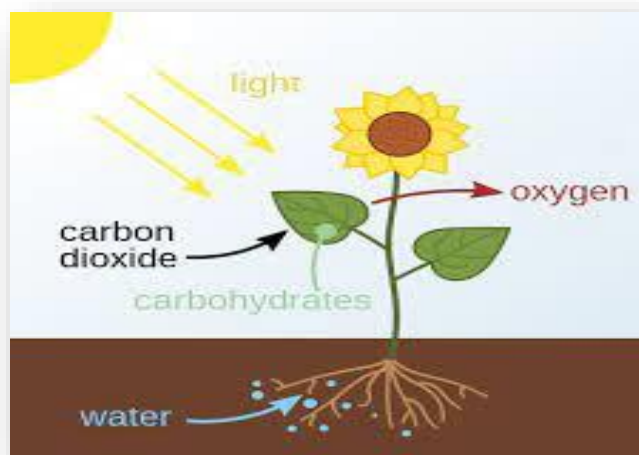
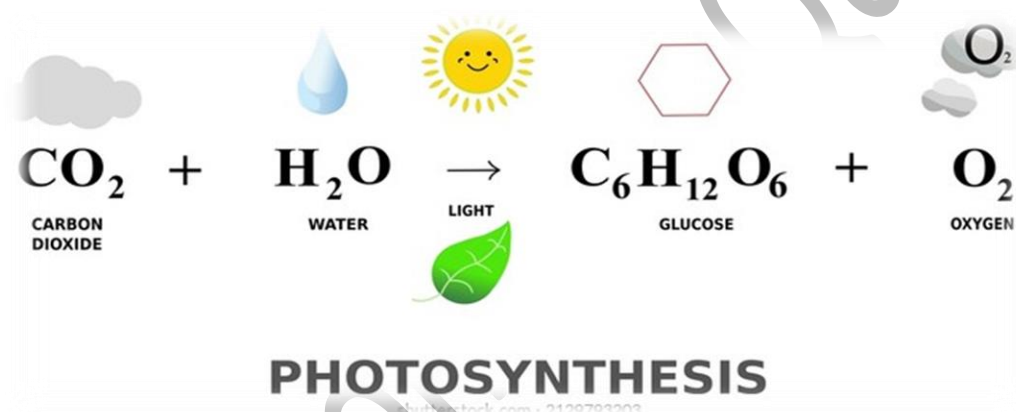


## Natural and Artificial Photosynthesis

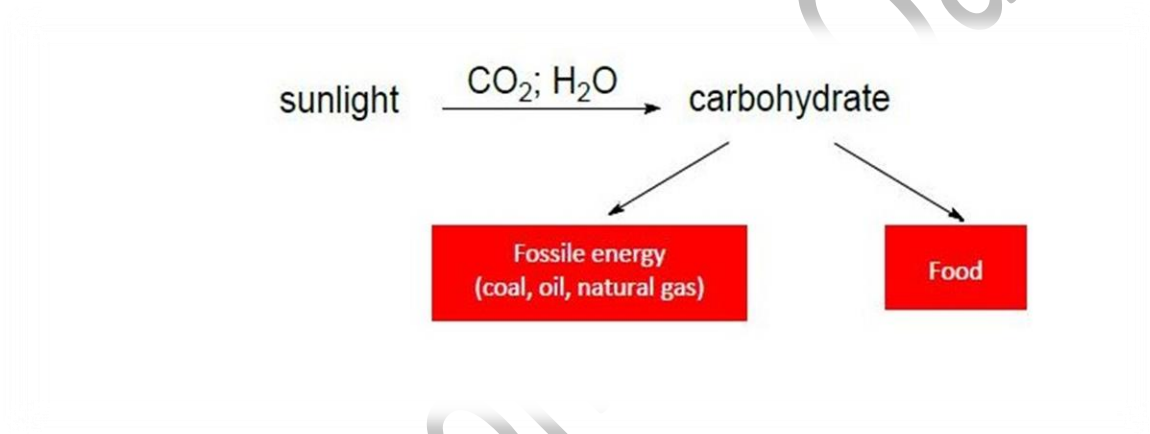
### Natural photosynthetic

the process essentially consists in the splitting of water by sunlight into oxygen, which is released into the atmosphere, and “hydrogen,” which is not released in the atmosphere but instead is combined with carbon dioxide to produce organic compounds of various types.



