

# Life takes Work!



**Organization**



*Reproduction*



*Growth and Development*



**Obtain energy**



**Respond**



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*Adaptation*

How do we make ATPs?



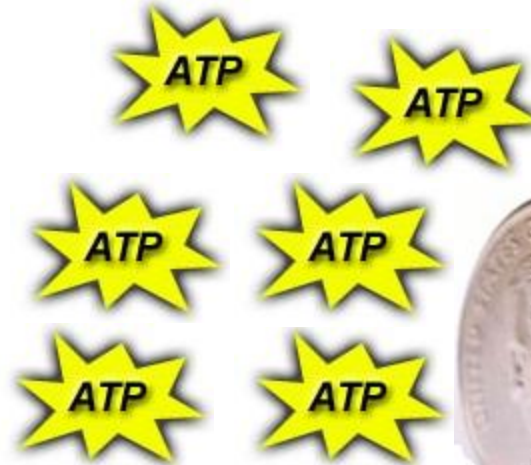
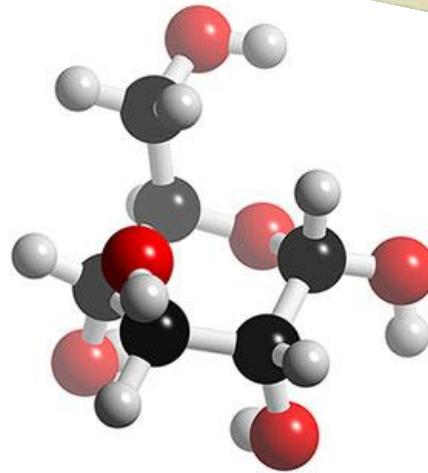
***Cellular  
Respiration!***

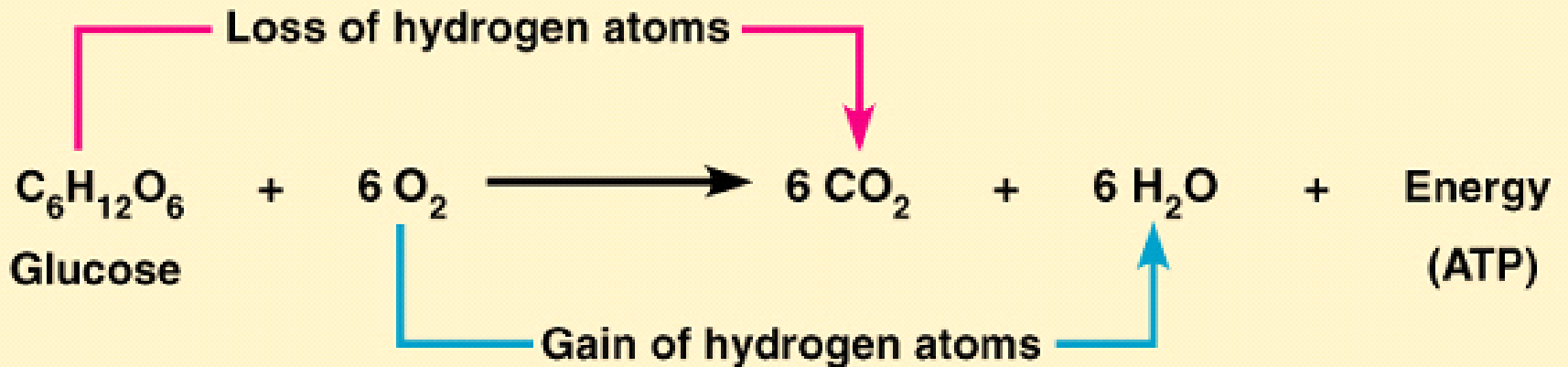
# What is cellular respiration?

- An almost universal process by which organisms utilize the chemical energy in food to produce enough ATP to perform all the necessary actions of living creatures.

