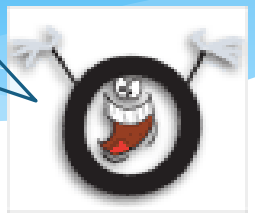
Cellular Respiration

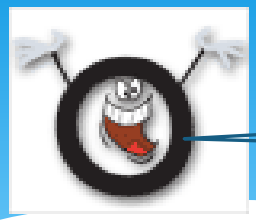
CH 4.4-4.5

Move over CO_2 – it's my turn

Respiration – what is it?

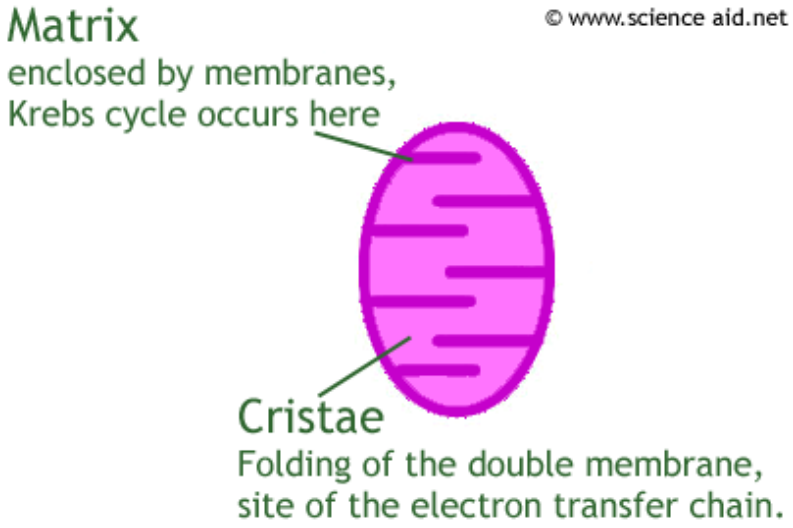
* Aerobic = needs oxygen
* Mitochondria = organelle where respiration occurs in both plants and animals
* Purpose = release chemical energy from sugars to make ATP



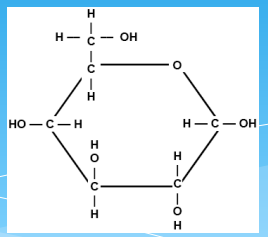


HOW?

