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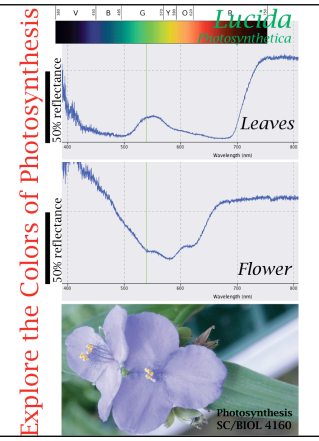
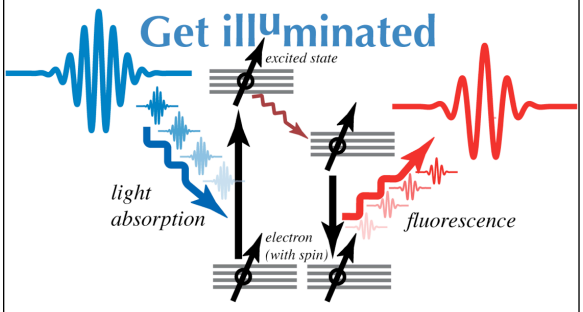
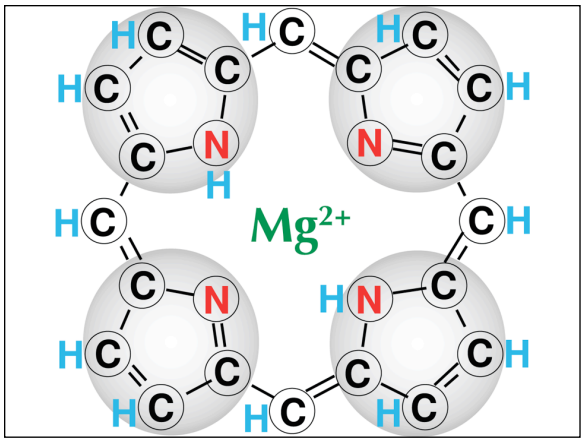
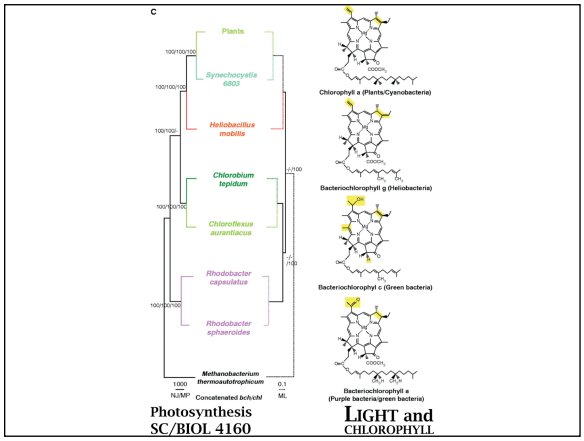
Photosynthesis

artwork by Michael Hagelberg









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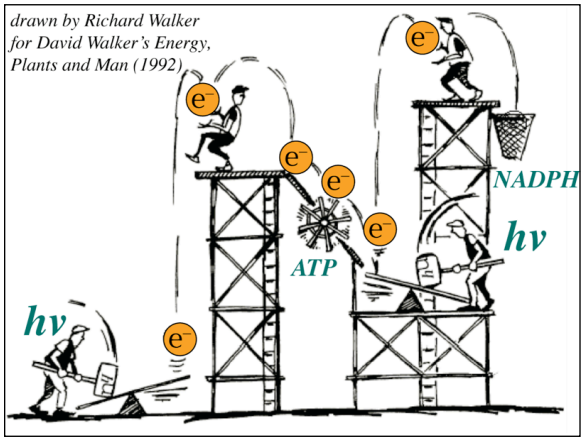
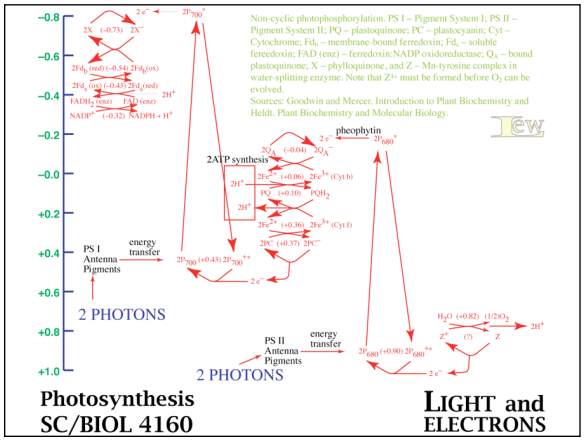
LIGHT and
CHLOROPHYLL





