

Chapter 7: Respiration

In: O_2
Out: CO_2



breathe
for
mitochondria

Cellular
Respiration

Reactants
Glucose + O_2
 $C_6H_{12}O_6$

$6CO_2 + 6H_2O$
Products
Out

In open systems, cells require E to perform work (chemical, transport, mechanical)

E flows into ecosystem as Sunlight

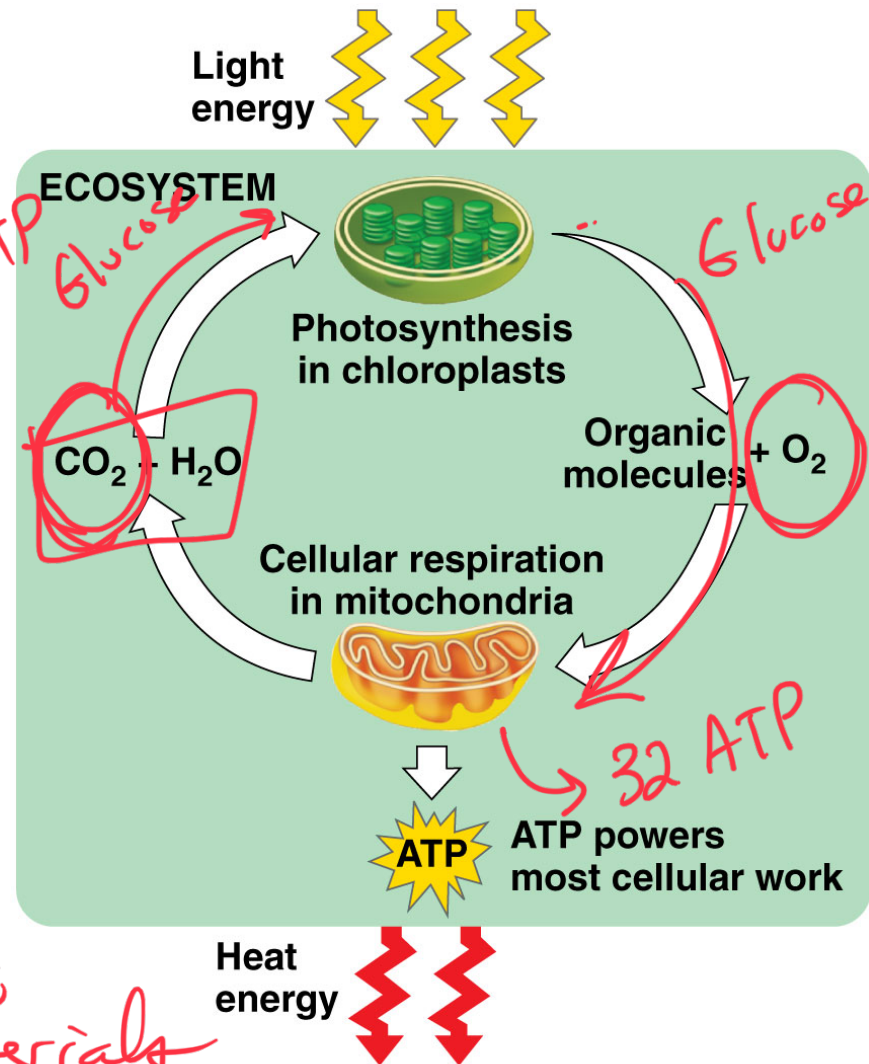
Autotrophs transform it into chemical E

O₂ released as byproduct

Cells use some of chemical E in organic molecules to make ATP

E leaves as heat

Carbon-fixation cycle
How carbon is introduced into organic materials





Exergonic $-\Delta G$

spontaneous

