Energy In Cells...

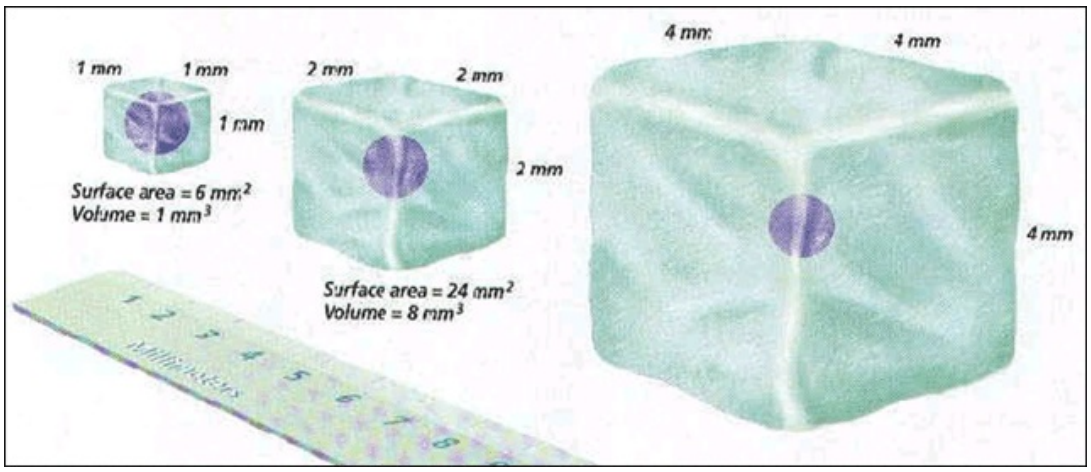
Cell Size and Energy Demand :

Cells have to be small in order to make use of passive transport (diffusion and osmosis) to take care of at least some of their needs.

Lets compare cell size to volume :

Cell radius	Surface area ($4\pi r^2$)	Cell volume ($4/3\ \pi r^3$)	S.A. : V ratio
2			
3			
4			
5			

The bigger the cell, the greater volume of cell space must be supplied. Bigger cells must make and use energy to bring materials across their membrane.



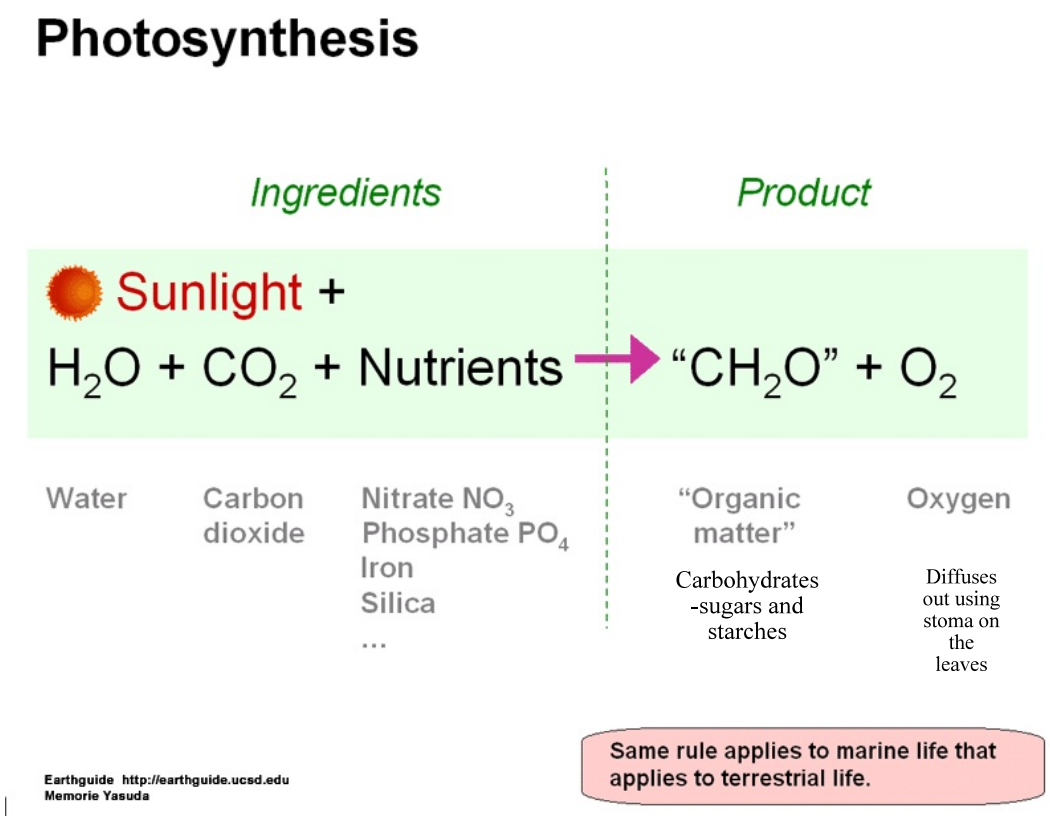
Making Energy in Plant Cells : "Photosynthesis"

Photosynthesis has three basic steps:

1. Energy is captured from the sunlight.
2. Light energy is converted into chemical energy - forming **ATP** and **NADPH** molecules

   (Photosystem Stages I and II)
3. This chemical energy is used to power the process of making organic molecules (e.g. carbohydrates) from inorganic carbon dioxide (CO_2).

