PARTS OF A RIVER

A river has many parts which include:

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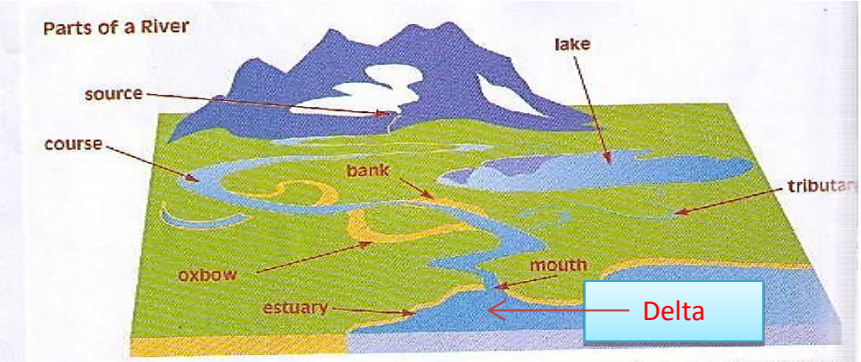


In land or flowing water bodies

River: Any body of fresh water flowing from an upland source to a large lake or to the sea, fed by sources such as springs and tributary streams.

Source: Place where the river begins

Mouth of the river: place where the river empties into a larger body of water

Tributary: A small river streams that flows into a larger river.

Delta: A triangular or fan shaped landform at the mouth of rivers.

Lake: A body of water completely surrounded by land.

Fjord: A long, narrow sea inlet that is bordered by steep cliffs.

Confluence: the place where a river flows into another river.

Drainage Basin or (Catchment): all the area of land which is drained by one river and its tributaries.
Watershed: (water parting or divide): this is the high land which separates the area draining into one river from that draining into another river. OR it is a crest line separating the headwaters of streams in a drainage basin.

Estuary: is the mouth of a river or part of a river that is below sea level that has freshwater at low tides and salt water at high tides.

River bank is the "**edge**" of a river where the **land begins**. Sometimes there is a gradual slope as the land rises above the level of the water.

Meandering: As a river curves to follow the terrain silt carried in the current is deposited on the inner edge of the curve because the current is slower. The fast current at the outer edge of the curve erodes the river bank and tends to widen the river at this point.

River as an energy system

A river has 3 types of work:

It erodes, it transports and it deposits.

Energy is the ability to do work. The amount of energy a river has determines whether it can effectively erode its valley transport the material and drop it in the form of deposition.

Terms:

a. Gradient: is the distance a river has to fall before it reached a lake or the sea.
b. Bedload: is the load transported along the bed of a river, mainly pebbles, gravel, boulders and course materials.

Energy used in erosion

Erosion in a river is caused by attrition, corrasion, (Abrasion) hydraulic action and chemical solution (corrosion).

(I) Attrition- process whereby pebbles are eroded by knocking together as they are rolled along a river bed.
(II) Corrasion (Abrasion)- is the wearing away of the bed and the banks by a rivers load.
(III) Hydraulic action- wearing away of the bed and the banks of a river by sheer weight of water hurled against them, most effective in fast flowing rivers.
(IV) Chemical solution (Corrosion)- dissolving of minerals from the rock and is most effective with soluble minerals.

The rate of erosion is determined by:

a. The weakness or resistance of the bed rocks, its solubility and its bedding planes or joints.

b. It's bedload, that is its volume, hardness and shape of materials transported. It is the load or particles that move individually along the bottom of a river.

c. The volume of the water and the mount of materials transported in suspension.

d. Its velocity. Its erosive powers increase with increased velocity due to a steeper gradient and the shape of the rivers channel (valley).

Deepening and widening or river valleys

A river's valley is deepened by vertical erosion and widening by lateral erosion.

(i) Vertical erosion- is deepening of its valley by the river as a result of it cutting downwards.

(ii) Lateral erosion- is the wearing away of the sides of the valley. Lateral erosion tends to be greatest on the outside of banks of meanders (bends in rivers) as the full force of the current is concentrated there.

