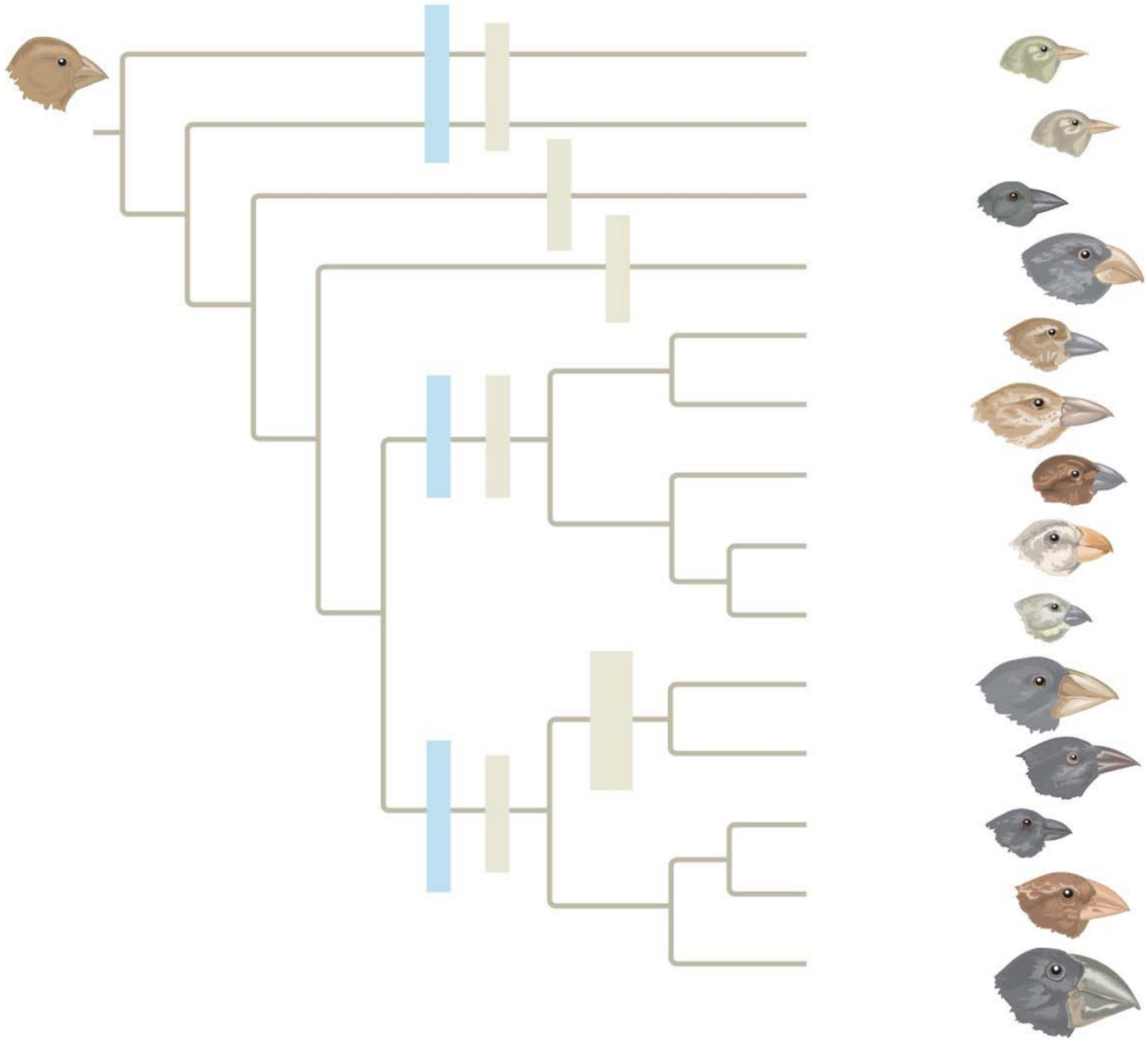
Optional Final Exam Review

Evolution

- Natural selection
  - Variation
    - Mutations



Energy

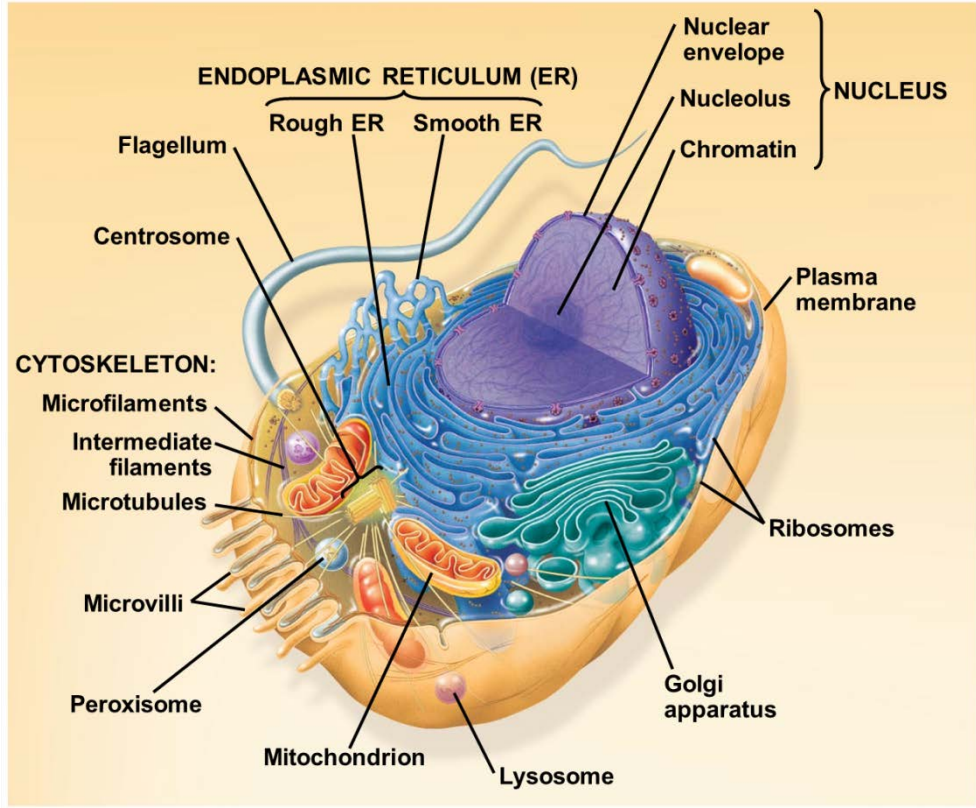
- Energy is the capacity to cause change (kinetic, potential, thermal, chemical)
- Enthalpy – is a measure of the total energy of a thermodynamic system.
- Entropy – is a measure of the disorder (randomness) of a system (usually the universe); entropy of the universe is always increasing
- First law of thermodynamics - the energy of the universe is constant, energy can be transferred and transformed, but it cannot be created or destroyed (conservation of energy)
- Second law of thermodynamics - every energy transfer or transformation increases the entropy (disorder) of the universe

