

# Unit 1 Dynamic Planet

## 6. River processes and pressures

1. Erosion Rivers erode in 4 main ways.

Erosion = \_\_\_\_\_

Abrasion = \_\_\_\_\_

Hydraulic action = \_\_\_\_\_

Attrition = \_\_\_\_\_

Solution = \_\_\_\_\_

2. Transport. A rivers transports its load in 4 main ways.

Solution = \_\_\_\_\_

Suspension = \_\_\_\_\_

Saltation = \_\_\_\_\_

Traction = \_\_\_\_\_

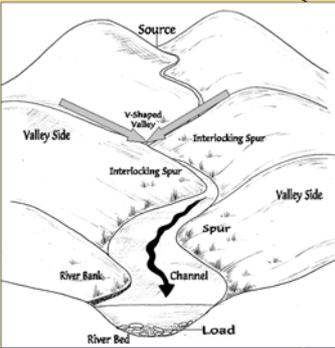
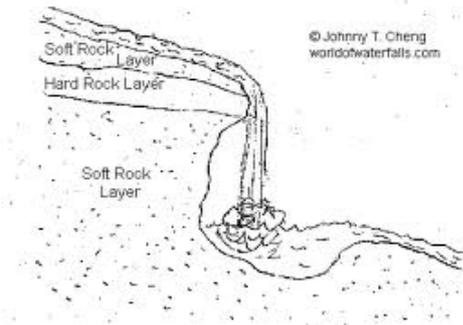
3. Rivers and their valleys change as they travel downstream from their source to the mouth.

Describe the characteristics of the river channel in the upper, middle and lower course next to the channel cross sections below.

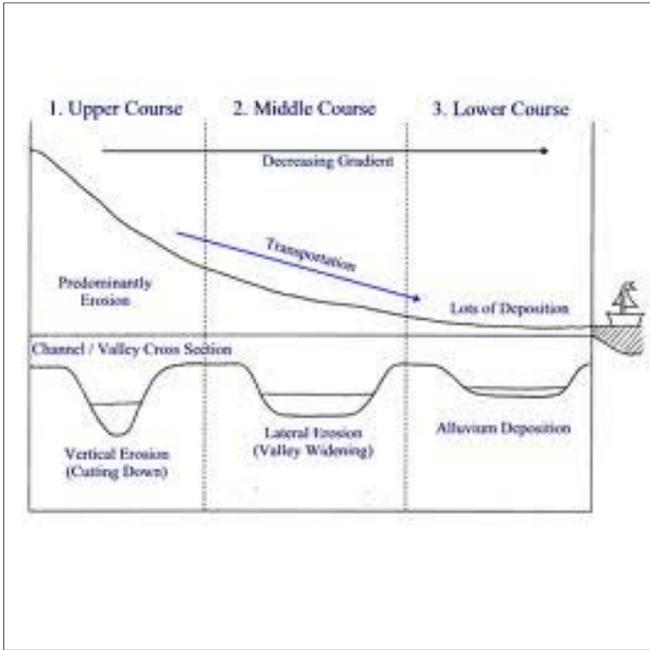
### Changing river channels—Loughton Brook, Essex South East England

	Width—m	Depth-m	Velocity—m per second	Gradient- degrees
Upper Course	Narrow	Shallow	Low As there is lots of friction in the shallow channel. There is large bed load causing friction	Steep/higher in the more hilly source (high beech) region
Middle Course	Medium	Medium		Medium
Lower Course	Wider The channel gets wider due to horizontal erosion	Deeper The channel gets deeper due to vertical erosion	The bed and banks are smoother. Proportionally there is less water in contact with the bed and banks meaning less friction. Bed load is smoother so less friction and a higher velocity.	Lower gradient/ less steep as the river travels into a lowland

4. Different landforms occur in the upper, middle and lower course. Complete the table below to show these landforms and how they are created. You must explain how erosion, transport and deposition create the landforms. The River Tees North Eastern England