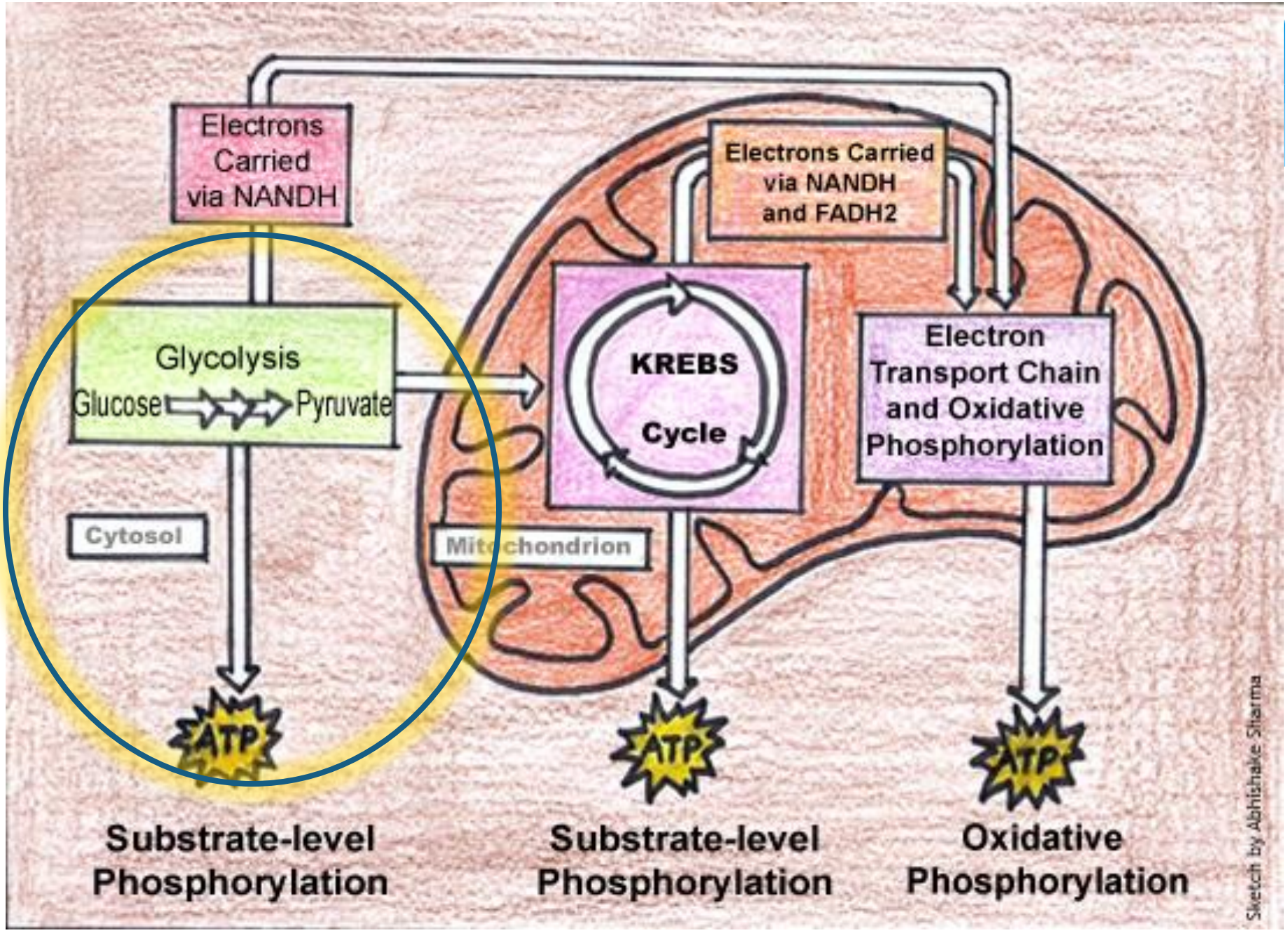
* Glycolysis - cytoplasm
* Kreb's Cycle – mitochondria matrix
* Electron Transport Chain – mitochondria membrane



The players



