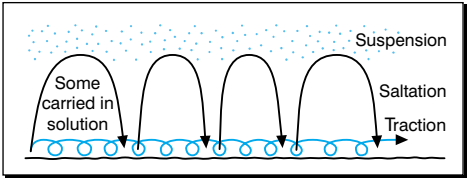
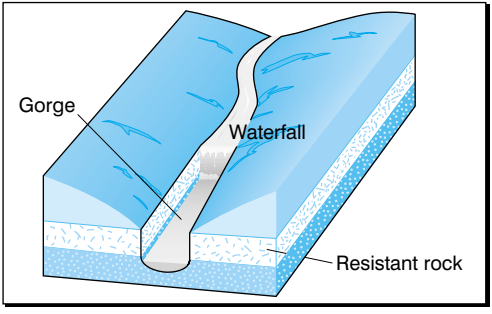
RIVERS (1)

- Water constantly cycles between the atmosphere and the earth's surface, through a series of **flows** and **stores**. The main flows are **evaporation**, **precipitation** and rivers. Examples of stores are the sea, glaciers and lakes. When precipitation reaches the ground it gets into rivers in three ways: direct flow straight from the atmosphere; surface flow; and flow through permeable rocks and the soil.
- The area drained by a river and its **tributaries** is called a **drainage basin** or **catchment**. The boundaries of the river basin or **watersheds** separate one basin from another.
- A river develops distinctive landforms as a result of **erosion**, **transportation**, and **deposition**. The processes of river erosion are **corrosion**, **corrasion**, **hydraulic action** and **attrition**. A river's load is transported by **solution**, **suspension**, **saltation** and **traction** depending on the size of material.



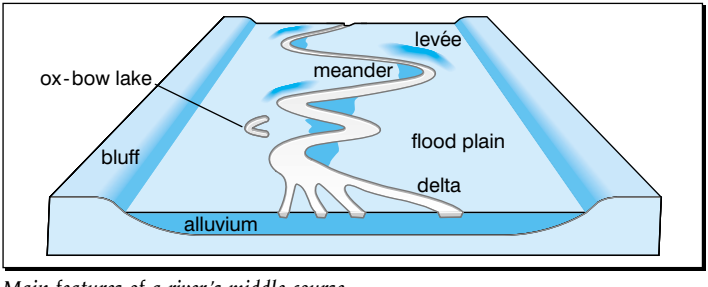
Transportation of a river's load

- A river's **long profile** or **talweg** and its cross section change from the river's source to its mouth. Moving downstream there is a decrease in the river's **gradient**, an increase in water volume and an increase in the amount of **sediment** carried by the river. These result in different processes and landforms developing in the river's **upper**, **middle** and **lower courses**.
- Landforms in the upper course form by erosion mainly. Potholing results in a V-shaped cross section. Waterfalls retreat upstream leaving a **gorge** as the result of headward erosion. The river is small and inefficient so it is easily deflected by obstacles in its path. This forms **interlocking spurs**.



Formation of a waterfall and gorge

- In the middle course the river begins to erode sideways or laterally. **Meanders** begin to form. The faster currents on the outside of river bends undercut the bank forming **river cliffs**. **Deposition** takes place on **slip-off slopes** found on the inside of meanders where the current is slower. The cross section becomes asymmetrical.

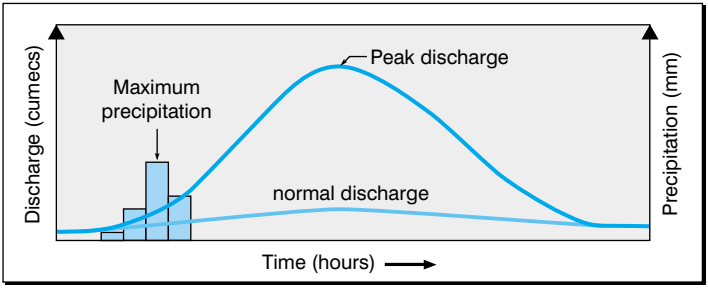


Main features of a river's middle course

- The main features of the lower course are a broad, shallow flood plain, with **ox-bow lakes** and **levées**. The river enters the sea through an **estuary** or a **delta**. Deltas occur where a river splits into a series of **distributaries**. This happens if the river flows into a sea where there are no strong tides or currents, or if the river is carrying large amounts of sediment.

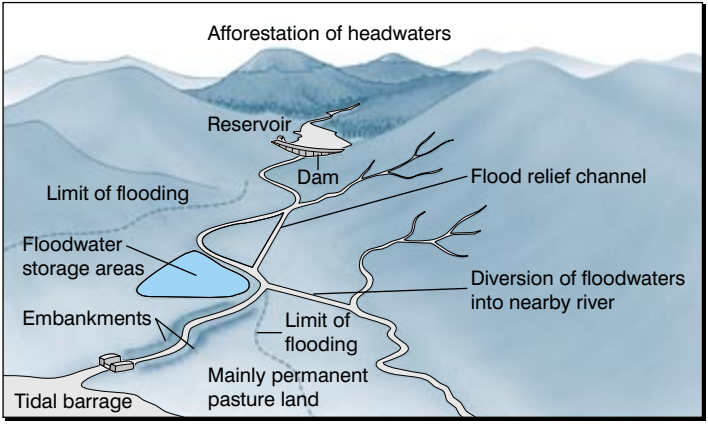
Flooding

- Rivers flood when their discharge or flow is greater than the channel can cope with. This often occurs when there is a large increase in precipitation or during a spring snow melt. The river regime shows the seasonal variations in a river's flow. The link between precipitation and **discharge** is shown in a **flood hydrograph**.