   (Calvin Cycle)



For the chemically inclined people :

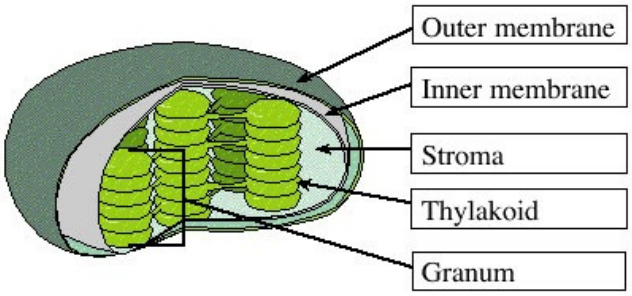
The organic material made by this process is either used by the plant (for growth, reproduction, repair, cell division, operating cell membranes) or stored for future use.

Consumers eat the roots, stems, leaves, or fruit of plants to get some of this stored chemical energy.

Two stages of photosynthesis.....

Photo stage (or "light dependent reactions")

- collect light in the thylakoids of chloroplasts



- chlorophyll A absorbs red and orange light, chlorophyll B absorbs violet and blue light inside these thylakoid structures, making some ATP molecules.

Want the details ?
Check out
http://www.starsandseas.com/SAS%20Cells/SAS%20cellphysiol/SAS%20photosyn/cellcalvin.htm

H2O + light + ADP + P ---> O2 + ATP + e-

After the above steps occur in **photosystem II**,
the electron is finally sent to **photosystem I**, where the following happens....

e- + NADP+ + H ---> NADPH

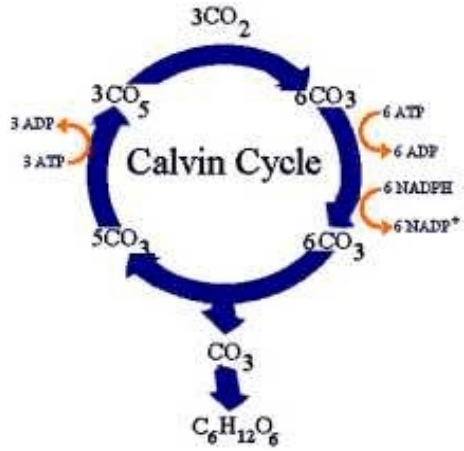
Synthesis Stage

(light independent reactions, or Calvin cycle)

The purpose of the **Calvin Cycle** is to take the energy from **photosystem I** and fix carbon. **Carbon fixation** means building organic molecules by adding carbon.

- happens in the liquid stroma of chloroplasts, where glucose is made by combining carbon with carbon dioxide

$C_5 + CO_2 + ATP + NADPH \rightarrow C_6H_{12}O_6$



In Animal Cells...”Cellular Respiration”

Two types :

Aerobic respiration -

needs oxygen in order to happen

(ex. In plant cells and animal cells)

parts -

1. glycolysis : breaking apart glucose to make pyruvate, ATP, and CO2
2. Krebs cycle : breaking apart pyruvate to yield ATP and electrons
3. Electron transport: those electrons fuel a series of reactions making a lot of ATP as oxygen carries electrons along

A complementary process to photosynthesis....the garbage made here drives photosynthesis. The garbage made there drives this cycle. A partnership.

Aerobic cellular respiration is the breaking apart of carbohydrates to release the chemical energy they contain. It happens in the mitochondria of eukaryotic cells.

Glucose molecules go through a series of chemical reactions to ultimately produce 36 ATP molecules.

Global Implications :

Photosynthetic creatures are the basis for most food chains, eaten by consumers. In this way, and decomposing matter, important nutrients (like carbon) are passed between living and nonliving parts of the environment.

The two energy process together make up most of the global carbon cycle.

Photosynthesis drives our forestry and agriculture industries. Indirectly drives the fishery and production of animals.

Chemical energy stored in creatures bodies is the basis of oil and natural gas reserves.

Anaerobic respiration -

doesn't have to have oxygen, still uses glycolysis as the first step, but molecules involved in the later steps are different - nitrates, sulfates, and sulfur.

Ex. Bacteria, archeans ?, cells in low oxygen environments