**Glucose** is the primary biomolecule degraded by cellular respiration.

- If ATPs were quarters, glucose is like a \$10 bill.
- Other organic molecules are converted to glucose for energy harvesting





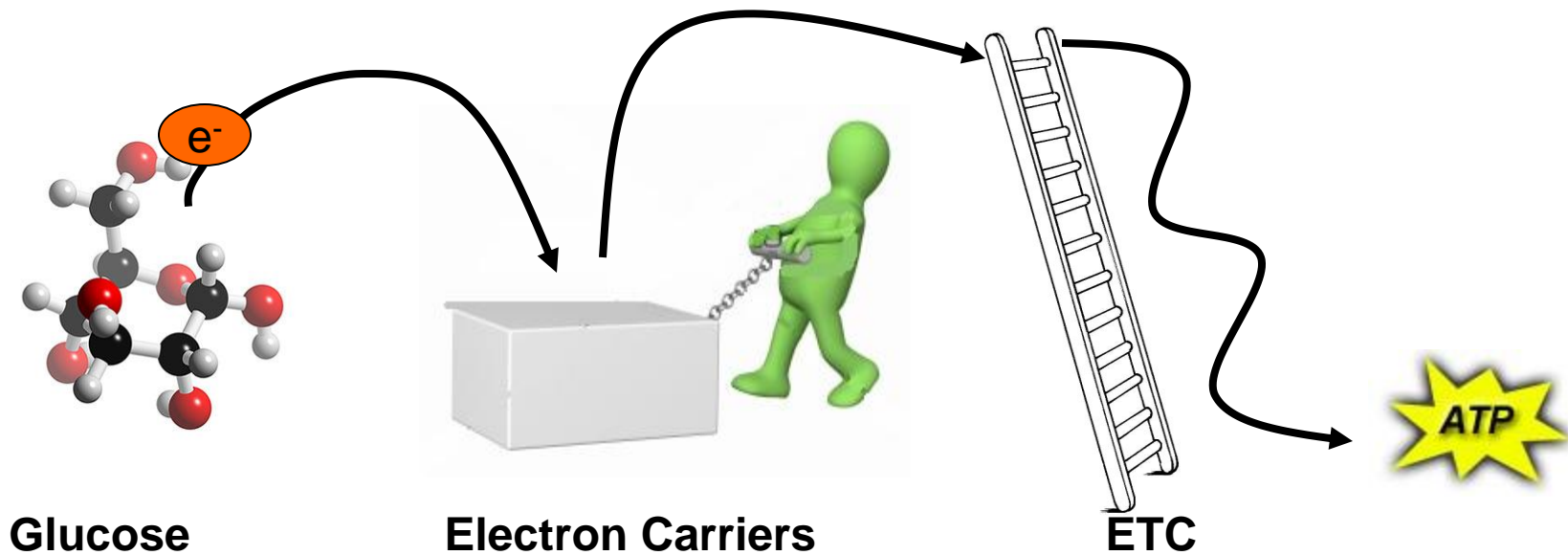
## It's a redox reaction!

- Glucose  $\rightarrow$  carbon dioxide = oxidation
- Oxygen gas  $\rightarrow$  water = reduction

# Burning Glucose

- Oxidizing glucose in cells is same overall reaction as burning it in a fire.
  - In fire, the energy is lost as heat in a *single reaction*.
  - In cells, a *series of reactions* occur to reduce energy lost as heat & to capture the energy in chemical bonds.





