

Earth Science: ①

Topic 1 = 10-15%

Soil Components: Clay - very fine. Compacts easily. low permeability to water. Easily water logs if too abundant.

- Earth- Core** (solid (inner), molten (outer), iron)
- Mantle (solid rock, largest part, top 3rd is plastic)
 - Crust (continental (30km deep), Oceanic (11km deep))
 - Moho (separates mantle + crust)

- Topic 2 = 10-15%
- 3 = 10-15%
 - 4 = 10-15%
 - 5 = 10-15%
 - 6 = 25-30%
 - 7 = 10-15%

- Plate Boundaries** - convergent - pushed toward each other
- Divergent - move away from each other
 - transform - slide past each other

- Volcanoes:** Mountains formed by magma from earth's interior.
- Subduction volcanoes - plates collide + slide over each other; 95% of M. form this way.
 - Rift volcanoes: plates move away from each.
 - Hot spot volcanoes: magma rises to surface (HI)

Pollution, released large amounts of $SO_2 \rightarrow$ sulfate ions (SO_4^{2-}) in stratosphere \rightarrow acid rain.

- Earthquakes:** Abrupt movement along tectonic plate boundary zones or mid-oceanic ridges.

- focus - location of origin of earth quake.
- epicenter - spot on surface of earth above epicenter.
- Richter magnitude - measured by seismograph. log. base of scale, so 2 \rightarrow 3 is ten times stronger.

- Rock Cycle** - Sedimentary - sediments build + compress: time stone. (fossils form here)
- Metamorphic - pressure + heat applied to rock inside earth's mantle \rightarrow slate.
 - Igneous - rock melts + resolidifies, magma goes to surface \rightarrow emerges as lava \rightarrow cools as basalt. soils come mostly from igneous.

- Soil! - Horizons:**
- O horizon - surface litter (leaves + partially decomposed organic debris), lots of organic substance. Thick in deciduous forest, thin in tundra/desert.
 - A horizon: Topsoil (organic matter (humus), partially decomposed organic matter. Thick in grasslands)
 - E horizon: Zone of leaching (dissolved + suspended material move downward).
 - B horizon: Subsoil (yellowish in color b/c accumulat. of iron, alum, clay, + humus.) May be rich in nutrients. "zone of decumulation"
 - C horizon: Weathered parent material (inorganic, partially broken down minerals.)
 - Bedrock: Unaltered parent material.

- Erosion:** Sheet Erosion: thin layer taken off
- Rill Erosion: fast flowing water cuts small channels.
 - Gully Erosion: extreme rill erosion (Grand Canyon)
 - Desertification: productive potential drops due to human activity. (overgrazing, single cropping) loss of native vegetation + increased wind erosion.
 - Salinization: accumulation of dissolved salts in topsoil. lower yield/youth

Water logging: Soil saturated with water. Envelops deep roots + kills plants.

- Fertilizers:** Organic: Animal manure, green manure, + compost. Improves soil texture, adds nitrogen, prevents erosion.
- Inorganic: Does not add humus. less ability to hold water + support living organisms. No micronutrients. Requires large amount of energy (produce, transport, + apply) Releases N_2O (nitrous oxide) a green house gas.

① **Atmosphere**

- Composition:** Nitrogen (N_2) (78%) - needed for living organisms deposited through fixation + lightning + rain. Returned through combustion of biomass + denitrification
- Oxygen (O_2) (21%) - produced through photosynthesis.
 - Water Vapor (H_2O) (0-4%) - greenhouse gas (most)
 - Carbon dioxide (CO_2) (<< 1%) - last 300 years, $CO_2 \uparrow$ by 25%. (fossil fuel burn + deforestation) produced by cell. respiration + decaying organic material
 - Methane (CH_4) (<<< 1%) - increased 150% from humans. such as coal mining + burning fossil fuels. green house gas
 - Nitrous oxide (N_2O) (<<< 1%) - green. gas - burning fossil fuels + increased fert. use.
 - Ozone (O_3) (<<< 1%) - 97% found in stratosphere. absorbs UV radiation. Produced in production of photochemical smog. (FC's break down ozone)

- Layers:** Troposphere (0-11km) Earth's daily weather.
- Stratosphere: (11-45km) ozone in this layer. (high temp)
 - Mesosphere: cold layer, meteors burn here
 - Thermosphere (ionosphere) Boresalis, Mol \rightarrow ions here.
- Climate:** Weather: daily temp. pressure, sunlight, wind speed, humidity
- Climate: year long (or long period of time) pattern of an area.
- Seasons: Caused by tilt of Earth's axis.
- Convection Currents: Vertical currents that rise from warm gases expanding and becoming less dense. hot \rightarrow cold

