Lecture One: Life + Scientific Process

Hypothesis: a tentative explanation for one or more observations that can be tested by experiments

Theory: a general explanation of natural phenomenon supported by lots of experiments + observations

Living Organism

- chemical system capable of undergoing Darwinian evolution
- can reproduce
- can change in response to changing environment
- Complexity - complex on many levels
- 1st Law of Thermodynamics
- 2nd law " "
- life comes from life
- Cellular basis of life

> 10 million species on earth

Observations → Hypothesis → Predictions → Experiment → Theory

1st Law of Thermodynamics
- energy cannot be created or destroyed

Stanley Miller 1953: discovered that, using a spark of electricity, amino acids can be created from prehistoric atmosphere

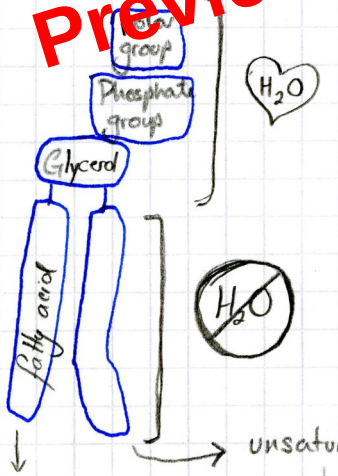
cell: simplest self-replicating entity that can replicate itself
- can harness energy + material from its environment
- central dogma: DNA → RNA → Protein

Gerald Joyce: chemical system capable of undergoing Darwinian Evolution

Robert Hooke: first person to use a microscope to look @ cells

Heterotroph: eats food (ie humans)

Autotroph: creates food by photosynthesis (ie plants)
- plants do both photosynthesis and respiration



Saturated (w/ Hydrogen) fatty acid

ex: butter

unsaturated fatty acid

some of the Carbons don't have enough H and so create double bonds and kink the chain

ex: oil

Cholesterol: amphipathic structure which allows phospolipids to pack tightly

Lipid Bilayer:

allows transport of gases, other lipids, and small polar molecules → H_2O

prevents: transport of ions, macromolecules, and polar molecules

Photosynthesis

60% - Photosynthesis takes place on land, the other 40% takes place in the oceans

- in · oceans, photosynthesis takes place — · photic zone, extending to ≈ 100 m deep
- the synthesis of carbohydrates from CO_2 in a redox rxn.
  - the ultimate electron donar is H_2O resulting — · formation of O_2

oxidation (looses electron)

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + O_2$$ → Endergonic Rxn

reduction (gains electron)

↳ and electron · boosted ↳ done by the photosynthesis's electron transport chain (PETC)

Step 1: absorbtion of sunlight · produces ATP and NADPH
Step 2: Photo. elec. trans. chain
Step 3: Calvin Cycle: when ATP and NADPH are used to form carbohydrates using CO_2

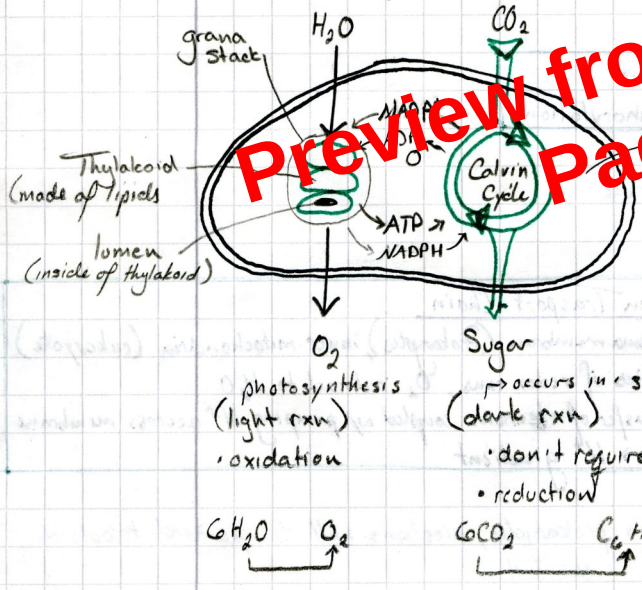
PETC

- prokaryotes: occurs in special membranes in the cytoplasm or in the cytoplasm itself.
- eukaryotes: occurs in · Thylakoid Membrane
  - sacs grouped into structures called grana
  - Grana connected together to form one lumen
  - the region surrounded by · thylakoid membrane is called · Stroma
  - Carb. synthesis takes place in · stroma

The Calvin Cycle (does not require light directly)

consist - 15 chemical rxns that CO_2 → Carbs

1) Carboxylation: CO_2 ↳ added to a 5 Carbon molecule
2) Reduction: energy + electrons ↳ transfered
3) Regeneration: ∴ 5 carbon molecule needed ↳ carboxylation



1. Where do plants get their mass?
   - From CO_2 in the air and water from the soil
   - The Carbs made in photosynthesis allow ✓ metabolic processes and building cell walls

2. Can too much O_2 be a bad thing for photosynthesis
   - Rubisco can't tell the difference b/t CO_2 and O_2 and if it grabs a O_2 it will cost · plant more energy. It will produce a 2-Carbon compound which needs to be converted to a 3-carbon compound through respiration. This uses up 50% of all carbohydrates already fixed by the plant
     solution: C4 plants w/ bundle sheath cells surrounding · veins