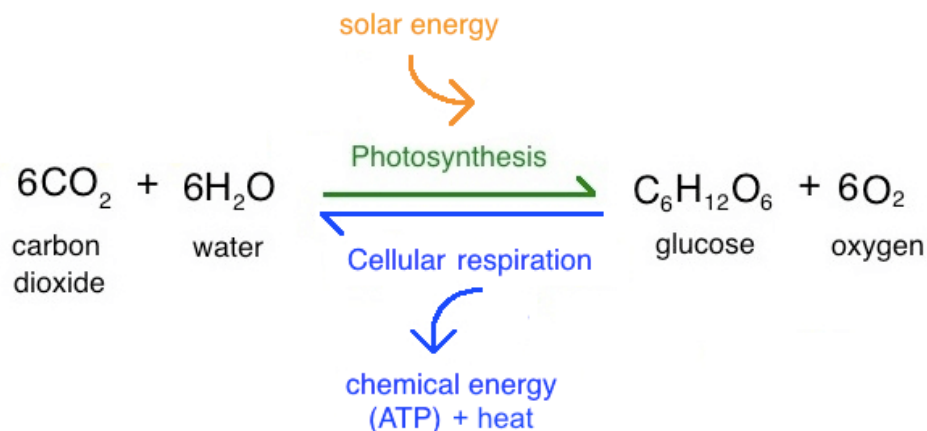
**Notes:**

- 1- In Natural photosynthesis the Chlorophyll acts as a catalyst absorbing and transferring the photon energy for reduction of carbon dioxide to carbohydrate).
2. This reaction maintains the life on the Earth:



**The burning of these organic compounds with the oxygen either by:**

- 1- Cellular respiration (food) to produce adenosine triphosphate (ATP), which is the form of energy that the body can use.
- 2- Combustion process (fossil fuels, wood, and biomass) to form the original compounds (water and carbon dioxide) and releases the stored energy that originated from sunlight.



while Artificial photosynthesis is the carries out a similar function to natural photosynthesis, whether the product be electricity or a fuel.

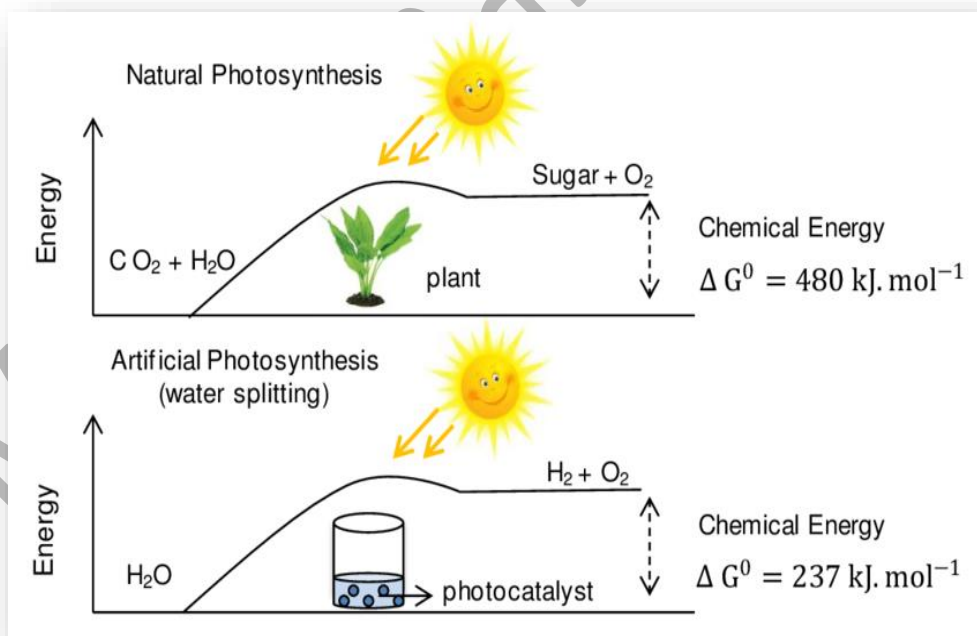


Fig. (12): A schematic explaining the natural and artificial photosynthesis

**Artificial photosynthesis** is a promising strategy for moving from fossil fuels to a climate-neutral supply of green fuels and basic chemicals.

Currently, different versions of artificial photosynthesis are investigated worldwide.

They focus especially on the photocatalytic production of hydrogen from water oxidation or the reduction of carbon dioxide to energy carriers and chemicals such as hydrogen, alcohols and hydrocarbons,

Due to the fact that both processes do not run without supplying great amounts of energy, the main challenge is to develop integrated apparatus and plants capable to use exclusively sunlight as energy source.

**The system of artificial photosynthesis includes:**

- 1- Light absorption.
- 2- Charge separation (with dye molecules and semiconducting materials).
- 3- Oxidation of water.
- 4- Conversion precursors (hydrogen ions and carbon dioxide) into energy carriers and basic chemicals.

