Earth Science

GEOGRAPHY 1710

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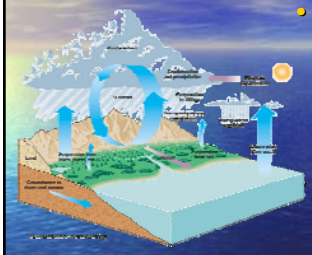
River Systems and Landforms

Chapter 14

Introduction

- Rivers and streams are dynamic systems that continually adjust to natural and human-caused changes
- Running water is the most important geologic agent modifying Earth's land surface and is a source of fresh water for industry, agriculture, and domestic use
- Management of erosion and flooding requires considerable effort and cost

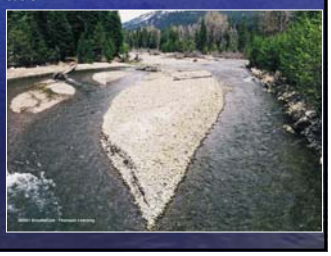
The Hydrologic Cycle



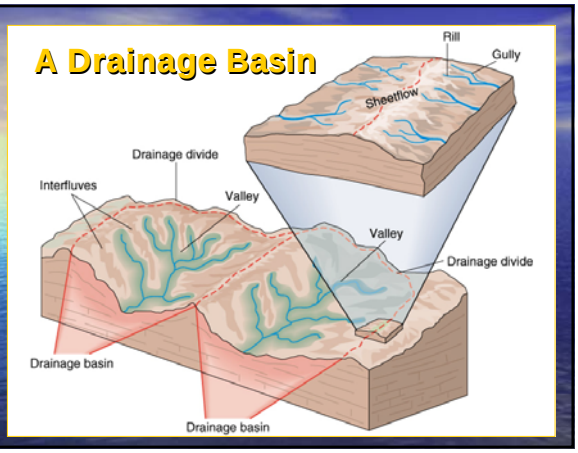
- Water is continually recycled from the oceans, through the atmosphere, to the continents, and back to the oceans
- Powered by solar radiation and occurs because water changes readily from a liquid to a gas under surface conditions
  - Evaporation, condensation, precipitation, and runoff characterize the movement of water, though some is stored in lakes, groundwater, and ice

Running Water

- Sheet Flow
  - water moves in a continuous sheet of shallow water moving over the surface
- Channel Flow
  - water is confined to long trough-like depressions



A Drainage Basin



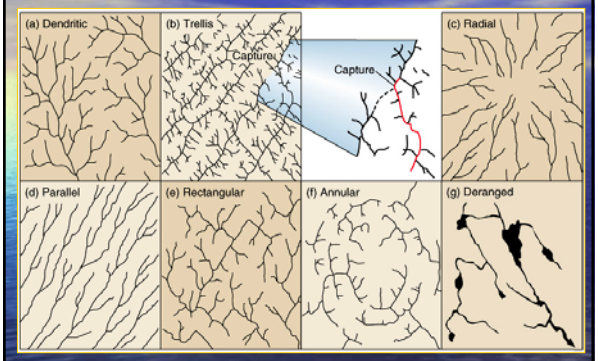
Drainage Basins

DRAINAGE BASINS

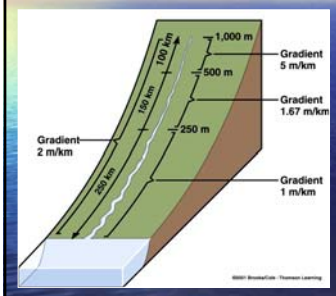
CANADA:
millions m^3 per year
(millions acre-feet per year)
Pacific 602,000 (488)
Arctic 440,000 (356)
Hudson Bay 682,000 (553)
Atlantic 670,000 (544)
Gulf of Mexico 105 (0.9)

UNITED STATES:
millions acre-feet per year
(millions m^3 per year)
Pacific 334 (412,000)
Gulf/Atlantic 718 (886,000)
Atlantic 293 (361,000)
—— Continental divides

