6202 FLUVIAL LAB VIDEO
(EARTH EXPLORER: LESSON 6)

Terms/Vocabulary

hydrologic cycle: the cycle of water from the oceans to the atmosphere to the earth's surface and back to the oceans

evaporation: to remove moisture by heating—to produce vapor

transpiration: the process by which water vapor escapes from plants and enters the atmosphere

headwater: the highest elevation of a stream—its beginning

tributary: a secondary stream that adds discharge to a primary channel

drainage basin: the area drained by a stream

drainage divides: the topographic high that divides 2 or more drainage basins

potential energy: energy that is a function of mass, height and the acceleration due to gravity

kinetic energy: energy that is a function of mass and velocity—the energy of motion

discharge: the amount of water in a stream that passes a certain point in a unit of time (1 sec.)

turbulence: swirling random motion—typical of most natural stream flow

channel roughness: the surface irregularities of a stream channel's bottom and sides

gradient: the downhill slope of a stream bed

wetted perimeter: in cross-section that portion of the stream channel in contact with the water

bed load: material being transported along the bottom of the stream

suspension load: material being transported in the stream from above the bed load to the stream's surface

solution: material that has been dissolved by water

hydraulic lift: an upward force produced by water flowing up and over an obstruction

abrasion: erosion due to impact—chipping and breaking

meanders: sinuous curves and bends in a stream channel

base level: the lowest level to which a stream can erode

physiographic flood plain: the set of morphologic features a stream produces when it reaches its base level; a broad flat surface

point bar: an accumulation of sediment on the inside of a channel curve

cut bank: an erosional feature on the outside of a channel curve

incised meanders: meanders which have cut vertically into the country rock

tectonic forces: forces that deform the earth's crust

rejuvenate: to renew the vertical erosion of a stream

TV Outline

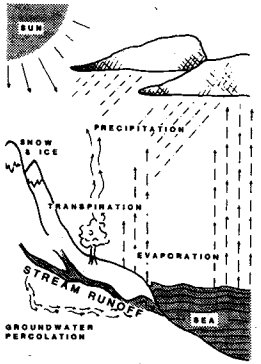
Notes/Questions

I. Introduction to "Water—A Cutting Edge With Time":
   A. Man relies on water for life, transportation and recreation.
   B. Under the influence of gravity, water is a dynamic and powerful geological process shaping the earth in unique and spectacular ways.

II. Hydrologic Cycle:
   A. Water circulates in various physical states from the oceans to the atmosphere to the earth and back to the oceans.
      1. On the earth's surface, some will evaporate.
      2. Some, used by plants and animals, is transpired.
      3. Some seeps into the ground fueling the ground water system.
      4. Some becomes locked up in glaciers which eventually will melt.
   B. Most water on the earth's surface flows across the surface leaving characteristic erosional and deposition landforms.

III. The headwaters location:
   A. When rain hits the ground, it initially flows as sheetwash or in tiny rills. These merge to form tributaries.
      1. Area drained by stream is called drainage basin.
      2. Basins are divided by high regions called drainage divides.
   B. Work and energy of a stream
      1. Standing water has potential energy which is a function of the water's mass and its position (elevation above sea level).
      2. Potential energy changes to kinetic energy when the water begins to flow.
      3. Kinetic energy is a function of mass and velocity and gives water its power to erode and transport material.
      4. At the headwater, both velocity and mass are small so not much work can be accomplished.

IV. Small v-shaped canyon—Brown's Canyon, Colorado:
   A. Tributaries have added together to form medium sized stream.
   B. Kinetic energy is now large enough to do work on the earth's surface and this work shows as vertical erosion which has produced a v-shaped canyon.
   C. The kind and amount of work a stream accomplishes is dependent on its velocity, discharge and degree of turbulence.
      1. Velocity is measured in ft/sec or m/sec. An approximation of the stream velocity can be made by floating on it over a measured distance. A correction factor of 0.8 must be used because of resistance to flow



The hydrologic cycle.

2. Discharge is measured in ft^3/sec (m^3/sec) and is the total amount of water flowing past a point during one second.
   a. One cubic foot of water weighs 62 lbs.
   b. 700 cfs is the calculated discharge.
3. Turbulence is difficult to quantify.
   a. Streams can flow in a smooth ordered fashion called laminar flow but they usually
   b. flow in a disordered way with swirls and eddies

D. Velocity, discharge and turbulence change with time and location in any stream so they are variables.

V. The Five Points Rapids location—Arkansas River, Colorado.

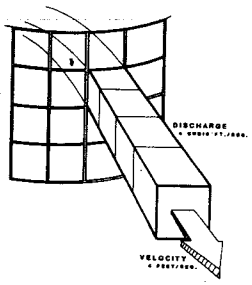
A. Changes in velocity are dependent on
1. channel roughness—at the specific location the channel roughness is large and is tending to slow the stream
2. gradient—the gradient is steep and this is causing an increase in velocity
3. channel cross-section is small which is also increasing the velocity.

B. Relationship of velocity, channel shape, and discharge.
1. discharge = velocity × cross-sectional area.
2. discharge through the short section of stream is constant
   a. in narrow section—since the cross-sectional area is small, velocity must be high D = V (↑) × a (↓)
   b. in the broad section—since cross-sectional area is large, velocity must be low D = v (↓) × A (↑)
   c. this fluctuation in area and velocity keeps the discharge constant.