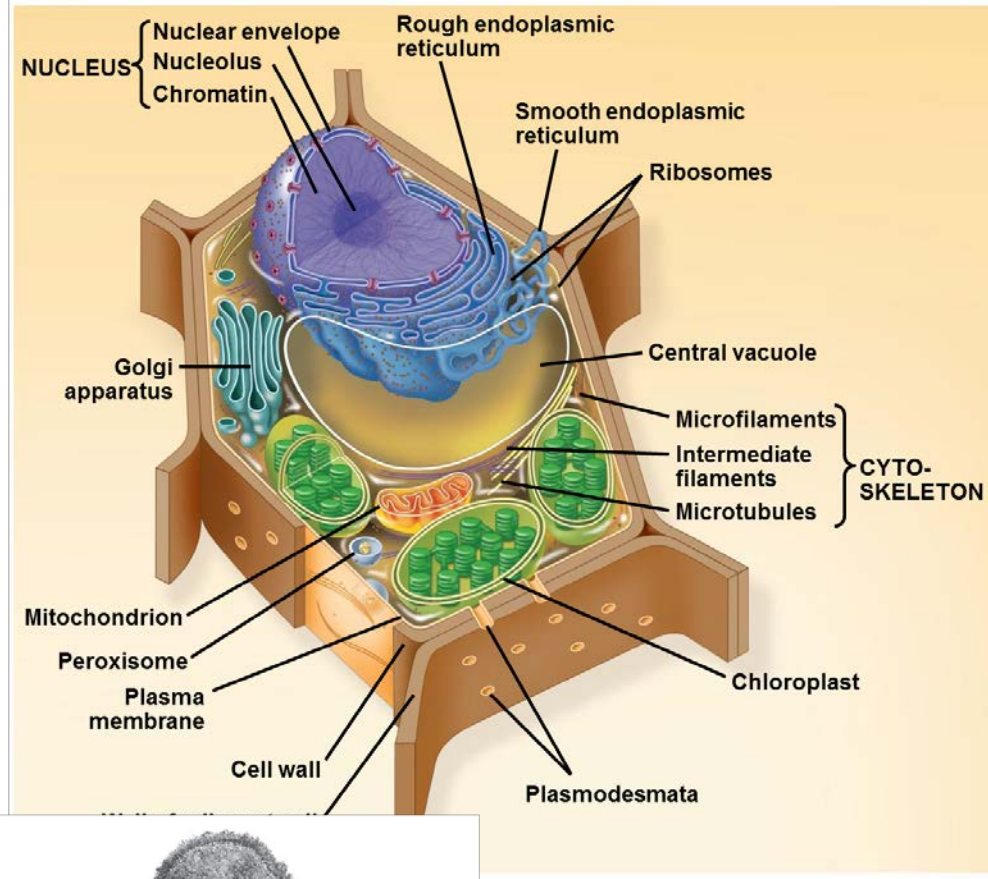
Energy

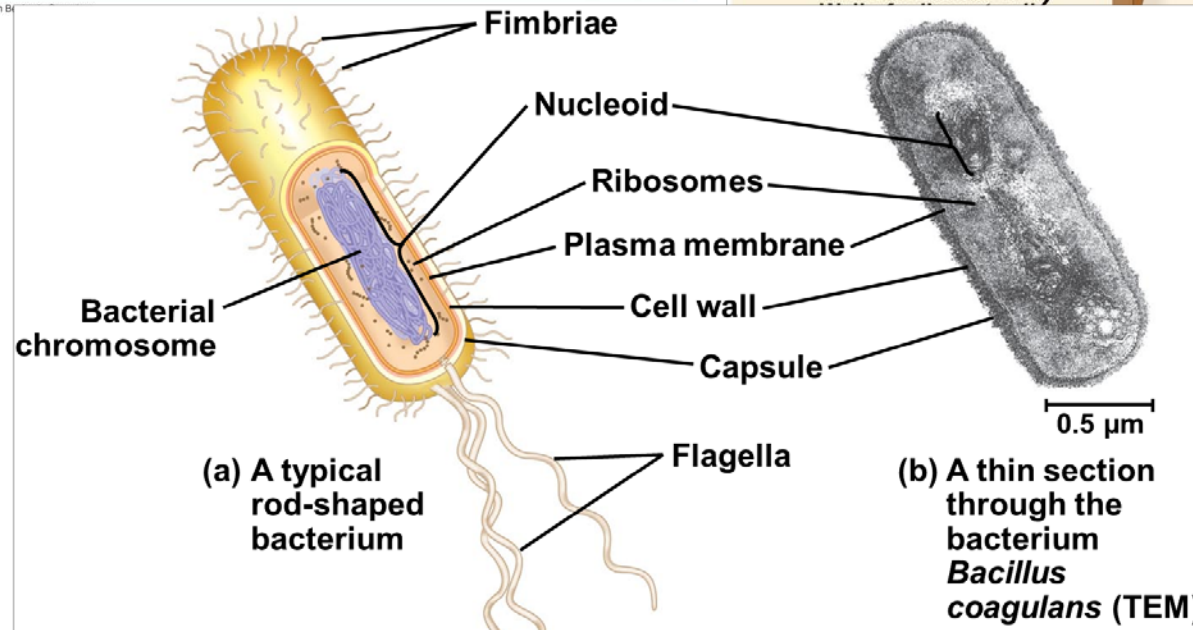
- Exothermic reactions release heat energy. Endothermic reactions absorb heat energy from the environment.
- Exergonic reaction - Usually enthalpy (energy) of the reactants is greater than the products, so the reaction proceeds spontaneously (ΔG is negative); entropy increases (cell respiration)
- Endergonic reaction - Usually enthalpy of the products is greater than the reactant, so energy (from the system, environment) is required to make the reaction proceed; the reaction is usually not spontaneous (ΔG is positive); entropy of the system (not the universe) usually decreases (forming chemical bonds, building molecules)

Cells

- Eukaryotes vs Prokaryotes
- Animal vs Plant
- Organelles?