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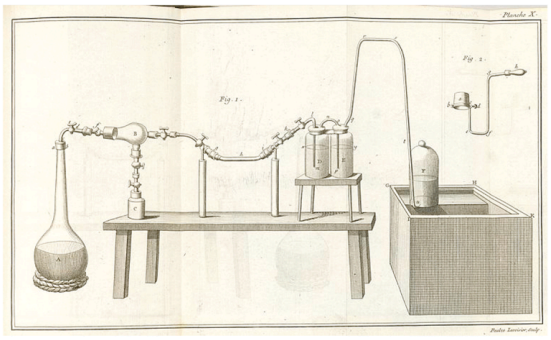
LIGHT and
ELECTRONS

Lavoisier, A. L. Traité élémentaire de Chimie. 1789



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LIGHT and
OXYGEN

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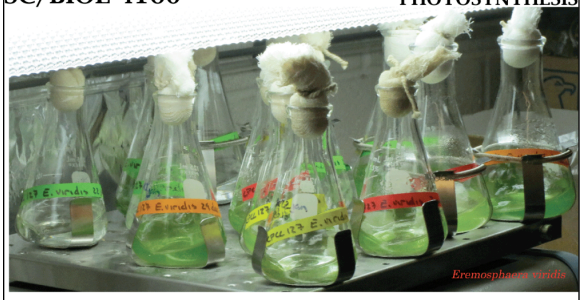
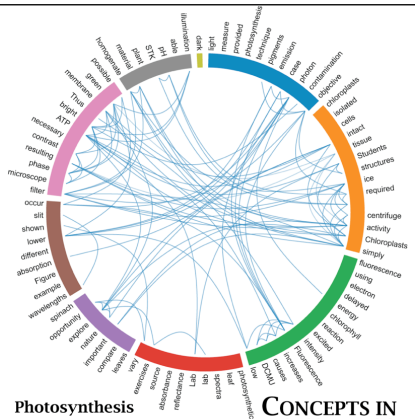
CULTURING
PHOTOSYNTHESIS





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CONCEPTS IN
PHOTOSYNTHESIS

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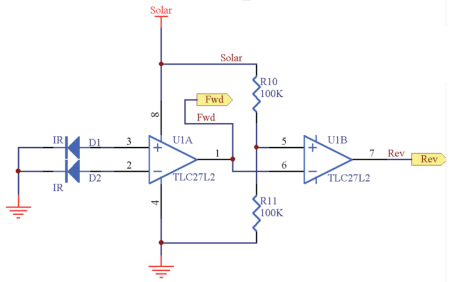
LIFE and
PHOTOSYNTHESIS

Sunflower / Power-plant schematic[1]



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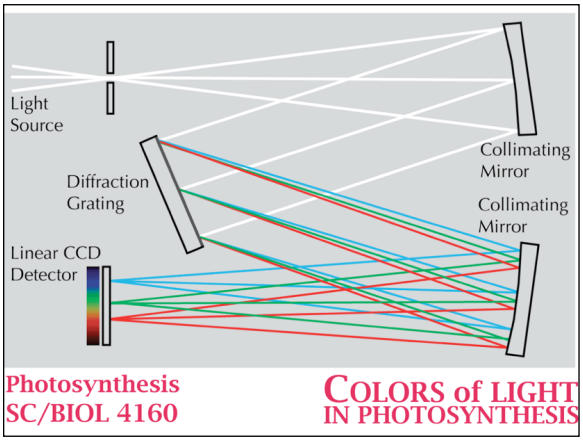
LIGHT and
POWER

[1]http://www.jcminventures.com/schematics.htm (These schematics are copyrighted (c) 2002 by JCM Electronic Services and remains the property of JCM Electronic Services. No unauthorized use of this design is permitted. These schematics may be used by individuals and educational institutions so long as no fee's are collected for it's distribution or use and this copyright notice is included.) (JCM Electronic Services (403) 284-2876)



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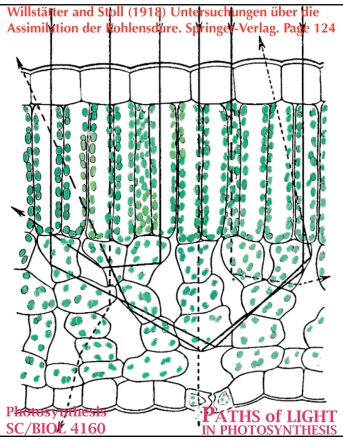
COLORS of LIGHT
IN PHOTOSYNTHESIS



