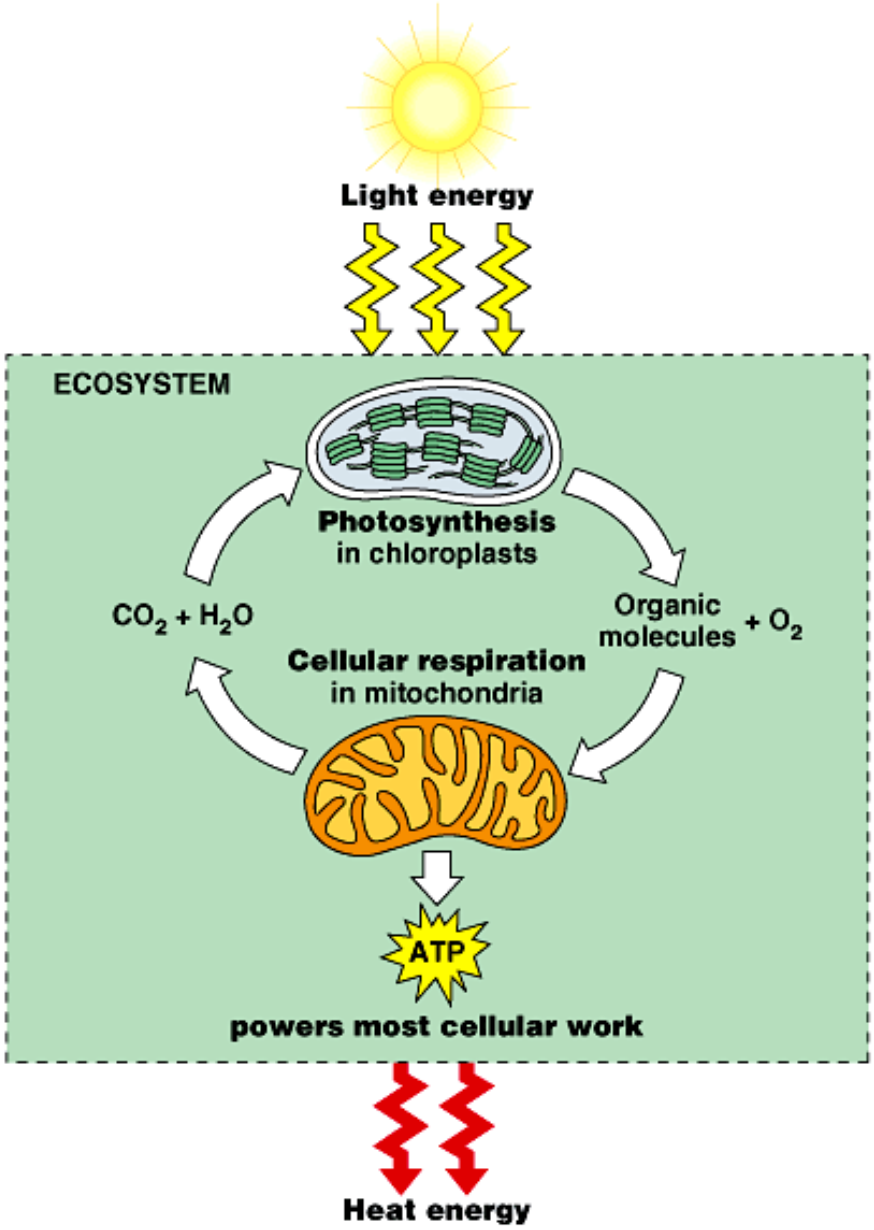
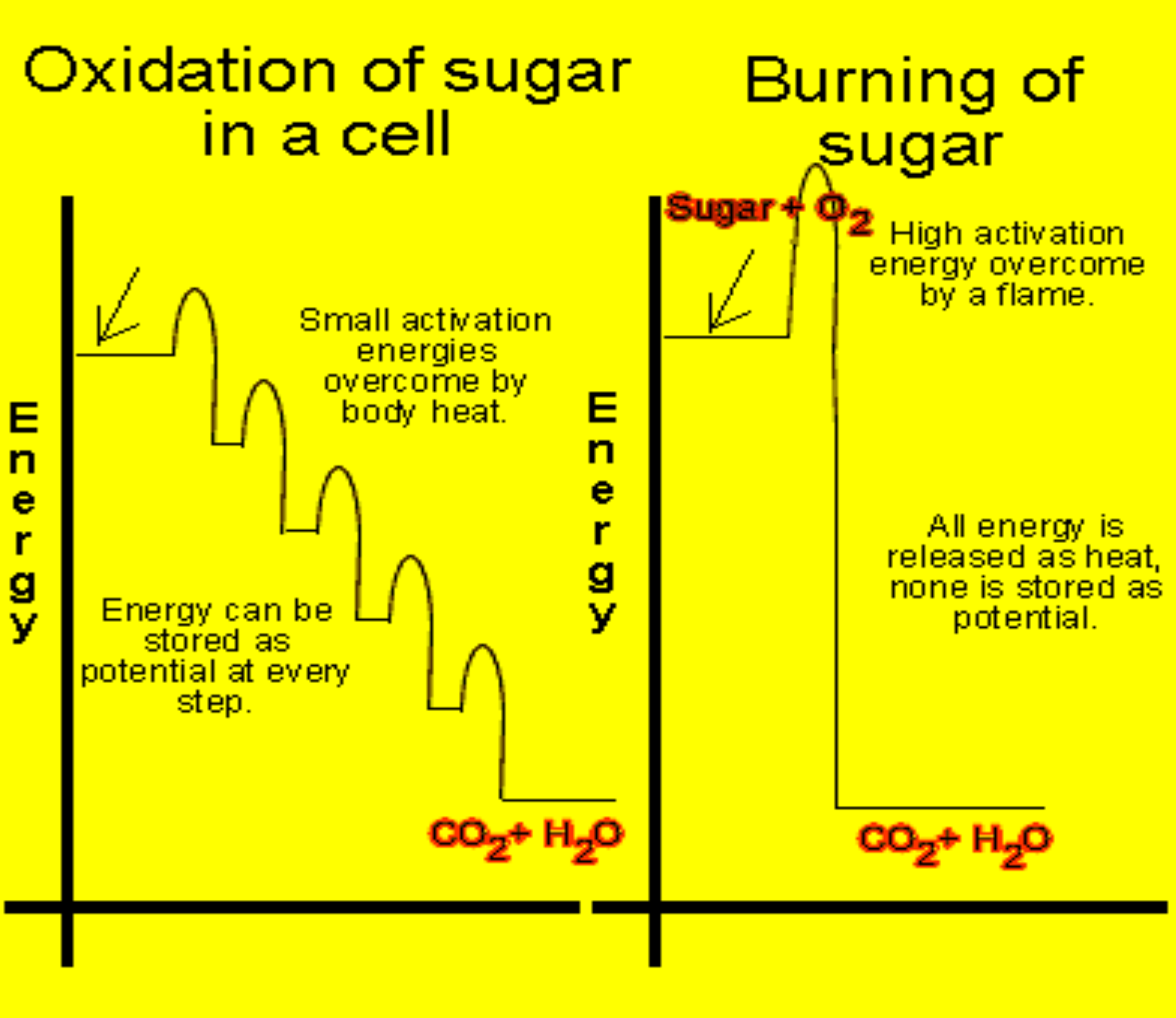
Cellular Respiration