Drainage Patterns

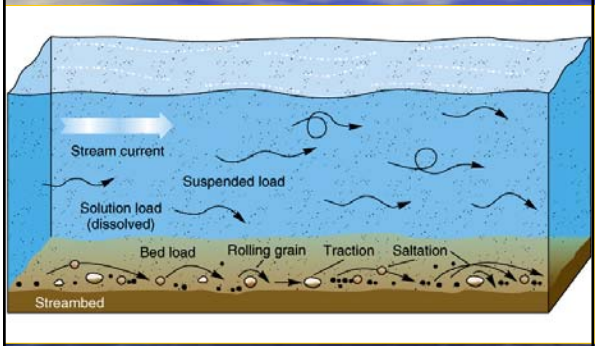


Gradient, Velocity, and Discharge



- Gradient is the average slope of the channel bed
- Velocity is the distance water travels in a given amount of time
- Discharge is the volume of water passing a point in a given amount of time

Fluvial Transport



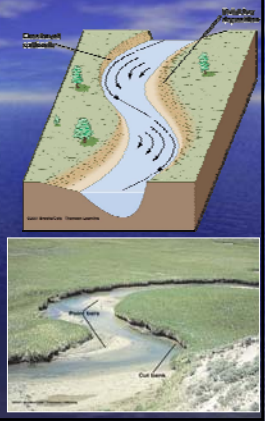
Deposition by Running Water

- Braided Streams
  - characterized by an intricate network of dividing and rejoining channels, separated by sand and gravel bars
  - develop when sediment supply exceeds the transport capacity of running water

Braided Streams

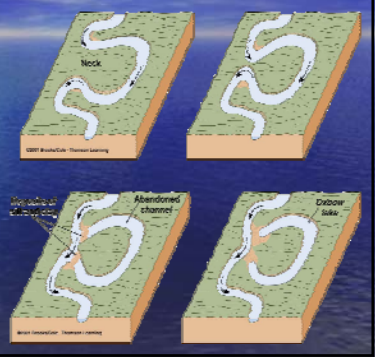
Deposition by Running Water

- Meandering Streams
  - defined by a single channel with broadly looping curves
  - cutbanks are found on the outside of meanders, point bars on the inside
  - unequal flow velocities in channels accounts for deposition and erosion in predictable patterns



Deposition by Running Water

- Meandering Streams
  - Oxbow lakes form when meanders become so sinuous that the thin neck of land between them is cutoff during floods

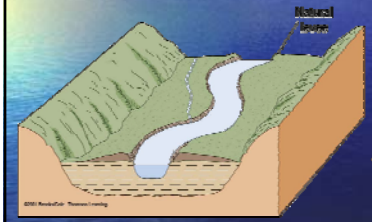


Itkillik River, Alaska

Incised Meanders

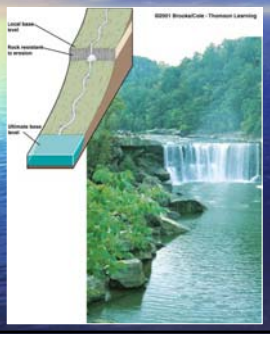
- Develop where an older meandering pattern is cut into underlying bedrock as tectonics uplift the region

Floodplain Deposits



- Water periodically overflows the channel and spreads sediment over flat-lying floodplains
- Natural levees build up from sand deposited adjacent to the channel

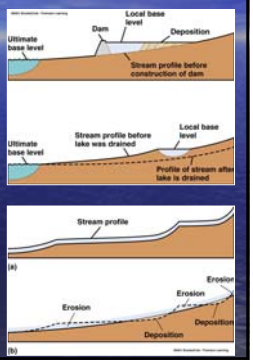
The Significance of Base Level



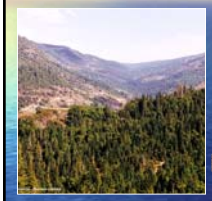
- Base level is the lowest level to which any stream can erode
- Sea level is taken to be the ultimate base level, but the rising of the sea or subsidence of land over geologic time make this concept a relative one
- Local base levels may control erosion and deposition

What is a Graded Stream?