- Weather:** trade winds - Northern Hem - NE trade winds. Southern hem. - SE trade winds. (wind blows from south east)
- Wind speed: based on differences of pressure. pressure \uparrow w/s \rightarrow Coriolis effect - earth rotation axis causes wind to not flow straight. Creates pressure differences.
- Hadley Cell: (Hawaii) Air heats near equator and rises. Air cools as it moves + lowers at sub-tropical climate zones. High humidity, clouds, + rain at equatorial region (tropical forest) inverse at sub-tropical climate (deserts)
- Ferrel Cell: between 30 $^{\circ}$ -60 $^{\circ}$. Defined seasons, strong annual cycles of temp. + precipitation. (deciduous + conifers)
- Polar Cell: 90 $^{\circ}$ - icy-cold air descends to ground. Sinking air suppresses precipitation. \rightarrow deserts. No water. little snow fall. Short summers \rightarrow Tundra + Taiga.
- Rain Shadow effect: Rain rises up a mountain + deposits all, leaving dry backside of mountain.

El Niño: Small circle
La Niña: Big circle

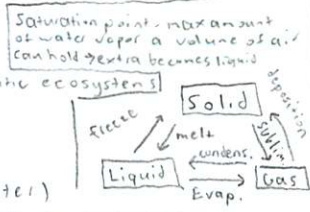
ENSO cycle: Pg. 107 in Dahlen's
El Niño: west winds warm west coast. regular upwell.

El Niño: Weather + winds, less circulation of water. less upwelling, warmer waters brought.
La Niña: stronger trade winds, more circulation of water. more upwelling, cooler waters flooding.

Water ① Ask about thermal strat in lakes & water of lakes

Properties:

- 1) Hydrogen bond - very strong
- 2) high specific heat - resilient to change in temperature
- 3) high boiling temp.
- 4) Universal solvent
- 5) filters UV radiation in aquatic ecosystems
- 6) cohesive to solid surfaces
- 7) Expands when frozen.



Distribution:

- 97% Ocean (salt water)
- 3% Fresh Water
 - 68.5% - ice & glaciers
 - 30% - groundwater
 - 5% - surface water
 - 87% Lakes
 - 11% swamps
 - 2% rivers

Lakes!

- Inputs of water: precipitation, runoff, groundwater channels, artificial sources.
- Outputs of water: evaporation, surface & groundwater flow, human extraction.
- Lake zones: Littoral zone: sloped, close to land.
- photic/open water: sunlight is abundant
- Benthic zone: sunlight + may leech, depends on turbidity.
- Secchi disk: determines turbidity. (Amount of suspended particles)
- Lake Types:
 - Oligotrophic: clear, low nutrient & plant life.
 - Mesotrophic: clarity, average nutrients.
 - Eutrophic: Excess nutrients, algal bloom
 - Hypertrophic: low water clarity, little DO.

Wetlands:

- Swamps, bogs, estuaries, & marshes. (water tables near or on land long enough to support aquatic life)
- Most biologically diverse ecosystem.
- Can be salt, fresh, or brackish water.
- Important plants: Mangroves, water lilies, & cattails
- Important animals: none; just know supports many birds/amphibians
- 1993 - half of world's wetlands completely drained for real estate etc.

Aquifers:

- geological formations that contain sufficient water to support a well or spring.
- Unconfined aquifers (water is its upper boundary) recharge through precipitation or body of surface water (lakes, rivers etc.)
- confined aquifers recharge through groundwater.

Oceans:

- 71% of earth's surface covered by it. Salt content = (3.5%)
- Ocean evaporation is primary source of precipitation.
- Vertical Zones:
 - Photic/Eutrophic: sunlight, biologically diverse.
 - Disphotic: Think "Dim" photic. low light, no photosynthesis
 - Aphotic: less than 1% of sunlight penetrates.
 - Benthic: lowest level.
- horizontal zones:
 - Pelagic: all open regions of ocean.
 - Nelitic/coastal: low tide mark to end of continental shelf.
 - Oceanic: sea beyond continental shelf.

The Ocean is Earth's giant insulator. The north has much less ocean; the northern hemisphere's temperature fluctuates much more.

Along with air currents, heat is also transferred by water convections. Density-driven currents move due to temperature & salt content differences.

