Ch. 6 Photosynthesis Note Outline

Forms of energy:

1) **Potential** – stored E or E of _____

2) **Kinetic** – E of _____

*__1st Law of Thermodynamics__ – E cannot be _____ or _____, only changed from one form to another

Energy tends to be _____:

- Approximately _____ the potential E in food is lost as _____ to the environment when it is changed into _____ E.

*E conversions reduce the state of order, **entropy**, in the environment (universe).

*__2nd Law of Thermodynamics__ – Disorder (_____) in the universe constantly increases; in a _____ system, E tends to be converted to less organized systems that are more _____.

Energy is carried by electrons (e-):

- E in food is stored in the _____ **electrons** in the C to H _____ ***BONDS*** and can be transferred.
- Chemicals pass e- from one atom or molecule to another in _____ - _____ (redox) rxns.

*__Oxidation__: _____ of e-'s LEO goes GER

*__Reduction__: _____ of e-'s lose e-'s = oxidation

Obtaining Energy gain e-'s = reduction

_____: org's that use E from sunlight or inorganic chemicals to make organic compounds

- "Can make their own food"
- use _____

_____: animals & other org's, obtain E from _____ instead of from sun or inorganic substances

- Have to _____ their food

Overview of Photosynthesis

- Produces organic compounds (_____) & _____ from _____ & _____
- carb's & O_2 are used during _____ _____ to produce CO_2 & H_2O and release E from bonds

2 Stages of Photosynthesis

1. **_____ _____:** light E is converted to chemical E & temporarily stored as ATP & NADPH (an _____ _____)
2. **_____ _____:** ATP & NADPH & CO_2 used to form organic compounds

$$6CO_2 + 6H_2O \xrightarrow{\text{Light E}} C_6H_{12}O_6 + 6O_2$$

* This equation does not show the **_____** ***pathway***

Light Reactions

- Require _____ to occur
- Light is absorbed in _____ (organelle in _____ & _____ w/ double membrane

In chloroplasts:

Thylakoids: _____ _____

Grana: stacks of _____

Stroma: fluid surrounding _____

Light & Pigments

- Sunlight appears _____ (visible light spectrum), but is composed of many _____
- These colors are _____, _____ or _____ by objects that contain **_____** (compounds that _____ light)

_____: pigment in membranes of thylakoids

Chlorophyll a*:* absorbs majority of light E in _____; absorbs _____ light

Chlorophyll b*:* an _____ pigment; absorbs _____ light

- Neither absorbs _____ (why plants look green)

Carotenoids: accessory pigments (_____, _____, & _____)

- _____ is not produced in fruit or flowers of plants; not produced in fall

Converting Light E to Chemical E

- _____ & _____ absorb light E

_____: cluster of few-100 pigment molecules & the proteins the pigments are embedded in

- Photosystem ___ & Photosystem ___

Steps of Photosynthesis (p116-118)

1. LIGHT GETS ABSORBED

2. e-'s in chlorophyll a (part of Photosystem II) become _____

- Leave the _____ molecule (an oxidation rxn)

3. e-'s get passed to _____ _____ _____

4. From here, e-'s are passed to _____ _____ _____**:** (ETC) series of molecules in _____ _____ that transfer e-'s from 1 molecule to the next

- Lose E as they move; this E is used to move protons (____ _____) into the thylakoid

Making ATP

Chemiosmosis: movement of protons _____ conc. gradient, coupled w/ synthesis of _____

-remember that H+ ions have been pumped into thylakoid from stroma, creating a _____ _____

ATP synthase: _____ that uses energy of moving H+ to add a ____ to _____ to form ATP

5. Light hits _____ ___; reenergizes e-'s

- e-'s leave chlorophyll a to _____ e- acceptor, then to another _____

6. Two e-'s reach the _____ side of the thylakoid memb.

- Combine w/ H+ & NADP+ (an e- acceptor)
- Forms _____
- e-'s _____ by chlorophyll need to be _____, or photosynthesis will _____
- e-'s are replaced by splitting a _____ molecule

$2H_2O \longrightarrow 4H+ + 4e- + O_2$

- This is why _____ is necessary for photosynthesis & how _____ is produced

Calvin Cycle

- Series of _____-assisted rxn's that produce a 3-Carbon sugar

_____ _____: incorporation of CO_2 from atmosphere into organic compounds

-occurs in the _____ of _____

*****NOTE: Calvin Cycle sometimes called _____**-**_____ ***Rxns*** or ***Dark Rxns***

- Not directly dependent on _____, but are dependent on products from light rxns (which do require _____)
- Are dependent on _____ & _____ from light rxns

- Calvin Cycle is the most common pathway used by _____ for production of _____

How Does CO_2 enter Plant? How Does O_2 Exit?

The _____!!!!

- When closed on hot/dry days, less water leaves, but less CO_2 enters, inhibiting Calvin Cycle

Alternative Pathways

_____ Pathway & _____ Pathway

- _____ preserving pathways used by plants in _____ &/or _____ environments

Summary of Photosynthesis

Stage of Photo.	Reactants	Products
Light Reactions	Light, H_2O, H+ ions (protons) & e-'s from H_2O, NADP+, & ADP	O_2, ATP, & NADPH
Calvin Cycle (Light-Independent Rxns)	ATP, CO_2, NADPH, RuBP	Organic Compounds (carb's), NADP+, ADP

- Plants use products of photosynthesis for their own purposes
- Most make more _____ than they need, so are stored as _____ in chloroplasts, roots, & fruit

Factors that Affect Photosynthesis

1) **_____ _____**: rate of photo. increases as light intensity increases
   - More light _____ more e-'s, so rxn's occur more _____
   - however, it will _____ _____ as all available e-'s become excited

2) **_____ _____**: increasing levels of CO_2 will stimulate _____, but will eventually level off (just as w/ light intensity)

3) **_____:** rate of photosynthesis increases as temp increases
   - Will peak at a certain temp, after which enzymes _____ effectiveness
   - Stomata will start to _____
   - Photosynthesis _____ & will eventually _____