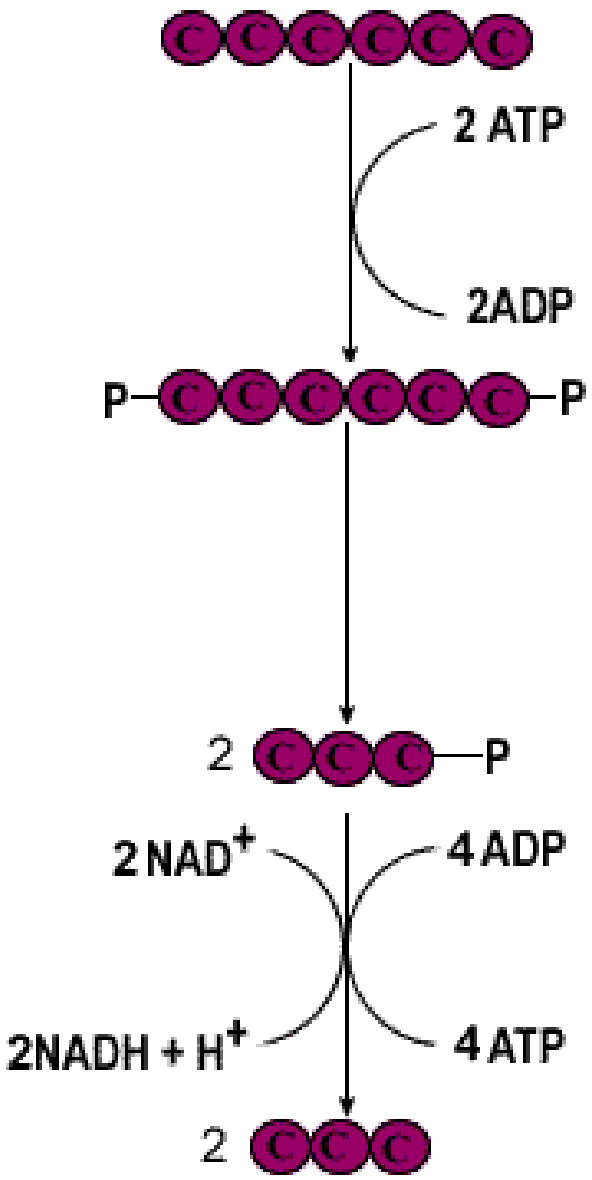
* Glucose – $C_6H_{12}O_6$
* low energy = ADP, NAD^+ , FAD^+
* high energy = ATP, NADH, $FADH_2$
* O_2 – likes electrons!