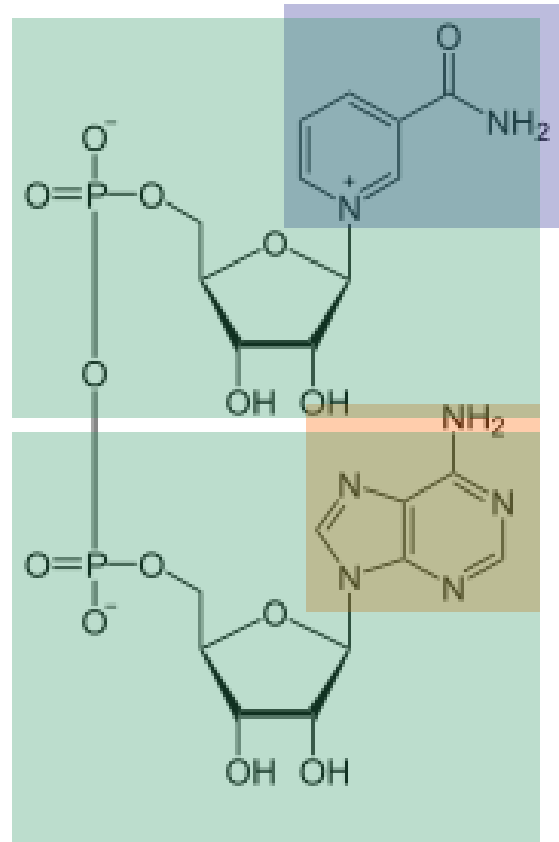
- A series of reactions move electrons (and their energy) from glucose to electron carrier molecules to an electron transport chain (ETC).
- At the electron transport chain the energy in the electrons is used to phosphorylate ADP (making ATP)