↳ "Great ocean conveyor belt." Warm Gulf stream water goes to cold Norwegian water on surface to start (Pg. 129 in balloons for full cycle.) Water sinks. → goes S. to Antarctica → E. to Canada. surfaces & returns.

Upwelling - warm, nutrient poor water near coast is blown to sea. Replaced by colder, nutrient rich water from below.

Water Use: 70% of freshwater used for agriculture

- Drip irrigation - most efficient irrigation. [no runoff & less energy require]
- 25% used in industry. (mostly cooling power plants)
- 5% domestic. (Most being flushing or toilet!)

Our Globe:

Water shortages = Consumption growing x2 faster than population

Water is a limiting factor; not enough water, not enough food.

Arctic sea levels: Thermal water expansion & melting of glaciers/caps.

Ecosystems / Biomes

Species:

- Interaction:
 - Intraspecific - organism interact w/ each other.
 - Interspecific - organisms interacting w/ other organisms.
 - Amensalism - ↓ ↔
 - Competition - ↑ ↓
 - Parasitism - ↑ ↓
 - Commensalism - ↑ ↔
 - Mutualism - ↑ ↑
 - predation - ↑ ↓

Biosphere → Ecosystem → community → populations → species → organisms.

Population dispersion:

- Uniform - even spacing between organisms
- Random - little interaction → random spacing
- clumped - some areas dense, others sparse.

Keystone species - plays large impact on ecosystem. Think keystone on a bridge.

Indicator species - representative of ecosystems well being.

Biomes:

- Deserts - < 25cm of rain per year. sandy soil. 15-25°C at.
- Shrubland - 50-75cm of rain. Hot, dry summers, dense shrub growth.
- Tundra - < 25cm of rain. Permafrost for soil. North 60° and up
- grassland - 10-60cm of rain. seasonal rainfall. "too wet for deserts & too dry for forest." Soil rich in humus. Agriculture land.
- Deciduous forest - 75-250cm. lots of rain/decaposition. Good for lumber/agriculture. poor nutrients/litter.
- Trop. Rainforest - 200-400cm. low biodiversity. Major timber source.
- Targa (Coniferous or Boreal forest) - 20-60cm of rain. cold forest high in latitude. poor nutrients. Acidic soil take decomposing needs. lots of litter & very slow decomposition.

Energy is lost at each trophic level (~10%).

Natural selection:

- Stabilizing - ↓ kills extremes
- directional - ↓ one extreme → shift
- disruptive - ↓ splits population into two.

Evolution. Speciation: isolated species within population → gene flow stop. (Galapagos Island Finches)

Convergent evolution: organisms not closely related develop similar characteristics independently.

Gradualism - evolution is slow, stepwise developments.

Punctuated Equilibrium - stability periods w/ sudden changes which are stress resulting in adaptation.

Ecosystem service - environment produces resources. (dispersing seeds)

Succession - Primary - colonization/pioneer species (lichens & moss)

Secondary - small/medium plants follow

tertiary - large trees (oaks) start to grow.

Progressive - communities become more complex/more biomass.

retrogressive - comm. deteriorates, loses biomass/diversity.

climax community - final stage of succession. Utopia!

producers: convert sun energy or chemical energy to useable energy. (photosynthesis, chemosynthesis)

consumers:

- primary consumers - herbivores only eat producers
- secondary consumers - eat primary
- tertiary - eat secondary
- detritivore - eats dead animals/fallen leaves
- decomposer - bacteria & fungi. break down plant material, waste, & dead bodies into inorganic forms.

Cycles + such

Carbon: Major sink: Marine sediments, plant matter, terrestrial biosphere, sedimentary deposits, ocean.

Methods of release:

- cellular respiration - plants/animals
- organic decomposition - decomposers
- burning fossil fuels, wood, coal, etc
- weathering of rocks (limestone, marble)
- volcanic eruption

Increased carbon in atmosphere due to burning wood/fossil fuels.

Nitrogen: Sinks: Atmosphere - (78%) composed of N_2
 organic matter - soil + ocean (air has 1 mill. times more)

Cycle: Atmospheric Nitrogen \rightarrow nitrous oxide by lightning \rightarrow soil by rain \rightarrow plants or animals \rightarrow soil as feces or decomposed to gas by bacteria.

(N. gas) (ammonia) (nitric acid)
 Fixation: $N_2 \rightarrow NH_3$ or NO_3^-
 10% - NO_3^- - lightning \rightarrow rain \rightarrow soil
 90% - NH_3 - N_2 splits + combines w/ hydrogen
 Nitrification - $NH_3 \rightarrow NO_2^-$ or NO_3^- by microorganisms
 "Plants ate nitrate"
 Assimilation, Ammonification, + denitrification probably don't even?