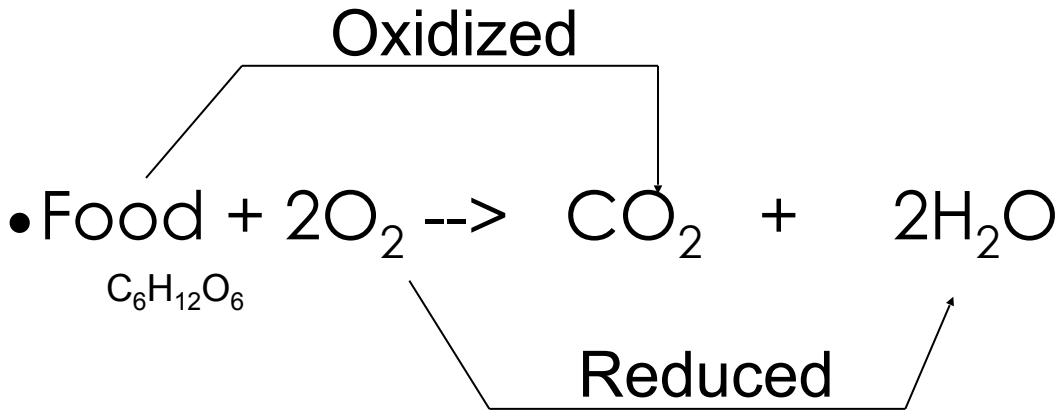



Oxidation of sugar in a cell
Energy
Small activation energies overcome by body heat.
Energy can be stored as potential at every step.
$CO_2 + H_2O$
Burning of sugar
Energy
$Sugar + O_2$
High activation energy overcome by a flame.
All energy is released as heat, none is stored as potential.
$CO_2 + H_2O$

During Cellular Respiration…

- Glucose is oxidized (OIL). Oxygen is reduced (RIG).
- Combustion of glucose releases a large amount of thermal energy
- However, in cells oxidation of glucose occurs in a series of steps (controlled oxidation by enzymes) to minimize energy loss

