

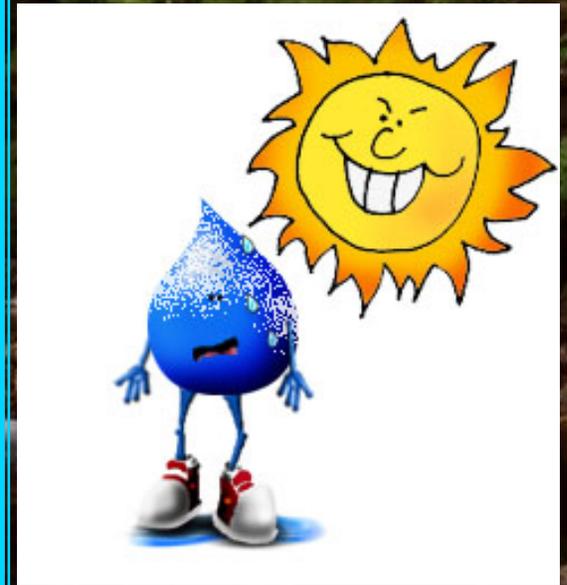
Chapter 10

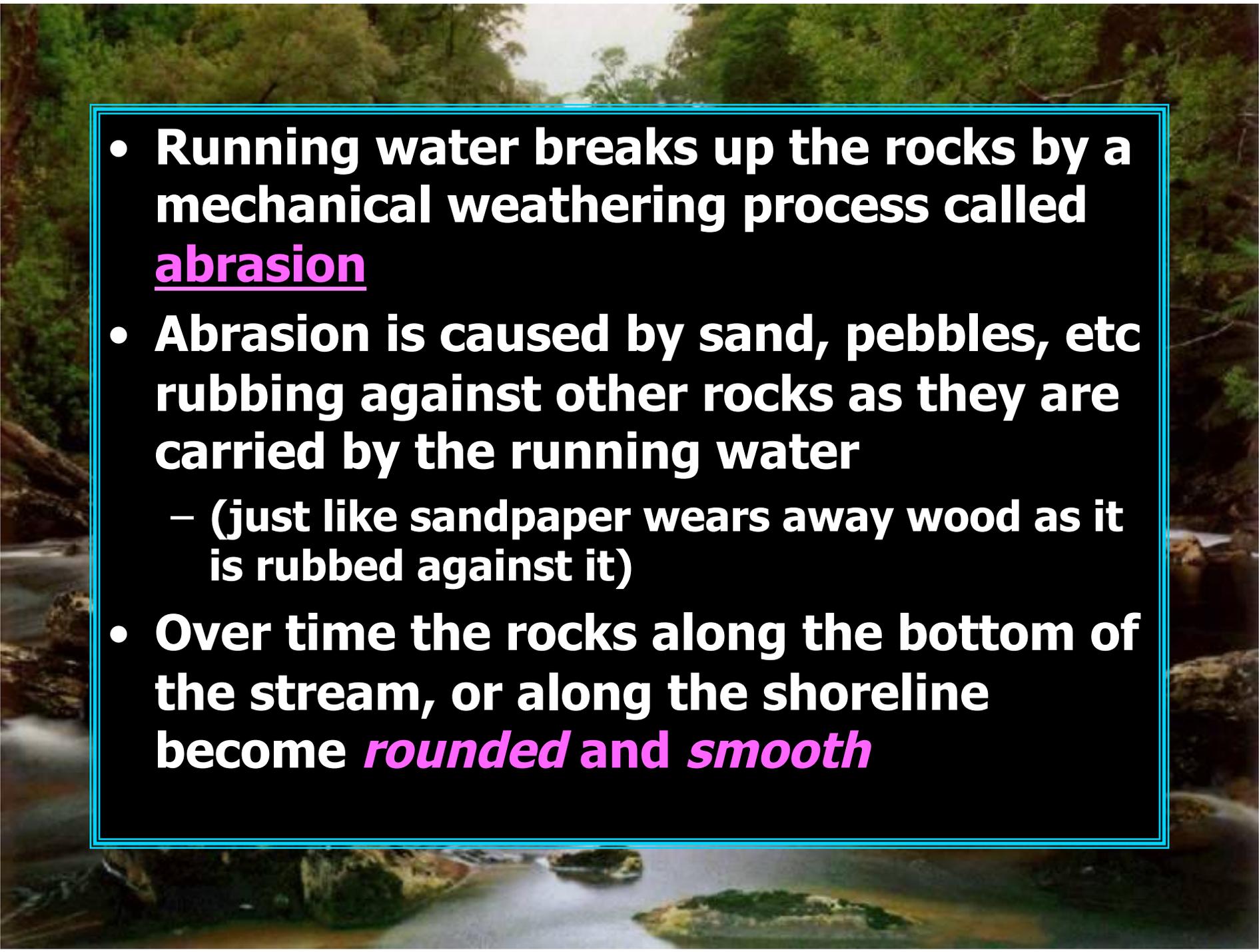


**Running Water
aka Rivers...
BFRB Pages 101-116**

Stream Erosion and Transportation

- Running water is all precipitation (rain, snow, etc) that falls on Earth and is pulled downhill by **gravity**.
- Running water originally gets its energy from the sun, since that is the source of energy for evaporation (which must occur for precipitation to form).



- 
- Running water breaks up the rocks by a mechanical weathering process called **abrasion**
 - Abrasion is caused by sand, pebbles, etc rubbing against other rocks as they are carried by the running water
 - (just like sandpaper wears away wood as it is rubbed against it)
 - Over time the rocks along the bottom of the stream, or along the shoreline become ***rounded and smooth***

Running water carries rock material in 3 ways:

- 1. Solution** - material (mainly minerals) that is dissolved in the water
Ex Calcium carbonate/sodium chloride dissolved into H₂O
- 2. Suspension** - materials are heavier than water, but do not sink because the water is moving too quickly (small materials like fine sand, clay and silt). **Materials carried in suspension usually make the water appear cloudy or muddy**
- 3. Bed Load** - particles of sediment that are too heavy to be carried in suspension. **They are pushed along the bottom (bed) of the stream/river via saltation ("jumping"). This process causes a lot of ABRASION!!!!**

air



Current Direction



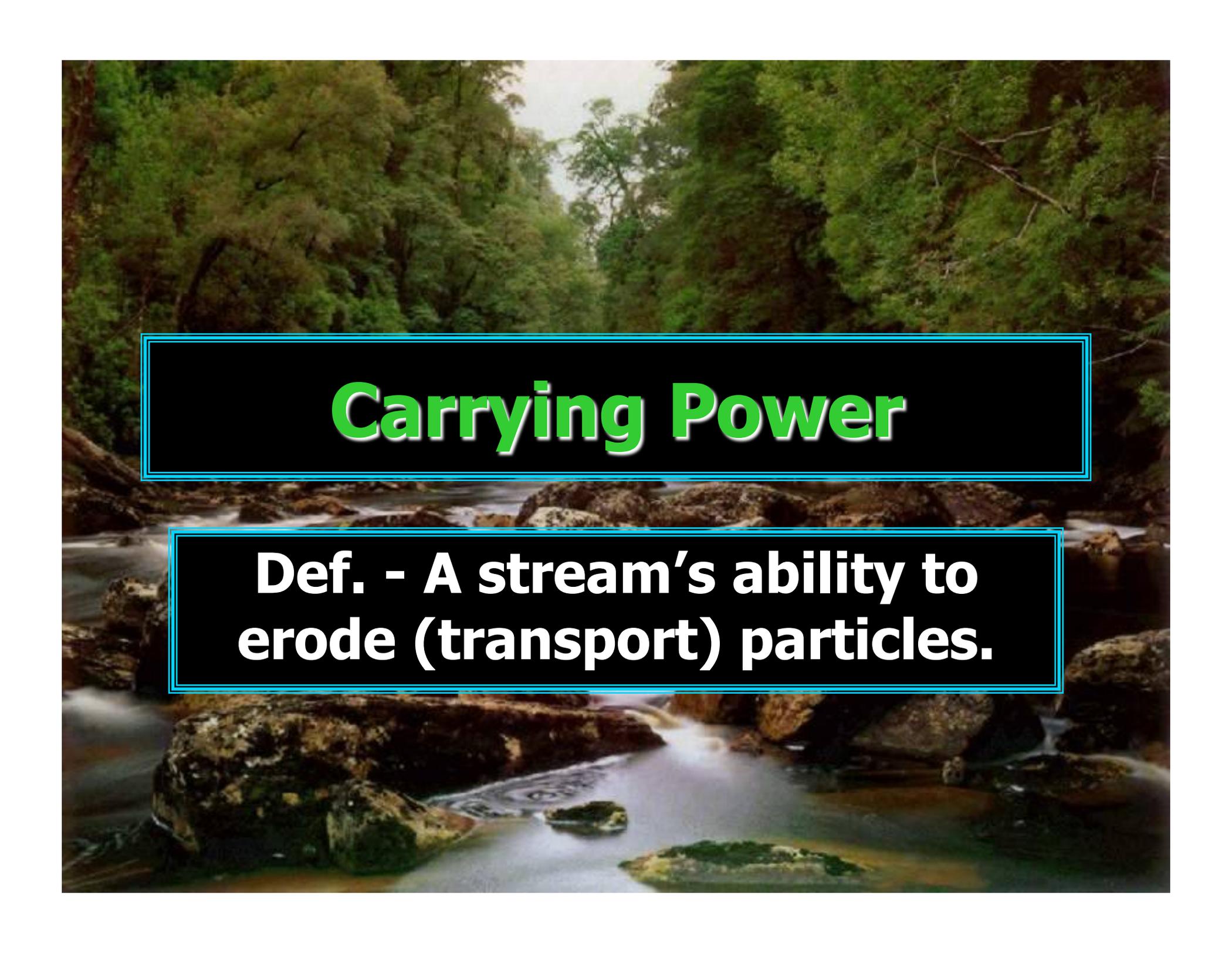
Solution – dissolved materials in the water

Suspension – solid particles carried in the water column

Bed load particles moving by saltation

[Link to stream sediments](#)

Stream Bed



Carrying Power

Def. - A stream's ability to erode (transport) particles.