Electrons Carried via NANDH
Electrons Carried via NANDH and FADH2
Glycolysis
Glucose
Pyruvate
KREBS Cycle
Electron Transport Chain and Oxidative Phosphorylation
Cytosol
Mitochondrion
ATP
ATP
ATP
Substrate-level Phosphorylation
Substrate-level Phosphorylation
Oxidative Phosphorylation
Sketch by Abhishake Sharma

1. Glycolysis

* Glucose molecule split into two 3-carbon molecules
* 4 ATP molecules made
* 2 NADH molecules made

Glycolysis:



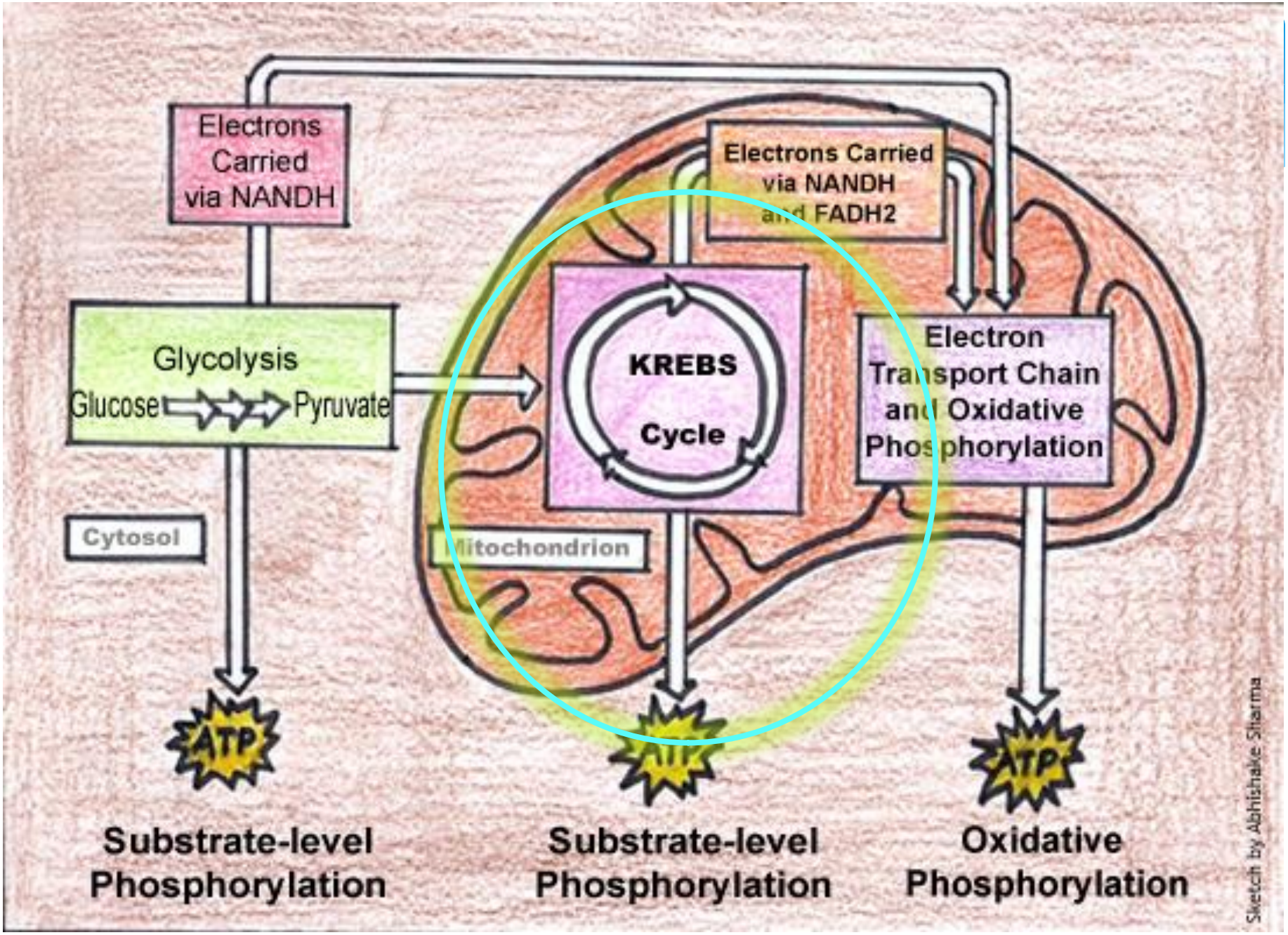
Glucose (6-carbon)