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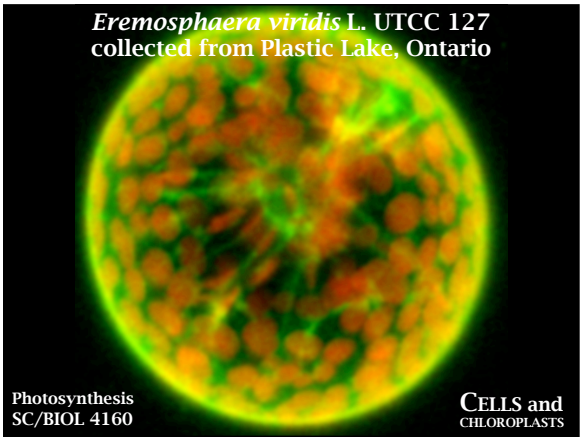
PATHS of LIGHT
IN PHOTOSYNTHESIS



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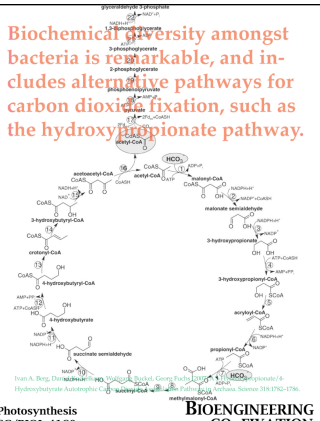
CELLS and
CHLOROPLASTS

Biochemical diversity amongst bacteria is remarkable, and includes alternative pathways for carbon dioxide fixation, such as the hydroxypropionate pathway.



Ivan A. Berg, Dana Kockelkorn, Wolfgang Buckel, Georg Fuchs (2007) A 3-Hydroxypropionate/4-Hydroxybutyrate Autotrophic Carbon Dioxide Assimilation Pathway in Archaea. Science 318:1782–1786.

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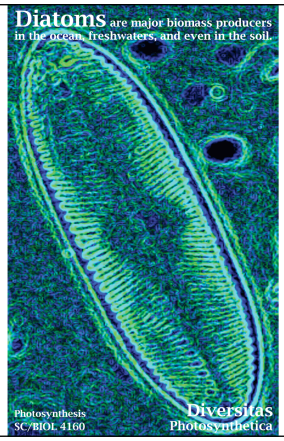
BIOENGINEERING CO_2 FIXATION

Diatoms are major biomass producers in the ocean, freshwaters, and even in the soil.



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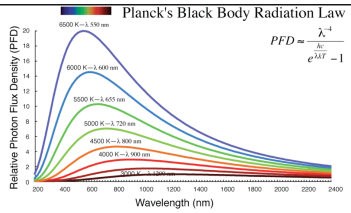
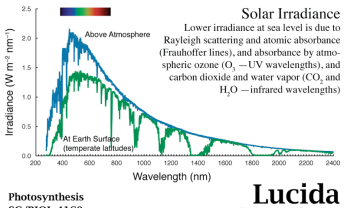
Diversitas Photosynthetica

Planck's Black Body Radiation Law



$$PFD \approx \frac{\lambda^{-4}}{e^{\frac{hc}{\lambda kT}} - 1}$$



Solar Irradiance

Lower irradiance at sea level is due to Rayleigh scattering and atomic absorbance (Frauhoffer lines), and absorbance by atmospheric ozone (O_3 —UV wavelengths), and carbon dioxide and water vapor (CO_2 and H_2O —infrared wavelengths)

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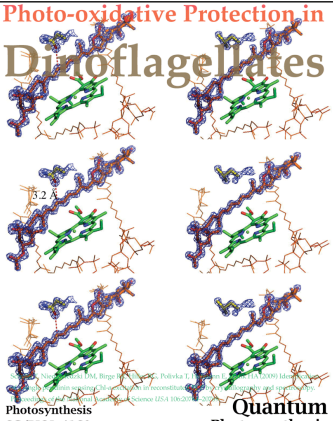
Lucida Photosynthetica

Photo-oxidative Protection in Dinoflagellates



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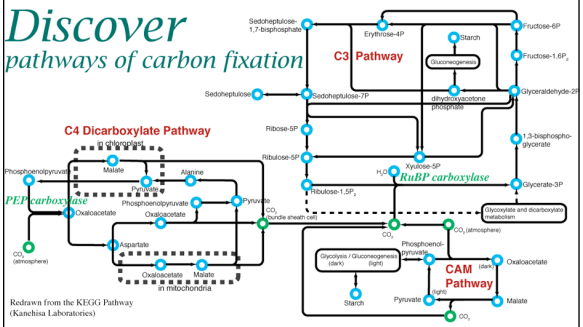
Quantum Photosynthesis

Discover
pathways of carbon fixation



Redrawn from the KEGG Pathway
(Kanehisa Laboratories)