Carrying power depends on a River's speed and speed depends on 2 things:

1) GRADIENT- determined by the steepness or gradient of the land the River is flowing over. We calculated gradient in our mapping unit! **The faster the stream moves, the larger the particles it can carry AND the more particles it can carry**
– (Reference Tables P. 6)



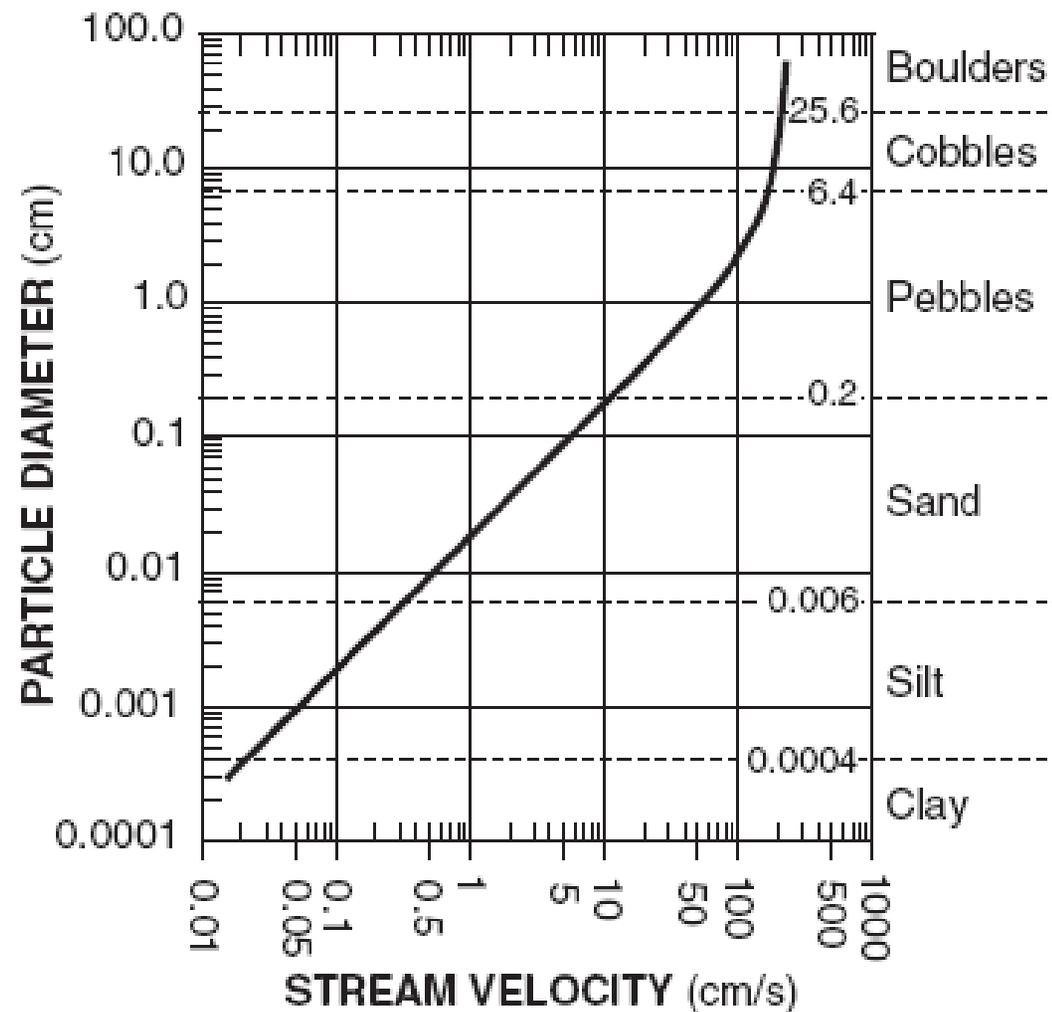
2) DISCHARGE - the volume of water flowing in the stream/river. **The greater the discharge, the faster the speed and the larger the particles and the more particles it can carry**



ESRT

P. 6

Relationship of Transported Particle Size to Water Velocity



This generalized graph shows the water velocity needed to maintain, but not start, movement. Variations occur due to differences in particle density and shape.

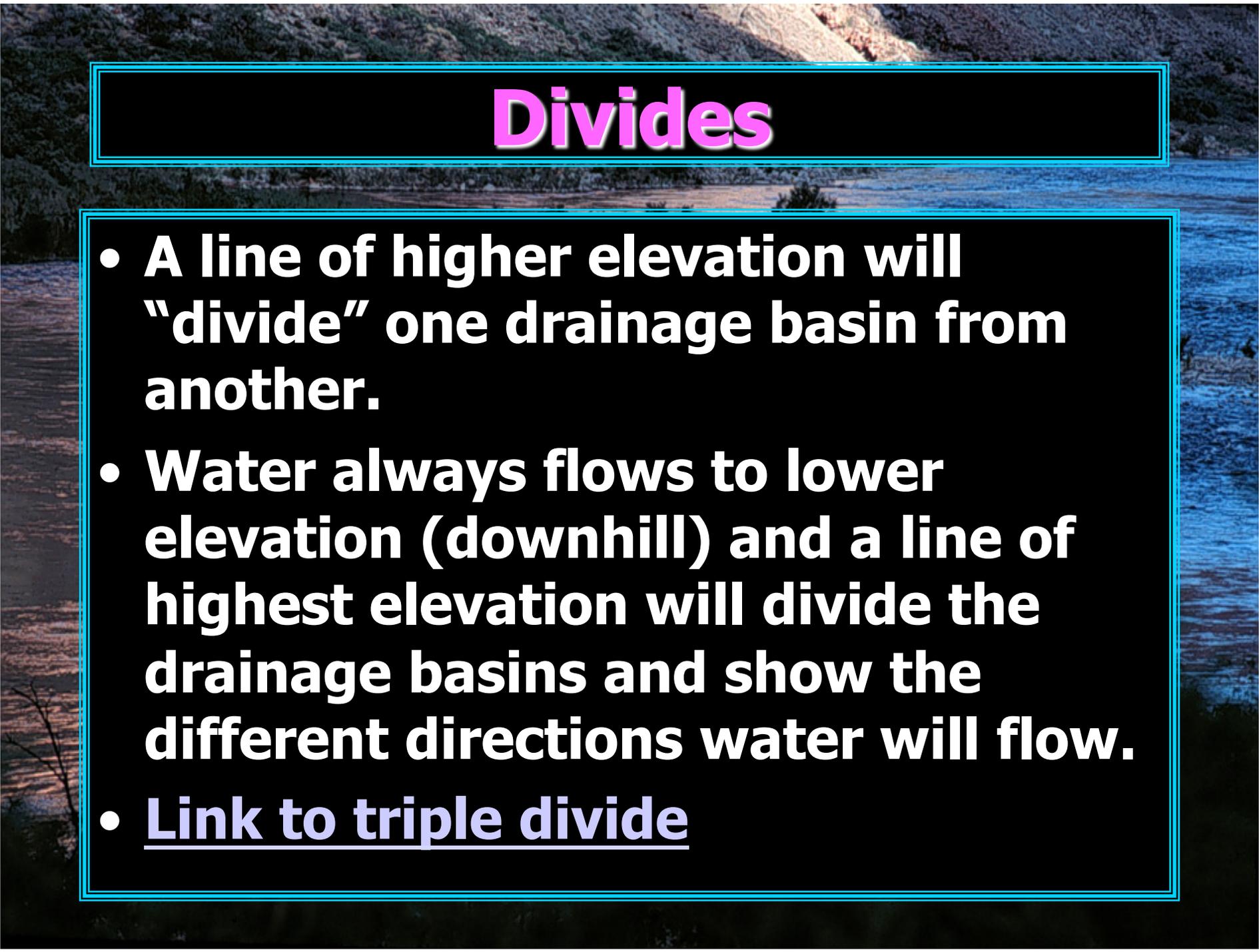
How do Streams Flow Over and Shape the Landscape?

Where do I flow?



Drainage Basins

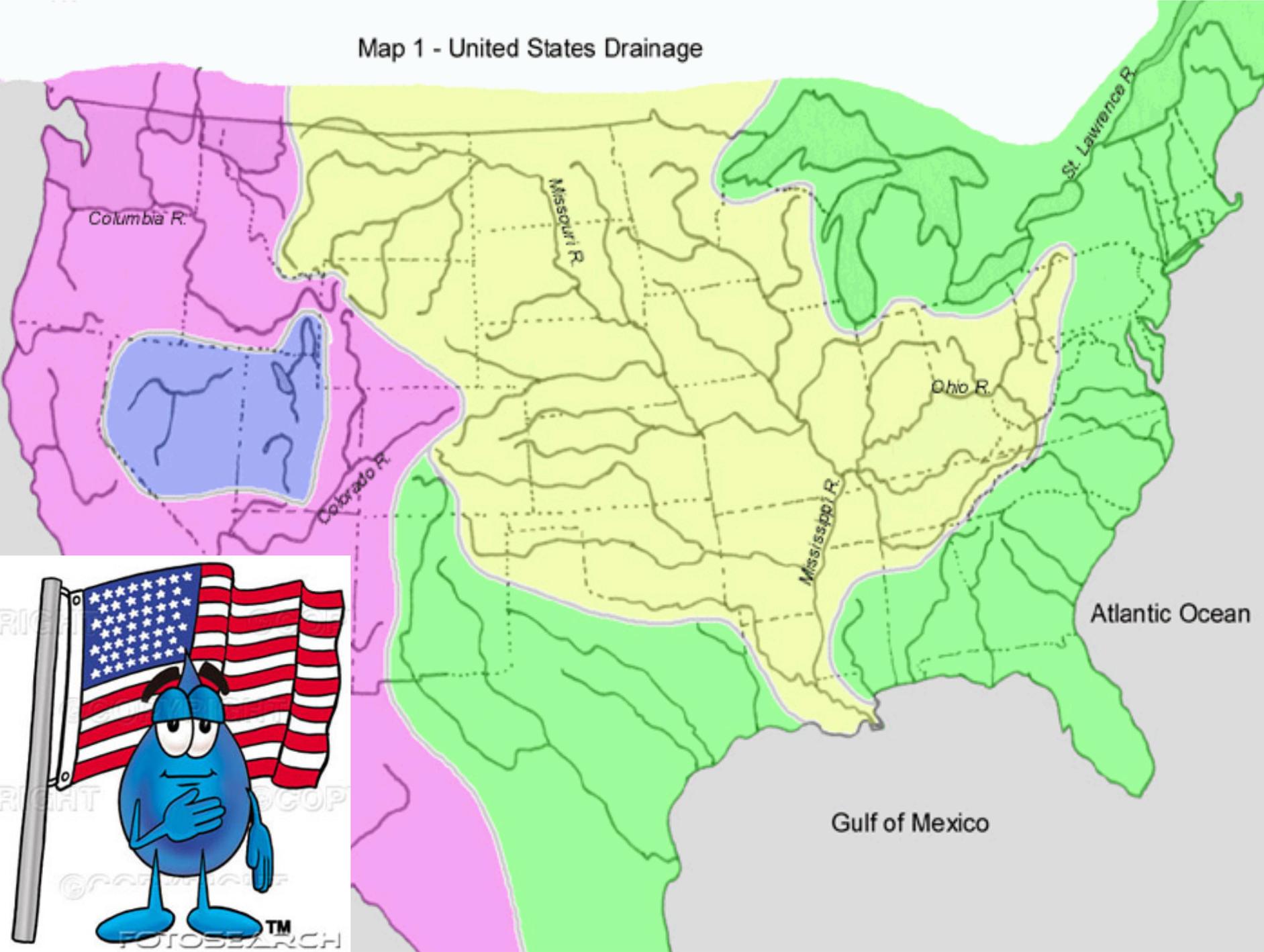
- ***A river and all of its tributaries (smaller streams that flow into the larger one) are part of a river system
- All of the land in which water drains into the river system is called a drainage basin or watershed
- Drainage basins are usually very large (Mississippi River drainage basin), whereas watersheds are smaller areas (Croton Watershed)