ATP used to add phosphate

Molecule split into 2 3-carbon molecules

ATP and NADH used to remove phosphates

New molecule = Pyruvate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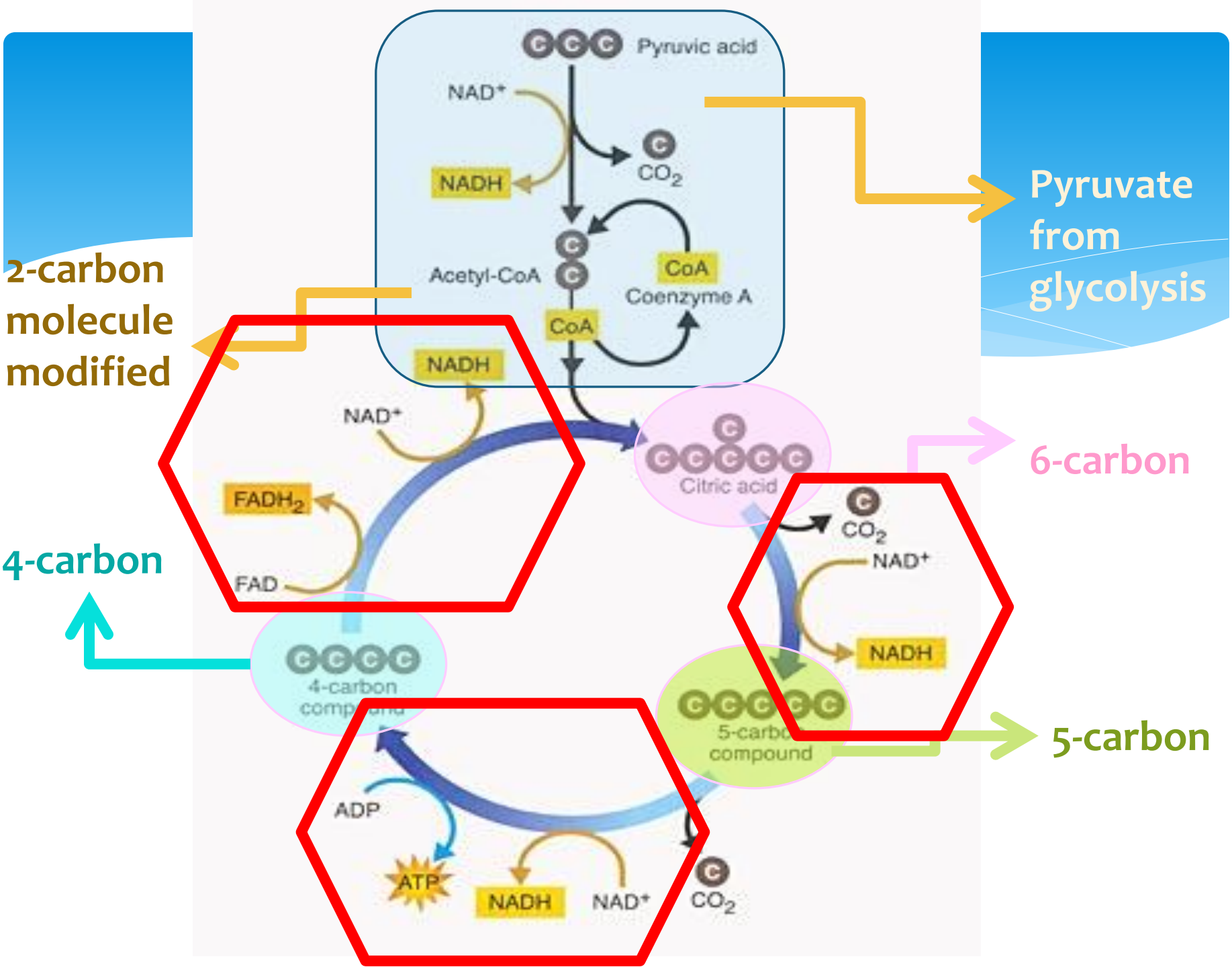
Oxidative Phosphorylation
Sketch by Abhishake Sharma