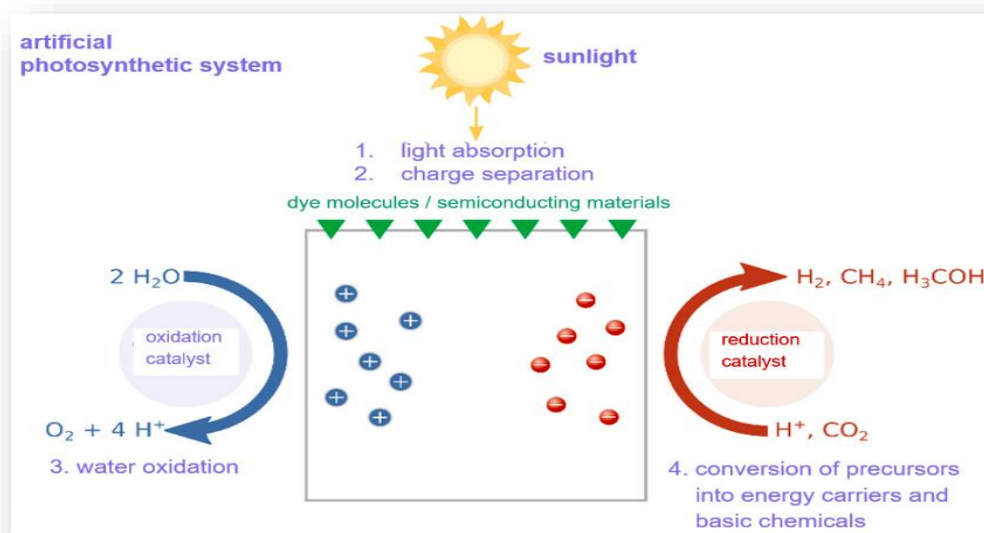


Fig. (13): A schematic explaining the artificial photosynthesis system

**Photocatalytic water splitting** is a process that uses photocatalysis for the dissociation of water ( $\text{H}_2\text{O}$ ) into hydrogen ( $\text{H}_2$ ) and oxygen ( $\text{O}_2$ ). Only are needed **(light energy (photons), water, and a catalyst)**.

### Why is Artificial Photosynthesis Important?

Use of fossil fuels has resulted in the greenhouse effect (global warming), As a result of accumulation of  $\text{CO}_2$  in the earth's atmosphere.

These fossil fuels and the cheap energy that they have contributed have powered the industrial development of the last two centuries, but global warming is a real directly linked to increasing carbon dioxide in atmospheric and fossil fuel resources are finite and artificial photosynthesis represents one possible solution to the problems of global warming.

The concept of artificial Photosynthesis is to mimic the light (photon collection) and energy conversion and CO<sub>2</sub> capture that produced from processes of natural photosynthesis.

### **What are the advantages of artificial photosynthesis?**

The main benefit of artificial photosynthesis is to

- 1- produce a hydrogen fuel that will be energy efficient and carbon neutral.
- 2- renewable source of energy which can be used for transportation.
- 3- It will not add any greenhouse gases into the atmosphere .... all using solar energy.

**The artificial photosynthetic technologies could prove especially important because.**

- 1- their implementation will reduce our greenhouse gas emissions and requirements water.
- 2- reduce or even eliminate use of fossil fuels.

### **What are the disadvantages of artificial photosynthesis?**

- 1- Materials used for artificial photosynthesis often corrode in water,
- 2- less stable than photovoltaics over long periods of time.
- 3- Most hydrogen catalysts are very sensitive to oxygen, being inactivated or degraded in its presence.

### Photocatalytic Generation of Hydrogen

Hydrogen is the fuel with the highest mass-related energy storage density. It amounts to 33 kWh/ kg and is thus twice as high as that of the fossil fuels petrol (12,5 kWh/kg), diesel (12 kWh/kg) and methane (14 kWh/kg).

Uses of hydrogen as an energy carrier and basic chemical, hydrogen technology is being promoted as a promising future scenario. However, its success depends on the extent to which “green hydrogen” can be produced in industrial quantities not at the expense of fossil fuels, as it is the case today, but exclusively using sustainable energy sources (sunlight energy).

A promising option is the direct photocatalytic production of hydrogen from water using solar light. This is possible according to the processes of artificial photosynthesis outlined.

إِعمل بجد في صَمْت؛  
وَدَعِ النِّجَاحَ يُحَدِّثُ الضَّجِيجَ.  
“Work hard in silence,  
let success make the  
noise.”