Divides

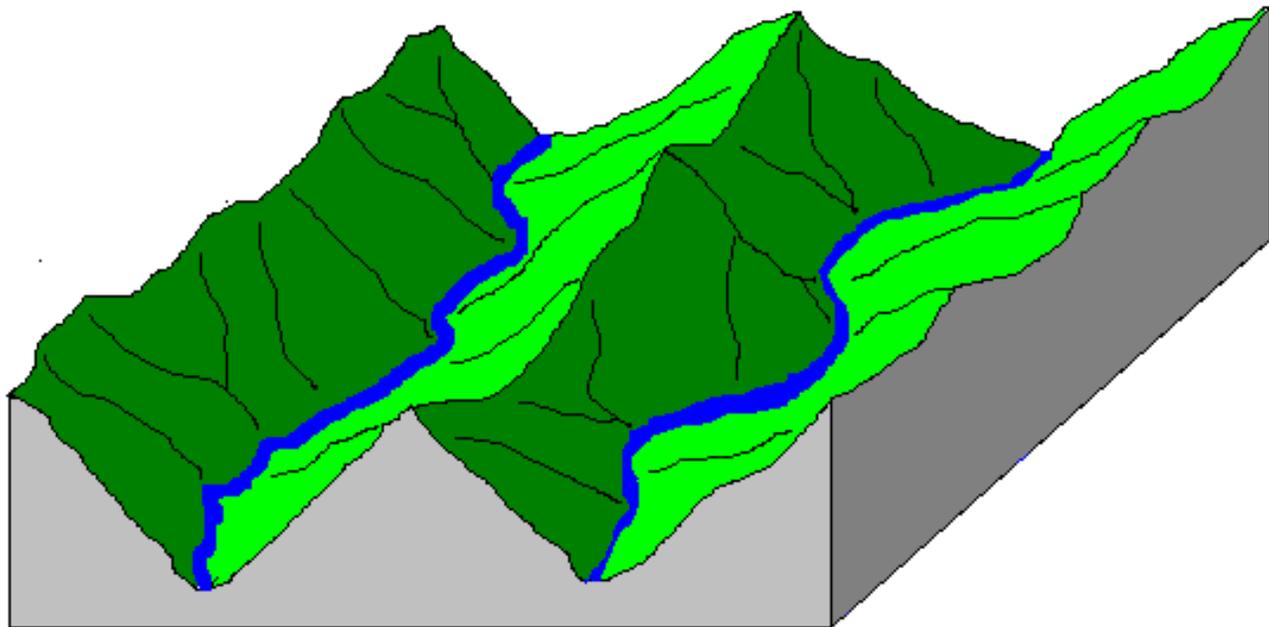
- A line of higher elevation will “divide” one drainage basin from another.
- Water always flows to lower elevation (downhill) and a line of highest elevation will divide the drainage basins and show the different directions water will flow.
- [Link to triple divide](#)

Map 1 - United States Drainage

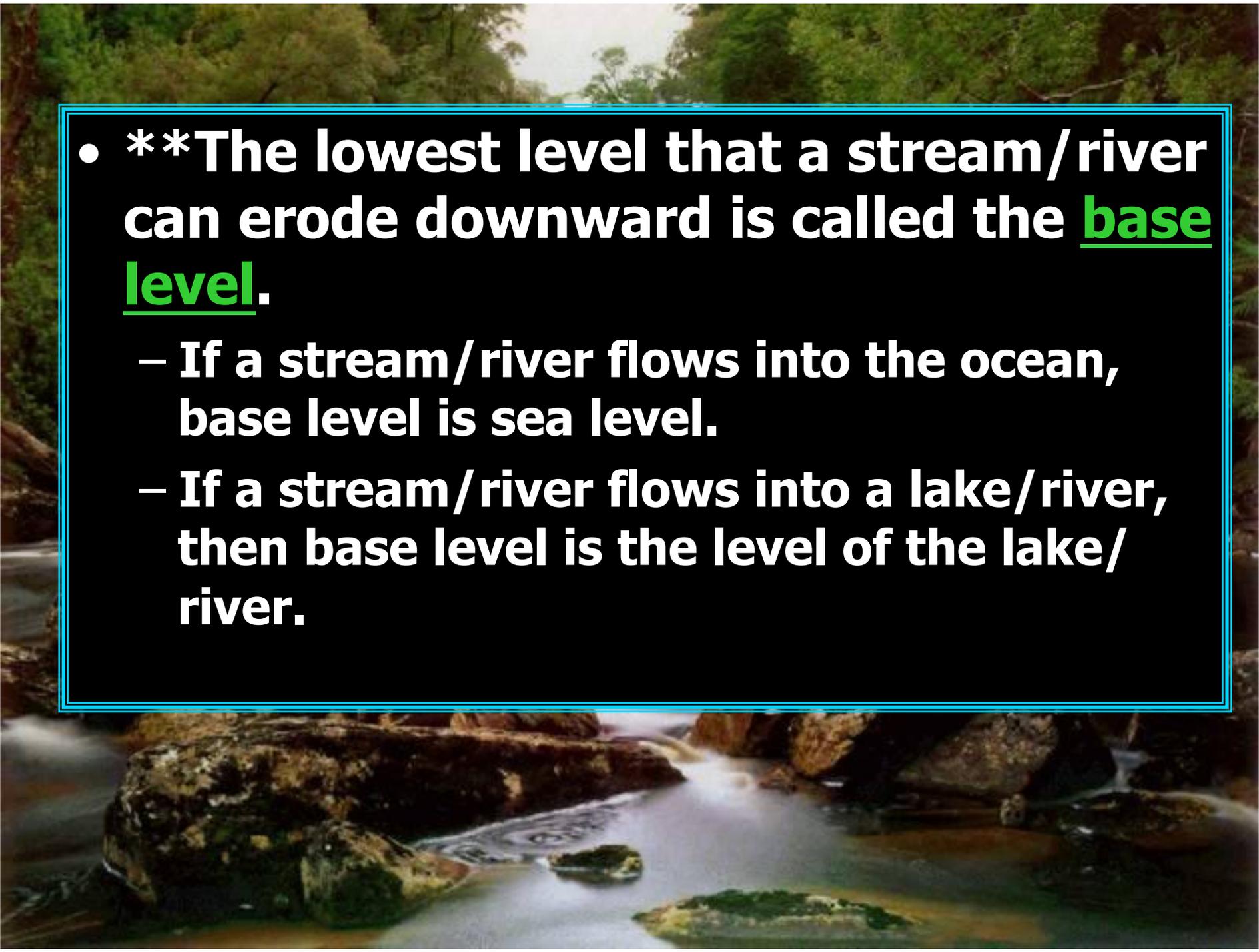




- **VIF****** As streams/rivers erode the land, they cut downward into the ground forming a **V-shaped valley** ******VIF**
 - (ex. Grand Canyon, AZ & the Ausable Chasm, NY)

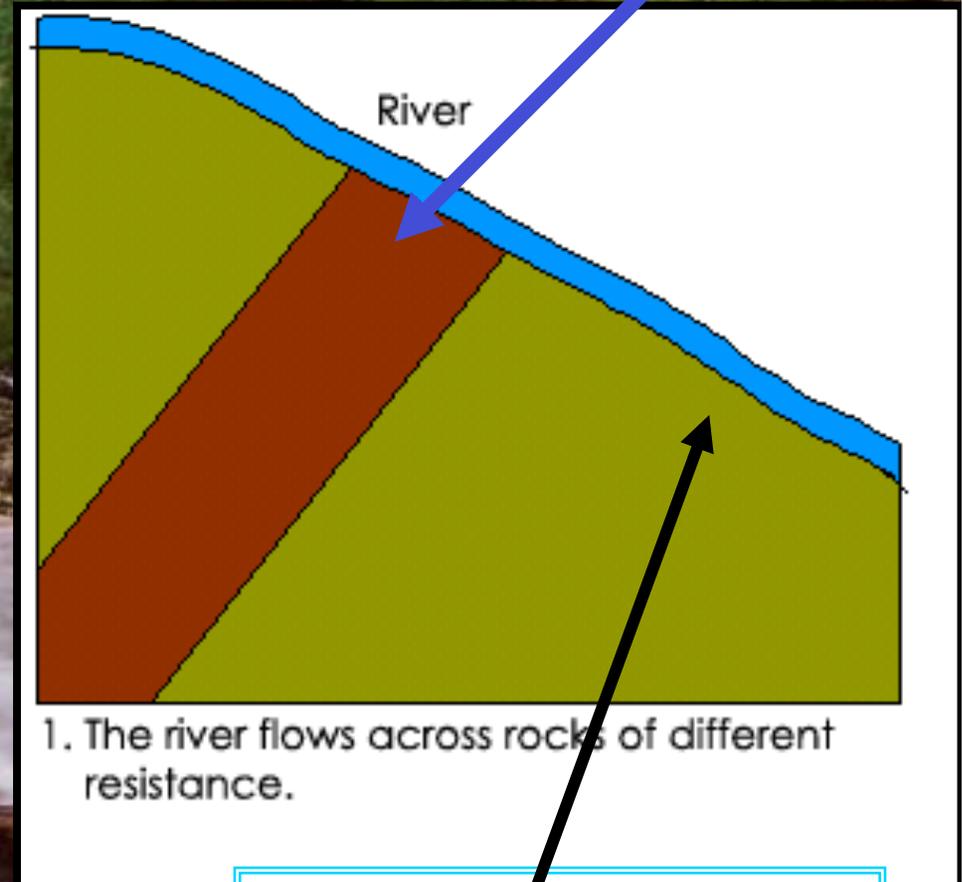




- 
- ****The lowest level that a stream/river can erode downward is called the base level.**
 - **If a stream/river flows into the ocean, base level is sea level.**
 - **If a stream/river flows into a lake/river, then base level is the level of the lake/river.**

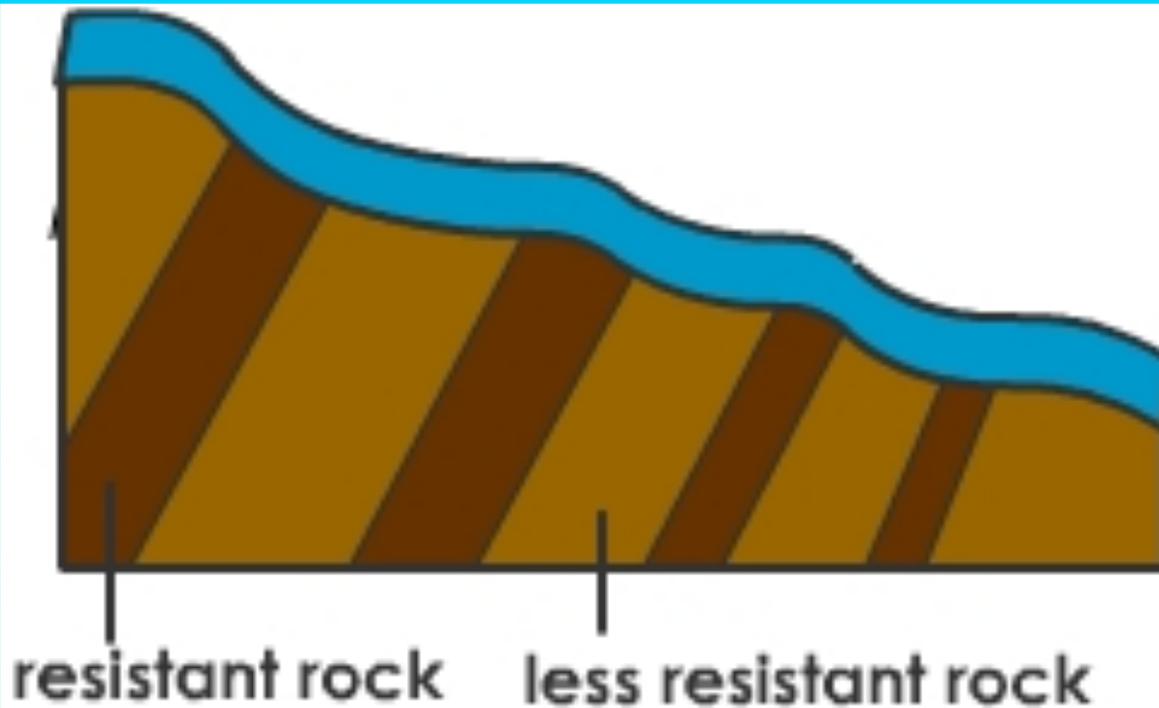
A waterfall is where a river falls steeply over a band of hard rock. It is formed through a very loooooong process in which a river flows over hard rock followed by soft rock, leaving a small step of hard rock sticking up into the river. Over thousands of years, the soft rock is worn away until the river falls from a great height.

