Overview Of Earth
Earth's place in solar system, galaxy, universe
Atmosphere, hydrosphere, biosphere, lithosphere
Earth’s interior
Earth's surface
internal processes
  plate tectonics
  isostasy
surficial processes

Matter & Minerals
atoms
elements
  atomic number
isotopes
  atomic mass
molecules & compounds
  bonds
    ionic bonds
covalent bonds
states of matter
minerals
  chemical composition
crystalline structure
  properties of minerals
chemical composition of earth's crust
major groups of minerals
  silicate minerals
    structural groups
crystallography
Igneous Rocks  
composition  
variation of minerals (reflected in color)  
variable composition of magma  
cooling history (related to silicate structural groups)  
crystal size/texture  
rate of cooling  
volcanic (extrusive)  
rapid cooling  
fine crystalline (aphanitic), glassy, or fragmental texture  
plutonic (intrusive)  
slow cooling  
coarse crystalline (phaneritic) texture  
porphyritic - variable cooling rates  
other textures

Surficial Processes  
hydrologic cycle  
atmospheric circulation patterns  
wind systems  
climate belts

Weathering & Soils  
weathering  
mechanical weathering  
clastic particles  
particle size classification  
chemical weathering  
stability series  
products  
clays (particles)  
oxides (particles)  
dissolved ions

soils  
soil profile  
development of soils  
types of soils  
pedocal – pedalfer - laterite  
controls of soil type  
P - parent material  
P - process - weathering  
T - time  
soil properties  
soil as a resource
Sedimentary Rocks

weathering
clastic sediment \( \rightarrow \) clastic rocks
   pieces of original rock
clays
oxides
chemical sediment \( \rightarrow \) chemical rocks
   solutions & sedimentary precipitates
   carbon cycle and limestones
erosion
transportation
deposition
   stratification
   sedimentary environments
diagenesis
   lithification
   porosity & permeability
   interpreting earth history
   fossil fuels

Metamorphic Rocks

contact metamorphism (high temperature)
regional metamorphism (high pressure)
   foliation
   metamorphic grades
   mountain belts

Rock Cycle

Geologic time
relative time
absolute time
   - - - - today (0 my ago)
Cenozoic Era
   - - - - 65 my ago
Mesozoic Era
   - - - - 250 my ago
Paleozoic Era
   - - - - 540 my ago
Precambrian Eon
   - - - - 4600 my ago
geologic timespans
rates of geologic processes
Mass Wasting
causes & conditions
types of slope failures
recognition of unstable slopes
slope stabilization

Wind and Deserts
climate belts
location of deserts

wind
erosion
deposition
sorting
hydrologic cycle

**Rivers and Streams**

- drainage basins (watersheds)
- drainage divides
  - headwaters
- stream order
- baselevel(s)
  - mouth

- source of water
  - runoff
  - springs

- mechanics of streams
  - gradient
  - graded stream profile
  - channel size (cross-sectional area)
  - velocity
  - discharge
    - variability
    - floods

- stream sediment
  - coarser upstream, finer downstream
  - sorting
  - erosion vs. deposition

- stream landforms
  - erosional
    - valleys
  - depositional
    - bars, floodplains, deltas, fans, terraces

- evolution of landscapes
  - P - parent materials
  - P - process
  - T - time

- drainage basin evolution
  - erosion cycles
  - climate belts
    - humid stream erosion cycle
      - importance of groundwater
    - arid erosion cycle
      - importance of wind

- differential erosion
  - Valley & Ridge topography
Groundwater
water table
porosity and permeability
aquifer vs. aquiclude/aquitard
movement of groundwater
climate
influent vs. effluent streams
geologic complexities
what geologists do
practical considerations
utilization of groundwater
contamination of groundwater
landforms – karst
PPT
carbon cycle
erosion of soluble rocks
deposition by groundwater

Glaciers
global distribution
high latitude glaciers
continental
high elevation glaciers
alpine
snowline varies with latitude
mechanics of glaciers
ice budget
accumulation vs ablation
glacial advance, retreat (recession)
glacier movement
fig. 1.12

Glacial erosion

Glacial deposition

Glacial sediment
lack of sorting

Glacial landforms
recognition of past ice ages
widespread effects of glaciation
sea level changes
isostatic adjustment
p. 411-413

