Ch. 5 "Running Water and Groundwater"

I. Water
   A. 326 cubic miles on earth
      1. 97.2% in oceans
      2. 2.15% in ice sheets/glaciers
      3. 0.65% lakes, streams, subsurface water, and atmosphere

II. Earth as a system: The hydrologic cycle
   A. Hydrologic cycle
      1. water evaporates from ocean
      2. winds transport moisture
      3. clouds and precipitation
      4. water makes its way back to ocean
         a) soaks into ground (infiltration)
         b) heavy rains cause runoff to sea
         c) plants absorb and give off water
         d) snow falls and can form a glacier
      5. The water cycle is in balance
         a) land has more precipitation
         b) ocean has more evaporation

III. Running water
   A. we use for energy, trans., & irrigation and it shapes our landscape
   B. stream flow
      1. water moves to sea by gravity
      2. how long it takes depends on speed of river (.5mph - 20mph)
      3. along straight stretches,
      4. slight change in speed can mean a big change in sediment transport
      5. factors that influence the velocity of a stream
         a) gradient
            (1) mountain streams huge
            (2) Mississippi river small
         b) shape, size, roughness of channel
            (1) water encounters friction
            (2) more rocks, more friction
            (3) larger channels, more efficient
            (4) rough channels are turbulent
c) discharge - volume of water flowing past a certain point in a given unit of time  

(Table 4.1)  
(1) Amazon largest in world  
(2) Mississippi largest in U.S.  
(3) precip. changes discharge  
(4) if discharge increases, channel size will increase  

C. Changes from upstream to downstream  
1. analyze a stream by looking at its profile (cross section) from its headwaters to mouth  

(Fig. 4.5)  
  a) source steeper than the mouth  
  b) discharge increases at mouth b/c tributaries  
  c) raging streams are not as fast as they appear  
  d) headwaters have steep gradients, small channels, a lot of friction where water moves backward  
  e) downstream less friction, more discharge  

D. Base level-  
1. 2 types of base level  
   a)  
   b) local base level - includes lakes, resistant layers of rock, and main streams  
      (1) stream entering a lake slows down speed  
      (2) layer of resistant rock can set up a waterfall (Fig. 4.6)  
      (3) dam causes base level upstream to raise (Fig. 4.7)  

IV. Work of streams  
A. erosion - removal of rock and soil  
   1. abrasive action of water carrying sediment acts like a sand blaster  
   2. pebbles bore circular "potholes" in channel floor  

B. transportation  
   1. stream transports load in 3 ways:  
      a) dissolved load  
      b)  
         (1) most streams carry this way  
         (2) usually only sand, silt, clay, but more during floods  
      c) _________ - rolling along the bottom  
         (1) only in motion intermittently  
         (2) important in down cutting  
   2. Mississippi river 750 million tons/yr.  
      a) 200 solution
b) 500 suspended  
c) 50 bed load  

3. 2 factors determine load carrying  
   a) competence- the max. size of particles a stream can transport  
      (1) vel. determines competence  
      (2) 2x vel., 4x competence  
   b) capacity - max. load stream can carry  
      (1) greater vel., greater capacity  

4. floods erode and transport more sediment than entire year  

C. deposition  
   1. stream transport provides mechanism by which solid particles of various sizes are  
      separated called "sorting"  
      a) alluvium- well sorted material  
      b)  
         (1) delta grows outward  
         (2) stream divides in smaller ones called  
         (3) N.O. is on a huge delta  
   2. natural levees- gently sloping structures created by repeated floods  
      a) parallel stream channel (Fig. 4.11)  
      b) area behind levee is poorly drained and "backswamps" result  
      c) _____________- tributary streams that can't reach river and must parallel the stream  
   3. artificial levees - flood control  
      a) higher and steeper than natural  
      b) continually raising levees  

D. Stream Valleys  
   1. narrow valleys (Fig. 4.13)  
      a) Yellowstone river  
      b)  
      c) v-shape indicates downcutting  
      d)  
   2.  
      a) no more downcuts, it widens  
      b) floodplains - side to side cutting produces a flat valley (Fig. 4.14)  
         (1) river confined to channel except during flood  
      c) meanders - sweeping bends of river on flood plain (Fig. 4.15)  
         (1) outside higher speed, while inside deposits "point bar"  
         (2) stream moves w/o widening
(3) cutoffs form (Fig. 4.16)
(a)
   d) artificial cutoffs - straightening for flood control