More resistant rock doesn't WED as fast

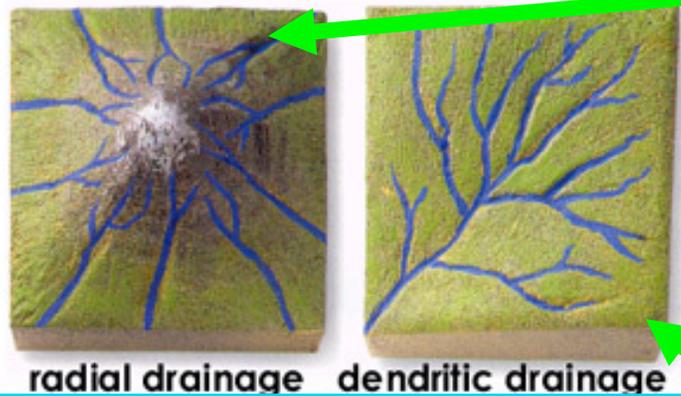


Less resistant rock WED's faster and goes away

Rapids are stretches of fast-flowing water tumbling over a rocky-shallow riverbed. They are caused by different resistance among various rock. They are formed when the water goes from one hard rock that resists the water's erosion to a softer rock that is easier eroded. The rocks break up the flow of the flow, but are not big enough to form a waterfall. Over time, rapids are formed.



If you could look down on a river from above, you would see that it branches. This is called a drainage pattern. The shape of the pattern depends on rocks, soil, climate and the changes made to the river. We will discuss these patterns more when we learn about Landscapes!!!

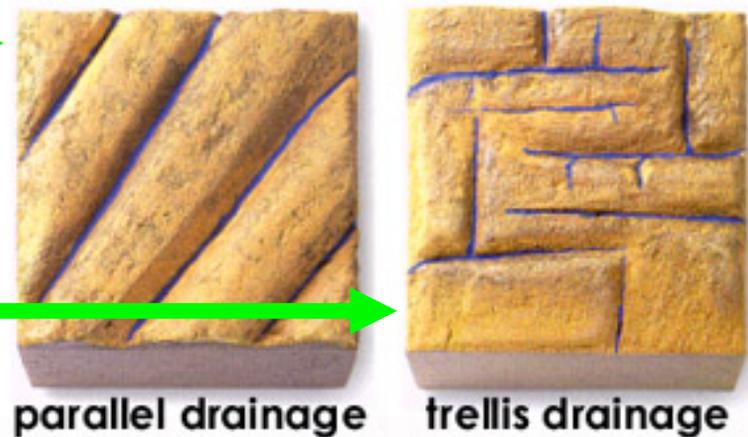


radial drainage dendritic drainage

Radial drainage happens when streams flow down and outward from a central high point, such as a mountain/volcano top. Other rivers, such as the Amazon, form a pattern like the branches of a tree. This is called **Dendritic** drainage. Like a dendrite at the end of a nerve!

Parallel (aka Annular) drainage happens when streams flow in valleys that are parallel to one another.

Trellis (aka Rectangular) drainage is common where massive layers of sedimentary rock have 'slipped' or where there's faults or joints (90° turns).



parallel drainage trellis drainage

Stream Characteristics

**Who am
I???**

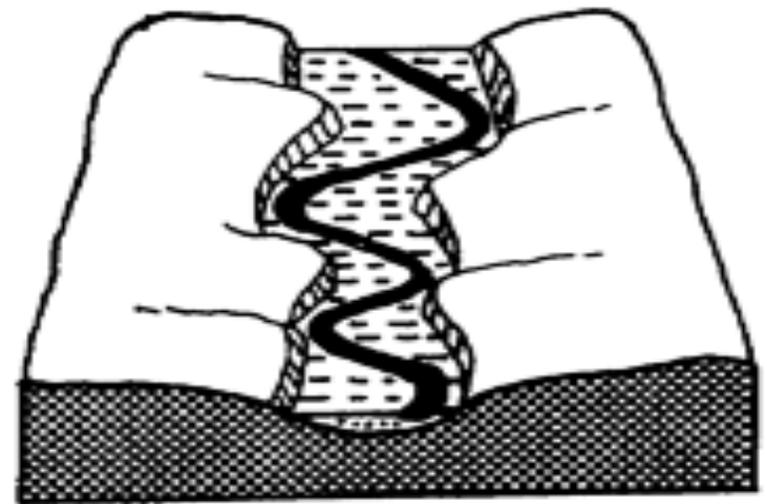


- **Young streams tend to flow quickly and over a straight, narrow path**
- **Over time the stream cuts deeper into the slope, and therefore the slope becomes less steep**
- **Because of this, the stream slows down over time**
- **It begins to spread/cut outward instead of cutting downward**