Stage	Landform	Diagram	Explanation (erosion, transport, deposition)
Upper course	<b>Interlocking Spurs</b>		<p>In the upper course of the river near the Pennine hills, near its source, the river has little power to erode rocks. Therefore it flows around the harder more resistant rock. This creates spurs that interlock on either side of the valley as the river flows downstream.</p>
Middle course	<b>Waterfall</b>		<p>Where a river flows over hard and soft rock the soft rock will be eroded more quickly (e.g. high Force on the river Tees). The water cuts into the softer rock creating an overhang. Eventually the overhang made from harder more resistant rock will collapse making the waterfall steeper. At the foot of a waterfall is a plunge pool. This is an area of deeper water created by rapid erosion as the water plunges over the waterfall.</p>
Lower course	<ol style="list-style-type: none"> <li>1. Flood Plain</li> <li>2. Levee</li> <li>3. Meanders/ Ox bow lakes</li> </ol>		<p>Meanders are bends in a river create when the water swings from side to side. The fastest water undercuts the outside of the bend forming a steep bank called a river cliff. On the inside of the bend the current is slower and deposition of sediment happens creating a river beach or slip off slope.</p> <p>Ox bow lakes are created when a narrow neck of land is eroded. Water cuts through the neck to take the shortest route. An ox bow lake is formed. Deposition seals off the old meander bend and an ox bow lake dries up.</p> <p>Flood plains are the flat land either side of a river that flood naturally. Sediment is deposited on flood plains after a flood. This forms natural banks called levees.</p>

5. The shape of the river valley changes as the river travels downstream. The diagram below shows how it changes. Describe the shape of the river valley.



**Upper Course** = The valley has steep sides. The valley bottom is narrow. As the river cuts down it creates a v shaped valley and it winds around interlocking spurs. Weathering (it is cold and wet in the upper course) means the rock on the valley side is broken up and travels down the slope as scree. Rock can move down slopes quickly as a landslide or slowly as soil creep.

**Middle Course** = The valley shape changes from a V shaped to U shaped as the flood plain widens the valley floor.

**Lower Course** = The river is no longer in a valley it meanders over a wide flat flood plain. There are natural banks made of deposited material either side of the river called levees.

6. Weathering and mass movement effect the shape of the rivers valley.

**Weathering** = Is the breakdown of rocks in situ. This means it happens where the rock is. Rocks are weakened by being chemically attacked, and mechanically broken down.

**Mass Movement** = The movement of rock fragments down slope under the influence of gravity. A landslide is rapid mass movement.

There are 3 main types of weathering. Complete the table below.

Weathering	Explanation
1. Biological weathering	Plant roots can penetrate cracks in rock in search of water. As they grow the rock is forced apart.
2. Physical weathering	Includes processes like freeze thaw action. If water freezes in a crack in the rock it expands breaking the rock apart. If it thaws and freezes the process is repeated.
3. Chemical weathering	Rainwater mixes with atmospheric gases like CO <sub>2</sub> to form weak acids that dissolve rocks like limestone.

6. Mass movement can happen rapidly or slowly. Rapid movements are called landslides or mudflows, slow movements are called soil creep.

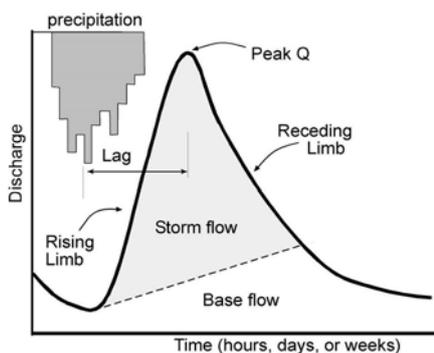
3 things effect the shape of the valley.

1. The speed of weathering. If scree piles up, weathering is taking place rapidly.
2. The speed of mass movement.
3. How quickly the river can remove material brought by mass movement.

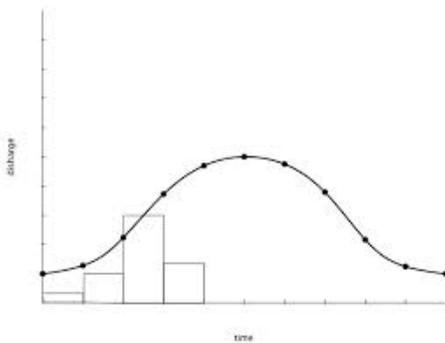
Explain how weathering and transportation effect the shape of the valley below.

1. **Steep valley** = If the river has plenty of energy it takes the material away and uses it to help erode the valley, helping to make it steeper.
2. **Gentle valley** = If the river runs slowly and cannot remove all of the material, weathered rock collects at the bottom of the slope, making the valley gentler and flatter.

**7. Flooding.** A flood happens when the discharge is too great for the rivers channel. Flooding can be shown on a flood hydrograph. A flood hydrograph can be for different periods of time e.g.. a storm or a year.



**Urban and deforested areas have short time lags.** Rain water enters rivers quickly through drains or as surface runoff (over impermeable- concrete surfaces). Deforested areas have less interception. Ground becomes saturated more quickly and there is more surface runoff. Rivers in these areas flood quickly as the amount of water in them increases quickly after a storm.



