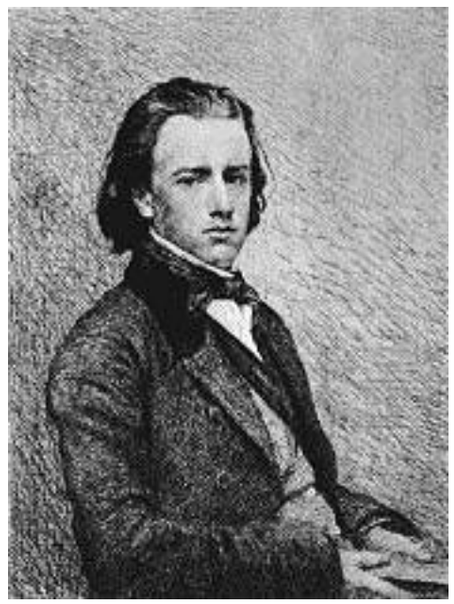
The fuel in the earth will be exhausted in a thousand or more years, and its mineral wealth, but man will find substitutes for these in the winds, the waves, the sun's heat, and so forth.

John Burroughs, 1916



Arizona State University
SES 194

Energy in Everyday Life

Photosynthesis and Respiration

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Many reactions in the human body are of a slow burning kind.

Enzymes can catalyze specific reactions, allowing them to occur rapidly.

As with any catalyst, reactions cannot be made to happen that could not have occurred otherwise; the catalysts merely hastens them.

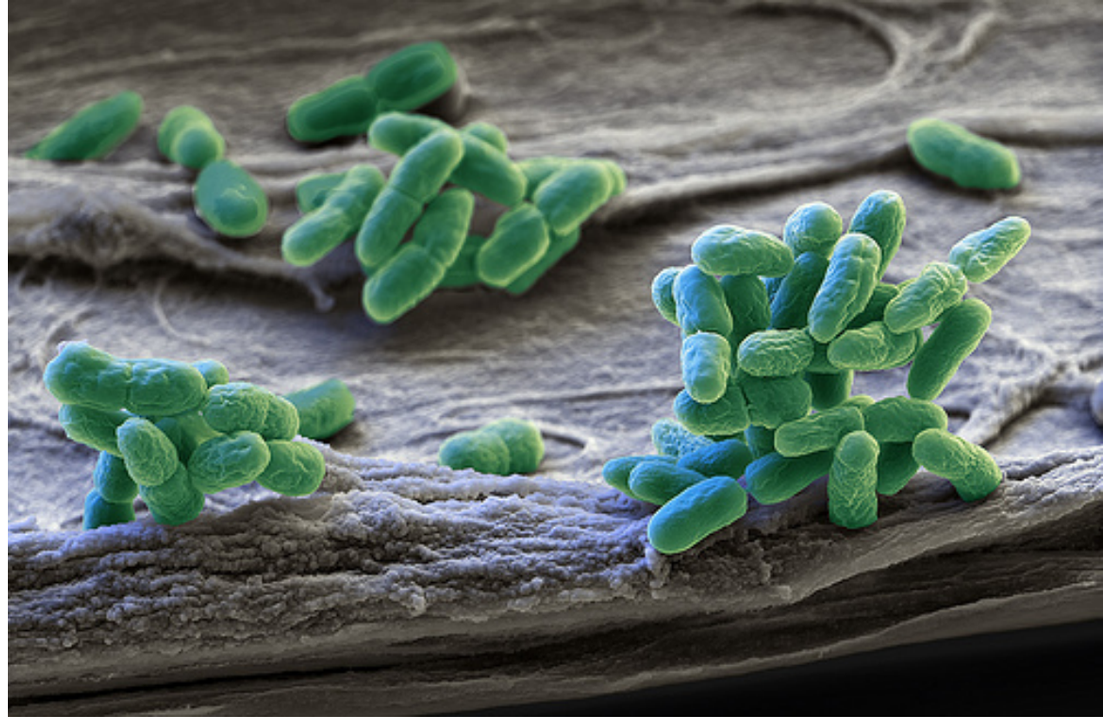
The body of an animal mines the energy deposited in plant cells by the Sun.