- Graded streams develop over time as a balance between gradient, discharge, flow velocity, channel shape, and sediment load is reached
- The concept is an ideal, but gives us a model to understand responses to changes in these parameters



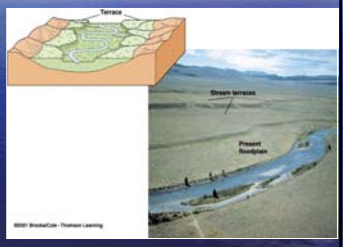
How Do Valleys Form and Evolve?



- Valleys usually have rivers running their length, with tributaries draining highlands on either side
  - downcutting occurs when a stream has excess energy to deepen its course
  - headward erosion occurs at the upstream end of the valley and results in stream piracy

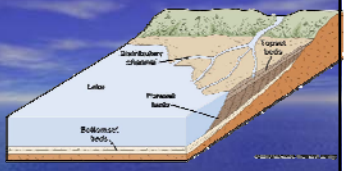
Stream Terraces

- Develop when a stream erodes into the deposits of floodplains formed when streams were formed at higher levels
  - several steplike terraces may exist above the present day floodplain
  - changes in base level or water supply can cause the formation of terraces



Deltas

- Flow velocity decreases as water flows into lakes or oceans
  - deposition occurs and may lead to the origin of a delta, which can prograde as sediment is continually supplied by the stream
  - topset, foreset, and bottomset beds are typical



Ganges River Delta

Figure 14.24

Nile River Delta

Mississippi River Delta

Floods and River Management

- Rating Floodplain Risk
- Streamflow Measurement

Streamflow Measurement

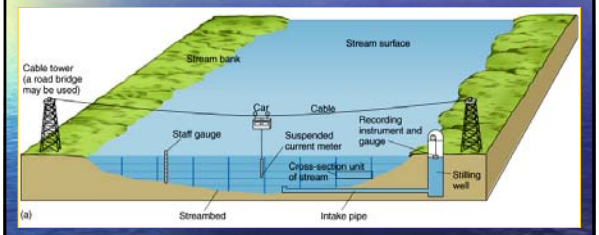


Figure 14.28

Can Floods be Controlled?

- Most common practices are dams and levees
  - both require large capital investments and constant maintenance
  - they are constructed to control finite amounts of water and sediment; if that is exceeded the water will end up in the floodplain anyway

Riparian Systems

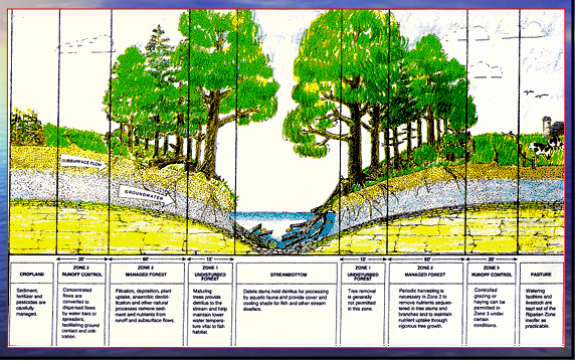
What is a Riparian Area?

Riparian zones or areas have been defined in several ways, but they are essentially the narrow strips of land that border creeks, rivers or other bodies of water. Because of their proximity to water, plant species and topography of riparian zones differ considerably from those of adjacent uplands. Although riparian areas may occupy only a small percentage of the area of a watershed, they represent an extremely important component of the overall landscape. This is especially true for arid-land watersheds, such as those in Eastern Oregon.

Functions of a Healthy Riparian System:

1. *Sediment Filtering*
2. *Bank Stablilization*
3. *Water Storage and Release*
4. *Aquifer Recharge*
5. *Wildlife Habitat*

Riparian Systems



Riparian Systems

A healthy system would have some or all these characteristics:

1.) High water table & increased storage capacity,
2.) High forage production,
3.) Good shade-Cool water,
4.) Good fish habitat-Good water quality,
5.) High wildlife habitat diversity,
6.) Vegetation & roots present to protect & stabilize banks,
7.) Higher late summer stream flows.

Denton Creek