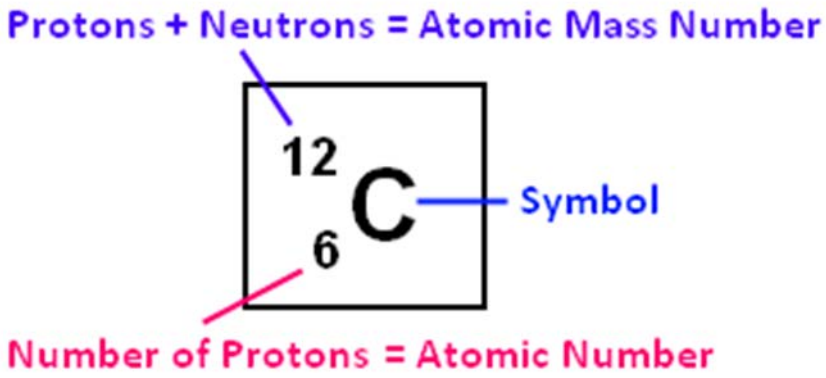






Chemistry

- An element's **atomic number** is the number of protons in its nucleus
- An element's **mass number** is the sum of protons plus neutrons in the nucleus

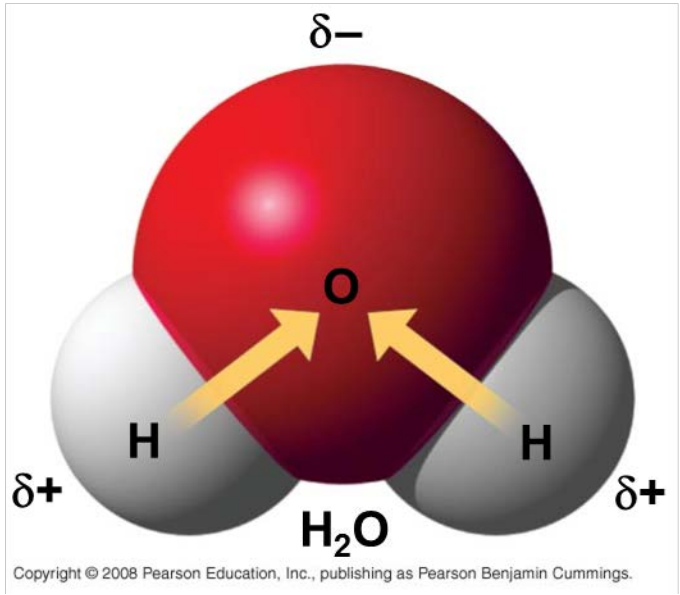


Isotopes are two atoms of an element that differ in number of neutrons

Bonds

- Polarity
- - when electrons are shared equally by the atoms, the bond is nonpolar
- - when electrons are shared unequally, the bond is polar
- - atoms of a molecule with a polar covalent bond have partial positive and negative charges; the molecule is neutral in charge
- Electronegativity is the tendency of an atom to attract electrons towards itself.

Fig. 2-13



- Hydrogen bonds
- Covalent bonds (polar, nonpolar)
- Ionic bonds

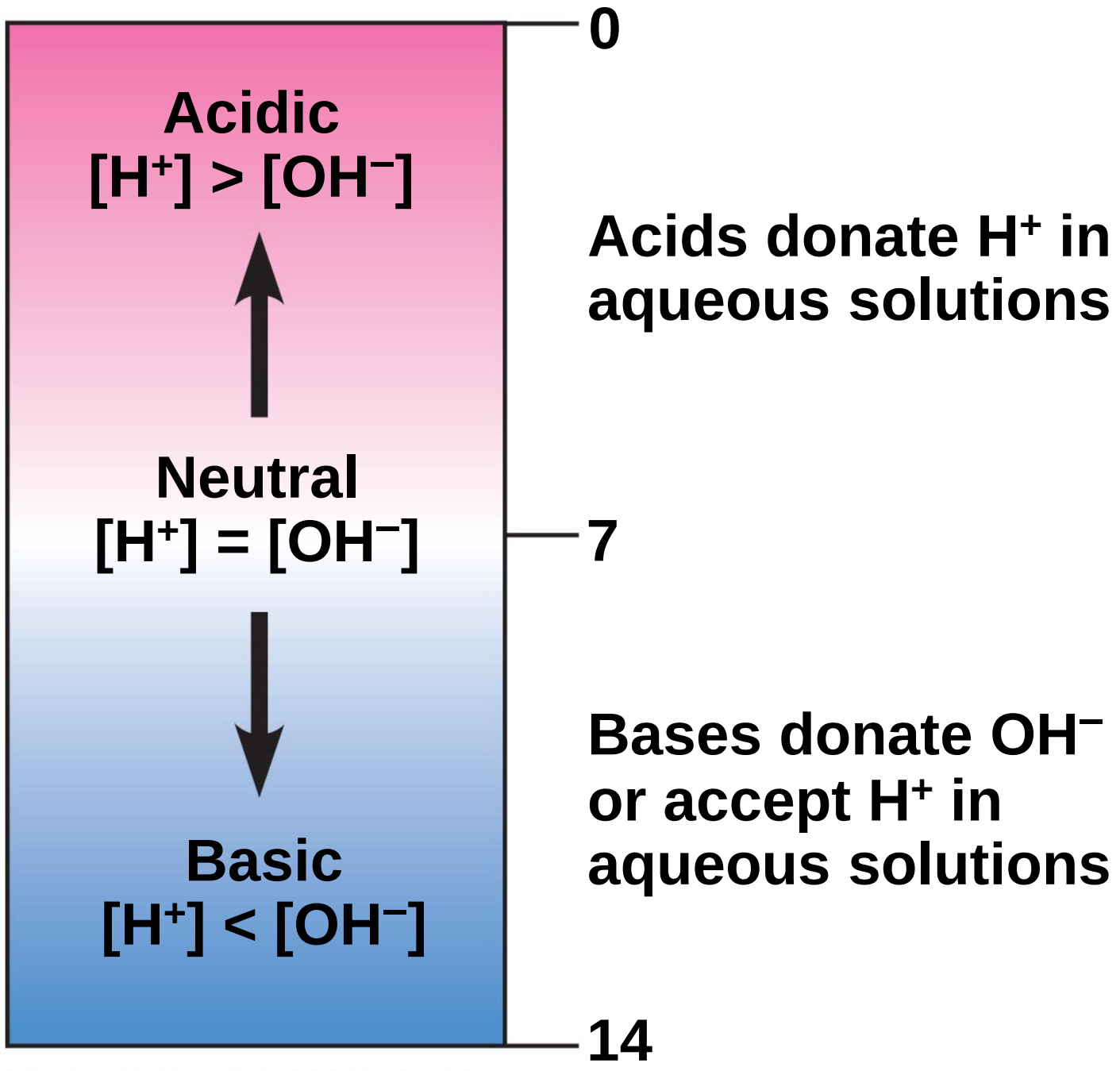
- Why is water “sticky”? What do we call two properties of “stickiness”?