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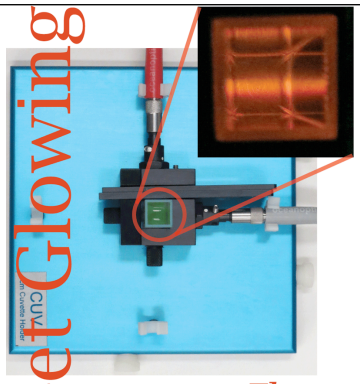
Get Glowing



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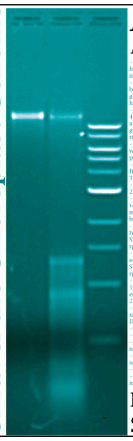
Photosyntheticia

Unravel the Chloroplast Genome



Hereditas
Photosynthetica

- Harvest 10 g of spinach seedlings (kept in dark for 48 hrs to reduce starch levels). Wash under tap water. Cut into 1 cm strips (directly into ice-cold buffer).
- Grind in ice-cold mortar with 20 ml of cold complete buffer for 2–4 minutes. Don't grind excessively; Homogenate should be "chunky" (with some incompletely homogenized material).
- Filter homogenate through 10 µm nylon mesh into a 50 ml Oakridge centrifuge tube. A filter funnel will avoid messes. The material in the nylon mesh can be gently squeezed to release more chloroplasts into the tube.
- Centrifuge for 20 minutes at 1 000 rpm at 4ºC. This will pellet nuclei and cell debris, leaving mostly chloroplasts (intact and broken) in the supernatant.
- Gently pour supernatant into a new Oakridge centrifuge tube and spin at 4 000 rpm for 20 minutes at 4ºC. This will pellet the chloroplasts.
- Discard supernatant and resuspend pellet (gently!) in 200 µl ST buffer.
- Transfer sample to microfuge tube and add equal volume of equilibrated phenol. Shake intensively for 5 minutes, centrifuge 5 minutes at 12 000 rpm. There will be 2 phases, green on bottom and clear on top.
- Transfer the clear upper layer to a new microfuge tube. Add equal volume of 1:1 phenol:chloroform. Shake 5 minutes and centrifuge 5 minutes at 12 000 rpm.
- Transfer upper layer to new microfuge tube and add equal volume of 24:1 chloroform:isoamyl alcohol. Shake 5 minutes and centrifuge 5 minutes at 12 000 rpm.
- Transfer upper layer to new microfuge tube and add 1/10th the volume of 5 M ammonium acetate and an equal volume of isopropanol. Store at -20ºC for at least 2 hours. (Until next lab session).
- Centrifuge 5 minutes at 12 000 rpm. Discard supernatant. You may see a small white pellet (this is the DNA).
- Resuspend pellet in 200 µl of 70% ethanol.
- Centrifuge 5 minutes at 12 000 rpm.
- Discard supernatant and air-dry the pellet, ensuring no ethanol remains in the tube.
- Resuspend pellet in 10 µl TE buffer. This is your DNA sample!
- Mix 5 µl of DNA sample with 1 µl of 6X loading buffer.
- Run sample on 1% agarose gel at 100 Volts for ~45 minutes.

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Create Oxygen

Aerobica
Photosyntheticium

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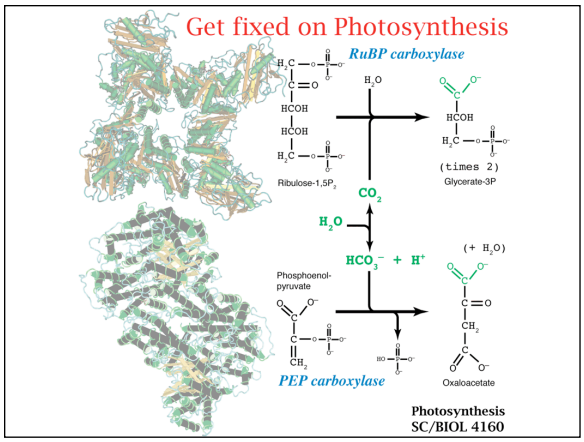

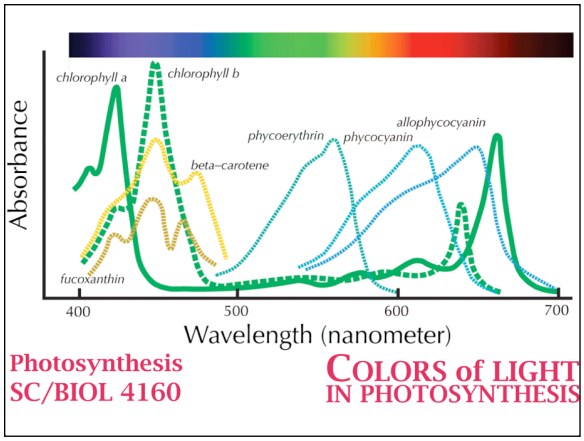

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Photosynthesis

artwork by Michael Hagelberg