Excess Nitrogen: Fossil fuel combustion - main contributor.
 NO_x contributes to acid rain, smog.
 NH_3 (Ammonia) - used as aerosol - decreases air quality
 N_2O (nitrous oxide) - greenhouse gas - fertilizers.

Phosphorus: Sinks: sedimentary rock, vegetation released through weathering, or clear-cutting major factor in fertilizer, Increase in atmosphere due to mining, agriculture, (mainly fertilizers)

Sulfur: Sink: underground rock + ocean deposits, released through weathering, volcanoes, burning fossil fuels, when in atmosphere, creates acid rain.

Population ③ - 10-15%

Carrying Capacity: "J" curve - exponential - no limiting factors.

"S" curve - growth overtime, limiting factors
 K - carrying capacity - max organisms a ecosystem can sustain.

Malthus: Discovered carrying capacity

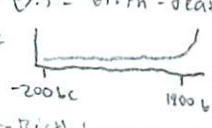
Strategist: R - roach - short life - type III curve - niche generalist - high adaptability

K - kangaroo - long life - type I or II curve - niche specialist, few offspring, narrow slow

Survivalship:
 1 - late loss - men
 2 - constant loss - birds
 3 - early loss - roach
 4 - early + late - Bam-bi!

Dynamics: Pop. Change = Crude birth + immigration - (death + emigration)

Actual growth rate (%) = $(birth - death) / 10$

Human Growth =  why?

Factors that effect - Birth: women education, freedom, religion, affluence
 Death: water accessibility, healthcare, sanitation/hygiene, food

Doubling time: 70 rule - $\frac{70}{\% \text{ growth}}$

TFR - avg. # of kids a women will have. Niger - 7.5 US - 2.1

Demo. transition - 1) Pre-industrial - high birth + death - Niger
 2) transitional - high birth low death - India
 3) industrial - low death low birth - China
 4) Post-indust - low growth, high quality of life. - Japan

Age-structure Diagram: Just pay attention in class.



Factors affecting Population Growth: Hunger: Uncontrolled pop. growth = hunger
 Disease; AIDS = 25 million so far - follows logistic curve for new cases.

Pandemics: Spanish influenza - 20-40 million.
 Other Diseases: Tobacco related - heart disease, cancer, respiratory disorders - leading killer in affluent countries.
 Tuberculosis - leading killer in poor nations.
 Malaria - major killer in Africa.

Land + Water USE ④ - 10-15%

Agriculture: Alley Cropping: strips of crops with trees/shrubs on either side. reduces runoff + erosion, increases aesthetics, yield, biodiversity.

Crop rotation: alternating crops, reduces nutrient depletion in soil. (rotating corn + beans)

Industrial Agg.: mechanization, monoculture, GMO, herbicides, pesticides, high yield/profit. Great for environment!

intercropping: planting crops in alternating rows.
 plantation. Killing native species to gain short term economic gain.

poly-culture: differing crops in same area. intercropping, Alley cropping, crop rotation all in one. More labor required but higher biodiversity.

Tillage - plowing soil - aerates - exposes to erosion - better growth.

Green Revolution - monocultures, inorganic fertilizers, pesticides, irrigation (artificial), to increase yield + money. (1950+)

1970+ - engineering crops (GMO)
 GMO - Pros - less water, fert, higher yield, less land, more resistant to disease.

Cons - ecological affect unknown, less biodiversity, harms beneficial insects.

Irrigation - 75% of fresh water used for irrigation. 9% of irrigation waste water (not drip irrigation).

Pesticides - Pros - kills pest, increase yield, less expensive food b/c higher supply, reduce labor cost.
 Cons - Bioaccumulation, pesticides develop resistance, inefficient, runoff into water tables.

Forestry: Tree plantations: larger, commercial or gov, managed forest. used for lumber/pulp. Pine, spruce, + Eucalyptus used most.

Old-growth forest! Biodiverse - little human contact.

Forest fires: Good for environment - clears underbrush + leaf litter, suppressing only means next fire will be worse, fire stimulates some germination, allows vegetation to grow.

Deforestation: selective cutting - specific age trees chosen to cut. shelterwood cutting - removing biggest + best trees. clear-cutting - cuts everything 1 time.

strip cutting - cutting strips of trees along land contour.
 Problems - reduced biodiversity/ecological services, reduces soil fertility + changes climate