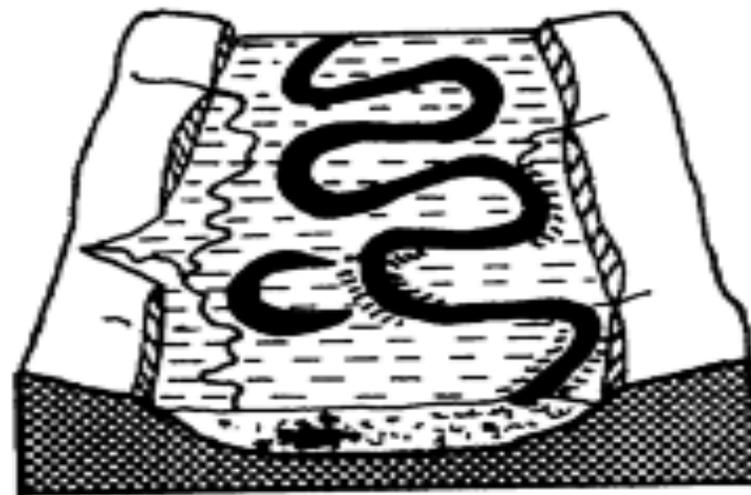




(a) Youthful

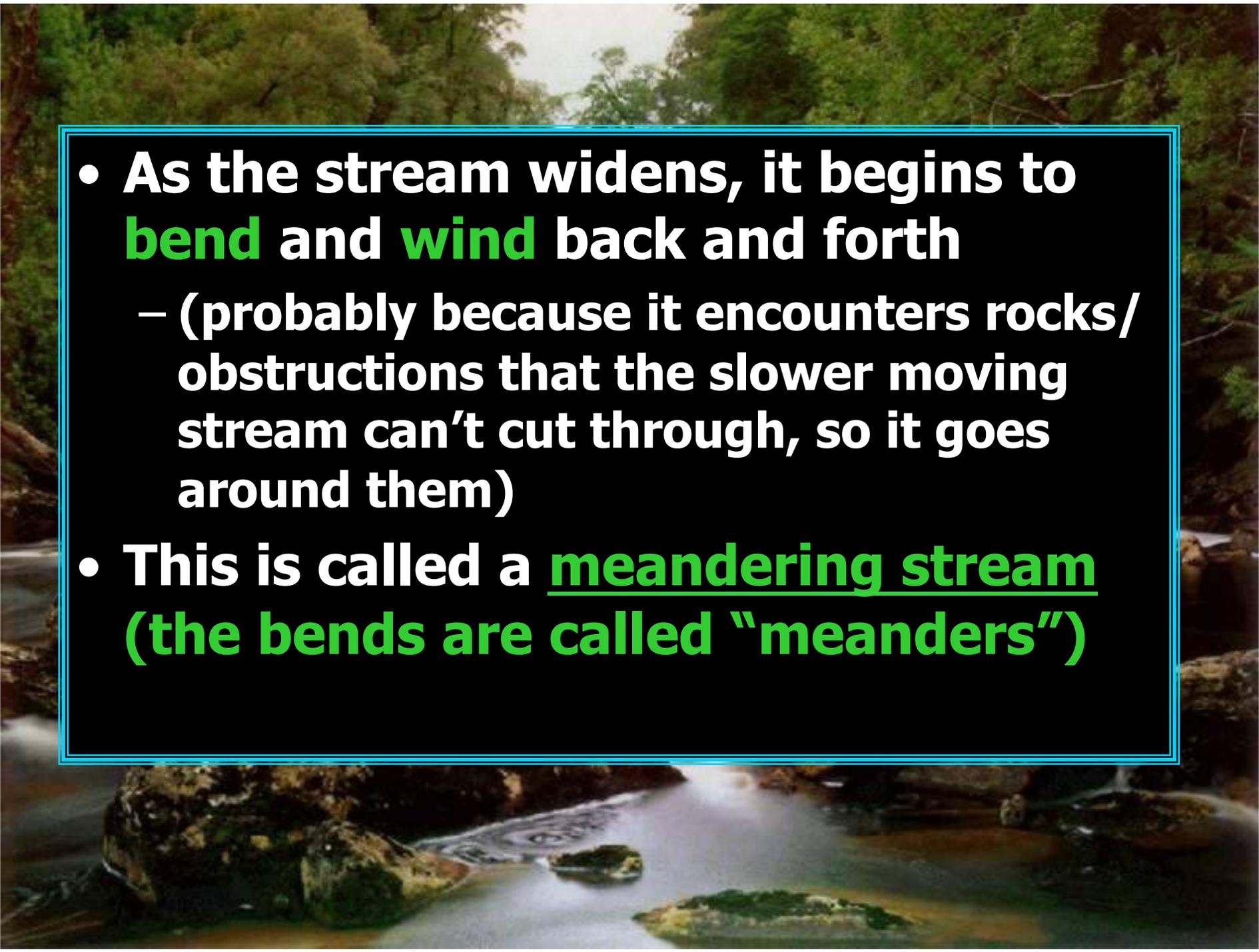


(b) Mature

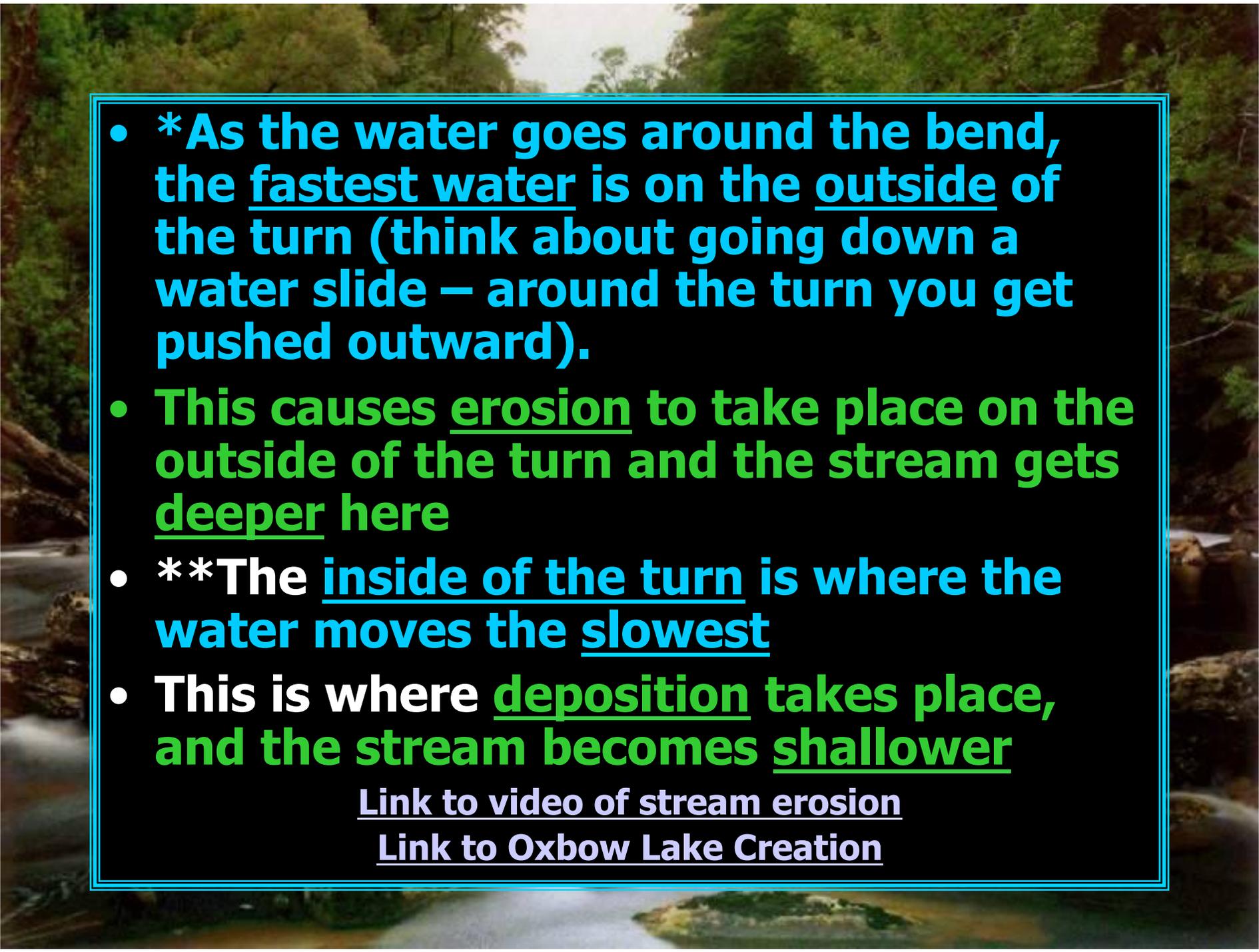


(c) Old Age

Figure 3-3. Stream evolution and valley development.

- 
- As the stream widens, it begins to **bend** and **wind** back and forth
 - (probably because it encounters rocks/obstructions that the slower moving stream can't cut through, so it goes around them)
 - This is called a meandering stream (the bends are called "meanders")

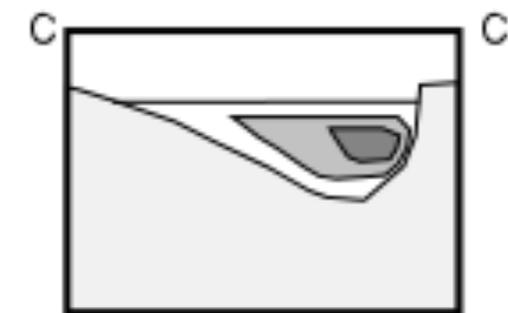
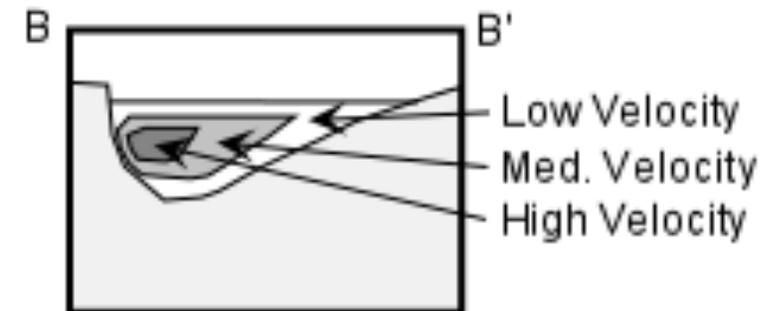
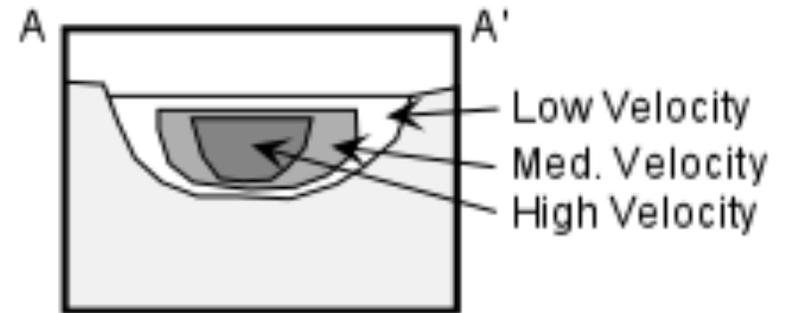
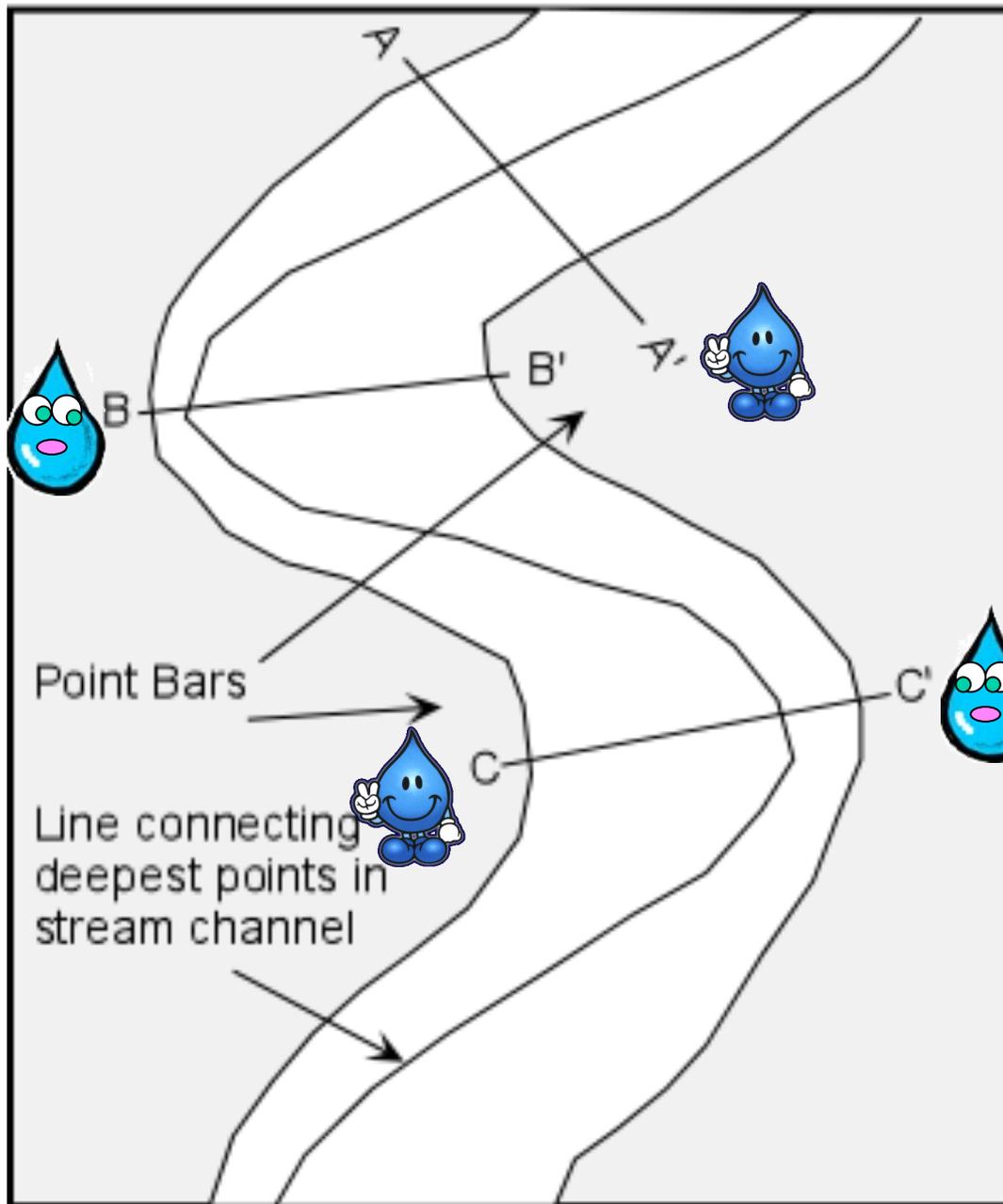


- 
- ***As the water goes around the bend, the fastest water is on the outside of the turn (think about going down a water slide – around the turn you get pushed outward).**
 - **This causes erosion to take place on the outside of the turn and the stream gets deeper here**
 - ****The inside of the turn is where the water moves the slowest**
 - **This is where deposition takes place, and the stream becomes shallower**

[Link to video of stream erosion](#)

[Link to Oxbow Lake Creation](#)