E. Drainage basins & patterns
1. drainage basin
   a) every stream has one
   b) "divide" - imaginary line that separates one drainage basin from another
      (1) can be small, or continental
   c) types of drainage basins (Fig. 4.18)
      (1) dendritic
         (a) most common form
      (2) radial
         (a) occurs with volcanoes
      (3) rectangular
         (a) found on joints/faults
      (4) trellis

F. Stages of Valley development
1. 
   a) stream is down cutting
   b)
   c) steep gradient
   d) few meanders, straight course
2. maturity
   a) erosion becomes lateral
   b) creates floodplain
   c) gradient is much less
   d) no rapids/waterfalls
3. 
   a) when it cuts floodplain wider than meanders
   b) stream is rarely near valley walls
   c) does not enlarge floodplain
   d) stream course shifts most rapidly
   e)
   f) natural levees are common
   g)
4. uplifted land
   a) youthful stream becomes more turbulent
b) mature stream becomes
   (1) meander remain but get deep (entrenched meanders) **Fig. 4.20-4.21**

G. Water Beneath the surface
1. water soaks into ground
2.
3. Importance of groundwater
   a) 6/10 of 1% of all water is groundwater
   b) freshwater importance is huge (**Table 4.2**)
   c) wells/springs drinking water/irrigation
   d) 50% drinking water, 40% irrigation
4. groundwater geological roles
   a) erosion goes on underground
   b)

V. Distribution and Movement of Groundwater
A. Distribution
1.
   a) water here is “groundwater"
   b) upper limit is
2.
3. water table is rarely level
   a) highest below hills
   b) lowest below valleys
   c) swamp - water table at sfc.
4. groundwater moves slowly

B. movement
1. amount of storage varies greatly
   a) depends on porosity
   b) permeability
      (1) small pores, less permeable (ex. clay)
      (2) layers that inhibit water transport called
      (3)
C. Springs - whenever water table intersects ground
1. Fascination of water continuously flowing
2. Hot springs
   a) water 10°F-15°F warmer than surroundings

D. Geysers (**Fig. 4.26**)
1. hot springs ejected from ground with great force over 100-200 ft.
2. as water stops, steam rushes out like thunder
3. Old Faithful (once/hr.)
4. Steps of formation
   a) extensive underground chambers of igneous rocks
   b) hot water down deep
   c) water under great pressure from above
   d) heating causes expansion
   e) water rushes out at sfc.
   f) boiling pt. lowers
   g) steam forms quickly and geyser erupts
E. Wells
   1. method for removing groundwater
   2. wells must go below water table
   3. water drawn reduces water table
   4.
F. Artesian Wells - well where water rises w/o pump
   1. Need 2 things: (Fig. 4.28)
      a) water must be on inclined acquifer
      b) aquiclude must be above & below layer
   2. water rises almost to top on incline
   3. farther from incline, less water rises
G. Environmental Problems of groundwater
   1. treating groundwater as a renewable source
      a) often take more than is supplied (Great Plains)
      b) irrigation takes more than rain/snow supply
   2. land subsidence caused by groundwater withdrawal
      a) San Jaoquin valley (Fig. 4.30)
   3. groundwater contamination
      a) septic tanks leak sewage into groundwater
      b) some contaminants are naturally purified
         (1) need deep porous soil
      c) highway salt
      d) fertilizers & pesticides
e) rainwater carries pollutants downward  
f) polluted water undetected for long time

H. Geologic Work of Groundwater
1. groundwater dissolves rock, esp. limestone
2. Caverns
   a) created at or below water table
   b) ___________ - hang from ceilings (dripping)
   c) stalagmites - 
3. _____________________ - land shaped by dissolving water
   a) areas underlain by limestone
   b) irregular terrain with "sinkholes"
   c) 
      (1) can develop slowly over years
      (2) can form fast if cave ceiling gives way
   d) lack of streams, all water sinks in