RUNNING WATER

The amount of water that becomes **runoff** rather than soaking into the soil is controlled by the intensity and duration of the rainfall, the prior wetted condition of the soil, the soil texture, the slope of the land, and the nature of the vegetative cover. When the ground becomes saturated, the rain becomes runoff and flows into a stream. A **stream** is a channelized flow of water of any size. A **river** is a main stream into which several tributaries flow.

Streamflow:

Water may flow either as laminar flow or turbulent flow. In **laminar flow**, the water particles flow in straight-line paths parallel to the channel and do not mix. In **turbulent flow**, the water moves in an erratic manner, swirling in whirlpool-like eddies.

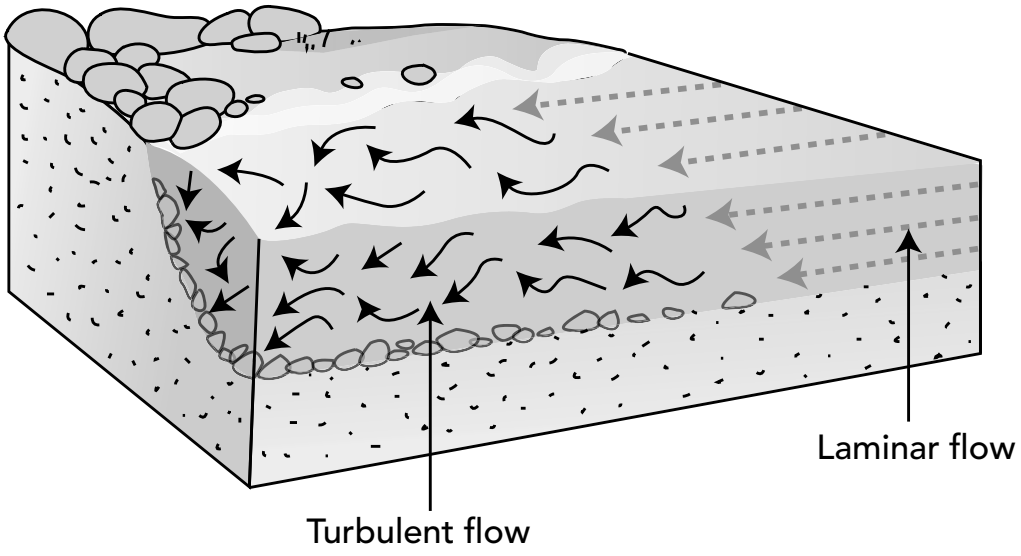
The **velocity** of the stream determines whether the flow is laminar or turbulent. Laminar flow occurs when the water moves very slowly in a smooth channel. With increased velocity or a rougher channel, the flow becomes turbulent. Most streamflow is turbulent, allowing erosion of the stream channel and transportation of suspended sediment downstream.

The velocity of a stream depends on the gradient, the shape, the size, and the roughness of the channel, and the discharge.

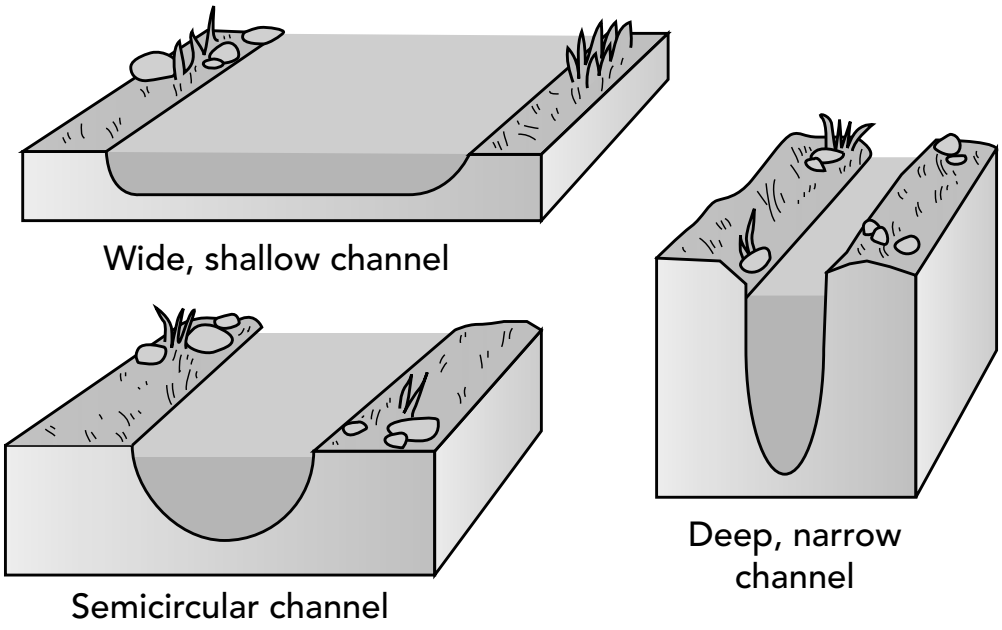
The **gradient** is the slope of the stream channel and is expressed as the vertical drop of a stream over a fixed distance. The higher the gradient, the more energy available for streamflow and the greater the velocity.