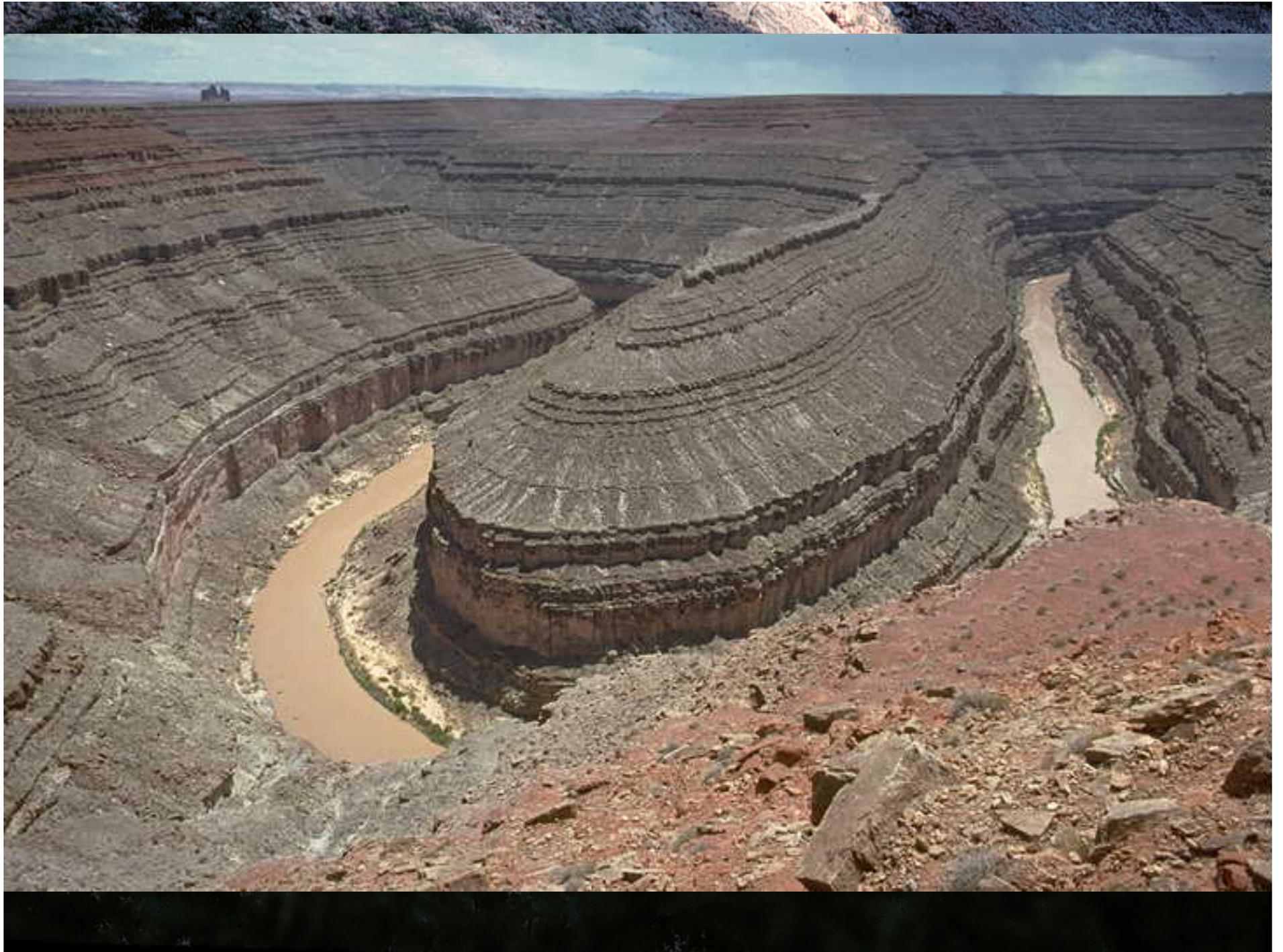
Meandering Channels



Rejuvenated Streams

- **If the land that an old river/stream runs through becomes uplifted due to tectonic forces, the stream can become faster running, making it youthful again.**

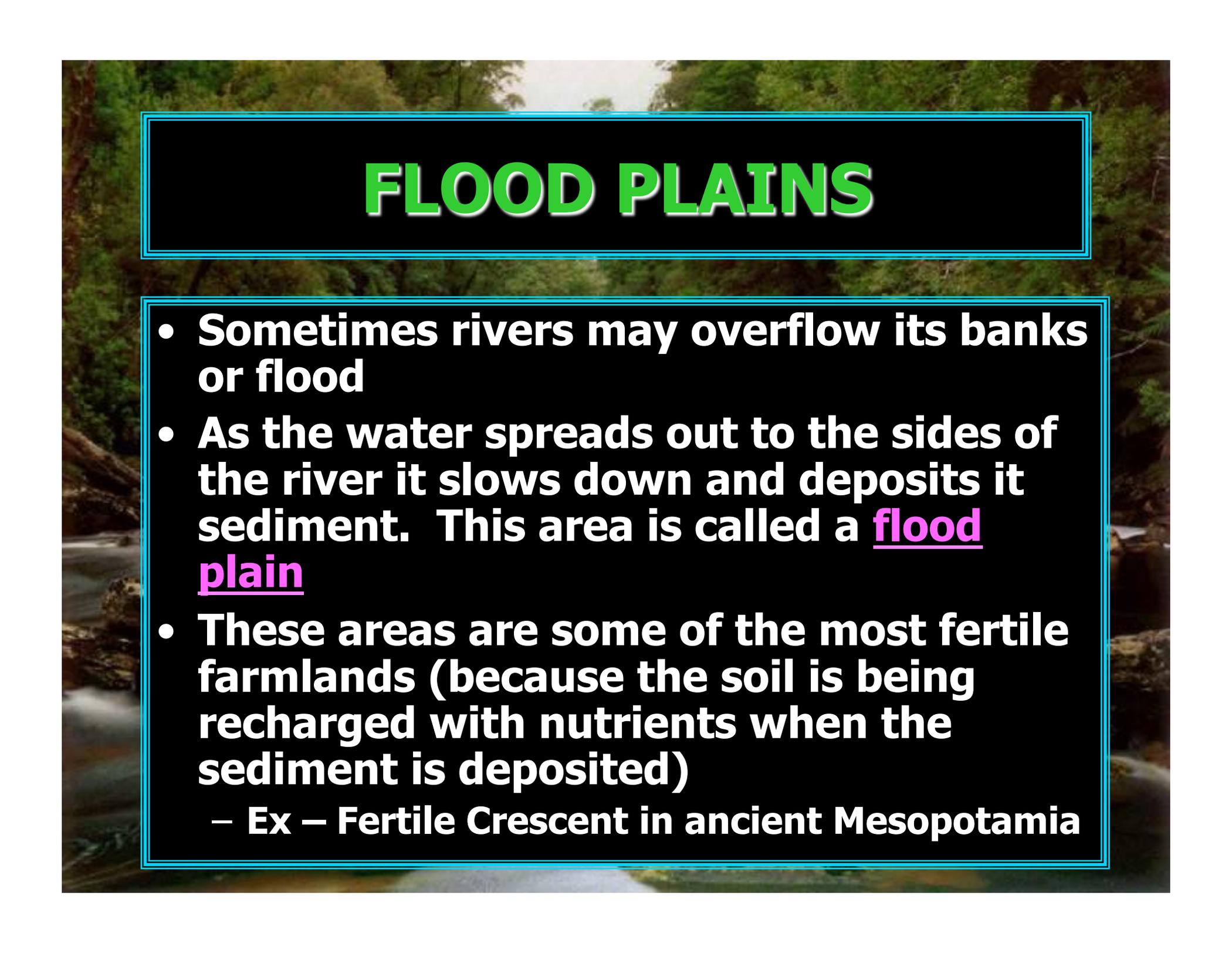




Deposition by Running Water

**Oh no!! I have
dropped my
sediments!!!**





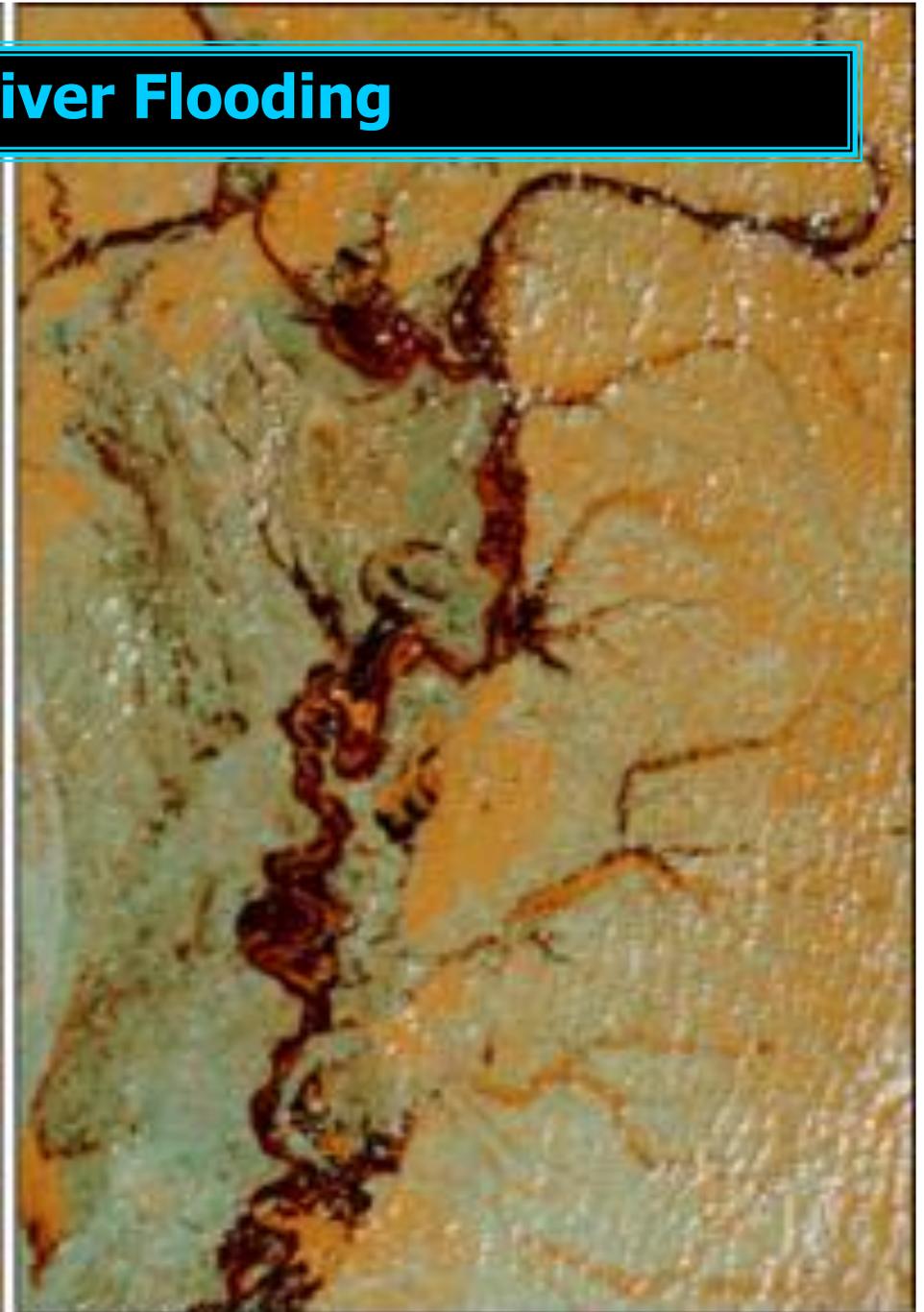
FLOOD PLAINS

- Sometimes rivers may overflow its banks or flood
- As the water spreads out to the sides of the river it slows down and deposits its sediment. This area is called a flood plain
- These areas are some of the most fertile farmlands (because the soil is being recharged with nutrients when the sediment is deposited)
 - Ex – Fertile Crescent in ancient Mesopotamia

