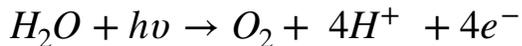


## Free Oxygen [O<sub>2</sub>] Chemistry

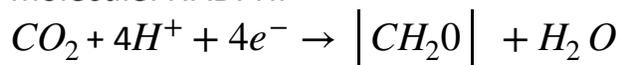


### Photosynthesis

With the aid of plants, Solar photon energy splits water molecules into free oxygen, protons (hydrogen ions) and energetic electrons.



On the dark side, the Calvin reaction adds CO<sub>2</sub> to create carbohydrate based molecules with entrapped energy. The electrons are transported by a special molecule: NADPH.



Finally it's O<sub>2</sub> added to the air and carbohydrate molecules in a plant.

The earth's atmosphere is 21% O<sub>2</sub> from past and current photosynthesis.

Today O<sub>2</sub> delivers energy for biological and industrial human needs.



### Respiration

Animals, and plants respire; their cells act to react O<sub>2</sub> with carbohydrate molecules (food) to release the energy needed to function. Humans breathe with lungs to capture O<sub>2</sub> into blood streams.

Glucose (sugar): [carbohydrate]



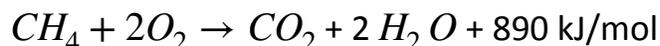
### Combustion

Photosynthesis molecules end up as complex organic matter like wood and methane. Over the ages, plant organic matter degenerates into fossil fuels. Oxidation releases some electron binding energy as heat.

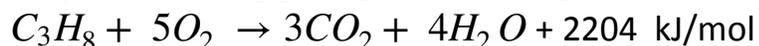
Coal: [just carbon]



Methane (natural gas): [hydrocarbon]



Propane (heating gas): [hydrocarbon]



Octane (gasoline): [hydrocarbon]



Note: For hydrocarbons, combustion heat is ~ 440 kJ/mol per O<sub>2</sub> mole.

1calorie = 4.18 joules, 1mol = 6.02 x 10<sup>23</sup> molecules