2. Kreb's Cycle

* Pyruvate splits into 2-carbon molecule
* Coenzyme A bonds with 2-carbon
* Joins with a 4-carbon molecule (citric acid)
* Citric acid changes to a 5-carbon molecule

2. Kreb's Cycle

* 5-carbon molecule breaks down into 4-carbon molecule
* 4-carbon molecule changes shape and releases energy
  * **ATP**
  * **NADH**
  * **$FADH_2$**

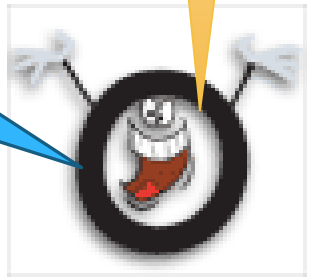

Pyruvic acid
NAD+
NADH
CO2
Acetyl-CoA
CoA
Coenzyme A
CoA
Pyruvate from glycolysis
2-carbon molecule modified
NADH
NAD+
FADH2
FAD
Citric acid
6-carbon
CO2
NAD+
NADH
4-carbon
5-carbon compound
5-carbon
ADP
ATP
NADH
NAD+
CO2

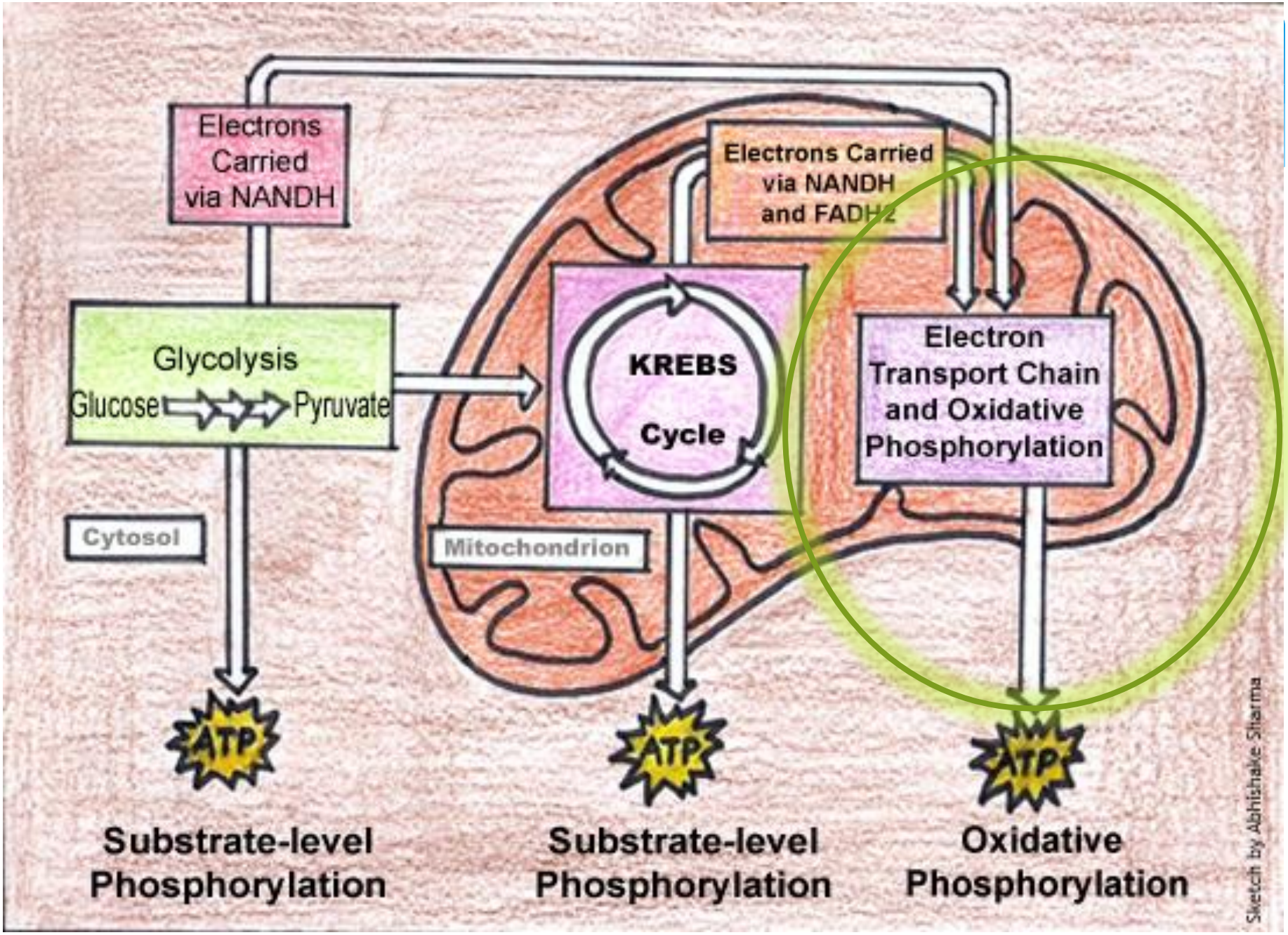
Kreb's Cycle

* 6 – CO_2 } **Waste**
* 2 – ATP } **ENERGY!**
* 8 – NADH
* 2 - FADH } **To Electron Transport Chain**

ETC to the rescue – more ATP to come!