Energy used to transport

A river transports its load in 4 ways:

(i) *By traction:* dragging of the bed load of pebbles along its bed.
(ii) *By suspension:* light sediments such as silt and mud float in the water.
(iii) *By solution:* chemicals dissolve in water.
Sediments are transported by a river until it has insufficient energy to move them further. It then deposits them.
(iv) Saltation: Smaller and lighter rock fragments and sand hop and bounce along the river bed.

A river's energy increases with its volume, velocity and with its regime (seasonal flow)

How does a river lose energy?

(I) *Decrease in volume* (or amount of water)=

- Extraction of water for residential, industrial, agricultural (irrigation) and dams on rivers Used for (H.E.P) Hydroelectric power.
- During times of drought or when it enters an arid (dry) region. (Nile River crossing the Sahara desert)
- River widens or there is more meandering
- When it crosses a region composed of porous rocks, i.e. limestone.

(ii) *Decrease in velocity*=

- Enters a lake or sea/ ocean
- Decrease in gradient (flat or gentle sloping plain) such as a valley bottom.
- Increase in friction due to widening, meandering.

$\frac{Y}{X} = \frac{\text{Rise}}{\text{Run}}$
= Slope (gradient)

Equation of a straight line

$Y=mx=+b$

M=slope or gradient (steepness)
B= the Y intercept (cross Y axis)
Y= how far up (rise)
X= how far along (run)

Deposition of a River's Load

Deposition is the dropping of the whole or part of the load.

This takes place when the load of the river is greater than the river's ability to carry the load along. This commonly occurs when:

(i) The velocity (speed) of the river is reduced.

(ii) The volume of the river (amount of water in it) is decreased.

(iii) The load itself is increased (e.g. size, shape and weight).

Loss of velocity is the most common reason for deposition and occurs when the gradient (slope) of the land over which the river is flowing is decreased.

Process of deposition

Courser, heavier materials {e.g. boulders, pebbles} is dropped first.

Smaller particles {e.g. sand, silt, mud} carried in suspension are dropped last.

All river deposits are regardless of their size are known as alluvium or alluvial deposits.

The usual pattern of deposition is to find finer particles lying above coarser (bigger) ones. The coarser particles are found further upstream and finer particles further downstream.

The development of a River Valley

A River like an animal or plant has a life cycle. It is divided into three (3) sections or stages.

1. Upper Course or Youthful or Torrent Stage
2. Middle Course or Mature or Valley Stage
3. Lower Course or Old Age or Plane Stage

1. Characteristics of a youthful river valley

- V shaped valley
- Has waterfalls and rapids
- Fast flowing, steep gradient
- Potholing due to corrosion & interlocking spurs

2. Characteristics of a mature river valley

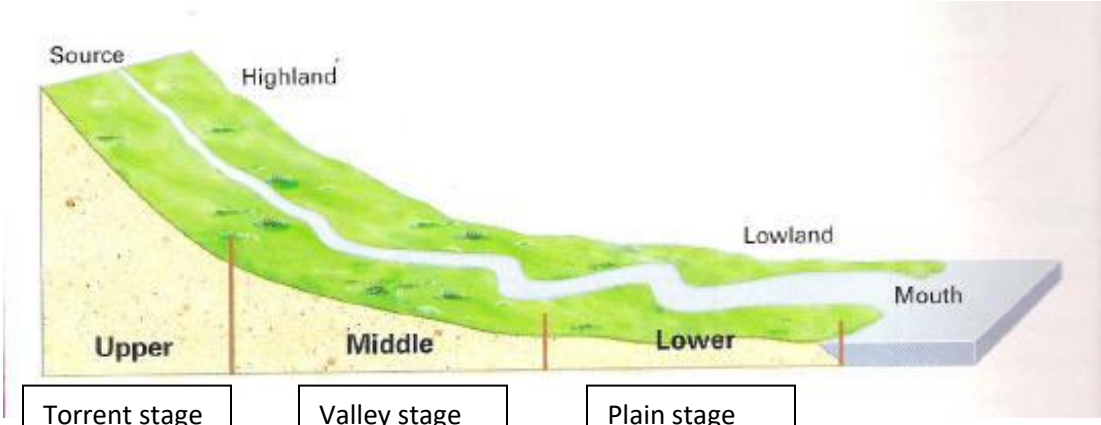
- U -shaped valley
- Moderate gradient (1-10 to 1 -100)