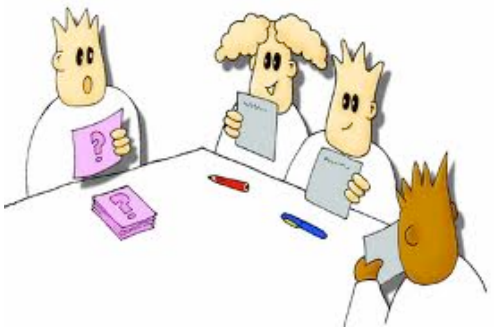
Energy Changes during Oxidation



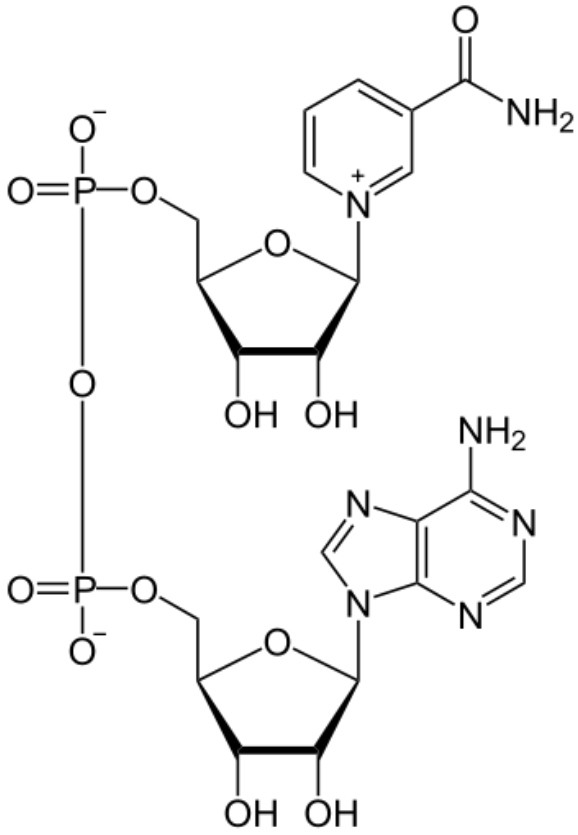
- C in food is effectively oxidized, O is reduced

(When food dismantled in cellular respiration, its bonds will lose electrons that carry energy, and oxygen will gain these electrons. During this process there is a release of energy that will produce ATP)

Energy Carrier : NAD^+
(Co-enzymes)

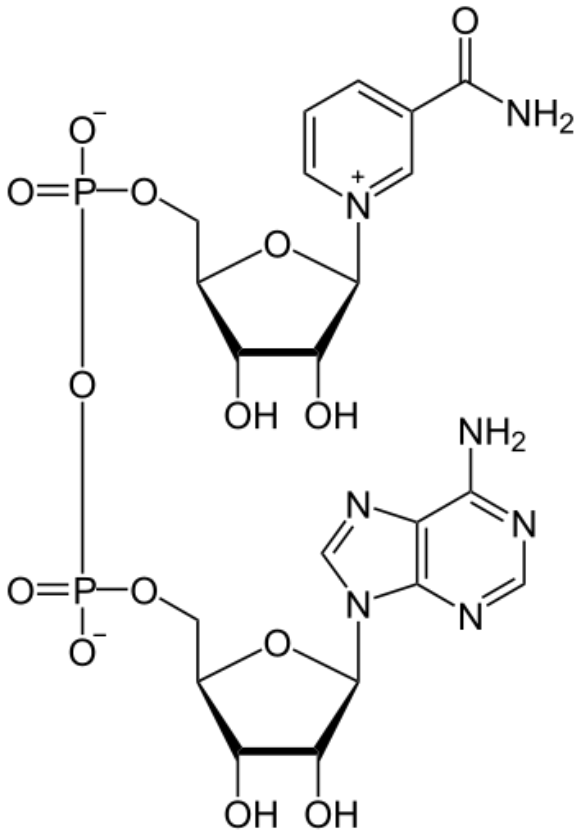


How is NAD+ like ATP?