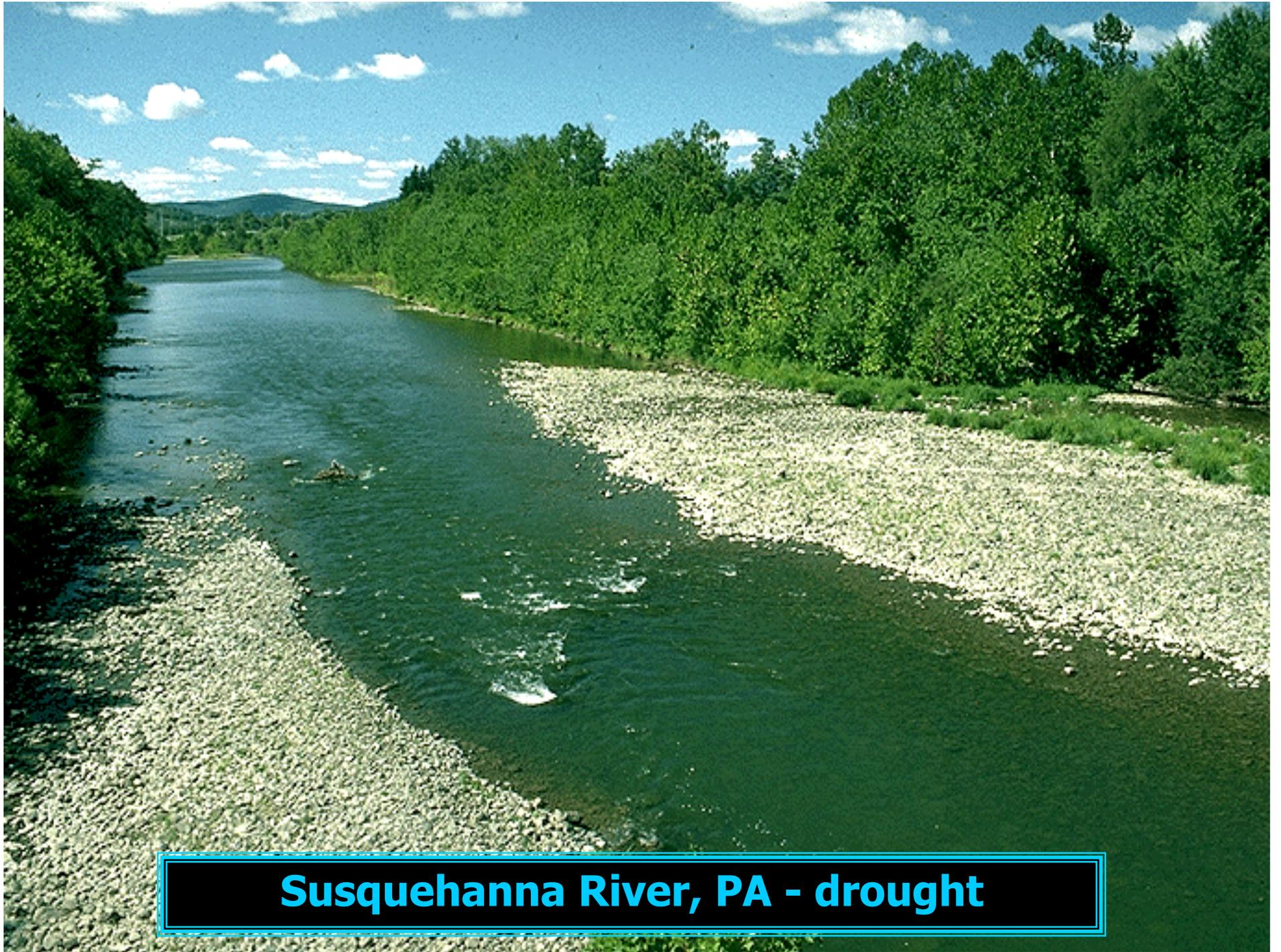
Mississippi River Flooding



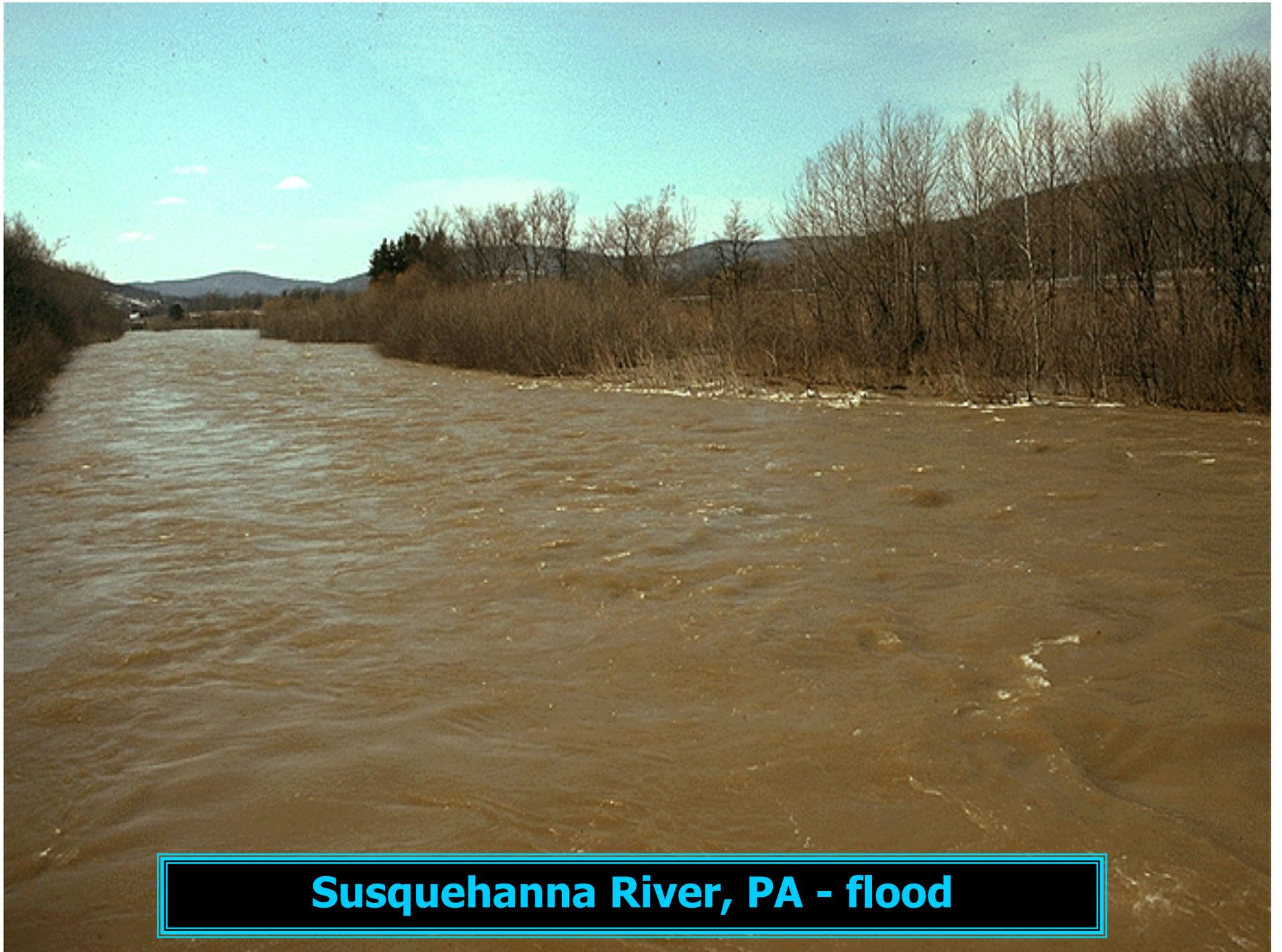
April 25, 2002



May 18, 2002



Susquehanna River, PA - drought



Susquehanna River, PA - flood



An aerial photograph of a river delta, showing a river branching into several smaller channels that flow into a larger body of water. The land is green and appears to be a wetland or marsh. The text is overlaid on a black rectangular box with a blue border.

DELTA

- **Deltas are formed at the mouths of rivers**
- **Sediment is deposited as the river slows when it enters the larger body of water**
 - **Mississippi River Delta formed where the Mississippi River empties into the Gulf of Mexico**
 - **The delta has a triangular shape like the Greek letter Delta (Δ)**

Deltas

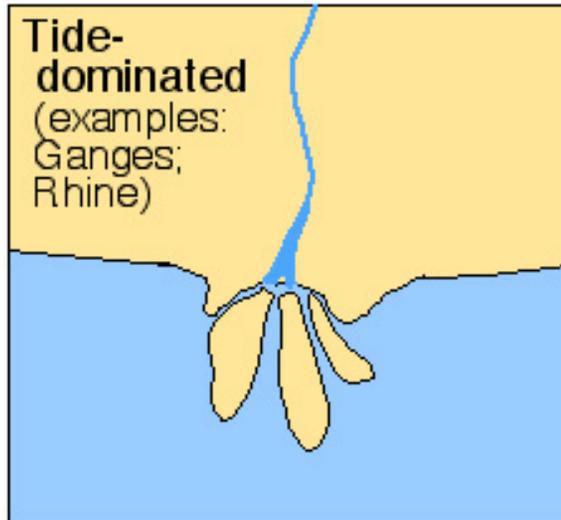
Accumulations of sediment
where rivers flow into lakes or oceans

Map views:

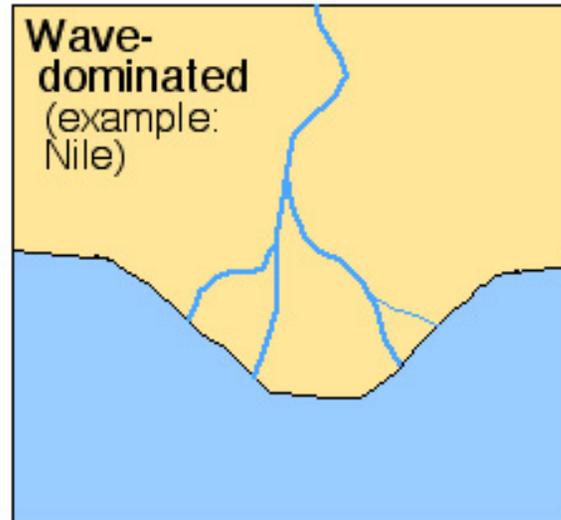
**River-
dominated**
(example:
Mississippi)