**Rural and forested areas have longer time lags.** Rain water enters the river more slowly. Water is intercepted by vegetation and evaporates. Water infiltrates into the soil and reaches the river slowly as throughflow and ground water flow. River levels rise slowly. Flood risk is low.

## 8. Flooding in Sheffield June 2007.

There were 4 main causes of the flood.

1. **Prolonged Rain** = It rained heavily in the spring and early summer. This made the ground saturated so no rain water could infiltrate. 100mm of rain fell in 1 day—more than 1 months rainfall.
2. **Soil saturation** = The soil was saturated and rain ran straight into rivers as surface runoff. Drains got blocked as there was too much water. River levels rose quickly causing floods.
3. **The confluence of several rivers** = 3 rivers join very close together. The river Don was not big enough to take all of the water from these rivers. The flooding was bad in this area– Hillsborough.
4. **The physical landscape** = Sheffield is in a basin surrounded by hills. The rainwater ran rapidly down into Sheffield overwhelming the drains.

## 9. Impacts of the Sheffield floods.

Social	Economic	Environmental
<ol style="list-style-type: none"> <li>1. 2 people drowned.</li> <li>1. 1200 homes were flooded making people temporarily homeless.</li> <li>2. 2. Health risk from raw sewage in food water.</li> <li>3. People were airlifted to safety from the roofs of flooded buildings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Extra work for builders repairing flood damage.</li> <li>2. Loss of income as Sheffield Meadow hall shopping centre was closed—stock was destroyed/ damaged.</li> <li>3. The cost for individuals repairing homes.</li> <li>4. Cost of insurance claims.</li> <li>5. Cost of repairing roads and bridges.</li> <li>6. A tool making company suffered £15 Million of damage.</li> </ol>	<ol style="list-style-type: none"> <li>1. Roads and bridges were damaged. The M1 motorway was closed for 2 days.</li> <li>2. Trees were felled by flood water.</li> </ol>

10. Sheffield had 4 types of flood hard engineering defences. How successful were these flood defences?

Flood defence	Did it work?	Explanation
1. Drains and culverts.	No	There was too much rain so the drains flooded. Where drains met rivers the river was already full so water could not enter the river. This meant water "backed up" the drain and flooded the streets.
2. Concrete lined river channel.	Yes	This speeds up the flow of the River. It took flood water away from the city.
3. Embankment around Meadowhall shopping centre.	No	It had an embankment around it to keep flood water out. It wasn't high enough and water was trapped in the shopping centre by the embankment.
4. Flood storage reservoirs.	Yes	They hold flood water in reservoirs upstream where population density is low until it is safe to release it. The reservoirs are also used for recreation and leisure- boating.

11. The environment agency is in favour of using **soft engineering** (like on the River Skerne in Darlington) to help reduce flooding/flood risk. Choose 2 types of soft engineering and

explain why the environment agency prefers soft engineering.

**1. Flood Plain Zoning.** This is a low cost solution it means that no new buildings are allowed to be built in flood risk areas.

**2. Flood abatement.** By changing land use e.g. planting trees to increase interception and reduce surface runoff. By reintroducing meanders to reduce the velocity of the river and causing it to flood in areas of low population density. This recognises flooding is a natural process and doesn't try to stop it. It increases biodiversity by increasing wetland habitats. It looks natural and attractive.

**3. Flood proofing.** E.g. building a garage on the ground floor and living areas on the first floor to reduce the impact of a flood.

**4. Prediction and warning.** People can be evacuated

## **12. Hard/Traditional engineering vs Soft sustainable engineering.**

### **Advantages of hard traditional management.**

1. Suitable to protect high value land, people and property.

### **Advantages of soft/sustainable management.**

1. Low cost
2. May improve visual environmental quality/look attractive.
3. Long term.
4. May create habitats for plants and animals.
5. Accepts flooding is a natural process and allows it to happen.

### **Disadvantages of hard traditional management.**

1. Expensive.
2. Needs to be repaired/maintained.
3. Looks unattractive e.g. Flood walls
4. Tries to prevent natural processes.
5. Destroys habitats e.g. a concrete lined river channel.

### **Disadvantages of soft/sustainable management.**

1. Not always effective.
2. Not suitable to protect areas of high value/populations.
3. May allow flooding to happen.
4. Is long term e.g. it takes time for trees to grow to intercept rainwater.
5. Takes large areas of land e.g. to create reservoirs.
6. Some residents may feel they are not protected by soft management.