ES 105 Mass Wasting

I. Gravity is relentless
   A. Define mass wasting: downslope movement of material under the direct influence of gravity
   B. Styles of mass wasting vary from imperceptible to catastrophic
      1. all can be damaging
      2. some are very dangerous
   C. Step of surface processes after weathering
      1. transfer debris downslope to streams
      2. to be transported to deposition site—usually ocean, eventually
   D. slopes change through time
      1. lowers surfaces over time
      2. internal processes continually raise material to be eroded
         a. catastrophic events occur in rugged, newly uplifted areas
         b. cessation of uplift allows mass wasting to conquer heights

II. Controls of mass wasting
   A. Gravity is the controlling force,
   B. factors that influence movement
      1. water
         a. rainfall destroys cohesion of particles—lubricates material
         b. adds weight to mass
      2. oversteepened slopes
         a. Angle of repose
            1) Steepest angle at which a material remains stable
            2) Depends on shape and size of particles
         b. Examples
            1) streams undercut on outer curves
            2) waves erode the base of cliff
            3) roadcuts, building sites also undercut base of slope
            4) addition of material to the upper portion of slopes
      3. removal of vegetation
         a. role of vegetation in slope stability
            1) roots hold soil in place
            2) provide protection of ground surface against splash effects
            3) absorb some of moisture to minimize lack of cohesion
         b. removal
            1) wildfires
            2) development, farming, logging
      4. triggering events—
         a. material may exist in unstable state without sliding
         b. ground shaking by earthquakes may trigger slide to occur
         c. can cause great amounts of destruction

III. Classifying mass wasting processes
  A. Classified by
    1. type of material involved
    2. type of motion involved
    3. how fast movement occurs
  B. Types of mass wasting
    1. slump
      a. downward sliding of rock or unconsolidated material moving as a coherent mass
      b. characterized by headward scarp, tilted rotated blocks
      c. cause: undercutting of slope
    2. Rockslide
      a. Sudden, rapid
      b. Bedrock breaks loose and thunders downslope
      c. Rockfall, topple,
      d. Causes:
        1) by snowmelt, or frost wedging
        2) earthquakes
    3. Debris flow
      a. Rapid, fluid movement with large amount of water
      b. Follow canyons and stream channels
      c. Causes: (Sudden) addition of water
        1) Protracted rainfall where loose material available
        2) Cloudburst in desert area
        3) Snowmelt on volcanic peaks
    4. Earth flow
      a. Less water, more earth than debris flows
      b. May continue slowly for days to years—(forever?)
      c. Liquefaction is type of earthflow caused by earthquakes
        1) Urban slumps—Japan, Alaska,
        2) Sand boils in water-saturated sand
    5. Creep
      a. Slow movement tilts ‘stationary’ objects
        1) bedrock, trees
        2) Fences, headstones,
      b. Caused by frost heave
    6. Solifluction
      a. Flowing of saturated soil above impermeable layer
      b. Common in permafrost areas
        1) Active layer thaws in summer
        2) Flows over permanently frozen subsurface layer

IV. Examples of devastating landslides
    A. Shohomish County, Washington, 2006—protracted rainfall
    B. US 50, Sierra Nevadas, 1997—rainfall, oversteepening
    C. La Conchita, California, 2005—rainfall, oversteepening
    D. Slide Mountain, Nevada, 1983—sudden snowmelt by rain
    E. Lahars: volcanic debris flow
        1. Toutle River, Mt. St. Helens, Washington, 1980—snowmelt by volcanic eruption
        2. Nevado del Ruiz, Colombia, 1985—
            a. snowmelt by volcanic small eruption
            b. 60 km/hr down channels,
            c. gained material as it traveled
            d. Armero 100 km from eruption
        3. Leyte Island, Philippines—protracted rainfall on debris, deforestation