

# Unit 4 Review

Chapters 8, 9

# Chapter 8 Highlights

- **Earth Systems (5 Steps, pg 37)**
  - *Geosphere*: Core (iron/nickel), mantle, crust (oxygen is highest), asthenosphere, lithosphere
  - *Plate Tectonics*: lithosphere is broken into plates and are in constant motion due to convection cells in asthenosphere.
    - *Divergent boundary*: plates spread apart -  $\leftarrow\rightarrow$
    - *Convergent boundary*: plates collide together -  $\rightarrow\leftarrow$
    - *Transform (slip-strike) boundary*: plates move side by side  $\uparrow\downarrow$ 
      - Crust is conserved (created at divergent, destroyed at convergent)
    - Action at boundaries causes earthquakes, volcanoes, mountains, tsunamis
    - *Hot spot*: plume of magma reaching lithosphere, intraplate volcanism
  - **Rock Cycle**: constant formation and destruction of rock
    - *Igneous* – formed directly from magma, original source of all rock (basalt, granite, gabbro)
    - *Sedimentary* – form when sediments are compressed and compacted; where fossils are found, most rock is sedimentary (sandstone, limestone, shale)
    - *Metamorphic* – when existing rocks are subjected to high pressure and heat (anthracite, slate, marble)

# Chapter 8 Highlights

- **Weathering**

- Physical weathering: mechanical breakdown caused by water, wind, gravity, organisms.
- Chemical weathering: breakdown by chemical reaction, dissolving of chemical elements; water is most common
  - Physical weathering makes surfaces more vulnerable to chemical weathering (more surface area exposed).
  - Erosion is the physical removal of soil and rock from landscape.

- **Soil**

- Combination of *air, water, mineral matter, and organisms* (4 spheres of Earth)
  - Formation affected by parent material, climate, topography, organisms, time
- *Soil horizons* (horizontal layers): **O, A, E, B, C, R**
- *Texture* (sand, silt, clay) determines permeability/porosity
- Soil **porosity** - Percent of pore space, reflects how much water can be held, related to particle size (large size = low porosity, high permeability).
  - **Clay** has high porosity, low permeability – can store lots of water, but water cannot flow through it easily. **ADVICE: Be able to read a soil texture triangle (pg 280).**

# Chapter 8 Highlights

- **Mining**

- *Surface mining: low-grade ore, mountain-top removal, habitat destruction, increased erosion, groundwater contamination (acid mine drainage), less labor, less dangerous for workers.*
  - Strip mining, open-pit mining, mountaintop removal, placer mining
- *Subsurface mining: high-grade ore, targeted at mineral seam, less destruction, more labor required, more dangerous for workers (**black lung**).*
- *Extracting, processing, and using minerals consumes energy and contributes a variety of pollutants and hazards to our environment. (pg 285)*
  - Mining Law of 1872 – regulates mining of silver, copper, gold, oil
  - Surface Mining Control and Reclamation Act of 1977 – regulates coal mining

# Chapter 9 Highlights

- **Freshwater availability**

- Only **0.024%** is available to us as liquid freshwater
  - The rest is too salty (97.2%), frozen in polar caps and glaciers, or deep underground and inaccessible.
- **Hydrologic cycle:** *groundwater, recharge area, zone of saturation, water table, aquifers.*
- **Dams and reservoirs:** used to capture and store freshwater, can provide electricity, control flooding, recreation and jobs.
  - *Many downsides:* habitat destruction, disrupts fish migration, sediment buildup, increased water loss through evaporation. (Columbia River, Hetch Hetchy, Three Gorges – dam examples)
- **Increase supply**
  - Desalination: removing salt from saltwater, expensive – Middle East uses extensively, disposal of salt a solid waste issue.
    - Distillation: evaporating and condensing water to remove salt.
    - Reverse osmosis: forcing saltwater through membrane impermeable to salt.

# Chapter 9 Highlights

- **Freshwater usage and conservation**

- Largest use worldwide is *agriculture* – *furrow, flood, spray, drip, hydroponic*

- Municipal use is least, flushing toilets is largest use domestically.

- **Moving water to where it is needed**

- Pumping groundwater too quickly can deplete aquifers, example of *tragedy of the commons*.

- Can lead to *land subsidence, saltwater intrusion*.

- Water diversion projects have altered aquatic ecosystems.

- Los Angeles Aqueduct, Owens Valley, Colorado River Aqueduct, California Aqueduct, Aral Sea

- *Stream channelization*: can help with flooding, but can also increase risk as water flows faster, encourages floodplain development, and reduces groundwater recharge.