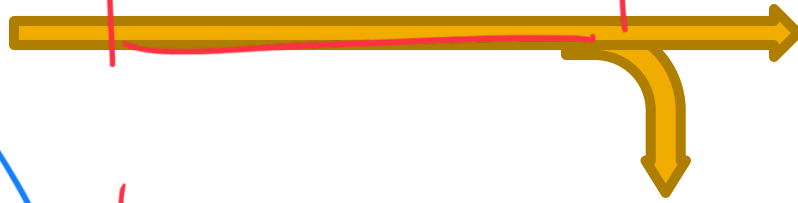
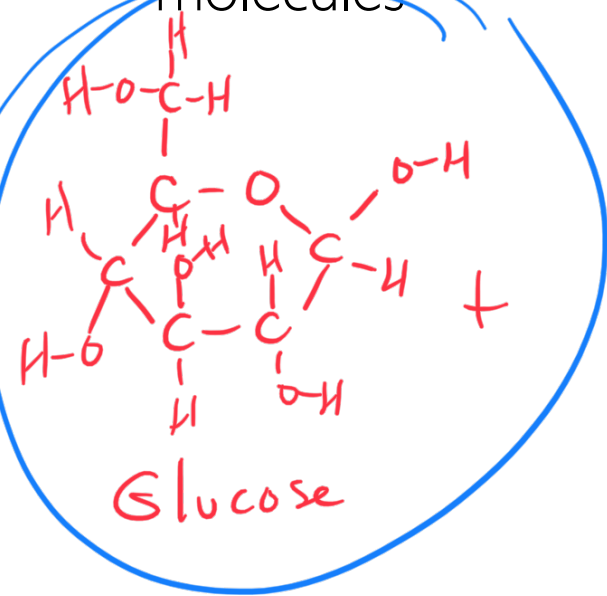


energy releasing

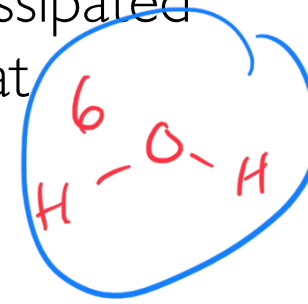
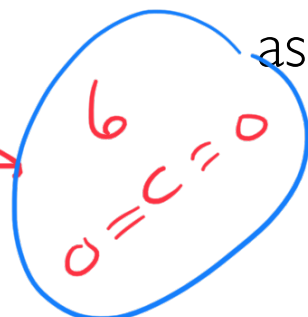
Catabolic Pathway

Simpler waste products with less E

Complex organic molecules

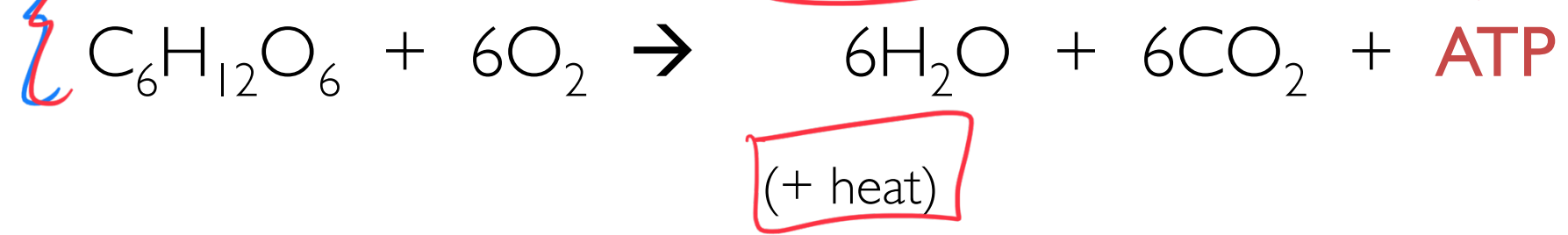


Some E used to do work and dissipated as heat



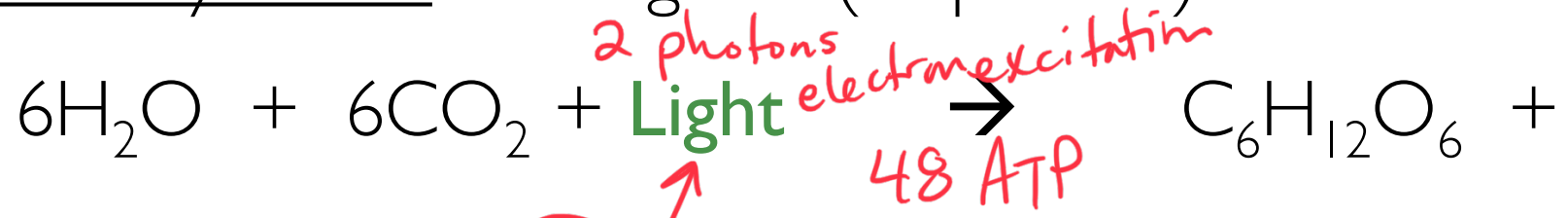
Energy + 32 ATP

Respiration: exergonic (releases E)



Reverse of cellular respiration

Photosynthesis: endergonic (requires E)



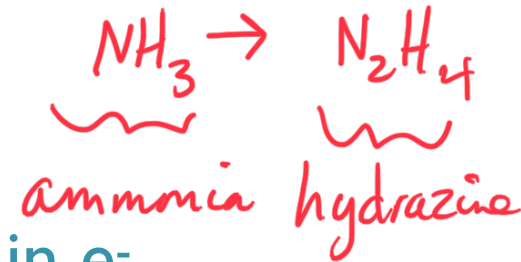
Redox Reactions (oxidation-reduction)