The **cross-sectional shape** of a channel determines the amount of water in contact with the channel and therefore the amount of frictional drag. A semicircular shape has less water in contact with the channel than a wide, shallow channel or a deep, narrow channel, and thus flows with greater velocity. A large, smooth channel allows greater flow velocity than a small, rough channel.

The **discharge** of a stream is the amount of water flowing past a certain point in a given unit of time. Thus, as the discharge of a stream increases, the width or depth of the channel must increase or the velocity must increase to accommodate the increased water supply.



Steamflow



Channel Shape

Profile of a Stream:

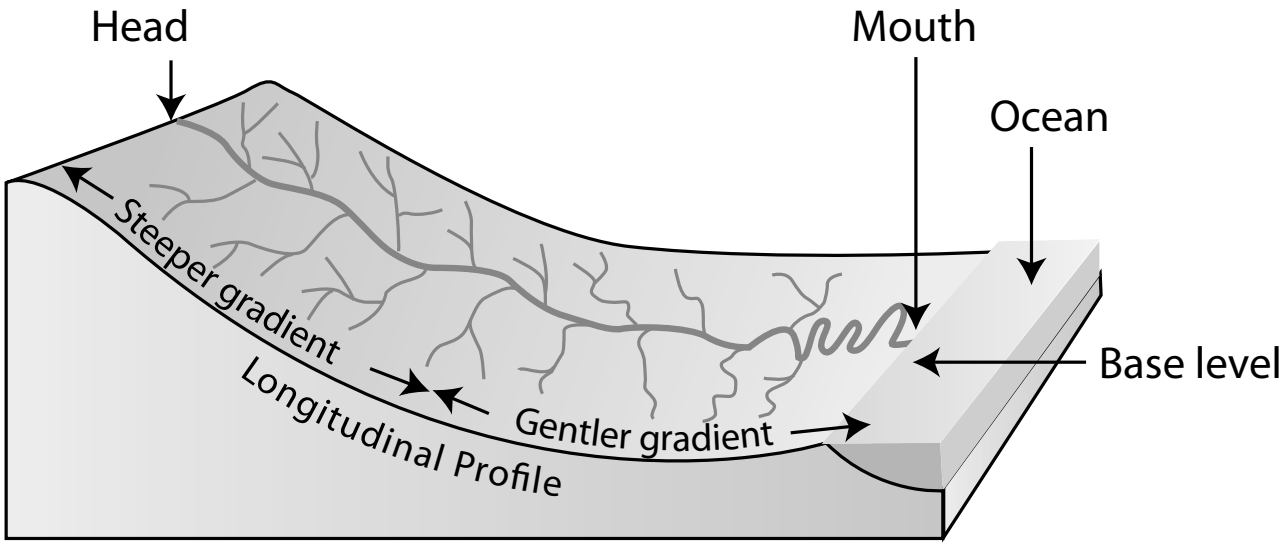
The **longitudinal profile** of a stream is a cross-sectional view of a stream from its **headwaters** (source) to its **mouth**, the point downstream where the stream empties into another body of water.