**Tide-
dominated**
(examples:
Ganges;
Rhine)

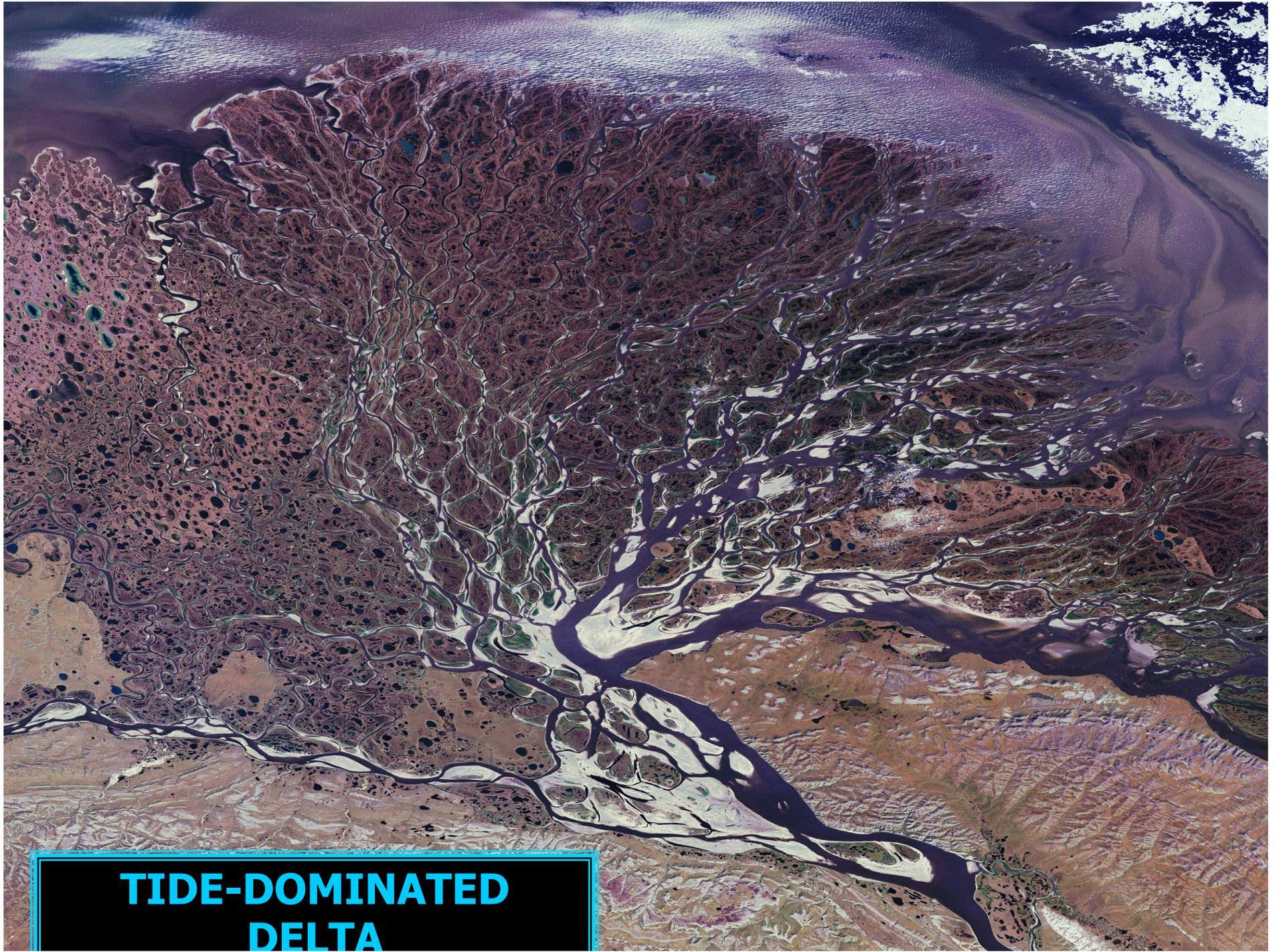


**Wave-
dominated**
(example:
Nile)





RIVER-DOMINATED DELTA



**TIDE-DOMINATED
DELTA**

Nile River Delta

6 April 1998



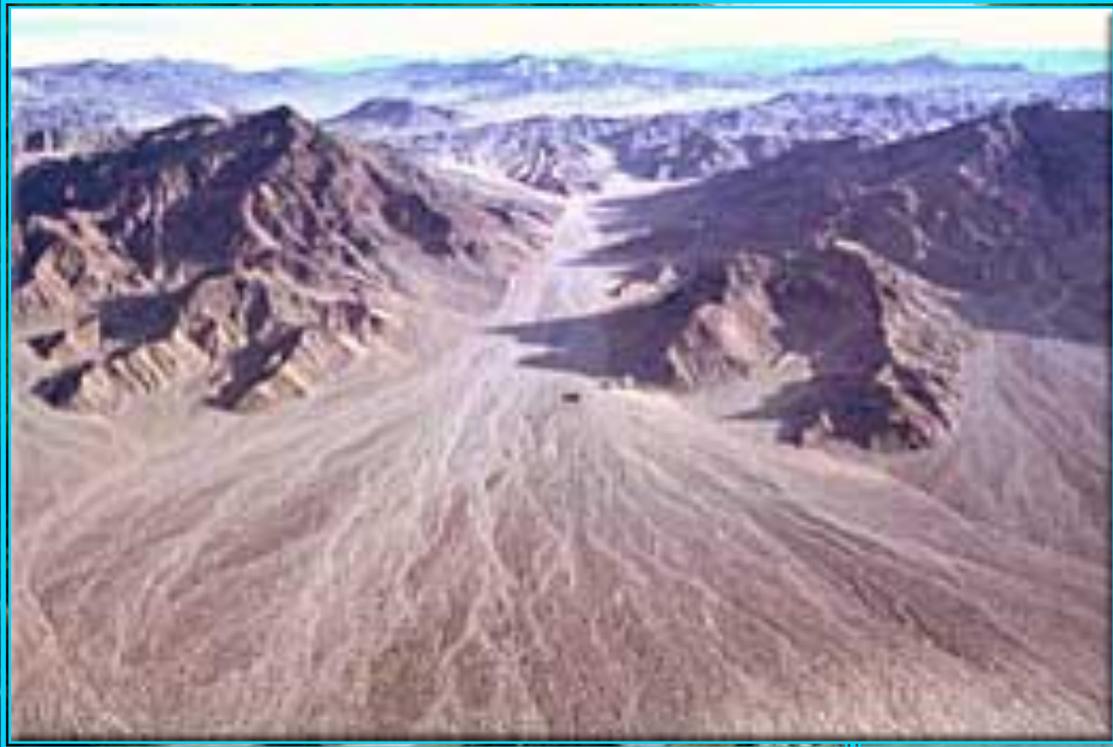
WAVE-DOMINATED DELTA

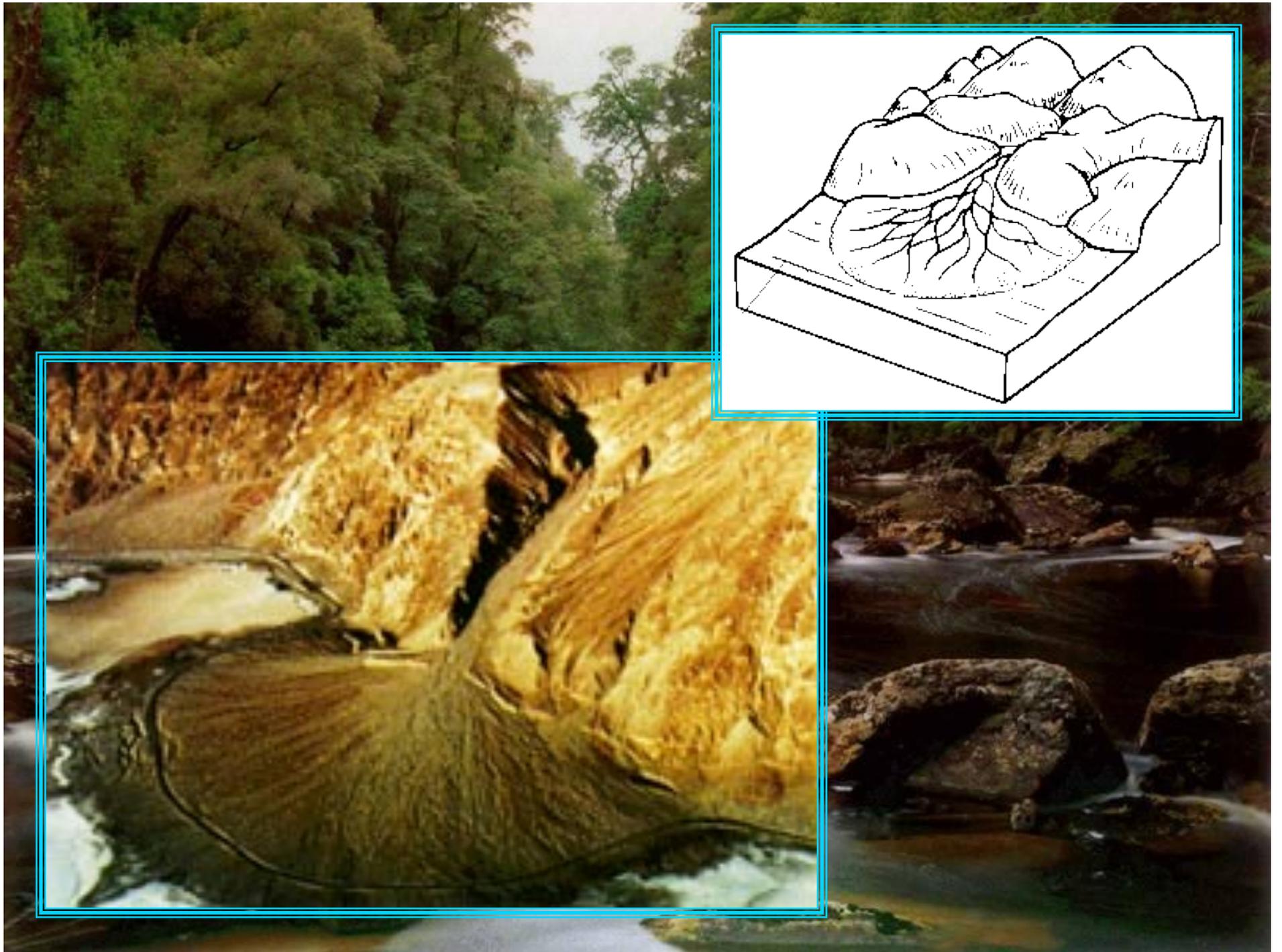
An aerial photograph of a river delta. The river flows from the top center and branches out into several smaller channels. A prominent feature is a large, fan-shaped area of light-colored sediment that has accumulated at the river's exit. The surrounding landscape is lush with green trees and vegetation. The sky is overcast.

ALLUVIAL FANS

- **Alluvial Fans are deltas formed on dry land**
- **Temporary streams formed by precipitation carry sediment down to the bottom of steep hills in dry areas**
- **When the streams dry up, a large fan shaped pile of sediment is left behind**







**THAT'S ALL
FOLKS! See you
in the water
cycle!**

**Peace
out!**