2 ATP? That's all???

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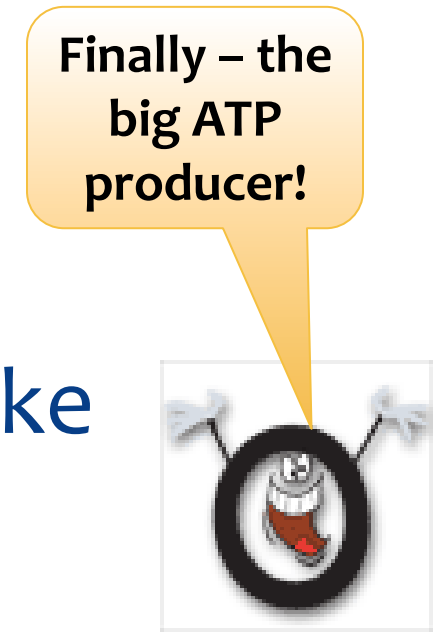
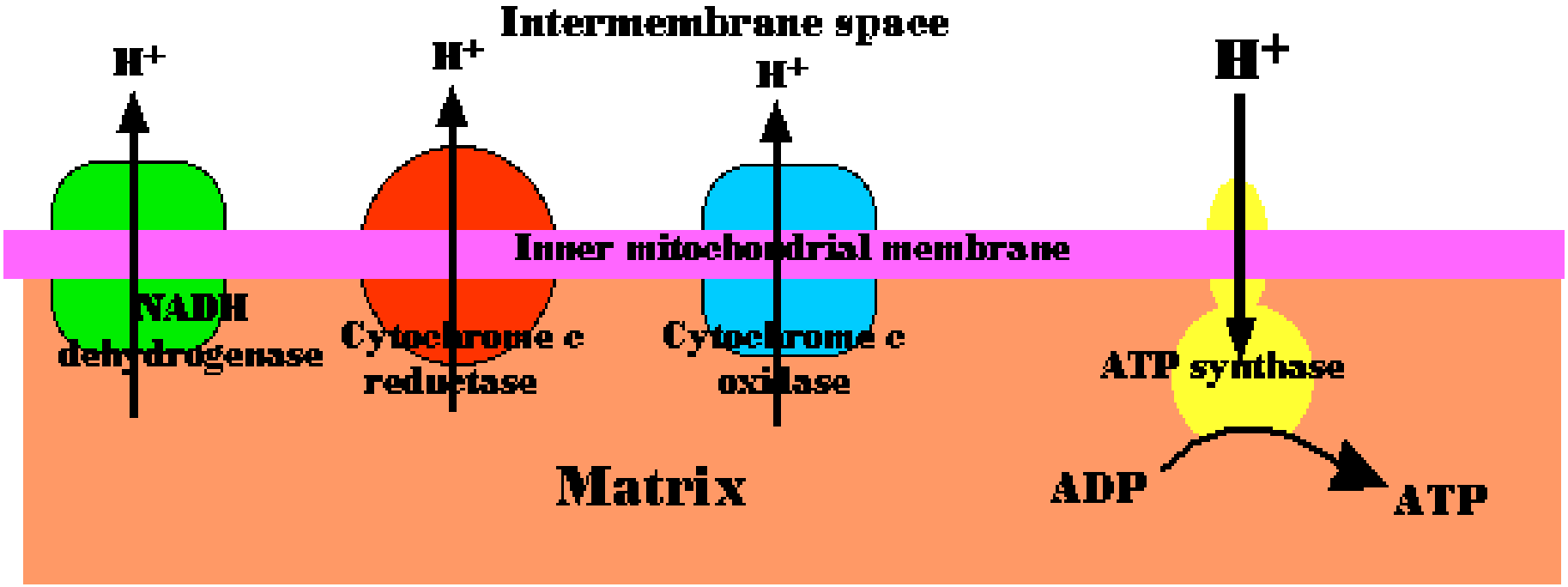
3. Electron Transport Chain

* Electrons removed from NADH and $FADH_2$
* Hydrogen ions move across membrane
* ATP is produced
* Oxygen takes electrons to make water