- Cohesion
  - Surface tension
- Adhesion

- Osmosis, Diffusion
  - Hypertonic, hypotonic, isotonic
  - Where does the water go?

pH: Acids and Bases

- Acid?
- Base?
- pH scale?



Macro(Bio)molecules

- Carbs
  - Mono-, di-, poly- saccharides
- Lipids
  - Fats, phospholipds, steroids
  - Saturated, unsaturated
  - Hydrophilic, hydrophobic – membrane structure
- Proteins
  - Amino acids

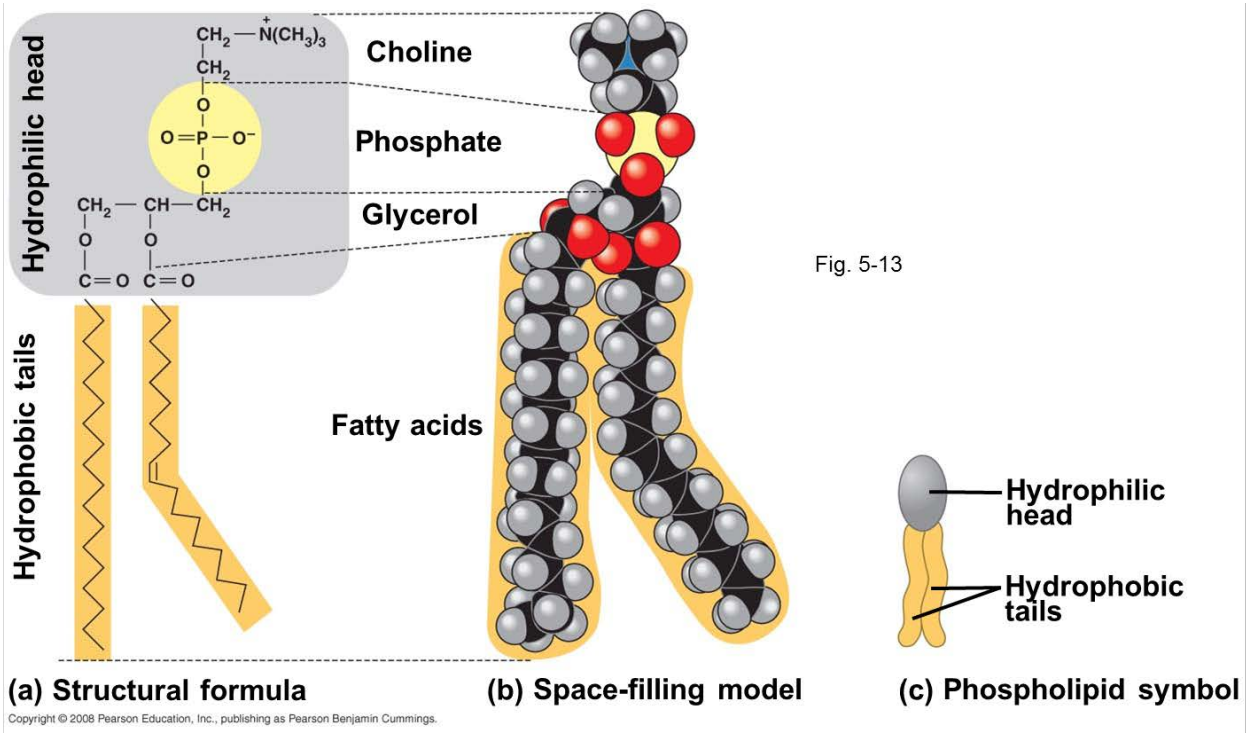
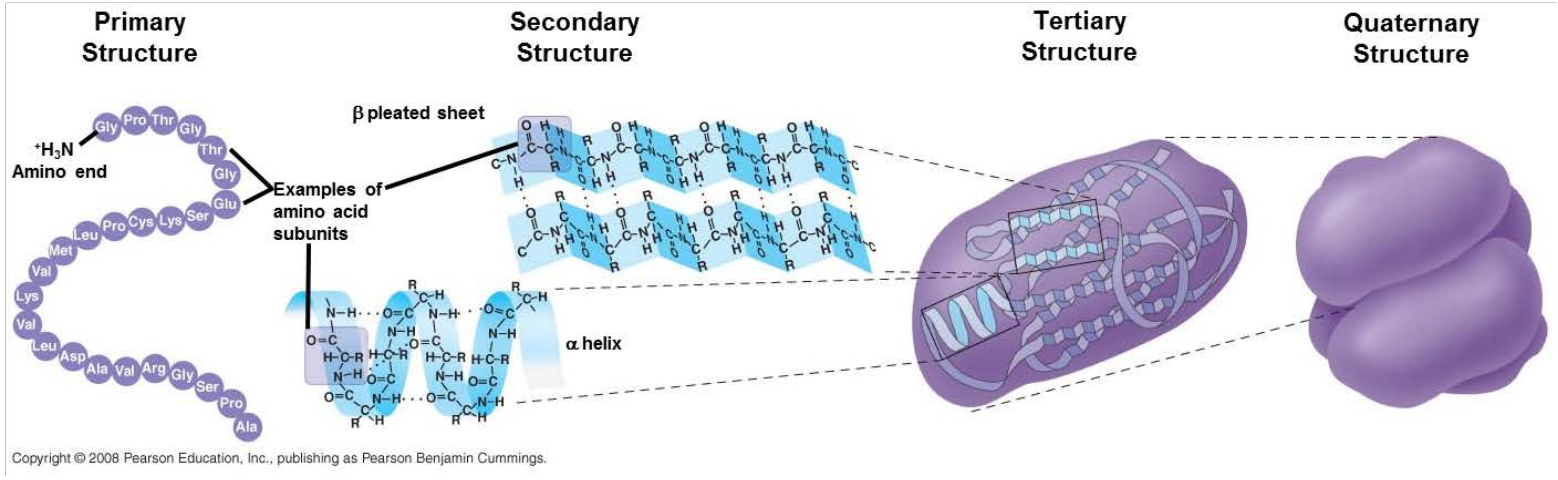