- Lateral erosion

3. Characteristics of an old age valley

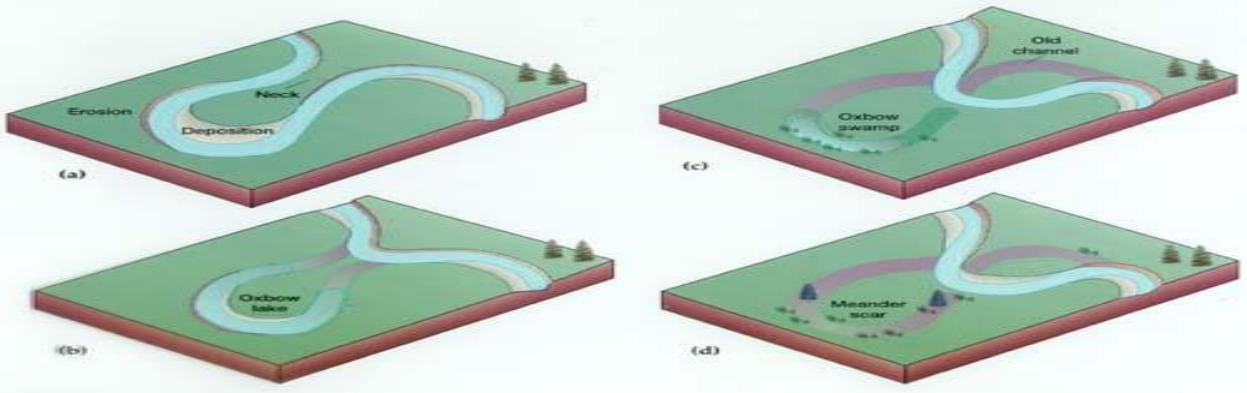
- Gentle gradient >1to 100
- Meander will develop with OX-bow lakes
- Wide flood plain
- Deposition > erosion

Cross section of a River



Formation of an OX-bow Lake

In the old stage of a river meanders are well developed because of lateral erosion. The meanders are circular forming loops. Erosion continues until the neck is cut across and the river flows along a straight path. The ends are eventually sealed off by sediments. The cut off or beheaded portion of the meander has a horse shoe shaped appearance which is known as an ox-bow lake.



Features formed in the upper course of a river

Potholes- when rivers flow over uneven beds the water may swirl causing pebbles to wear away circular depressions in the river bed.

Interlocking spurs- are ridges which descend from the mountain to the lower part of the valley side. These occur as the river twist and turns around hard rock.

Waterfalls- these are formed where the bed of a river becomes suddenly steep. Formed in two ways:

(i) Uplifted land, lava flows and landslides.

(ii) Differences in hardness of rock strata along course of river.

Examples of waterfalls are: King George VI (Guyana), Kaieteur Falls (Guyana), Victoria Falls (Canada) and Niagara Falls (Canada).

Plunge pool- a plunge pool is a hollow (depression) formed at the foot or base of a waterfall.

A rapid is formed where the river flows unusually fast or rough because of sudden change in slope (gradient).

Gorges- a gorge is a narrow steep sided river valley in which vertical corrosion is dominant, E.g. The Rio Cobre Gorge in Jamaica. Gorges are formed when the roofs of limestone caverns collapse.

Canyon- a canyon is a deep, steep-sided gorge, cut by river action in which vertical corrosion or down cutting is dominant. This means its height is greater than its width. Canyons usually occur in dry regions or as a river retreats upland towards its source. E.g. the Gran Canyon in U.S.A.

Alluvial fans and cones- sediments which build up and spread out in a fan-shaped pattern at the base of a mountain slope E.g. The Pyrenees in North France.