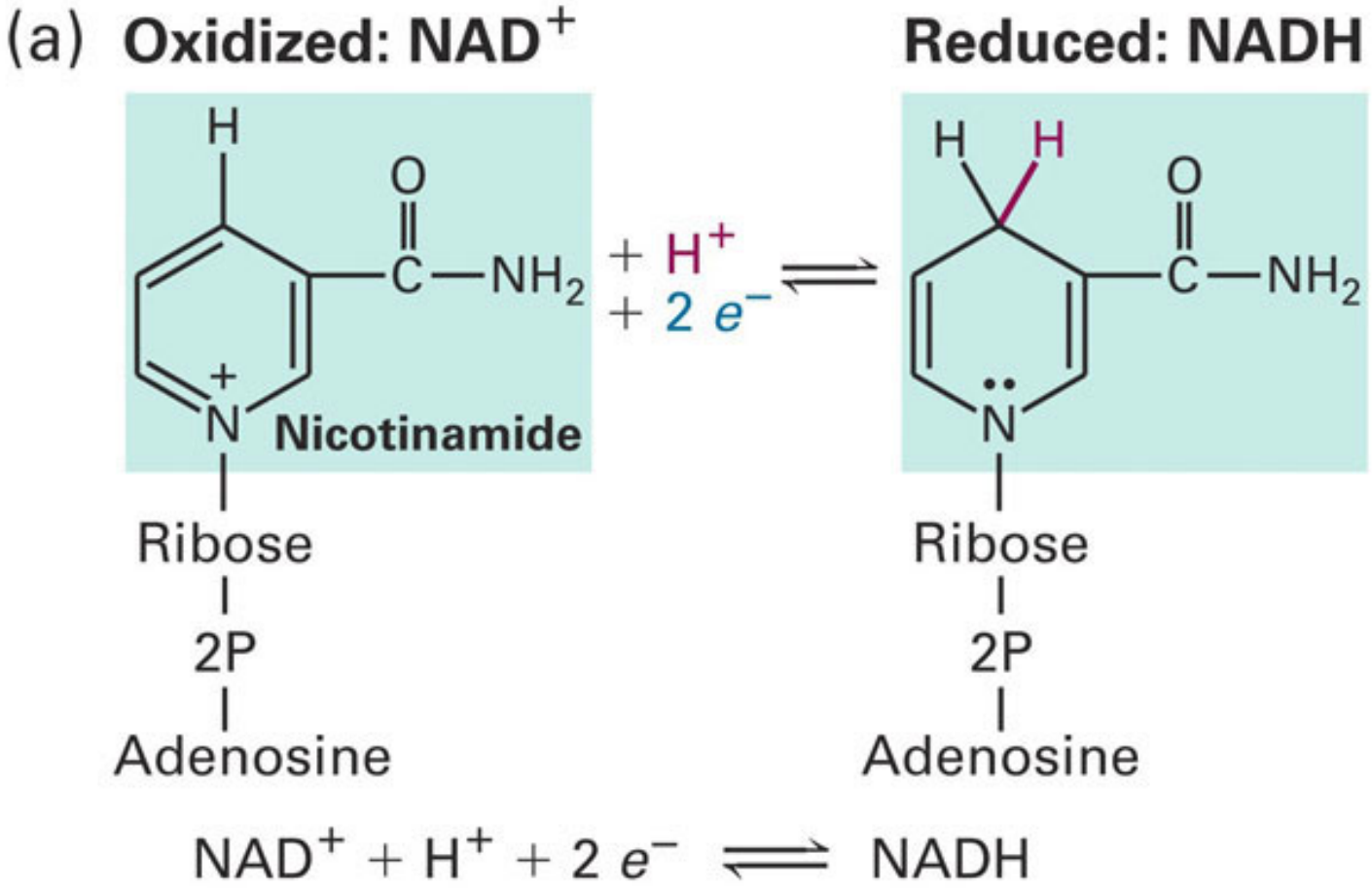


Energy Carrier : NAD^+
(Co-enzymes)

- NAD+ (nicotinamide adenine dinucleotide) is a co-enzyme found in all living cells
- Captures free energy released in cellular reactions (held in 2 high energy electrons and 1 H^+)
- vitamin B_3 (niacin) derivative
- Catalyzed by dehydrogenase which facilities the transfer of electrons

