Energy

a. Organisms use free energy for organizaon, growth and reproducon. Loss of order or free energy flow results in death.

b. More free energy (ex. Food) than needed will be stored for growth (roots, glycogen, fat, etc.).

c. Maer and energy are not created but change form (1st law of thermo; ex. Sun energy to bond energy in glucose) and entropy is increasing in disorganizaon of energy (i.e. heat released by cell respiraon). More organized or built up compounds have more free energy and less entropy (i.e. glucose) and less organized have less free energy and more entropy (i.e. carbon dioxide).

d. Reacons can be coupled to maintain a system, ex. Photosynthesis and cell respiraon

Cellular respiraon $C_6H_{12}O_6 + 6O2 \rightarrow 6CO_2 + 6H_2O$

a. Makes ATP for cell use; uses glucose and oxygen makes waste products of carbon dioxide and water; occurs in mitochondria; NADH is electron carrier used

b. Glycolysis

(1) occurs in cytoplasm; anaerobic

(2) rearranges the bonds in glucose molecules, releasing free energy to form ATP from ADP through substrate-level phosphorylaon resulng in the producon of pyruvate.

Kreb's cycle

(1) occurs in mitochondrial matrix

(2) also called the citric acid cycle

(3) occurs twice per molecule of glucose

(4) Pyruvate is oxidized further and carbon dioxide is released ; ATP is synthesized from ADP and inorganic phosphate via substrate level phosphorylaon and electrons are captured by coenzymes (NAD+ and FAD).

(5) NADH and FADH2 carry electrons to the electron transport chain.

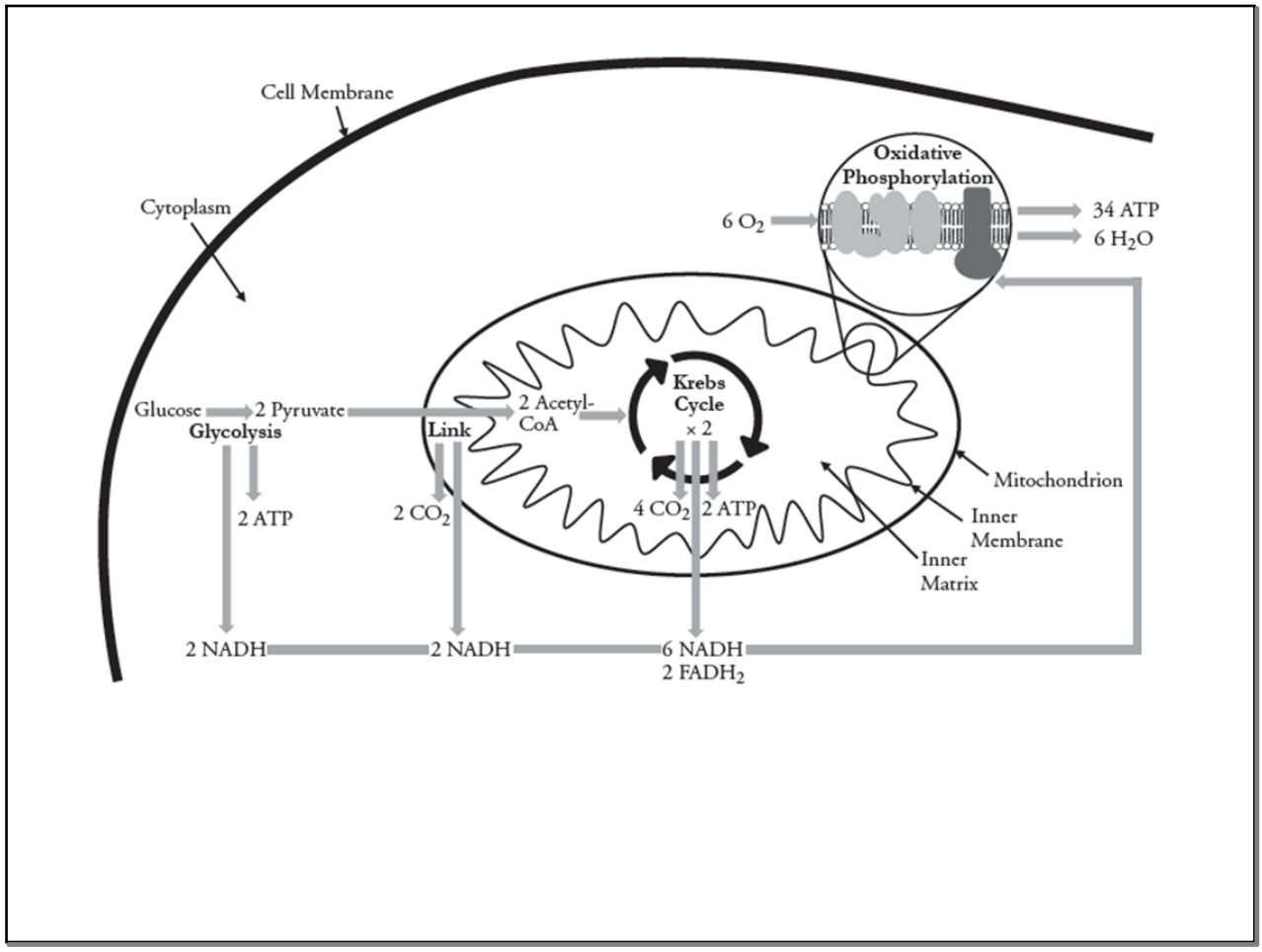
Electron Transport Chain and Chemiosmosis

(1) The electron transport chain captures electrons, pumping H^+ ions into the inter-membrane space of the mitochondria.