Energy carrying sunlight is absorbed by chlorophyll in plants and allows an endothermic reaction of water and carbon dioxide to take place.

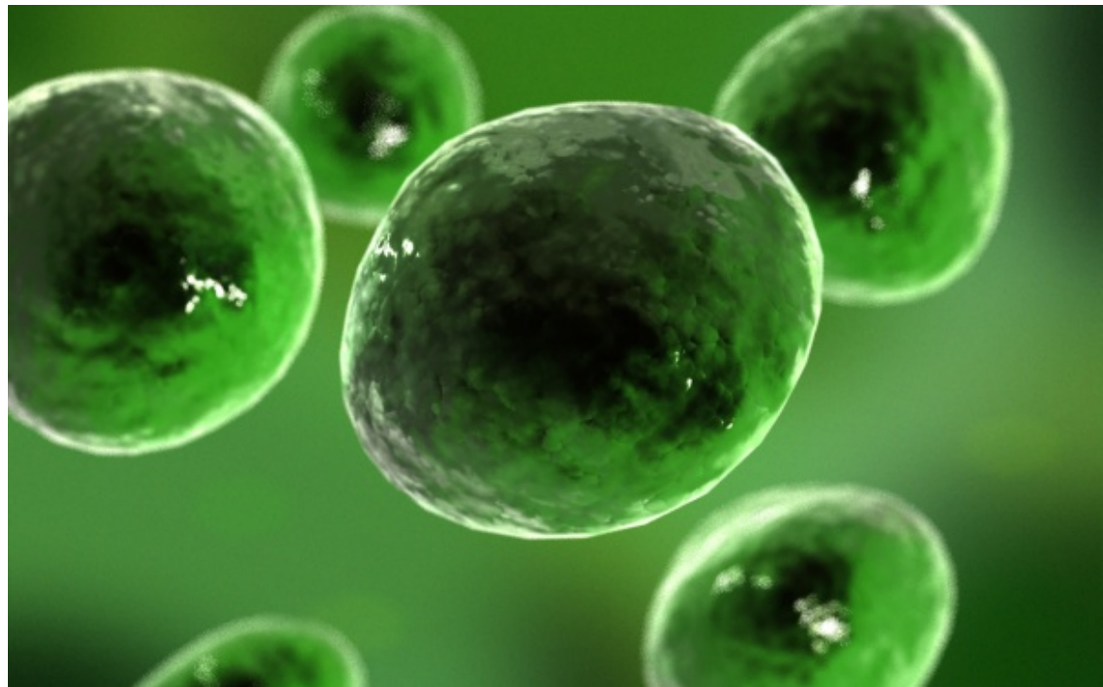
Carbon dioxide and water form glucose, a sugar, which stores much of the energy. Overall, photosynthesis is

$$6CO_2 + 6H_2O + \text{radiant energy} \rightarrow C_6H_{12}O_6 + 6O_2$$

The simplest organisms that photosynthesize are cynobacteria (blue-green algae).



Other algae and the higher plants also photosynthesize. A green plant cell can produce up to 30 times its volume of oxygen each hour.



In photosynthesis an energy of about 6.2 kJ/kg is stored as chemical energy - the sugars - in plants.

The reverse of photosynthesis, respiration, is used by animals to utilize the food they eat:

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

Note that the six carbon dioxide molecules locked up in photosynthesis have been released by the animals in combination of the sugar with oxygen.

Many millions of years ago, plants in swamps used photosynthesis to produce stored energy.

Some of the plant life fell into the muck, making the swamps into a peat bog.

Geologic processes laid sediment over the peat.

The biological action, the heat from inside the Earth, and the pressure of the overlying sediment (turned to rock) resulted in the formation of a coal deposit.

Aconi Seam

Coal is stored solar energy. A similar process, involving other kinds of organic material, leads to the formation of oil and gas deposits ; they too are stored solar energy.

Coal and oil resources for 50 - 100 million years from now are currently being formed on Earth. These are renewable resources, but on timescales somewhat long for humanity.

Wood, plants, and ocean algae form a much shorter timescale reservoir of stored solar energy, and animals tap this energy reservoir to sustain their daily existence.