Flood hydrograph

- Flooding is more likely when precipitation is heavy and intense. If the soil is saturated water will run off quickly into rivers. Flooding is less likely if the main rock types are porous or permeable.
- Human actions can increase flood danger. Flood plains have dense populations because the fertile alluvial soils are good for farming and the river can be used for irrigation. The flat land encourages industry and settlement. The building of roads and houses increases **surface run-off**. Deforestation also increases surface run-off.
- The impact of floods can be reduced by flood preventative measures. These minimise run-off and use **reservoirs** to store excess water. Flood water can be confined to rivers by **embankments** and **relief channels**. Excess water can be removed by increasing the flow rate. For example by widening, deepening and straightening the river channel.



Flood control and prevention

Human activities

- The most effective management of rivers is by a whole-basin approach. In addition to flood control measures, **irrigation** and navigation can be improved. **Dams** and reservoirs can be used to generate **hydroelectricity** as well as providing opportunities for recreation and leisure.
- The upper parts of a river basin are used for sheep farming, quarrying and water storage. High precipitation and narrow valleys are suitable for dam and reservoir construction. The slopes of the valleys can be forested. There are greater opportunities for agriculture and industry further downstream. Estuaries are favourable sites for industry as they allow import and export facilities and the flat land is suitable for building. Often there are large areas of mud that can be reclaimed and used for large industrial sites.

Rivers (1–4)

1 Why is the movement of water between the atmosphere and the earth's surface called a cycle? (1)

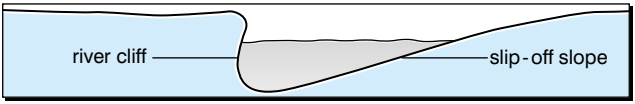
2 How does river water corrade? (1)

3 Which form of river transport is most important in eroding the landscape? (1)

4 Why are waterfalls only temporary features on a river's course? (1)

5 Why is the American term 'cut off' appropriate for an ox-bow lake? (1)

6 Which part of a river's course has the following cross section? (1)



7 Why is there a time lag between the time of maximum precipitation and the peak discharge of a river? (1)

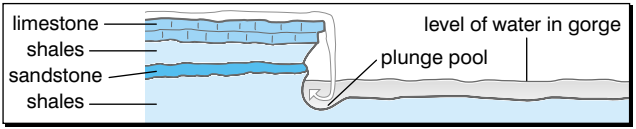
8 What is the difference between a tributary and a distributary? (1)

9 Why do deltas form in the Mediterranean Sea? (1)

10 How may the straightening of a river's course reduce the danger of flooding? (1)

11 Why do rivers erode most when they are in flood? (3)

12 Explain the features shown on the following cross section of Niagara Falls. (3)



13 How can deforestation increase the danger of flooding? (2)

14 Why can water control measures in a river basin be considered multipurpose? (2)

SCORE

1 There is continuous movement of water to the earth's surface (precipitation), across the land (river flow) and back to the atmosphere (evaporation). (1). This can be shown in a diagram.

2 By the abrasive actions of sediments carried by the river on its bed. (1) Remember that abrasion and corrasion both contain 'a', while corrosion and solution don't.

3 Traction. (1) The largest materials erode as they roll along the river's bed.

4 Waterfalls erode backwards as the river smoothes out its profile. (1)

5 The river 'cuts off' the neck of the meander to leave the rest stranded as an ox-bow lake. (1)

6 Middle course. (1)
This is where the river starts to erode laterally.

7 Peak discharge includes water falling directly into the river as well as surface run-off and through flow. (1) Surface run-off and through flow take longer to reach the river.

8 A tributary takes water to the main river, whereas a distributary takes water away. (1) Distributaries are found in deltas.

9 The sea is tideless and there are no strong currents. (1)

10 It increases the speed of flow. (1)
This reduces the danger of the river breaking its banks.

11 They have a greater amount of water and carry a greater load. (1) They flow faster. (1) Relatively, there is less frictional loss so the river is more efficient. (1)

12 The softer sands and shales are eroded more easily and undercut the more resistant limestone. The overlying limestone eventually collapses. (1) The Falls erode backwards leaving a gorge. (1) The river hits the bottom of the Falls to form a plunge pool. (1) This leads to the eventual removal of the waterfall.

13 It increases the rate of surface run-off and decreases the risk of infiltration. (1) This increases the peak discharge. (1) The steeper the limbs of the hydrograph the greater the flood danger.

14 The measures are used for more than one purpose. (1) Dams store water and regulate the flow, but can also be used to generate HEP. (1)

TOTAL