(2) Electrons are accepted by O_2 molecule forming H_2O

(3) Concentraon of H^+ builds up within inter-membrane space lowering the pH and ions rush through ATP synthase into the mitochondria matrix. Rush of ions "spins" ATP synthase protein, causing ADP and P_i to join forming ATP by oxidave phosphorylaon

Cell Review Cards Pt 3



Photosynthesis $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

a. Photosynthec organisms capture free energy present in sunlight and use water and carbon dioxide to make carbon products and free oxygen.

b. Light-dependent reacons- photophosphorylaon

1. Photosystems I and II (chlorophyll and proteins) are embedded in the internal membranes of chloroplasts (thylakoids of the grana). They pass electrons through an electron transport chain (ETC). When electrons are passed they allow hydrogen ions (protons) across the thykaloid membrane. The formaon of the proton gradient powers the process of ATP synthesis to add a phosphate ADP to ATP (chemiosmosis).

2) Electrons are passed to NADP+ to make NADPH (electron carrier)

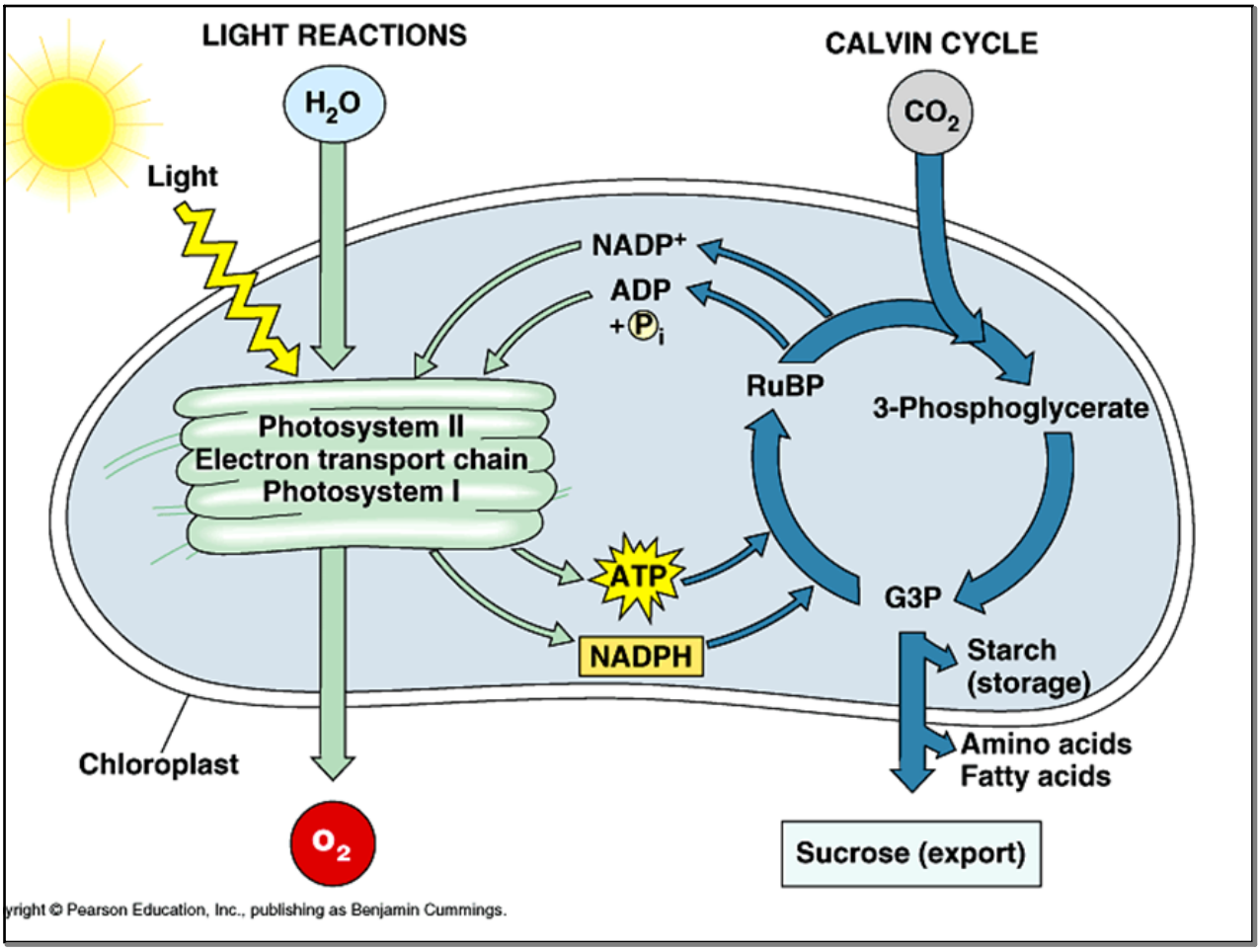
3) H_2O is used and O_2 released as by-product

4) Red and blue light works best (green is reflected typically)

5) Energy converted from sun into chemical energy of ATP and NADPH to be used in building of sugar (Calvin Cycle)

Light-independent reacons - Calvin Cycle

1. carbon fixaon occurs (carbons of CO_2 used to make sugar)
2. occurs in stroma of chloroplasts
3. ATP and NADPH generated by light-dependent reacons are used to assemble glucose



Anaerobic Fermentaon

a. No oxygen; cell only goes through glycolysis followed by fermentaon
b. Fermentaon recycles NAD needed to restart glycolysis
c. alcohol fermentaon ex. yeast cells- glucose → ethyl alcohol + CO_2+ NAD^+
d. lacc acid fermentaon ex. muscle cells- glucose → lacc acid + NAD $^+$
e. Fermentaon does not make ATP but glycolysis does- 2ATP; very inefficient; sufficient for microorganisms