Modification of land surface

Ice ages
evidence of climate change
history of climate change
causes of ice ages & climate change

carbon cycle
marine processes

**Shorelines**

processes
- cyclical
  - waves, tides, seasons
  - concept of equilibrium shoreline
- non-cyclical
  - storms, tsunami
  - global sea-level change

coastal landforms
- PPT
- coastal evolution
  - primary coasts
  - secondary coasts

clastic shorelines
- energy vs. sediment supply
  - finer sediment seaward
  - high vs. low energy shorelines

carbonate shorelines
- carbon cycle
  p. 158-159

deep sea
- calm environment
- deep marine sediment
- submarine "landforms"
  - origin not due to surficial processes
    - plate tectonics
  p. 377-381
INTERIOR PROCESSES

**Earthquakes**

- seismic waves
- intensity vs. magnitude
- focus (hypocenter)
- epicenter
  - locating earthquake epicenters
  - maximum intensity
  - triangulation
- earthquake zones = zones of deformation = plate boundaries
  - intra-plate seismicity

**Earth's Interior**

- \(D=VT\) (distance = velocity x time)
- seismic refraction
  - know \(D\), measure \(T\), calculate \(V\)
  - \(V_{sol} > V_{liq} > V_{gas}\)
  - \(V\) increases with density
  - predict nature of earth’s interior regions
  - seismic discontinuities
- seismic reflection
  - know \(V\), measure \(T\), calculate \(D\)
  - depth to seismic discontinuities
- characterizing earth’s interior
  - oceanic crust
  - continental crust
  - MOHO (M-discontinuity)
  - mantle
  - low velocity zone
  - outer core
  - P-wave shadow zone
  - S-wave shadow zone
  - inner core
  - weak P-waves in P-wave shadow zone

**Crustal deformation**

- types of geologic structures
  - folds
  - faults
    - tensional - normal fault
    - compressional - reverse fault
    - translational - strike-slip fault
Plate Boundaries

Types of plate boundaries
  divergent
    oceanic ridges & continental rift zones
    normal faults
    shallow focus, low magnitude earthquakes
    associated with transform faults (strike-slip)
    process: rifting
  convergent
    submarine trenches
    reverse faults
    shallow to deep focus earthquakes (Benioff zone)
    low to high magnitude earthquakes
    process: subduction
  translational
    transform faults & fracture zones
    shallow focus earthquakes
    very low to very high magnitude earthquakes
    strike-slip faults
earthquake prediction
  spatial, temporal, severity

Volcanism

review igneous rocks
 generation of magma
  partial melting
  mantle source
  crustal source
 crystallization of magma
  differentiation
 volcanoism
  properties of magmas
    density
    viscosity
    gas content
 types of eruptions - relationship to plate boundaries
  divergent plate boundaries
    mantle source
    mainly basaltic volcanism
    lava flows
  convergent plate boundaries
    crustal source
    mainly andesitic to rhyolitic volcanism
    pyroclastic eruptions
    batholiths
 hot spots
 prediction of volcanoes
  spatial - temporal - severity
Plate tectonics
Paleomagnetism

- Earth's magnetic field
- Magnetic inclination
- Remanent magnetization
- Determination of paleo-latitude
- Ancient pole positions
- Polar wandering
- Continental drift
- Polarity reversals

Evolution of Oceans

- Geology of Iceland
- Magnetic stripes
- Patterns of stripes
- Mechanics of rifting
- Age of the sea floor
- Evolution of ocean basins & oceanic crust
- Sea floor spreading
- Reconstruction of past 200 my

Mountain Building

- Geology of Himalayas and Indian Ocean
- Patterns of magnetic stripes at trenches
- Relationship between mountain belts and subduction zones
  - Destruction of oceanic crust
  - Evolution of volcanic arcs
- Relationship between oceans and continents
  - Wilson cycle

Evolution of continents & continental crust

- Continental crust
  - Mountain belts
  - Platforms & shields
  - Model of growth of continents
  - Origin of continental crust

Past, present & future earth
Energy & Mineral Resources

- Energy resources
  - Renewable vs. non-renewable resources
  - Exploration, extraction, processing
  - Utilization vs. environmental preservation
  - Fossil fuels
    - Carbon cycle
  - Alternate energy resources
- Mineral resources & mining