلى الأنهار.
- 6- يتبخر جزء من المياه من المسطحات المائية والقسم المتبقي يرجع إلى البحر بواسطة الأنهار.

Water Resources Types:

- 1- **Atmospheric Water:** All water in the environment passes through the atmosphere at some time during the hydrological cycle such as (precipitations).
- 2- **Surface Water:** such as (Rivers, Lakes, reservoirs, tributaries, Oceans, gulfs, Ice cap, ... etc.).
- 3- **Groundwater.**

SURFACE WATER:

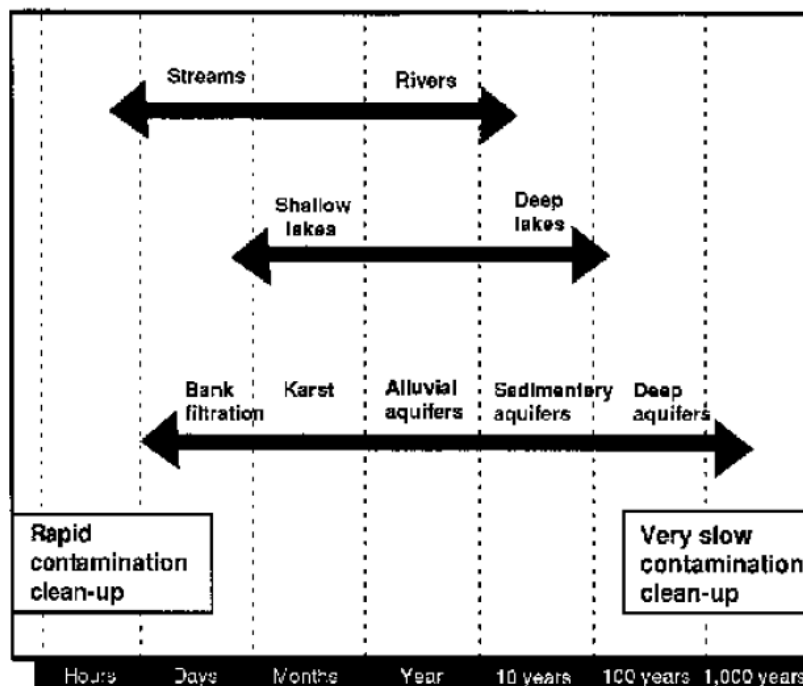
Surface water is a general term describing any water body which is found flowing or standing on the surface, such as streams, rivers, ponds, lakes and reservoirs. Surface waters originate from a combination of sources:

- 1- Surface run-off: rainfall which has fallen onto the surrounding land and that flows directly over the surface into the water body.
- 2- Direct precipitation: rainfall which falls directly into the water body.
- 3- Interflow: excess soil moisture which is constantly draining into the water body.
- 4- Water table discharge: where there is an aquifer below the water body and the water table is high enough, the water will discharge directly from the aquifer into the water body.

Characteristics of surface waters:**1- Hydrological characteristics**

The common ranges of water residence time for various types of water body are shown in Figure (2).

Figure 2.1 Typical water residence times in inland water bodies.



The theoretical residence time for a lake is the total volume of the lake divided by the total outflow rate ($V/\Sigma Q$). Residence time is an important concept for water pollution studies because it is associated with the time taken for recovery from a pollution incident. For example, a short residence time (as in a river) aids recovery of the aquatic system from a pollution input by rapid dispersion and transport of waterborne ^{المنقولة} pollutants. Long residence times, such as occur in deep lakes and aquifers, often result in very slow recovery from a pollution input because transport of waterborne pollutants away from the source can take years or even decades. Pollutants stored in sediments take a long time to be removed from the aquatic system, even when the water residence time of the water body is short.

2- Rivers:

Generally in rivers the flow is greater in the winter than the summer due to a greater amount and longer duration of rainfall. Precipitation carries appreciable amounts of solid material to earth, such as dust, pollen, ash from volcanoes, bacteria, fungal spores ^{أبواغ} and large organisms. The sea is the major source of many salts found dissolved in rain, such as chloride, sodium, sulphate, magnesium, calcium and potassium ions. Atmospheric discharges from the house and industry also contributed material to clouds which are then brought back to earth in precipitation. These include a wide range of chemicals including organic solvents, and the oxides of nitrogen and sulphur that cause acid rain. The amount and types of impurities in precipitations vary due to location and time of year, and can affect both lakes and rivers.

The quality and quantity of water in surface waters are also dependent on the geology of catchment. In general, limestone catchments result in clear hard waters, while impervious rocks, such as granite, result in turbid soft water. When the rivers which fed from aquifers through the riverbed, its retain a constant clarity, constant flow and indeed a constant temperature throughout the years, except after the periods of prolonged rainfall. The chemical nature of these rivers is also very stable and rarely alters from year to year. The water has spent a very long time in the aquifer before entering the river, and during this time dissolves the calcium and magnesium salts comprising ^{شمل} the rock, resulting hard water.

In comparison, Soft Water Rivers are usually raised as run-off from mountains, so flow is very much linked to rainfall. Such rivers suffer ^{يعاني} from wide fluctuations in flow rate with sudden floods and droughts. Chemically these rivers are turbid due to all the silt washed into the river with the surface run-off and, because there is little contact with the bed rock, they contain low concentrations of cations, such as calcium and magnesium, which makes the water soft with a neutral to acidic pH. Such rivers often drain upland peaty soils and so the water contains a high concentration of humus material giving the water a clear brown-yellow color.