- **Conservation efforts**

- Xeriscaping (low-water landscaping), fix leaks, efficient sprinklers (LEPA), increasing water price, reduce use

# Unit 5 Review

Chapters 10, 11

# Chapter 10 Highlights

- **Land Use and Management**
  - Externality – cost or benefit of a good that is not included in purchase price
    - Environmental pollution or destruction is a negative externality
  - Forest management
    - **Deforestation** leads to: increased runoff (warms streams), decreased soil fertility, loss of habitat, premature extinction of some specialized species, increased flooding, release of CO<sub>2</sub>.
      - *Clear-cutting*: removing all trees from an area, efficient for companies, but considerable harm.
      - *Strip cutting*: clear-cutting just a strip of trees, lessens impact.
      - *Selective cutting*: cut mature or medium-age trees in small groups, preserves forest integrity, least impact, most expensive form.
      - *Slash and burn*: tropical rainforest clear-cut and burned to release nutrients to soil. Supports up to 3 years of agricultural growth before moving to another plot and repeating.
    - Forest fires: *prescribed, surface, ground, and crown* (worst)
      - **Fire suppression** can lead to buildup of fuel causing small fires to escalate.
  - Protecting public lands
    - National Park System – world's first, Yellowstone in **1872**.
    - *Wildlife Refuges and Wilderness Areas*: large tract of lands legally set aside as undeveloped.

# Chapter 10 Highlights

- **Urban Sprawl**

- Expansion of cities, removal of clear boundaries between rural areas.

- *Factors contributing to urban sprawl:* automobile and highway expansion, reduced living costs, **urban blight** (degradation of urban cores as citizens leave for suburbs), government policies

- Cities are expanding worldwide as population shifts from rural to urban; **population density is increasing**

- **Smart Growth:** strategies that encourage the development of sustainable, healthy communities

- EPA outlines 10 basic principles of smart growth (pg 347)

**ADVICE: Familiarize yourself with the underlying concepts of these 10 principles.**

# Chapter 11 Highlights

- **Energy subsidy**
  - Fossil fuel energy and human energy input per calorie of food produced.
- **Meat consumption** – often used as indicator of wealth
  - **Pros:** high in protein, iron, zinc, vitamins
  - **Cons:** requires large amounts of land, water, energy, and feed to raise cattle, large methane production, huge amounts of waste, increased water pollution.
  - **Vegetarians** are helping to **prevent** *deforestation* and *habitat destruction*
    - More land and energy efficient to use the land to grow crops for human consumption – eating lower on the food chain = more energy per unit area, governed by ***second law of thermodynamics***.
    - Growing food for animal consumption and then eating the animal is an inefficient way of acquiring energy.

# Chapter 11 Highlights

- **Industrial agriculture**

- **High-input** model of agriculture used in *developed countries*
  - Contrasted by *traditional agriculture* used in *developing countries*.
  - Contrasted by *sustainable* and *organic agriculture*.
- Uses **monoculture** (one genetically identical species), large amounts of *water, energy, fertilizers, pesticides*.
- *Green revolution* (genetic modification) paved way for industrial agriculture and monoculture farming – **reduces biodiversity**.

- **Soil conservation & fertility**

- *Reduce soil erosion*: conservation-tillage, terracing, contour farming, strip cropping, alley cropping, windbreaks.
- *Increase soil fertility*: inorganic fertilizer, animal manure, green manure, compost, crop rotation, strip cropping.

# Chapter 11 Highlights

- **Pesticides**

- *Pest*: organism that disrupts or degrades our enjoyment of a resource; a nuisance, undesirable by our culture. Pesticide kills pests.
- Pesticide has lots of **benefits**, lots of **negatives** – *know them!* (pg 368)
  - *Pesticide treadmill*: coevolution, organisms adapting/responding to pesticides.
- “ideal” pesticide: narrow-spectrum, biodegrades quickly, stays in place. NINJA!  
Reality: broad-spectrum, persistent, spreads easily.
- **DDT** (*dichlorodiphenyltrichloroethane*) – oh chemistry.
  - *Synthetic botanical, chlorinated hydrocarbon* – attacks nervous system
  - *Silent Spring* by **Rachel Carson** in 1962 brought affects of DDT to public attention.
    - Widely regarded as the “mother of environmental movement”.
- **Bees**, crucial *keystone species* (pollinator), are vanishing due to *neonicotinoids*, insecticide – *colony collapse disorder*. Example of non-target species affected.
- **Integrated Pest Management (IPM)** uses a variety of *biological, chemical, and physical* methods to **reduce** pest impact, **not eradicate**. *Biological control, crop rotation, pheromones, low-dose narrow-spectrum pesticides* are common techniques.
  - More expensive, slower, requires education. More sustainable, less harmful ecologically.
- **FIFRA** is the legislation dealing with pesticides.