# Electron Carrier Molecules



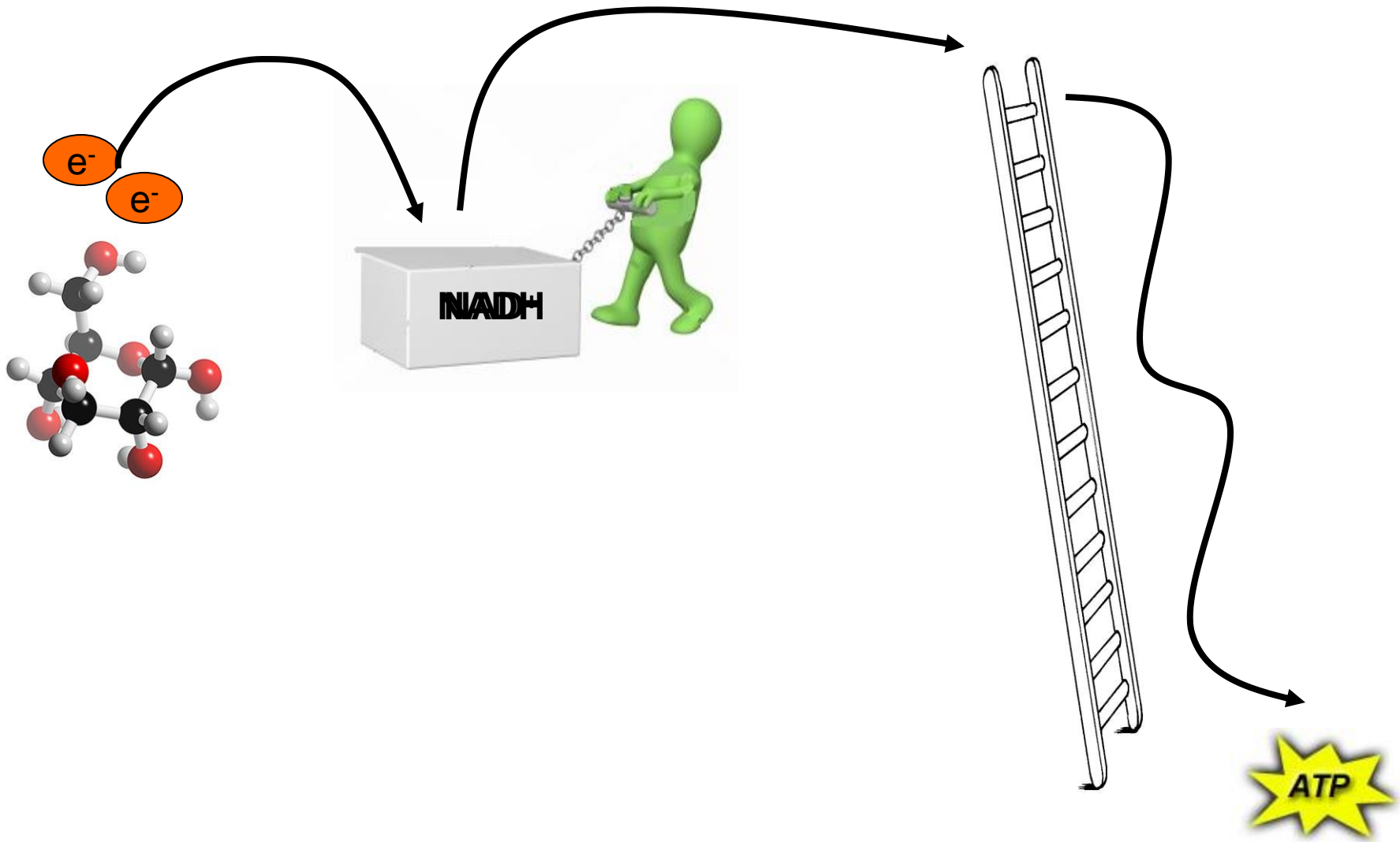
## 1. NAD<sup>+</sup>

- Nicotinamide adenine dinucleotide



–NAD<sup>+</sup> accepts electrons from other molecules to form **NADH** which can then donate electrons to the ETC