Fig. 5-13

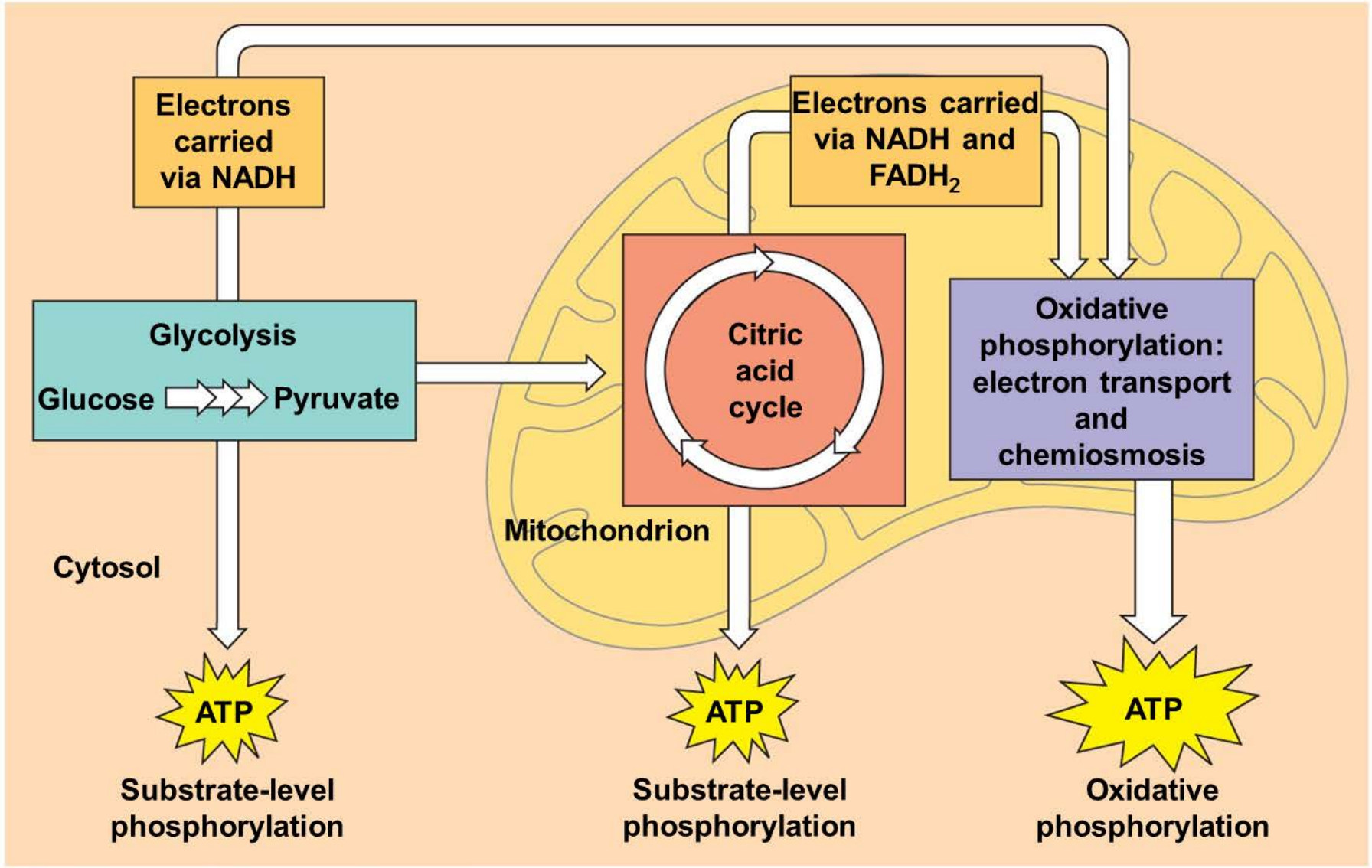


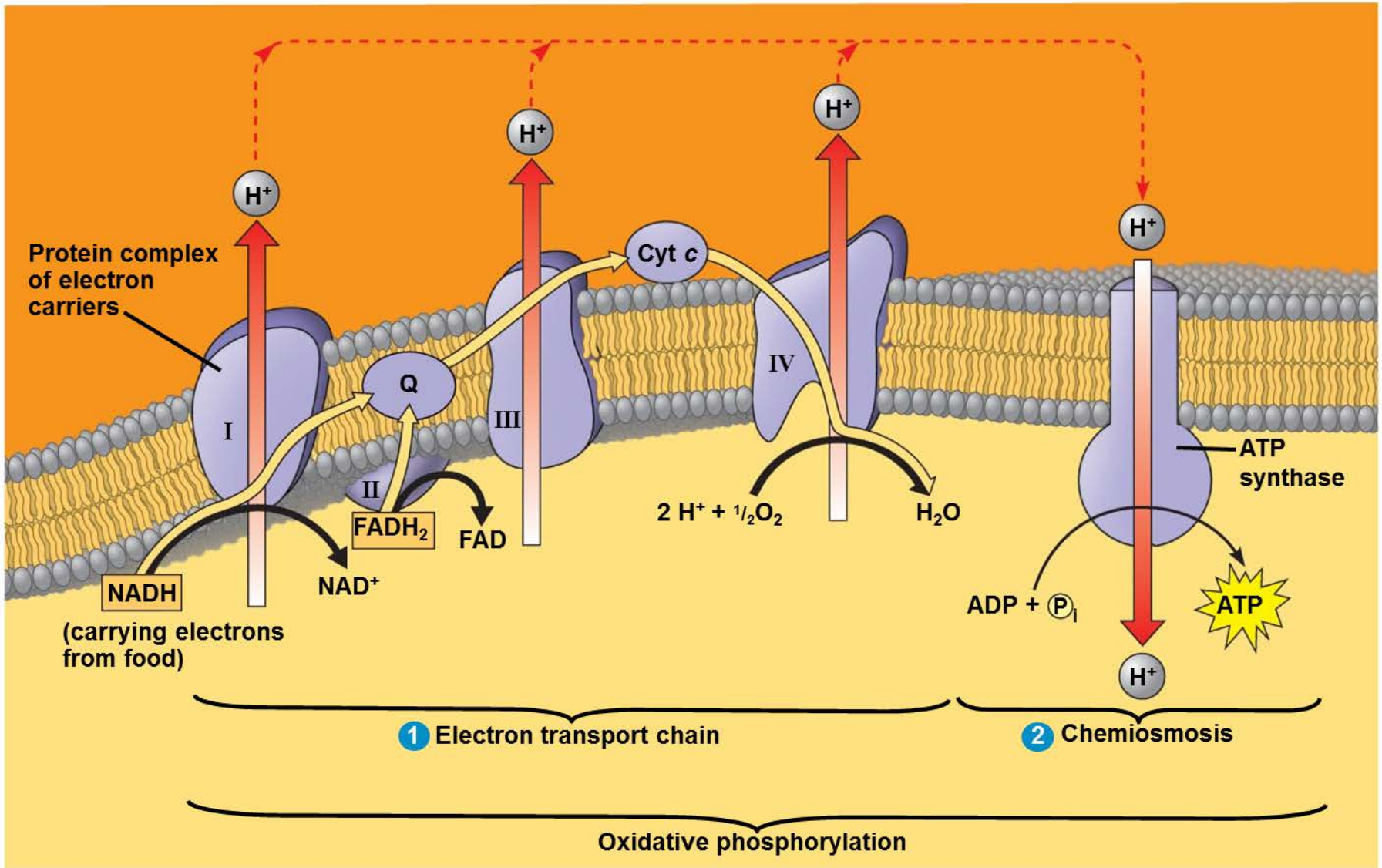
Enzymes

- Apoenzyme?
  - Cofactor, coenzyme?
- Activation energy?
- Denaturation?
- Feedback inhibition? What kind of enzymes?

Metabolism

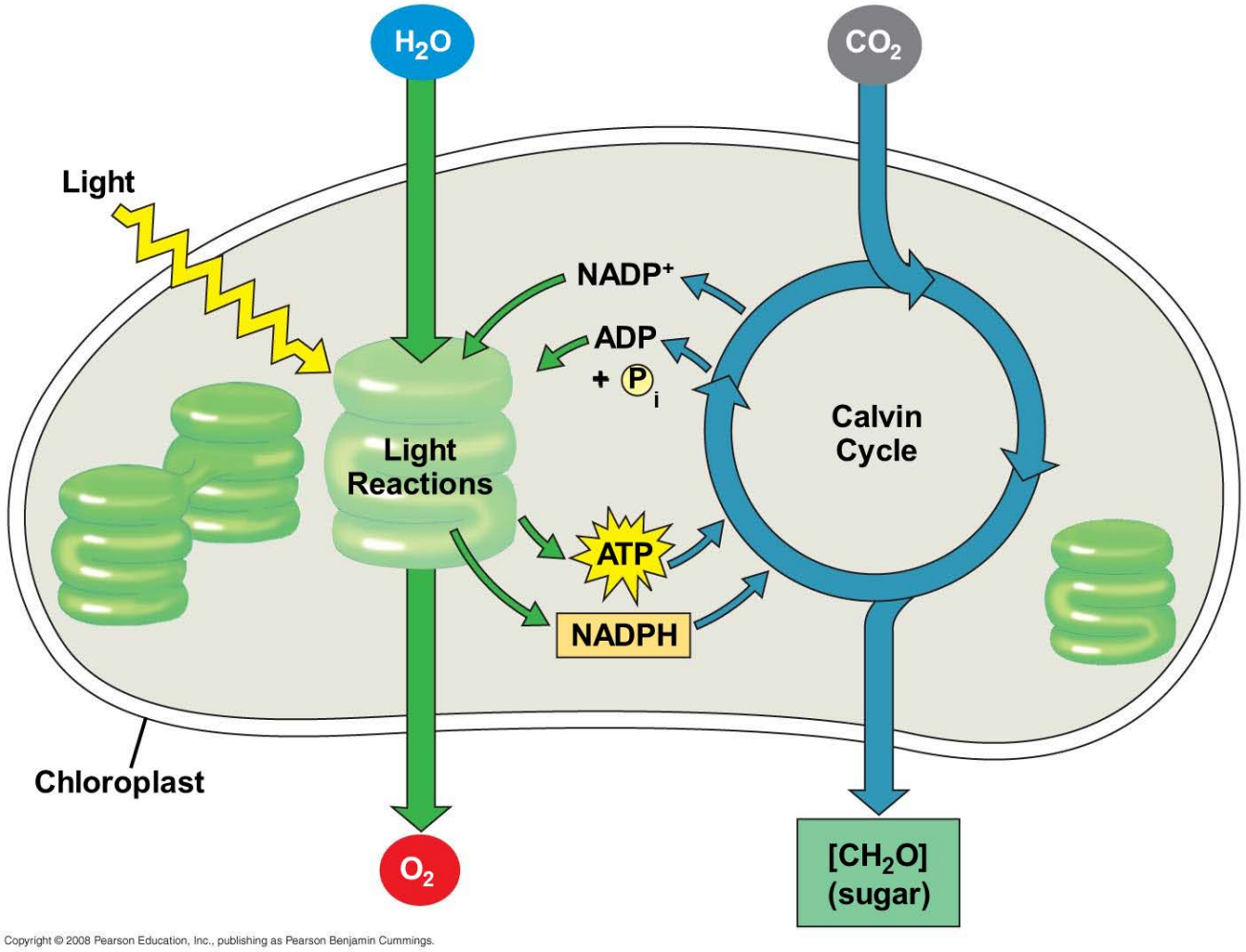
- Catabolic reactions (catabolism) are exergonic. ATP and heat are produced.
- Anabolic reactions (anabolism) are endergonic. ATP and sometimes heat are consumed/used.
- Aerobic Cell Respiration
  - Glycolysis, Krebs, ETC (who, what, where, when, how?)
    - Phosphorylation – substrate level, oxidative, photo?
- Fermentation?
- Oxidation / Reduction