There are three basic types of deltas

1. Arcuate Delta- This type is very common. It has coarse sediments. It is triangular in shape (almost arc –like). It has a lot of distributaries. E.g. The Nile Delta (Egypt), Niger Delta, Ganges Indus, Hwang-Ho (China) and Irrawaddy.

2. Bird's Foot Delta- It has very fine sediments called silt. Several main branches like the foot of a bird. E.g. The Mississippi Delta (U.S.A.)

3. An Estuarine delta- This is formed from materials deposited in the submerged mouth of a river. It is sometimes known as a Cuspate Delta as it forms where a river reaches a straight coastline along which wave action is vigorous. E.g. Elbe (Germany) Amazon (South America) Ob (Russia) and Vistula (Poland).

Conditions necessary for the formation of a delta

1. The river must have a large load and this will happen if there is active erosion in the upper section of its valley.
2. The coast should be sheltered, preferably tide-less.
3. The speed of the river must be relatively slow.
4. The river's load must be deposited faster than it can be removed by the action of currents and tides.

The value of rivers and their valleys to man

a. Natural source and supply of water. Many rivers can be used to irrigate agricultural regions. E.g. Nile, tigress-Euphrates Rivers.

b. Domestic Purposes- water channeled into dams or reservoirs for domestic purposes.

c. For the development of Hydro-electric power (H.E.P.) and promote manufacturing industries.

d. Some river mouths contain deep sheltered water and enable ports to be developed there. E.g. Mississippi Delta.

e. Rivers form natural route ways which can be useful for transport. E.g. Mississippi.

f. River environments help to produce a healthy fish population.

Dams

A **dam** is a large structure usually of concrete, sometimes of earth, built across a river usually to hold back a large body of water for irrigation and for supplies to domesticate and industrial users.

Some rivers like Mississippi in USA, the Poe in Italy and the Huang He in China have built up their beds so that they flow above the level of their floodplains. Such rivers can only be prevented from flooding by building dams, diversions channels and artificial embankments (e.g. levees).

Dams are also used as a defense against floods. It is associated with the generation of hydro-electric power [H.E.P].

Examples of dams around the world include:

1. The Three Gorges Dam- China
2. The Aswan High Dam-Egypt
3. Kielder Dam England

The benefit of Dams to people

1. River level remains steady all year
2. Flood control; protects people from flooding.
3. It increases the area of cultivation so that more than one crop can be grown.
4. Higher yield of crops.
5. Modern electric pumps used for irrigation.
6. The river is navigable all year.
7. Tourist attraction of the dam.
8. Provides Hydro-electric power (cheap electricity), which allows new industries to develop and decrease the dependency on coal and in so doing reduce the emission of greenhouse gases (Sulphur dioxide).
9. Enough water is stored and can be used in times of drought.

The environmental and social problems associated with the building of dams

1. Dams are expensive to build usually taking a couple of years (10-20) for completion, possibly diverting funds from other developments.

2. Dam is likely to trap sediment behind it so fewer nutrients reach the sea-floor for fish and other aquatic life.
3. Delta begins to retreat due to no new supplies of silt.
4. Delta becoming saltier as not washed by the annual flood.
5. More irrigation canals have increased the number of bilharzias snails and cause Stalinization.
6. Fewer crops are grown for the locals.
7. No more salt deposited so more fertilizer is needed.
8. Resettlement of people to make way for the dam.
9. Local people in the area may lose valuable farm land.

Aerial view of a river system

Drainage Patterns

Types of Streams:

Gaining streams are those that take in water with time and tend to widen.

Losing streams are those that lose water with time and tend to become narrower.

Intermittent streams are those that are wet during the wet season and dry in drier times.