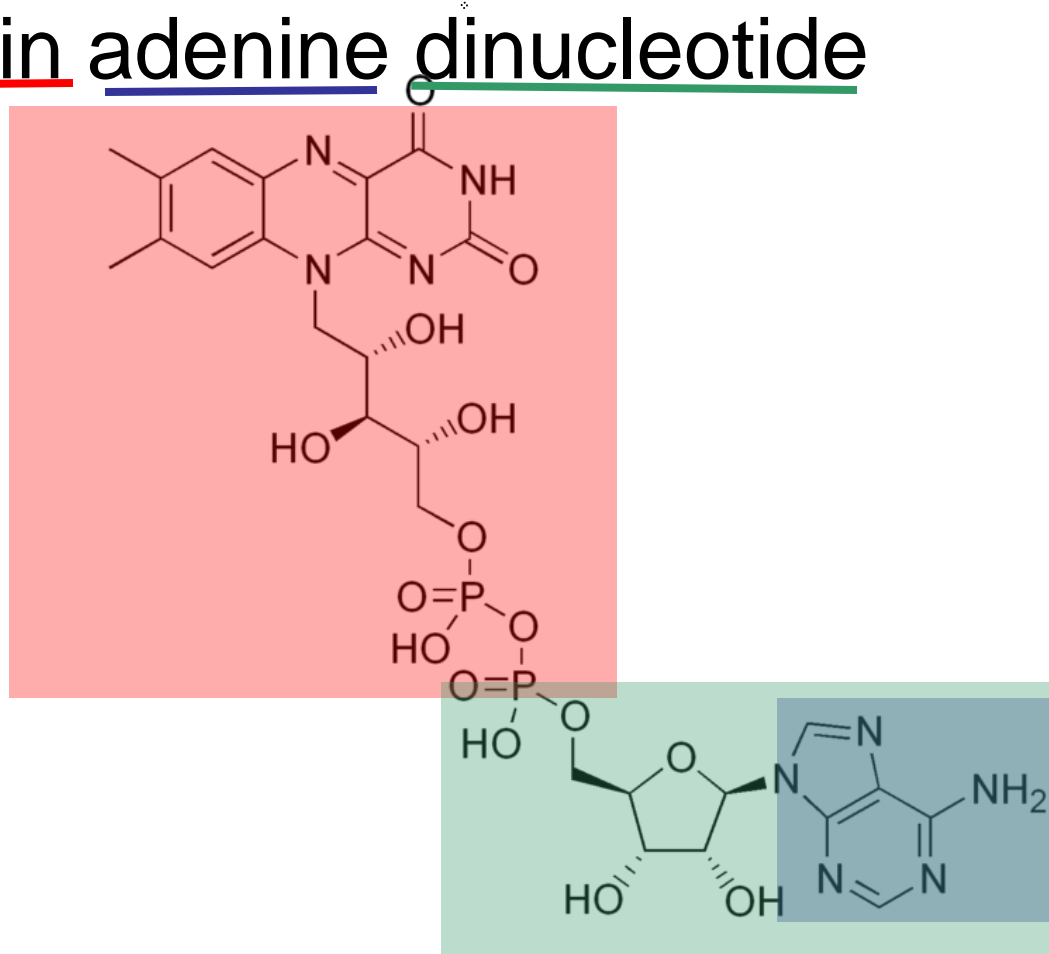
# Electron Carrier Molecules



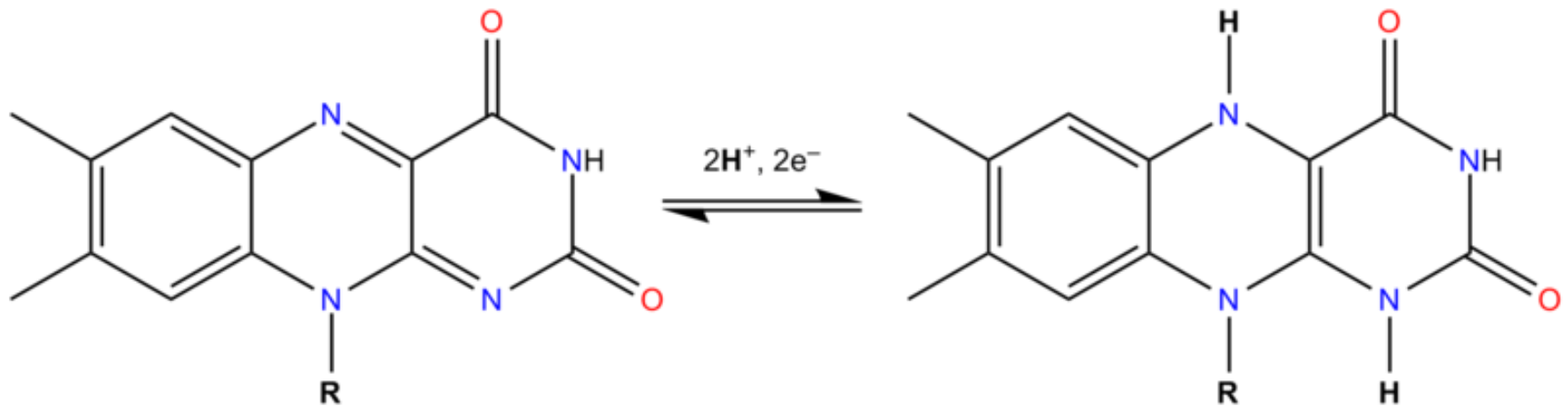