# Chapter 11 Highlights

- **Overfishing**

- Prime example of *tragedy of the commons*: overfishing in international waters – private gain at public expense.
- *Maximum sustainable yield*: maximum number of fish that can be harvested annually without causing a population drop.
- *Optimum sustainable yield*: takes into account interactions among species, allows room for error.
- **Methods (pg 373)**
  - *Trawler fishing*: dragging a weighted net on ocean floor, most destructive form of fishing.
  - *Purse-seine fishing*: “coin-purse”, circular net catches entire schools of fish, commonly catches dolphins
  - *Longlining*: up to 80 miles long, thousands of hooks, large amounts of bycatch (unintended species), ghost lining
  - *Drift-net*: up to 40 mile long net hanging up to 50 feet below surface, easily leads to overfishing, tremendous amounts of bycatch, U.N. banned in 1992.

# Unit 6 Review

Chapters 12, 13

# Chapter 12 Highlights

- **Fossil Fuels**

- Nonrenewable, energy is ultimately traced back to the sun (carbon cycle, photosynthesis) – CO<sub>2</sub> released when combusted. 85% of US energy is from fossil fuels.

- **Coal**

- Terrestrial plants buried 300-400 million years ago and subjected millions of years of heat and pressure.
  - Stages of formation: **Peat – Lignite – Bituminous – Anthracite (PLBA)**
    - » Water content decreases, heat and carbon content increase as time progresses.
- Used to provide 40% of world's electricity, 49% in the US.
- **Cheap, plentiful** (most abundant fossil fuel, estimates are 225-900 years, US has most, 25% of world's supply)
- **Dirtiest** source of energy – CO<sub>2</sub>, sulfur, particulates, mercury.
- Surface mining & *Mountain-top removal* – huge amounts of land disturbance.

- **Oil**

- Decayed remains of marine organisms, buried 100-500 million years ago.
- **Petroleum** (crude oil), **petrochemicals** (products of oil distillation or separating by boiling point) are used in a variety of products: *pesticides, plastics, paints, medicines, etc.*
- **Organization of Petroleum Exporting Countries (OPEC)** – 60+% of oil reserves
- Expected to run out of conventional reserves by end of century.
- Unconventional or heavy oil (**oil sand & oil shale**) has large supply (Canada has most), but low net energy-yield, severe land disruption, severe water pollution.

# Chapter 12 Highlights

## – Natural Gas

- Mixture of gaseous *hydrocarbons* – mostly **methane** (50-90% CH<sub>4</sub>)
- Conventional natural gas lies above most reservoirs of crude oil.
- Used to provide **21% of US electricity**, used for heating space and water.
- **Russia** has largest reserves, 21% of world's supply – US has 3% of supply, but uses 21% and increasing.
- Cleanest fossil fuel, viewed as a *transitional* energy source.

## • Nuclear Energy

- Fuel is uranium dioxide rods made from uranium-235, must be enriched from 0.7% to 3%.
- Controlled nuclear **fission** reaction – fusion occurs in stars.
- Reaction must be controlled (control rods absorb neutrons), coolant removes heat (common are water and sodium)
- Provides about 20% of US electricity, most on East coast.
  - Provides **France** with 77% of electricity, **Japan** and **South Korea** 39%.
- Low direct environmental impact, but expensive, nonrenewable, uranium must be mined, thermal pollution, radioactive waste disposal, security risk.
- Several case studies involving nuclear accidents: **Three Mile Island** (Pennsylvania, 1979), **Chernobyl** (Ukraine, 1986), **Fukushima** (Japan, 2011)
- **Half-life calculations!**                      **ADVICE: Check out table on pg 424.**

# Chapter 13 Highlights

- **Energy efficiency**
    - Reducing energy waste (43% of energy output) has numerous *economic* and *environmental* advantages – best, cheapest, easiest solution
      - Prolongs fossil fuel supplies, reduces oil imports, improves energy security, reduces pollution and environmental degradation, saves money!
    - 41% of energy is wasted unavoidably because of energy transformations – Second law of thermodynamics: no reaction is 100% efficient.
      - Incandescent lightbulb – **5-10% light, 90-95% heat** (LEDs, CFLs are efficient alternatives)
  - **Renewable Energy**
    - Like biomes and endangered species, know a bit about each source – no need to memorize every detail, but ***be familiar with pros and cons of each.***
    - **Solar:** passive/active solar heating, photovoltaic cells, expensive, storage issues.
    - **Hydroelectric:** dam provides positives/negatives, clean, high efficiency, dependable source.
    - **Wind:** fastest growing, cheap, quick, noise pollution, eyesore, birds.
    - **Geothermal:** low impact, efficient, expensive, limited locations, odor.
    - **Biofuels:** reduced carbon emissions, compete with food, increased agriculture.
- ADVICE: Check out table on pg. 462.**