Types of Drainage Patterns

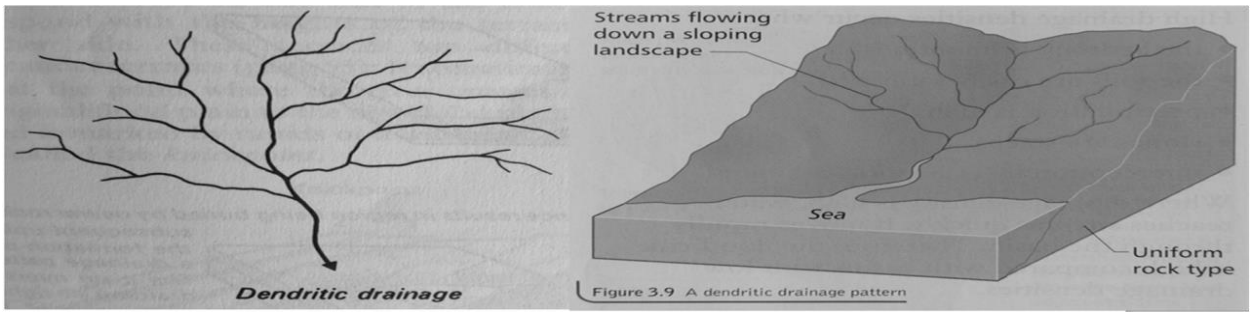
There are (3) main types:

- **Dendritic** – branching
- **Radial** -- associated with uplifts/hills

- **Trellis** -- associated with resistant ridges

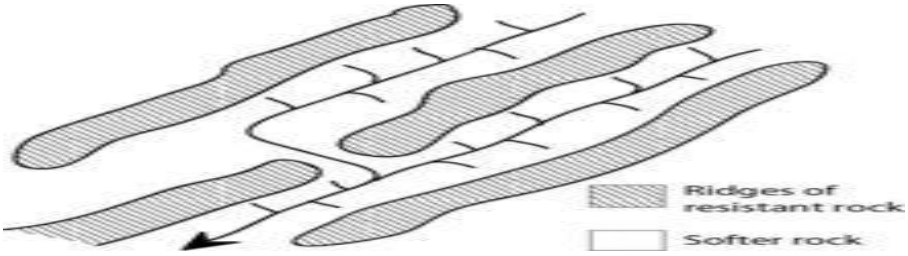
Dendritic Drainage Pattern

- The most common form of drainage system.
- Looks like twigs or branches of a tree.
- Dendritic systems form in V-shaped valleys; as the rock types must be impermeable or non-porous.



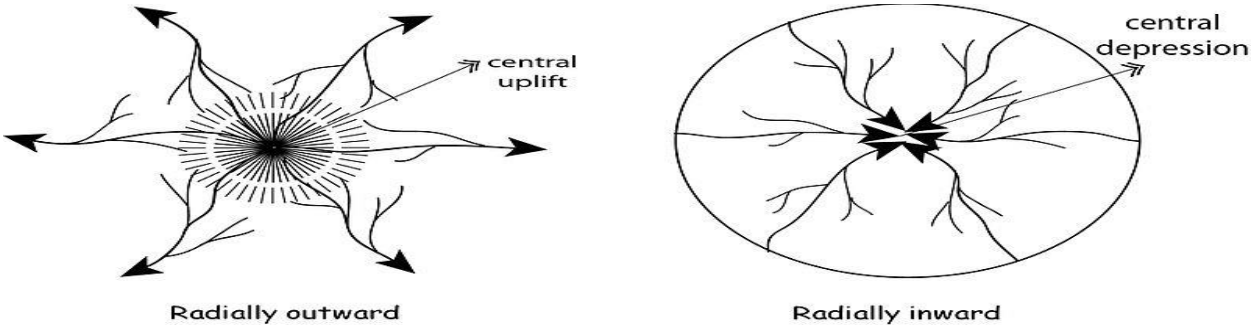
Trellis Drainage Pattern

- Smaller tributaries feed a main river from the steep slopes on the sides of mountains.
- These tributaries enter the main river at approximately 90 degree angles.
- Characteristic of folded mountains, e.g. Appalachian Mountains in North America.



Radial Drainage Pattern

- Streams radiate outwards from a central high point.
- Volcanoes usually display excellent radial drainage.
- Other geological features on which radial drainage commonly develops are domes and laccoliths.