## 2. FAD<sup>+</sup>

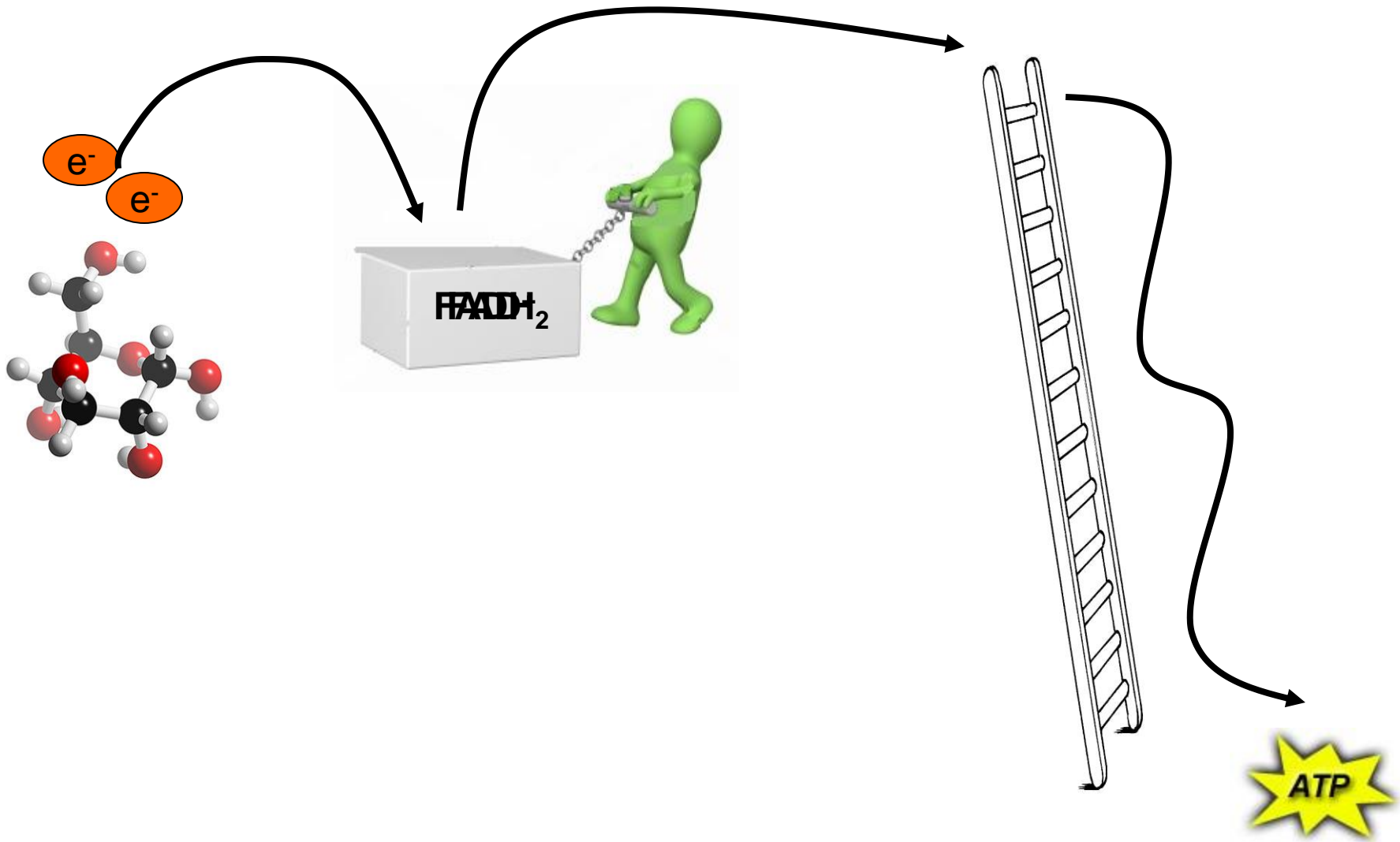
misnomer

- Flavin adenine dinucleotide

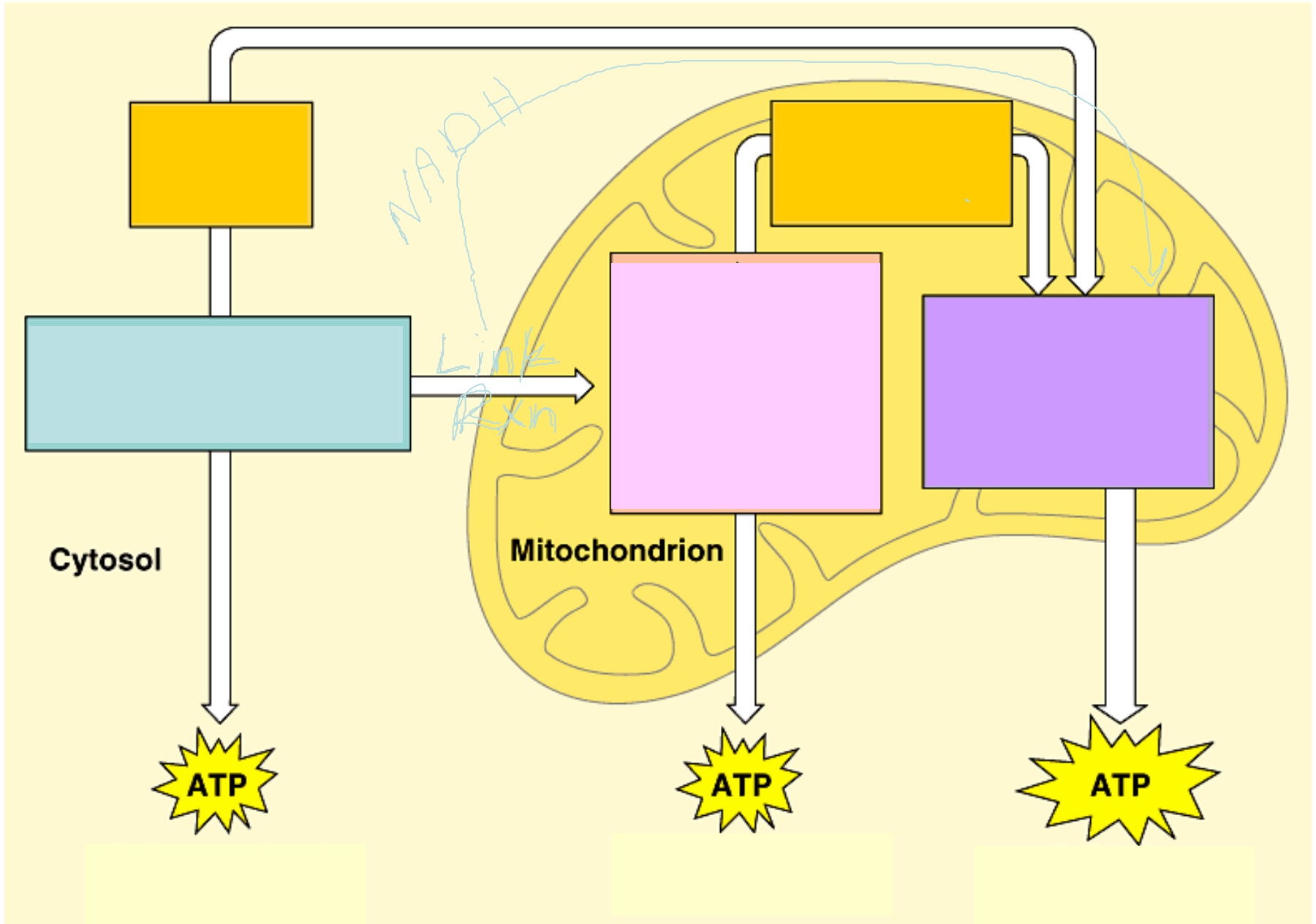


- $\text{FAD}^+$  accepts electrons from other molecules to form  **$\text{FADH}_2$**  which can then donate electrons to the ETC