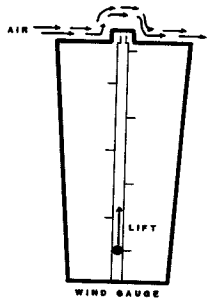
C. Ways in which sediment transported
1. bed load—rolling along bottom of stream
2. suspended load—turbulence and hydraulic lift keep smaller material in suspension
3. solution load—material that has been dissolved by the water.

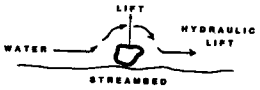
D. Ways in which material is eroded.
1. dissolving rocks—this is what yield the solution load.
2. hydraulic lift—a low pressure is created above a particle as water flows over it causing the particle to rise into the stream; this contributes to the suspended load.
3. abrasion—particles bumping into one another as they tumble along.

Notes/Questions



Stream discharge.





Hydraulic lift.

VI. Meander location:

A. Stream process starting to change from one of vertical downcutting to later erosion and deposition
1. forms meanders.
2. discharge increasing.

B. Stream is approaching base level.
1. ultimate base level is approximately sea level.
2. as stream approaches base level, it cuts a broad plain—physiographic flood plain.

C. Meanders—curve in stream
1. on inside of curve—low velocity produces a point bar—deposition.
2. on outside of curve—high velocity produces a cut bank—erosion.
3. this asymmetry is the stream process causing lateral migration of the stream which produces a fining upward sequence.

D. Summary of landforms
1. vertical erosion, v-shaped canyons in the upper reaches of the stream
2. lateral erosion, flood plains and meanders in the lower—near base level reaches.

VII. Big Thompson Canyon, Colorado—rate of adjustment:

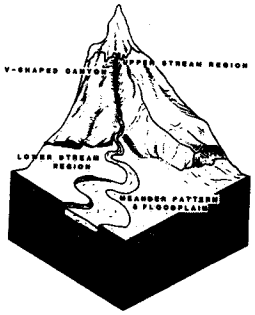
A. Limits to flow velocity in natural streams.

B. Morphologic change in channel depends on bedrock.
1. If unconsolidated loose sediment—then shape adjustment is rapid.
2. If hard resistant rock like granite, then the channel cannot adjust rapidly and the stream will leave its banks and go into flood.
3. On July 31, 1976 such was the case and many lost their lives in the Big Thompson flood.

VIII. The Canyonlands, Utah:

A. Incised meanders of the Green and Colorado Rivers
1. River first cut to base level and established a flood plain and meander course.
2. Base level then changed
   a. either river elevated above base level by tectonic forces or
   b. base level dropped because sea level dropped
3. Whatever the case, the river maintains its meander course but begins to cut down to its new base level—carving the meander pattern into the earth's surface. The resulting landscape is said to be "rejuvenated."

Notes/Questions



Stream pattern and morphology changes from upper region to lower.

TV Focus Questions

1. Make a sketch and discuss the workings of the hydrologic cycle.
2. What is the difference between potential energy and kinetic energy and when does this transformation take place in our study of water?
3. What three factors determine the type and amount of work a stream can accomplish?
4. Stream velocity is related to what 3 channel characteristics?
5. How is stream velocity and channel shape related to discharge?
6. What are the 3 ways a stream transports material?
7. What 3 ways can a stream erode the earth's surface?
8. What changes in the stream process occur as it approaches its base level?
9. Discuss the asymmetry of the stream process at a meander.
10. How does a meander become incised and what is meant by rejuvenation?

Test

T/F

1. _____ Kinetic energy changes to potential energy as water begins to flow.
2. _____ Downcutting by streams usually occurs in the upper reaches of a stream.
3. _____ The surface float velocity of a stream is the maximum velocity.
4. _____ Turbulent flow is more common than laminar flow in natural streams.
5. _____ A narrowing of a stream channel would generally cause an increase in stream velocity.
6. _____ For most rivers, the bulk of the material transported is done so by suspension.
7. _____ Hydraulic lift causes a decrease in stream velocity.
8. _____ Lateral cutting is the dominant form of erosion in the lower, near base level, reaches of a stream.
9. _____ Meanders migrate laterally because of an asymmetry in the stream process.
10. _____ Ultimate base level is determined by the major stream in a drainage basin.

Multiple Choice

1. The circulation of water from ocean to atmosphere to earth's surface and back to the ocean is called
   a. the stream process
   b. rejuvenation
   c. the hydrologic cycle
   d. transpiration
2. The discharge of a stream can be computed by
   a. multiplying the stream's velocity by its cross-sectional area
   b. observing its gradient
   c. dividing the transported load by the suspended load
   d. measuring the rate of rainfall and subtracting from it the rate of downward percolation
3. A stream's velocity is related to
   a. channel roughness
   b. gradient
   c. cross-sectional area
   d. all of the above
4. Material might be transported in a stream by
   a. suspension
   b. transpiration
   c. incision
   d. all of the above
5. The base level of a stream is
   a. defined by its tributaries
   b. the level at which it starts
   c. the lowest level to which it drains
   d. the upper surface of the water

For ANSWERS, see page 131