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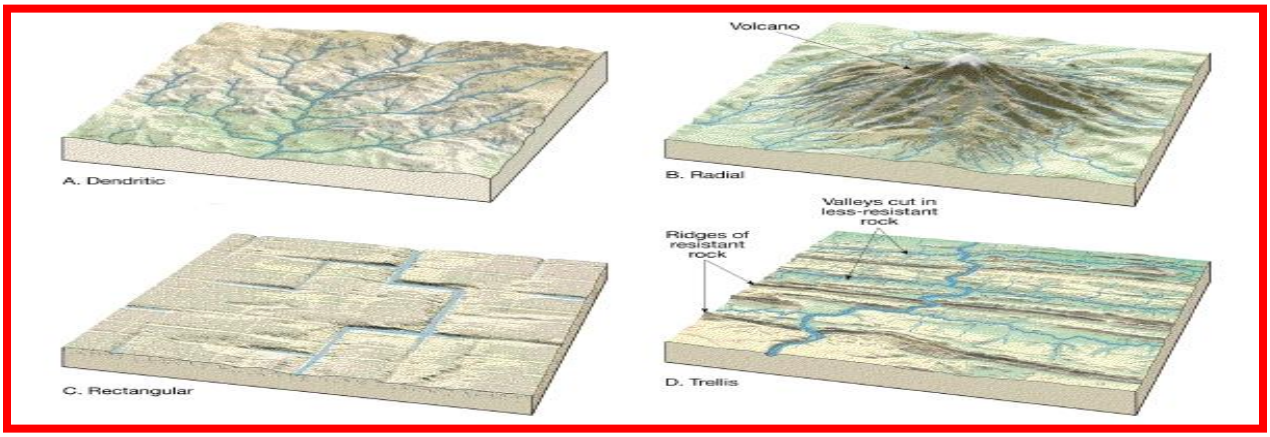
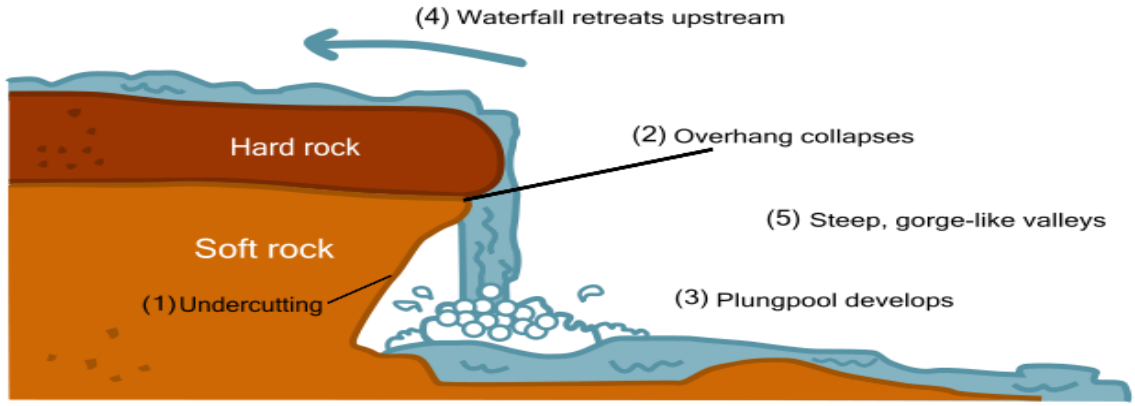


Waterfall Formation



What is a waterfall?

A waterfall is a place where water flows over a vertical drop in the course of a river.

Formation of a waterfall

Waterfalls are often formed where a layer of harder rock overlays a layer of softer rock.

As the river passes over the softer rock, it is able to erode it at a faster rate, forming a **step** in the river bed.

The force of **hydraulic action** does two things: Further erosion makes the **plunge pool** and **notch** bigger over time.

As the **notch** grows, eventually there isn't enough support under the harder rock and so it collapses into the **plunge pool**.

This adds rocks and boulders to the plunge pool, and so the process of **corrasion** works with **hydraulic action** to further erode the **plunge pool** and **notch**.

The processes of erosion continue, further eroding out the notch and plunge pool. Eventually the harder rock above will collapse again, meaning that the waterfall will retreat upstream over time.

As it retreats, it leaves behind a steep sided **gorge**.