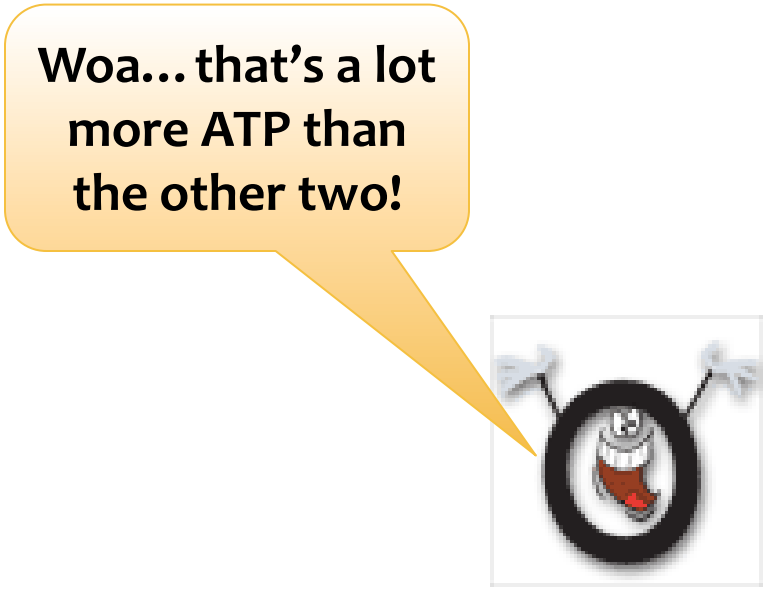


Electron transport chain

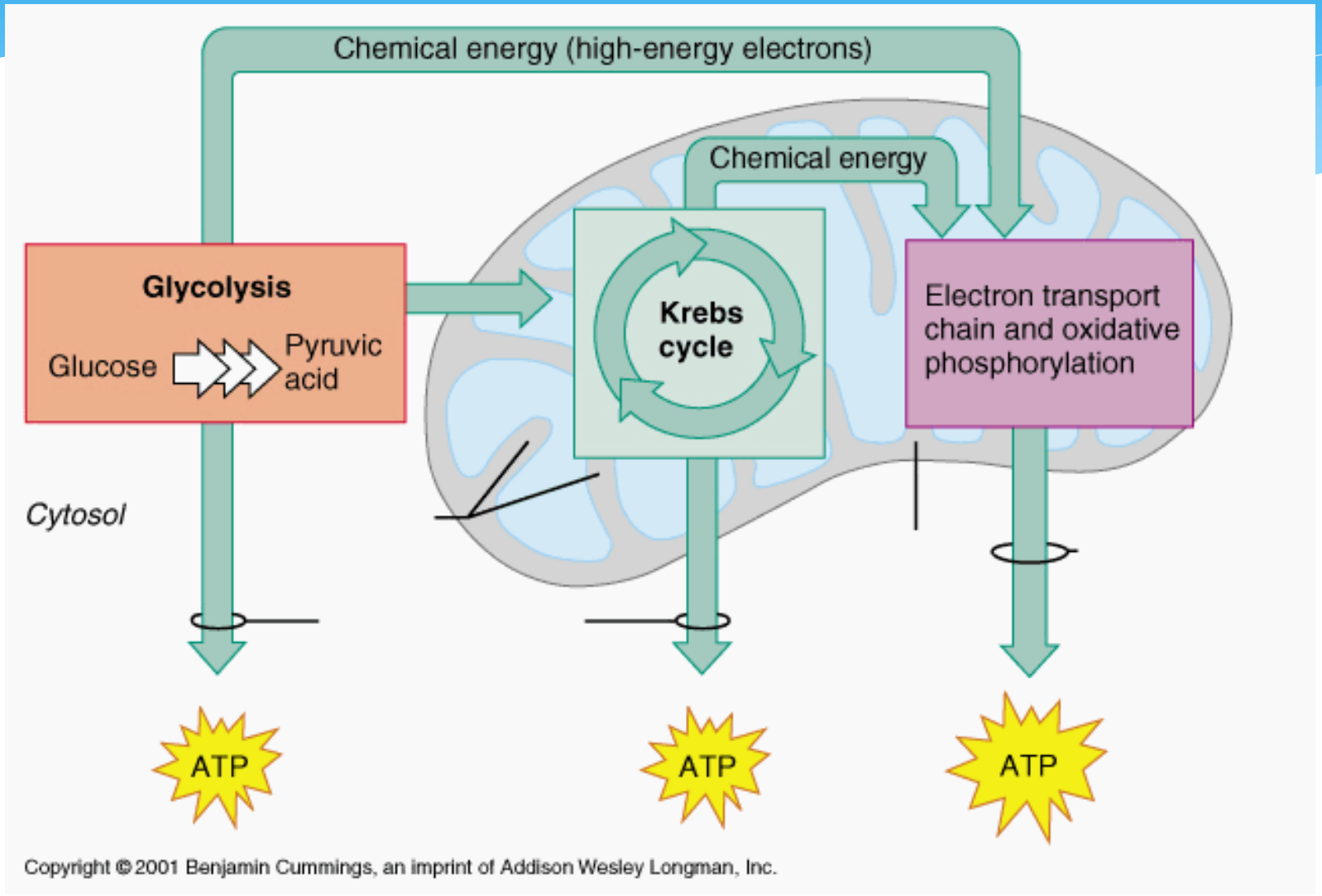


3. Electron Transport Chain

* Uses oxygen, NADH, and $FADH_2$
* Makes 34-36 ATP molecules



Wrap it up…


Chemical energy (high-energy electrons)
Chemical energy
Glycolysis
Glucose
Pyruvic acid
Krebs cycle
Electron transport chain and oxidative phosphorylation
Cytosol
ATP
ATP
ATP
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