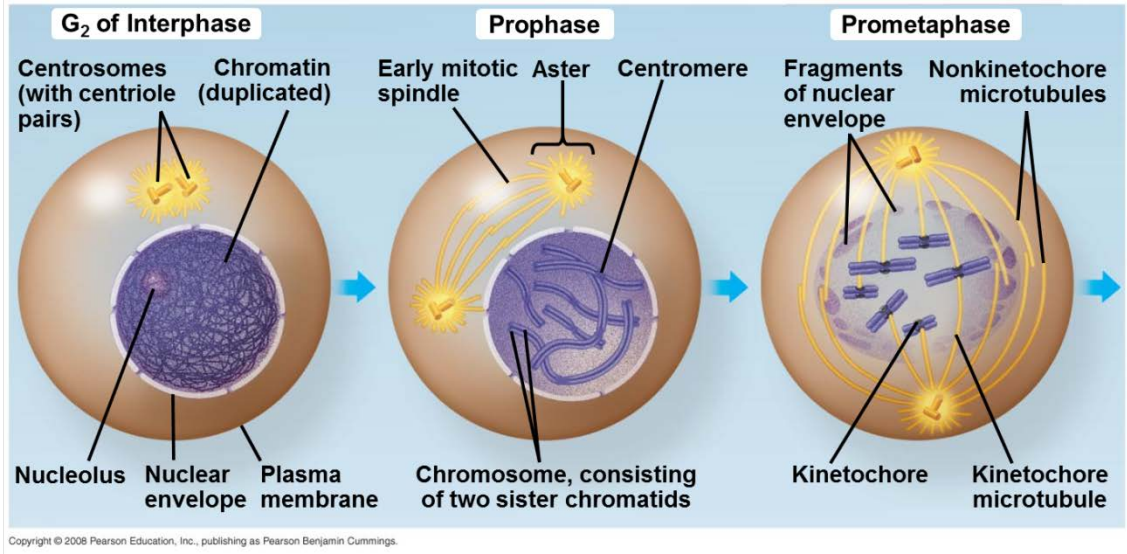
Photosynthesis

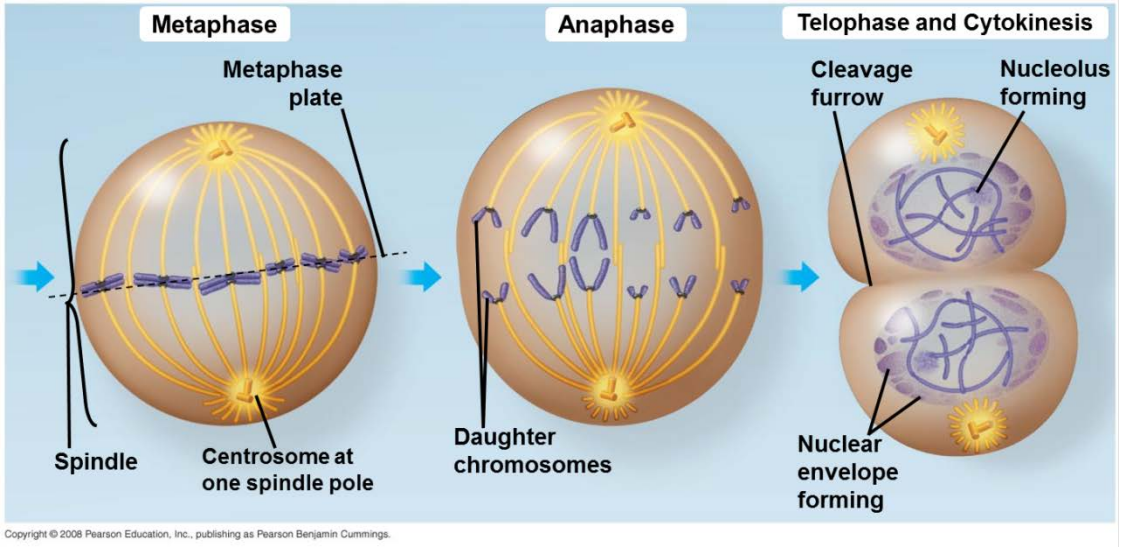
- Who, what, where, when, how?



Cell Cycle and Mitosis

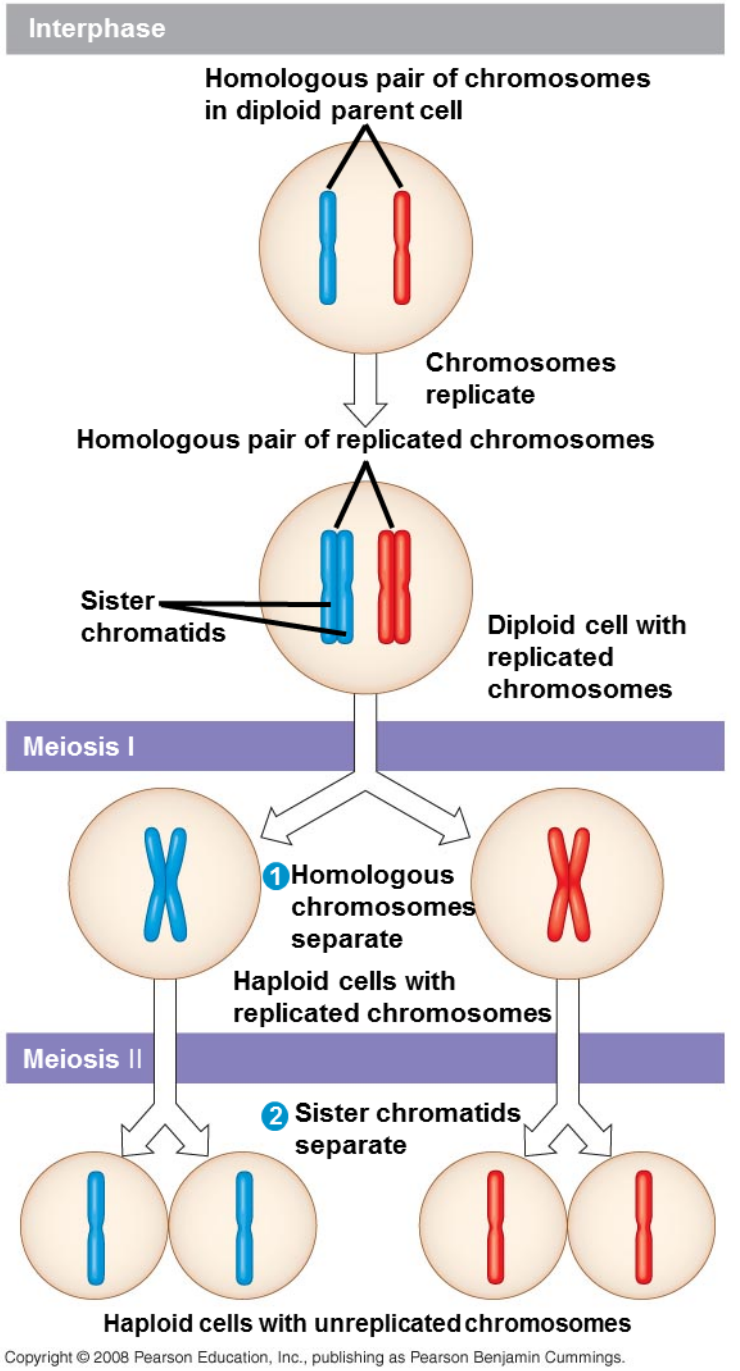
- G1, S, G2
- Mitosis
  - Phases? Events?
- Kinetochore? Centromeres? Sister chromatids?
- How cells know when to stop dividing?





Meiosis

- Purpose?
- I, II, phases?
  - Key events
    - Crossing over?