There is a constantly decreasing gradient from the headwaters of a stream to its mouth. However, the velocity of the stream increases downstream. The headwaters of a stream have a small channel and rough bed that create drag and inhibit forward movement. Farther downstream, the bed material becomes much smaller, offering less resistance to flow; the width and depth of the channel increase to accommodate the greater discharge. Thus the water may flow more freely and more rapidly.

Base Level:

The **base level** of a stream is the lowest elevation to which a stream can erode its channel. The **ultimate base level** is sea level. **Local or temporary base levels** are lakes, resistant layers of rock, or main streams. When a stream enters a lake, its velocity quickly approaches zero, and its ability to erode ceases. If the base level of a stream changes because of drainage of a lake, the building of a dam, the uplifting ot the land, or the lowering of sea level, the stream may build up or downcut its channel to accommodate these changes.

A **graded stream** has the correct channel characteristics to maintain exactly the velocity required to transport the material supplied to it. Thus, the stream has reached a state of equilibrium where it is not eroding or depositing material, but merely transporting it. The graded stream adjusts to all changes in its base level.



Longitudinal Profile of Stream

Stream Erosion:

Streams erode their channels by lifting loosely consolidated material, by abrasion, and by solution activity. In turbulent flow, water whirls and eddies, dislodging particles from the channel and lifting them into the moving water. Thus the force of running water swiftly erodes the poorly consolidated materials on the bed and banks of the stream. The stronger the current, the faster the erosion occurs. The solid particles carried by a stream, especially sand and gravel, constantly bombard the bed and banks of the channel, abrading even solid bedrock. Steep-sided gorges are formed in this way. The individual sediment grains also abrade each other, forming smoother, rounder grains.

Rounded depressions called **potholes** are commonly formed on river beds by the abrasive action of particles swirling in fast-moving eddies. The rotational motion of the sand and pebbles acts like a drill to bore the holes.

Activities;

1. Examine streams that show erosion.
2. Examine pictures of erosion activity.
3. Examine the pebbles in the stream for angularity.
4. Examine pictures of potholes in stream beds. Pictures of streams in Arizona and Utah show excellent examples of potholes.

DEPOSITION OF SEDIMENTS

Sediments are deposited according to **particle size**. As the velocity of a stream decreases, it can no longer carry large particles and the large particles settle to the bottom. As the velocity decreases further, the next largest particles settle out and so on. This is called **sorting**. The well sorted material deposited by streams is called **alluvium**.

Channel Deposits:

Sediments deposited within a channel are usually composed of sand and gravel and are called **bars**. The bars are only temporary, as the material gets picked up and transported further downstream by the running water.

When streams flow in a series of bends called **meanders**, the velocity of the water on the outside of the bend increases, causing erosion; the velocity on the inside of the bend decreases, causing sediment to settle out. These deposits occur on the inside 'point' of the bend and are called **point bars**. The point bars are really crescent-shaped deposits of sand and gravel.

When a stream deposits sediments on the floor of its channel, the deposits choke the channel, forcing the stream to split and follow different paths. There is a complex network of converging and diverging channels that thread their way among the bars. The stream is said to be **braided**. Braided streams form at the end of glaciers, when there is an abrupt decrease in gradient, or when there is a decrease in the discharge of the stream.

Activities:

1. Examine pictures of streams to find meanders and bars.
2. Examine pictures of streams, especially those near glaciers, for a braided stream.
3. Examine the sediments deposited in a bar or point bar to determine their composition and how well they are sorted.

Floodplain Deposits:

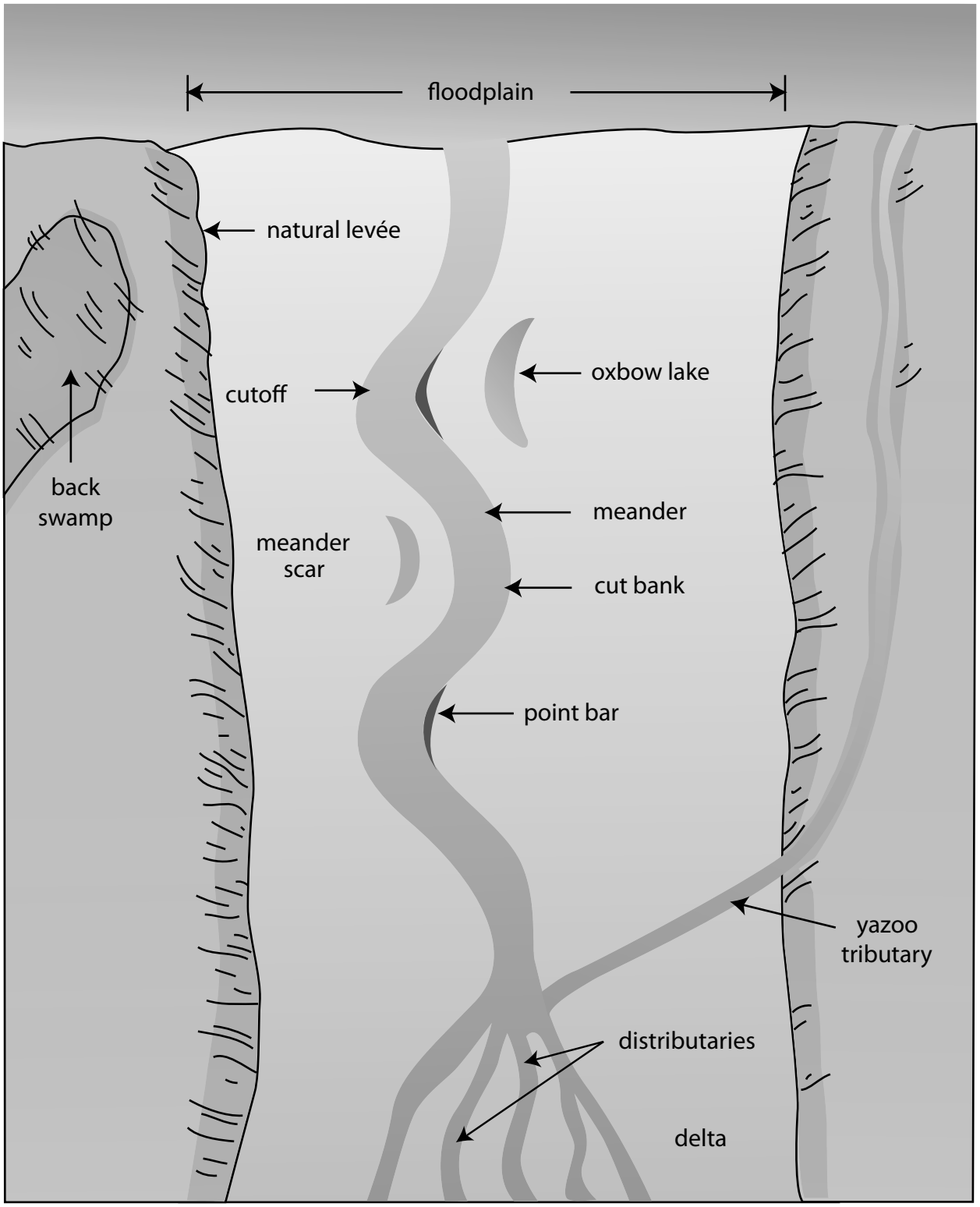
A **floodplain** is that part of a valley that is inundated during a flood. The **alluvium** consists of coarse sand and gravel from point bars deposited as the stream meandered over the valley floor, and of fine sand, silt, and clay deposited during floods.

Streams in broad, flat-floored valleys sometimes form **natural levees** of coarser material parallel to the stream channel during many successive floods. The levees are higher than the rest of the valley, causing poor drainage in this area and forming **back swamps**. Sometimes the levees prevent tributaries from entering the main stream, forcing the tributary to travel parallel to the main stream for long distances before it finally enters the main stream. These streams are called **yazoo tributaries** after the Yazoo River which follows the Mississippi River for more than 300 kilometers.

Activities:

1. Pictures of floodplains and flooding rivers.
2. Pictures of the Mississippi River with its natural levees and the Yazoo River tributary.

Stream Valley



Stream Valley