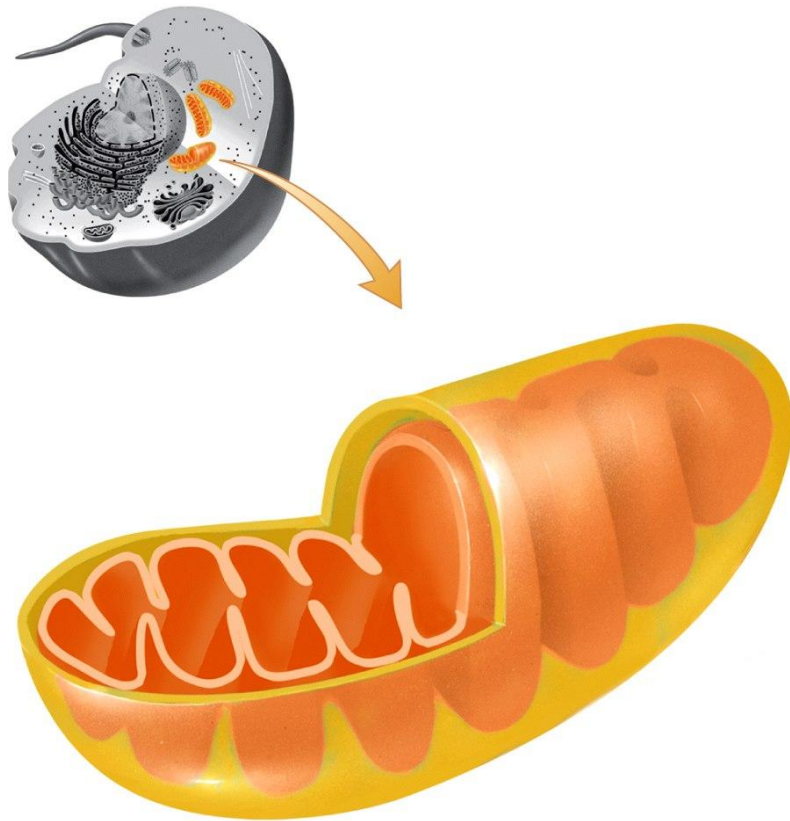


# The Big Picture



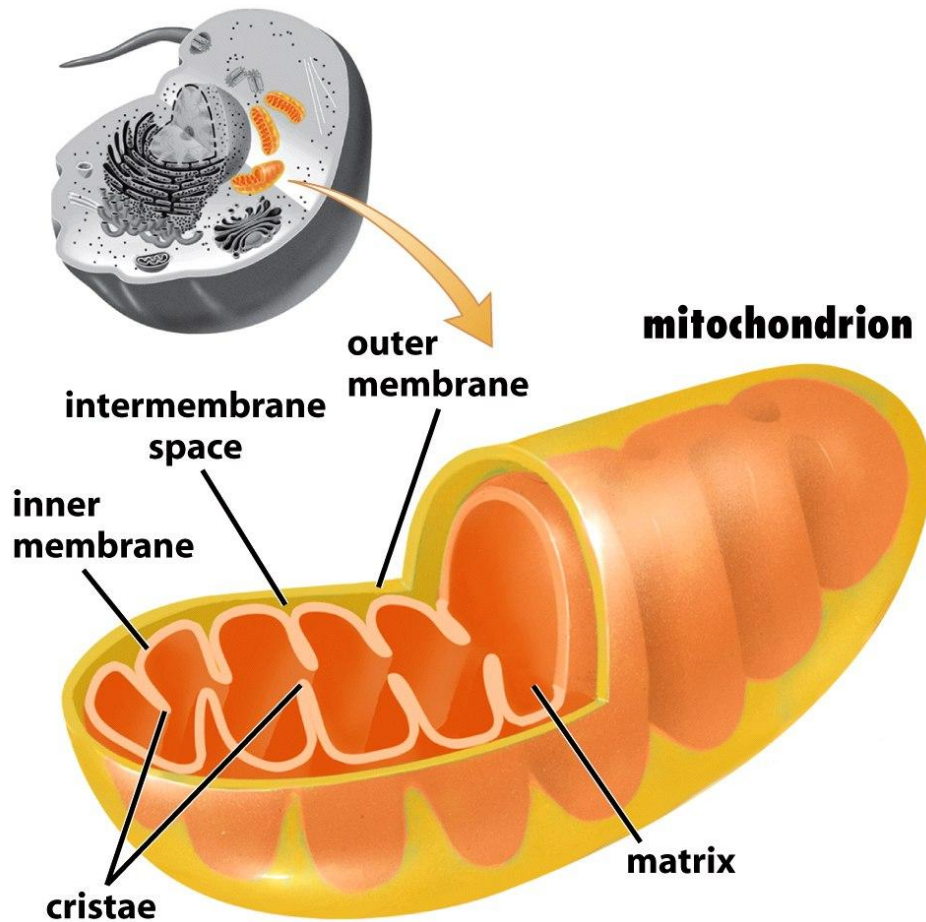


# Where the Reactions Occur



- The mitochondria are the location of the last steps in respiration.
  - organelle in eukaryotic cells.
  - abundant in locations where lots of energy is needed.

# Where the Reactions Occur



- System of membranes divide spaces.
  - Outer membrane
  - Inner membrane
    - Intermembrane space between them.
  - Cristae are folds in inner membrane.
  - Matrix is space inside.