DNA

- Nucleotides
  - Base pairing
- Replication
  - DNA pol
  - Direction?
- Mutations?
  - Types?
- Chromosome number – humans?
  - Same for all species?
  - Does chromosome number reflect complexity?
- Telomeres? Consequences?

Transcription and Translation

- Central Dogma?
- Types of RNA's?
- Enzyme?
  - How know where gene starts? Stops?
- Nucleotides?
- Introns? Exons?
  - Splicing?
  - Post-transcriptional modifications?
    - Purpose?

Transcription and Translation

- Codons?
  - Genetic code
    - Redundant? Wobble?

- Ribosomes?
  - How know where to start and stop?

Genetics

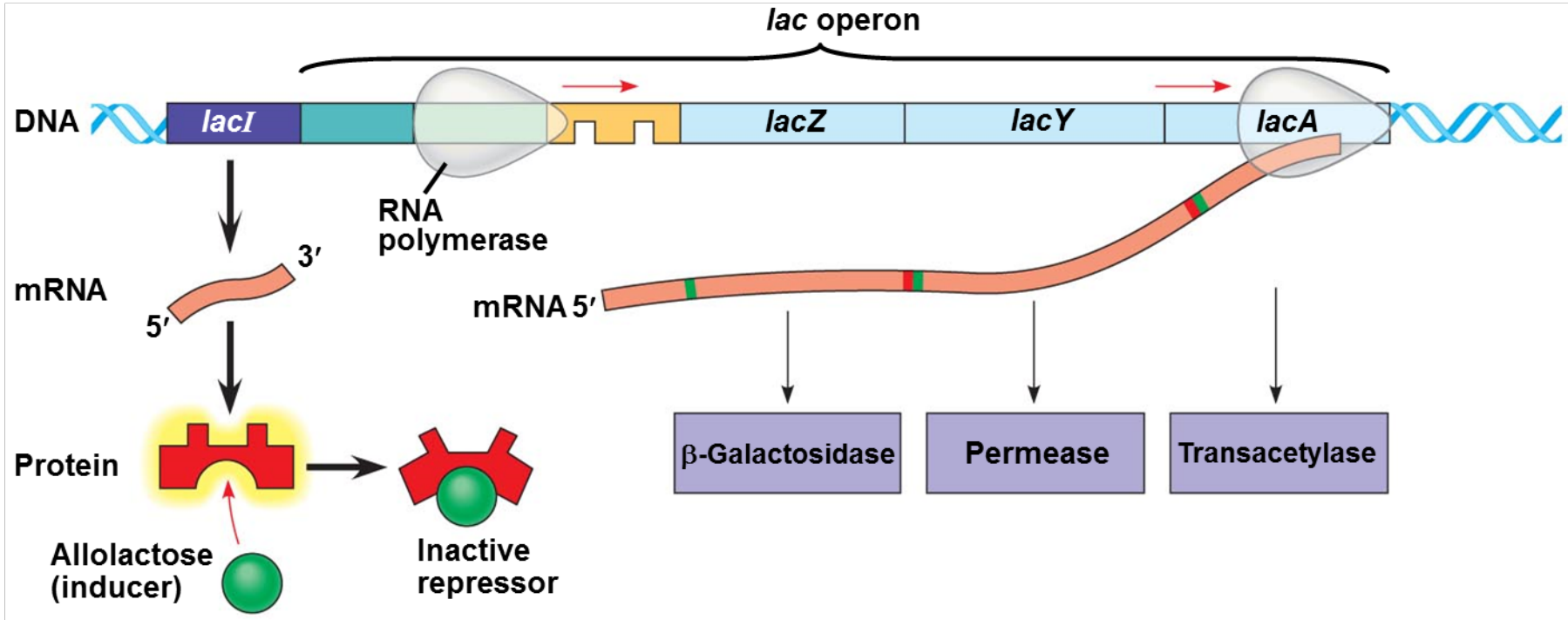
- Autosomal?
- X-linked?
  - Why do males suffer more?

- Review genetics problems handout.

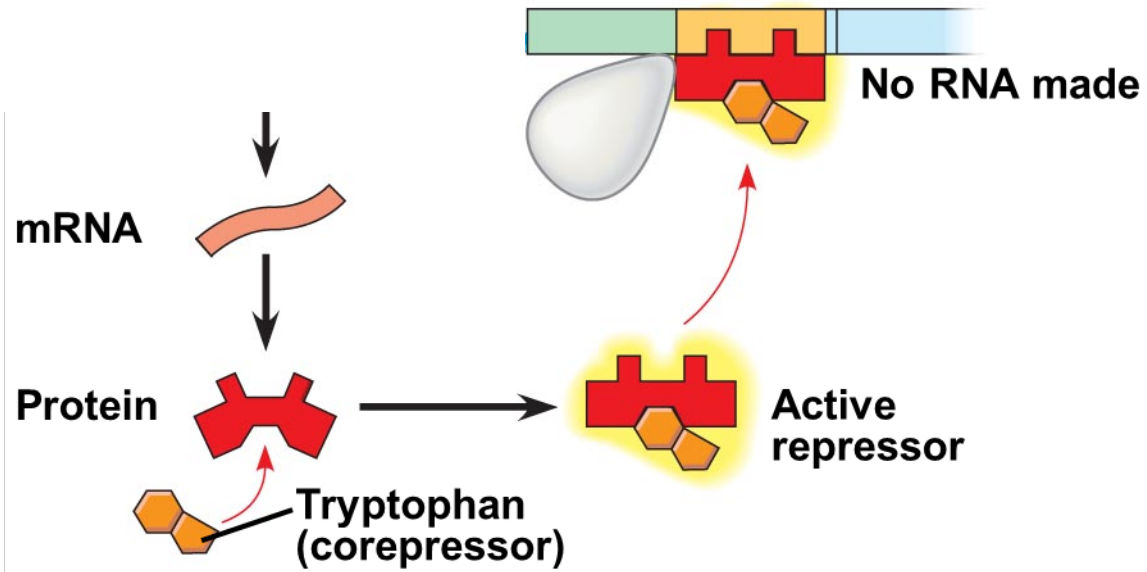
Operons

- Inducible
  - Inducers, substrates, repressor protein
  - Normally on or off? Why?
- Repressible
  - (Co)repressors, repressor protein, products
  - Normally on or off? Why?
- Lactose Operon
  - Type? How regulated?

- Tryptophan Operon
  - Type? How regulated?



(b) Lactose present, repressor inactive, operon on



(b) Tryptophan present, repressor active, operon off