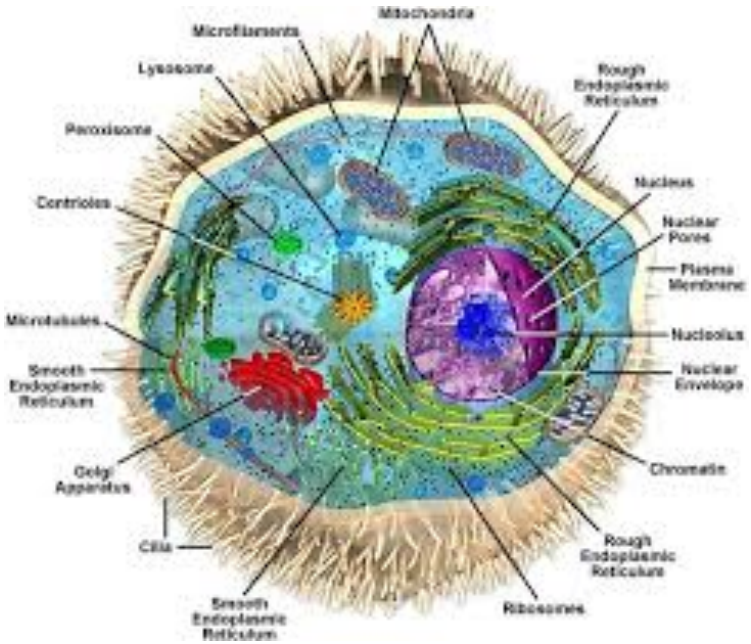


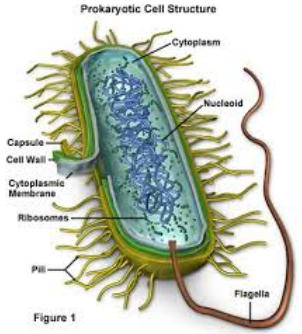
Reduction of NAD+

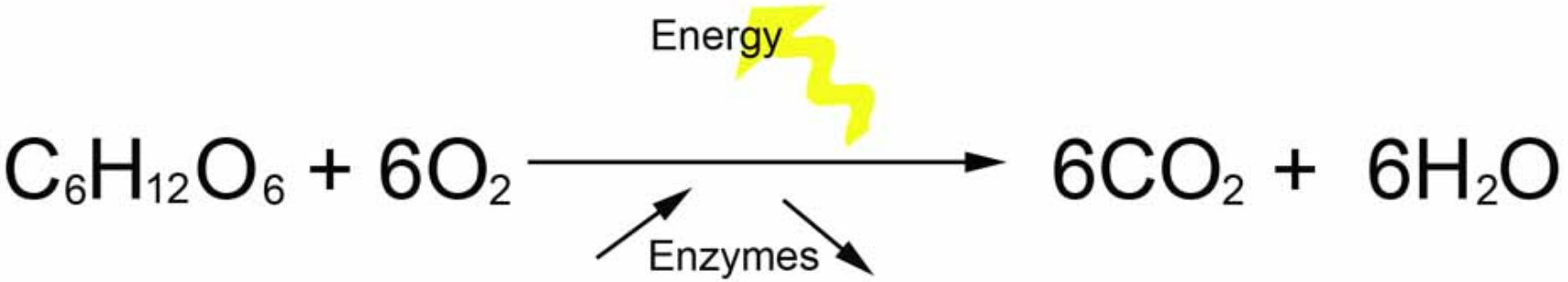


Aerobic Cellular Respiration

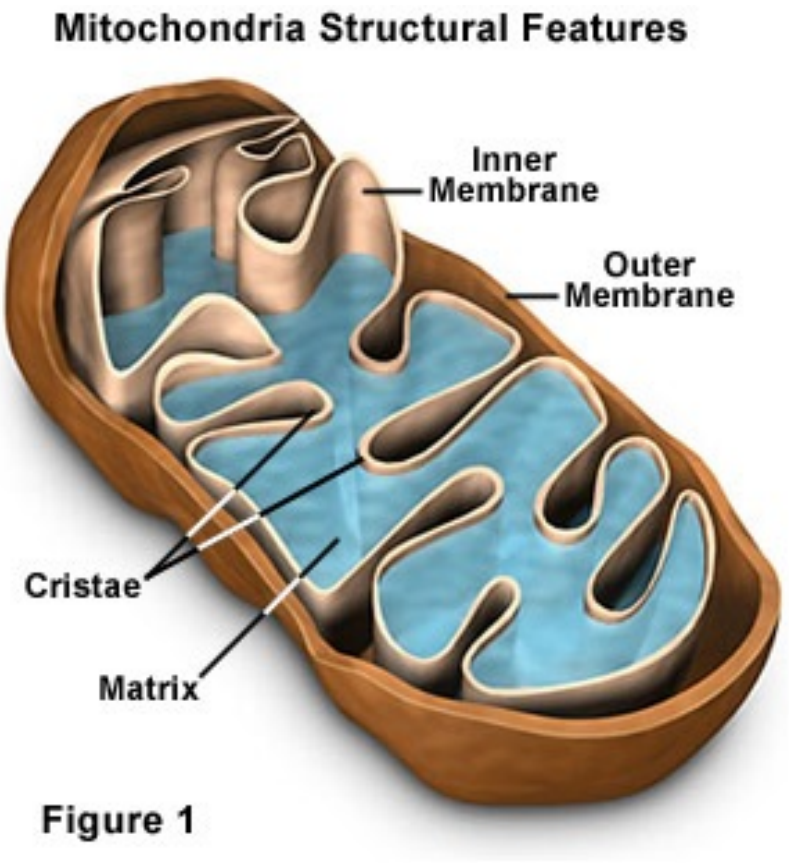
- extracts energy from food in the presence of oxygen
- energy is used to synthesize ATP from ADP and P_i
- eukaryotes & **prokaryotes that are obligate aerobes undergo Cellular respiration**






Energy
C6H12O6 + 6O2
6CO2 + 6H2O
Enzymes

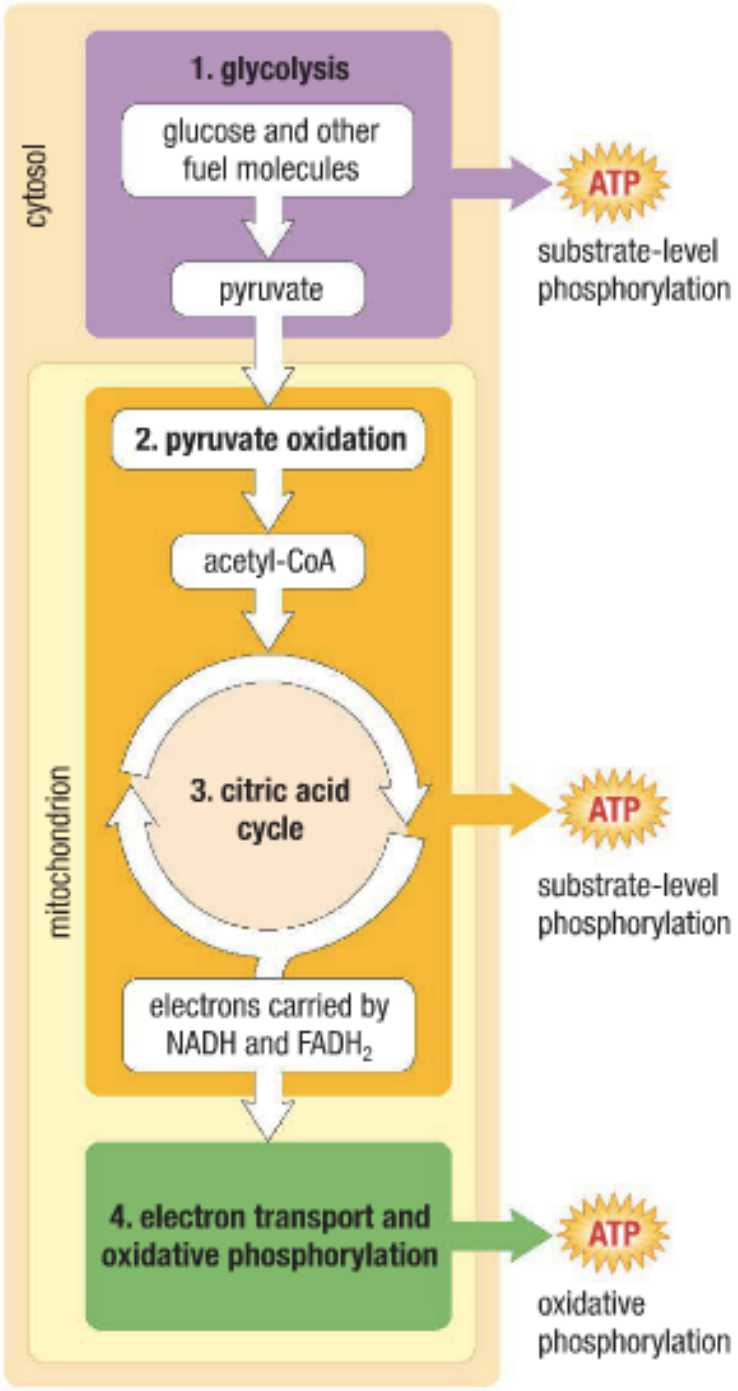
“The Powerhouse”