*Reduction
increases
energy*

oxidation (donor) lose e⁻



reduction (acceptor) gain e⁻



- Oxidation ^{is} = lose e⁻
- Reduction ^{is} = gain e⁻

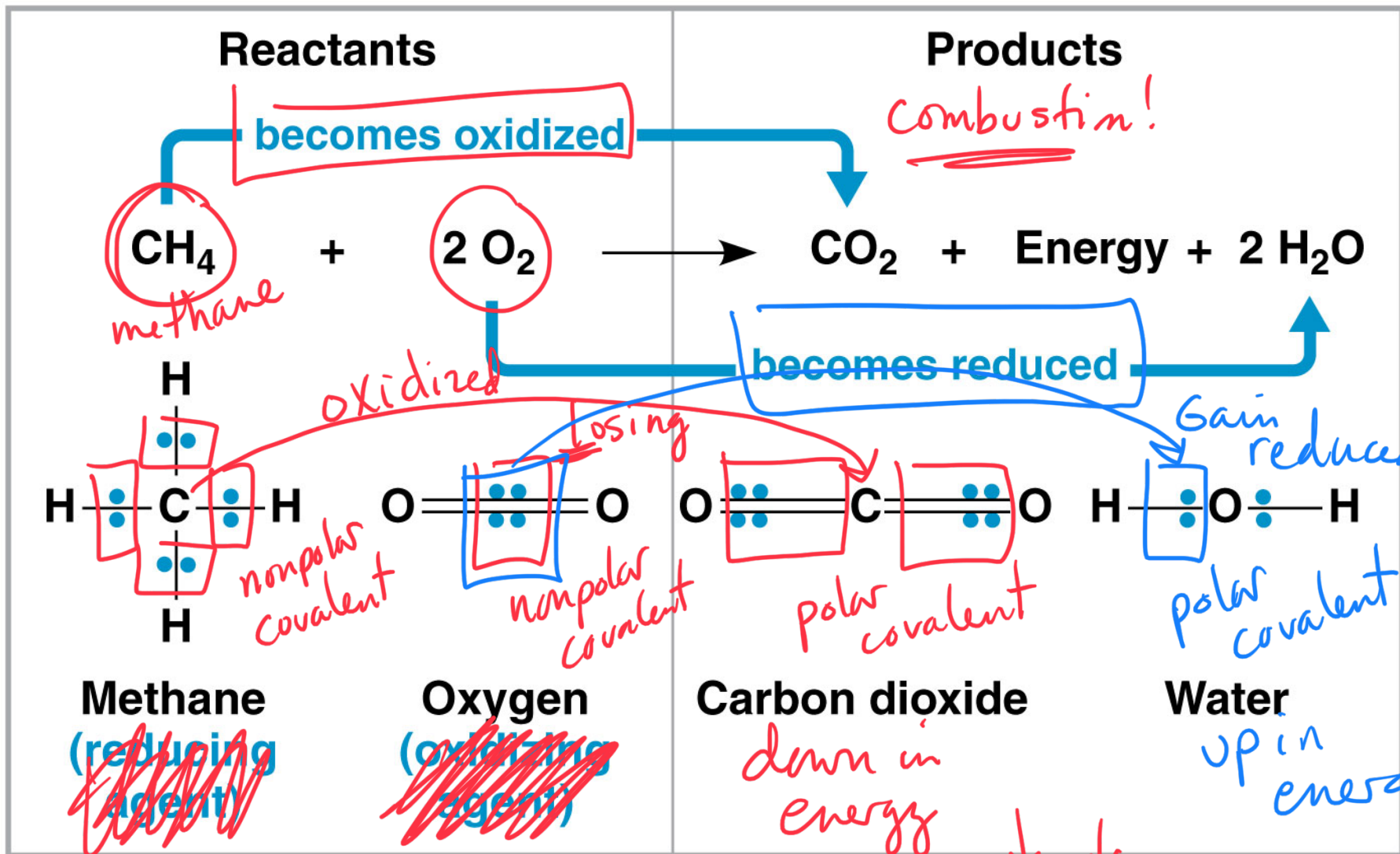
OILRIG or ~~LeOGeR~~