Aerobic Cellular Respiration

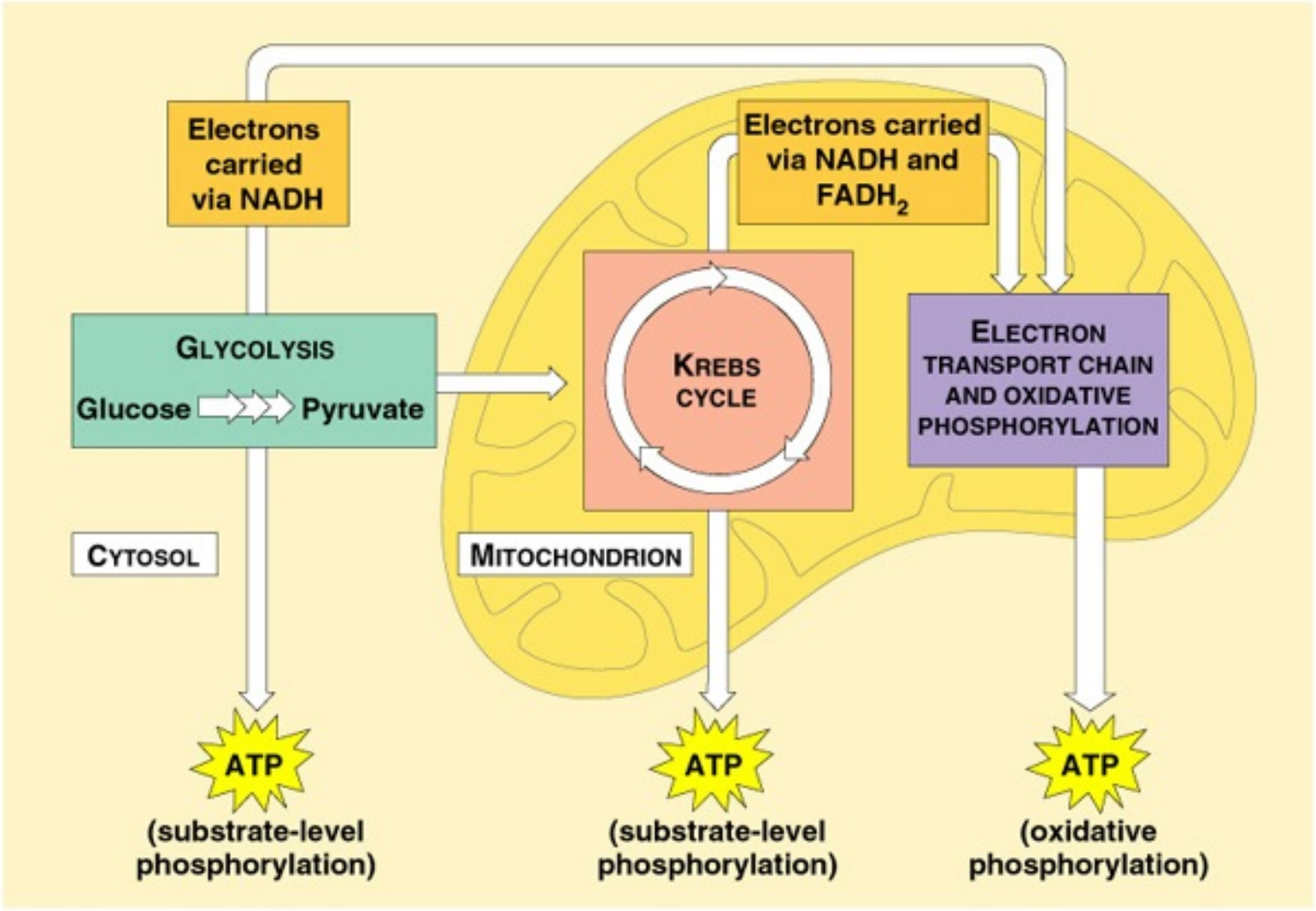
4 stages:

1. **Glycolysis**
2. *Pyruvate oxidation (Transition stage)*
3. **Citric acid cycle (KREBS)**
4. **Electron transport Chain & oxidative phosphorylation**



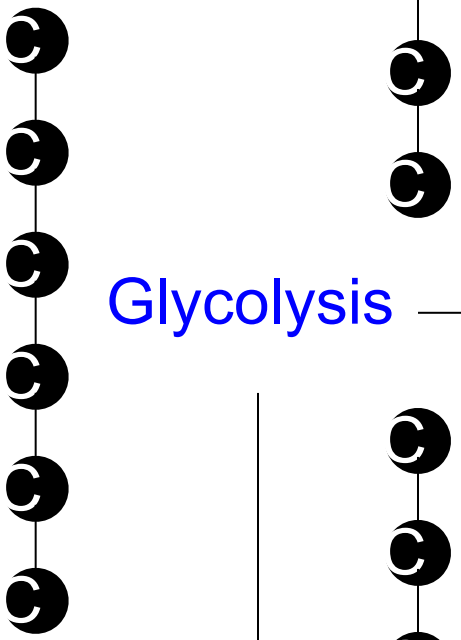
Note the graphic on the next slide and consider:

- *Make note of where each stage of CR takes place. You may want to add that information to your diagram of the mitochondria.*
- *At what stage of Cellular Respiration is most of the ATP made?*



http://www.sumanasinc.com/webcontent/animations/content/cellularrespiration.swf

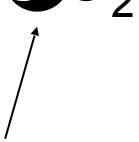
6 Carbons
Glucose sugar



Glycolysis

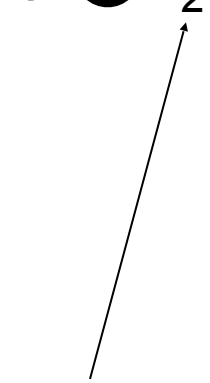
2 ATP

Pyruvate oxidation



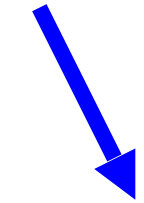
2 CO_2

Citric Acid Cycle



4 CO_2

2 ATP



$6O_2$

Electron Transport Chain

$6H_2O$

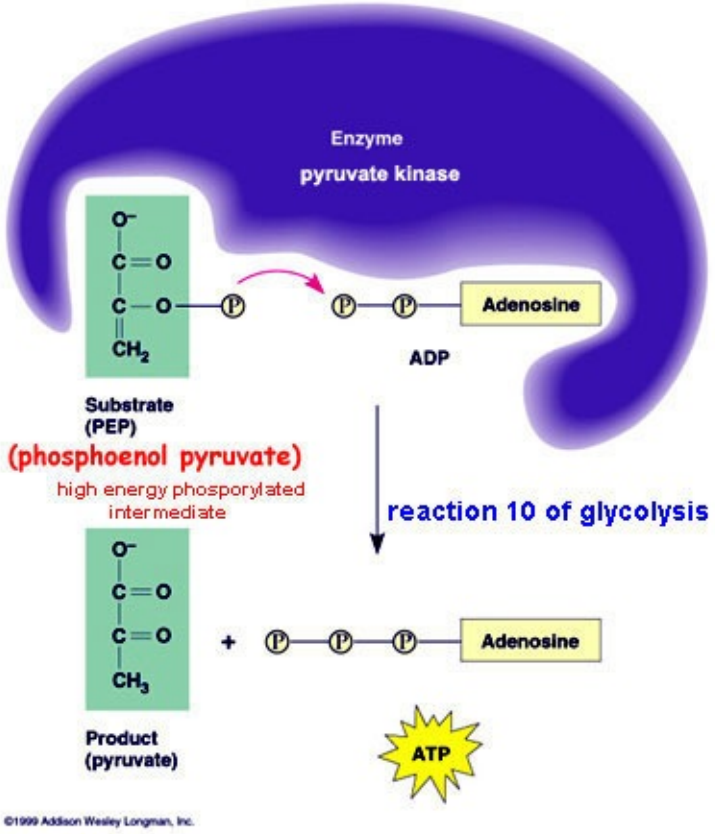
(34) ATP

ATP can be produced in two ways:

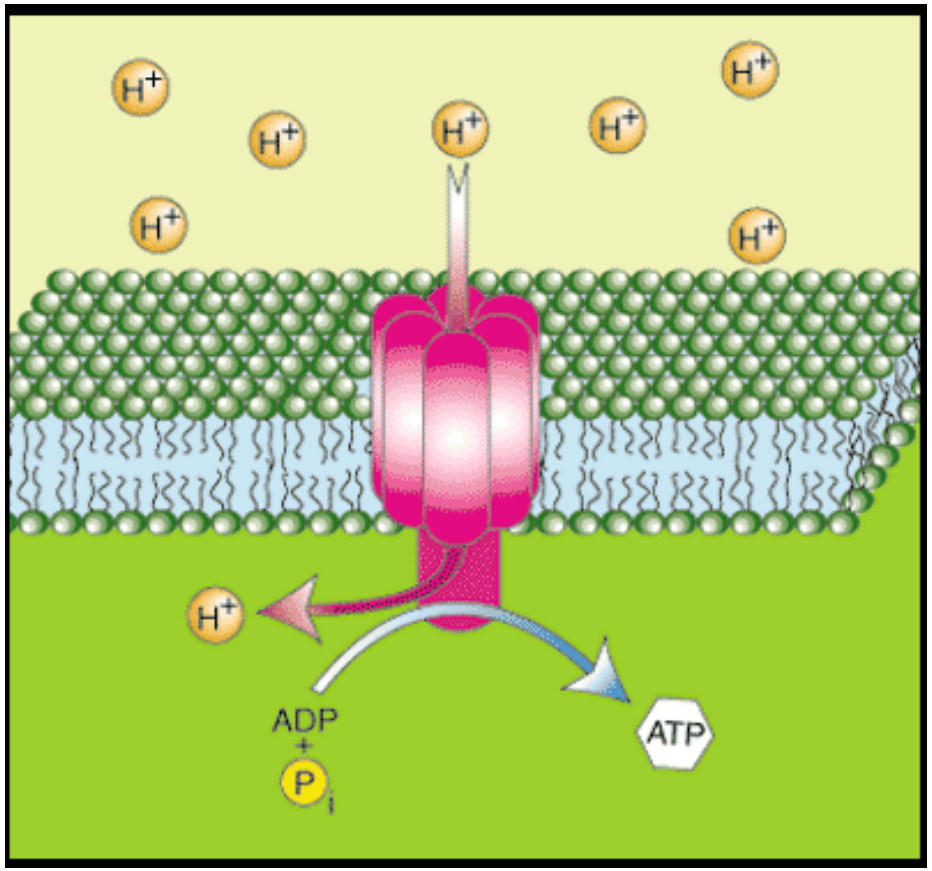
1. **Substrate-level phosphorylation**

- *catalyzed by a kinase*

- phosphate is transferred directly from a substrate

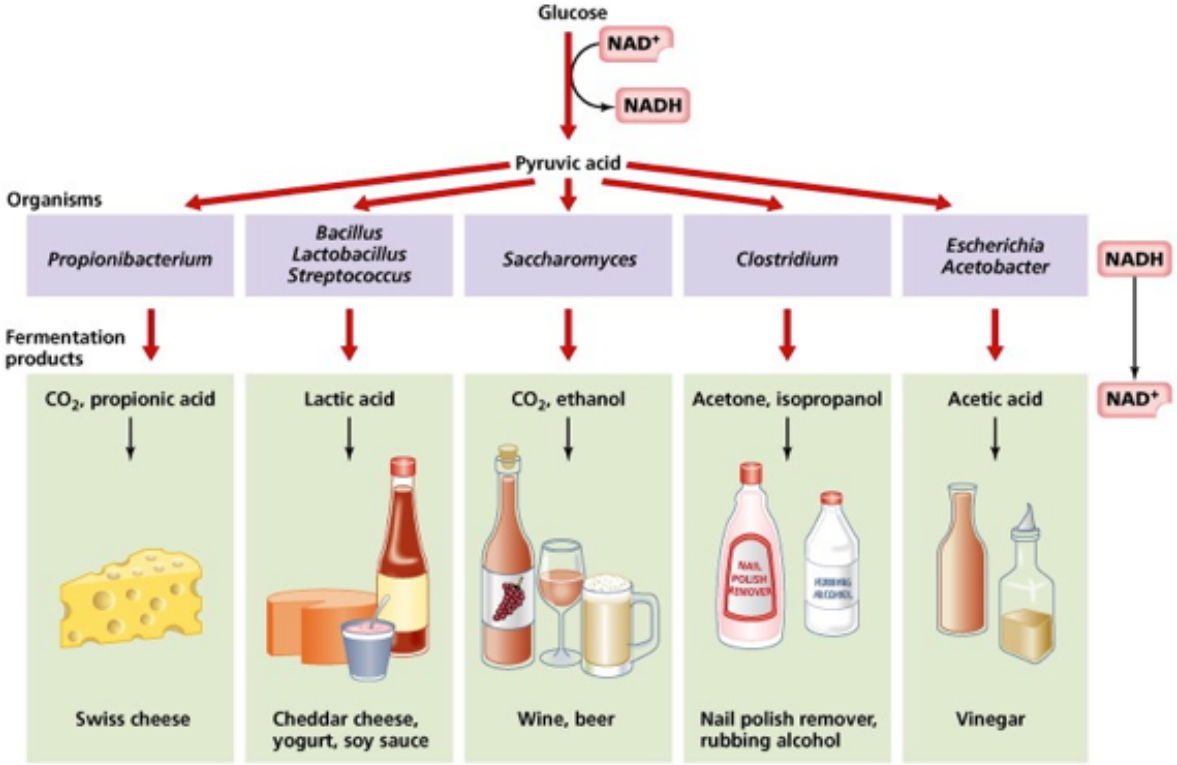


2. **Oxidative phosphorylation- process uses energy transferred indirectly from a series of reactions involving electron transfers**



What if there is no O_2?

- many organisms can extract energy from food without using oxygen using **anaerobic respiration** and **fermentation**
- much lower amount of energy release in anaerobic pathways



Classwork/Homework