oxidation



reduction





OIL RIG

Energy Harvest

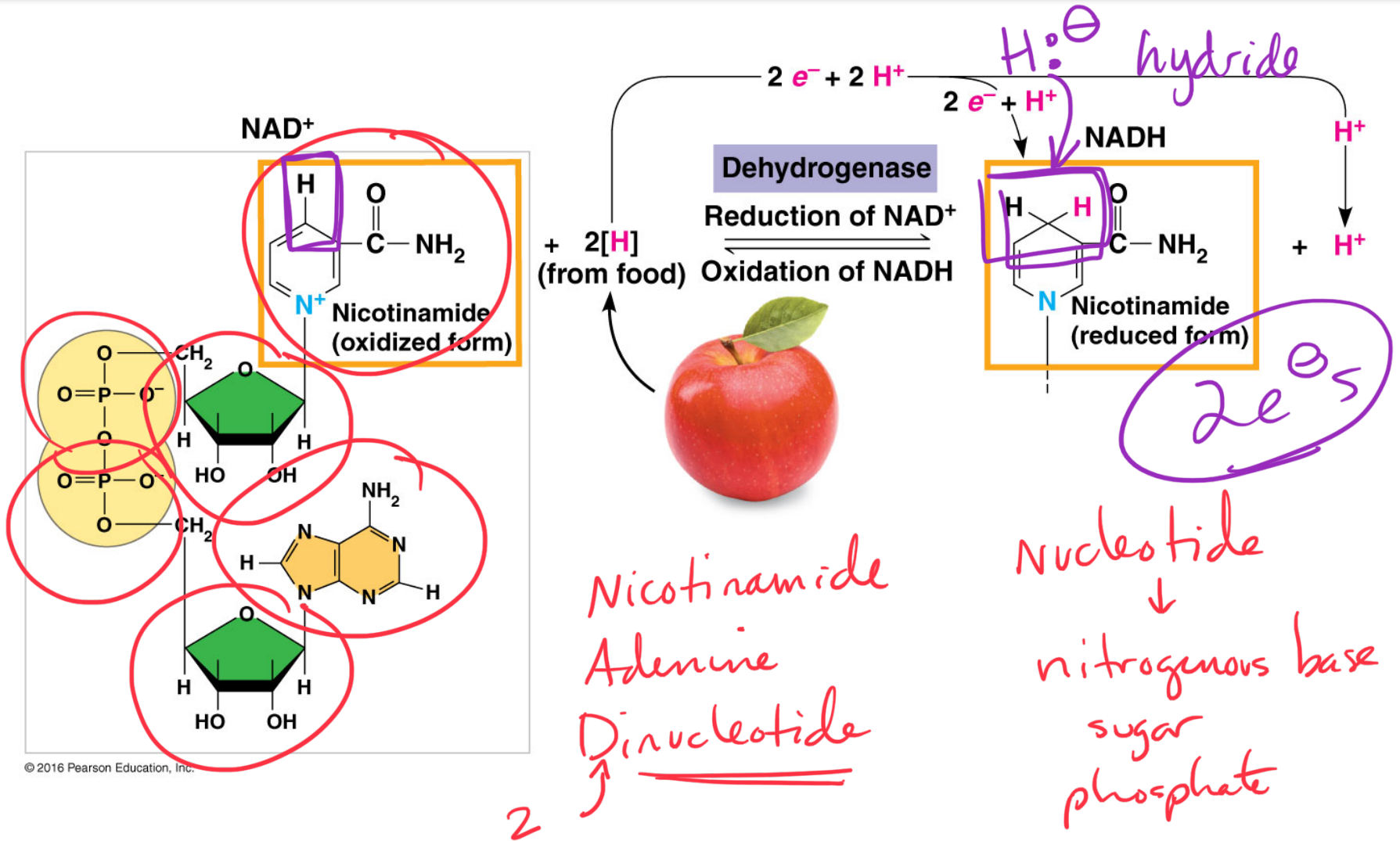
- Energy is released as electrons “fall” from organic molecules to O_2

- Broken down into steps:

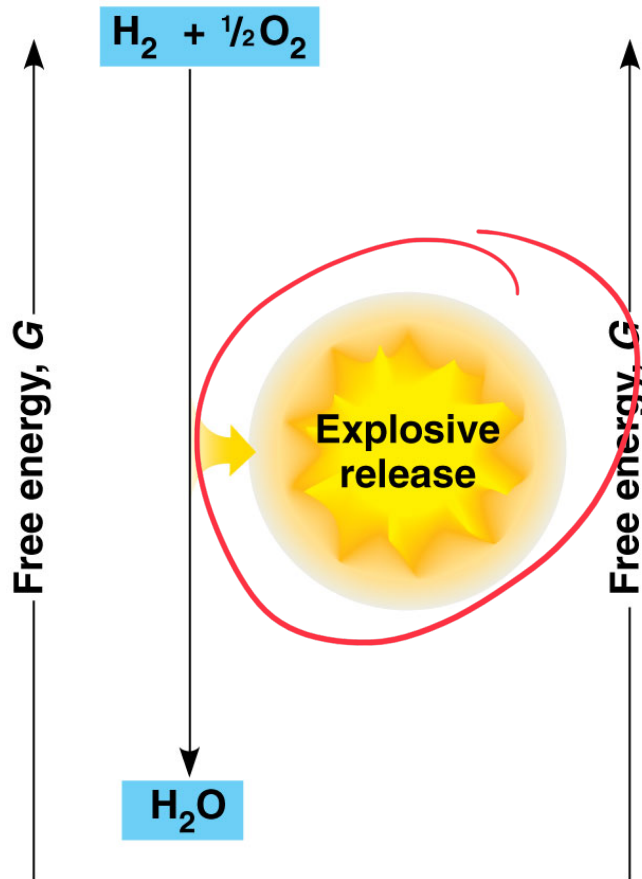


- Coenzyme NAD^+ = electron acceptor
- NAD^+ picks up $2e^-$ and $2H^+$ \rightarrow NADH (stores E)
- NADH carries electrons to the electron transport chain (ETC)
- ETC: transfers e^- to O_2 to make H_2O ; releases energy

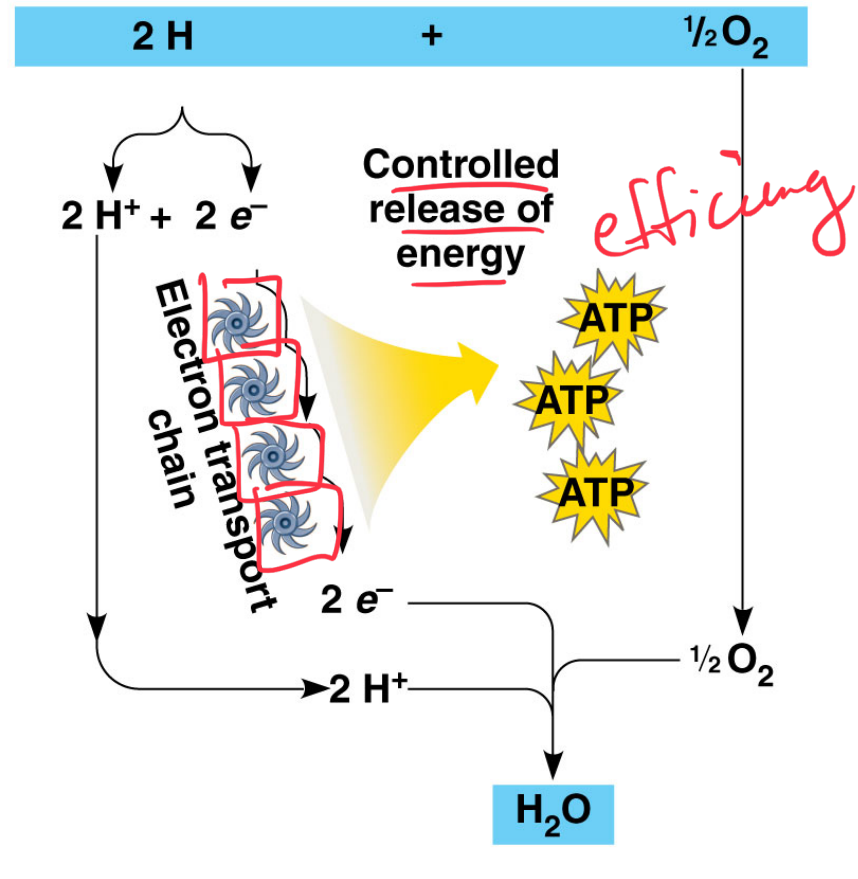
NAD⁺ as an electron shuttle



Electron Transport Chain



(a) Uncontrolled reaction



(b) Cellular respiration

Stages of Cellular Respiration

- takes place in cytosis → sugar → to cut with or without O_2
1. Glycolysis (2 ATP)
 2. Pyruvate Oxidation + Citric Acid Cycle (Krebs Cycle) (TCA Cycle) (2 ATP)
 3. Oxidative Phosphorylation (electron transport chain (ETC) & chemiosmosis) (28 ATP)

mitochondria - redox reactions

Overview of Cellular Respiration

