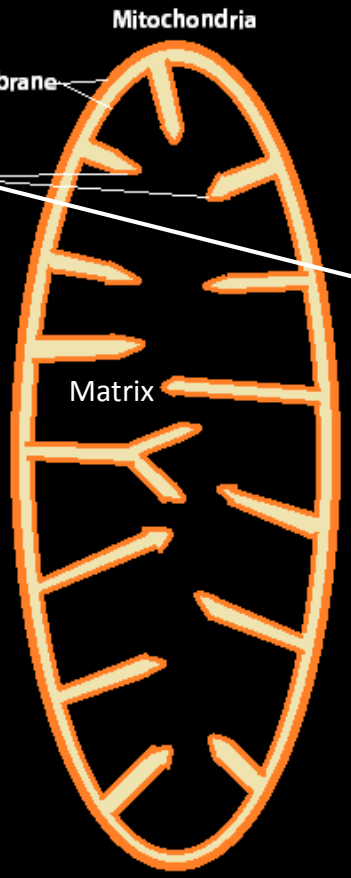
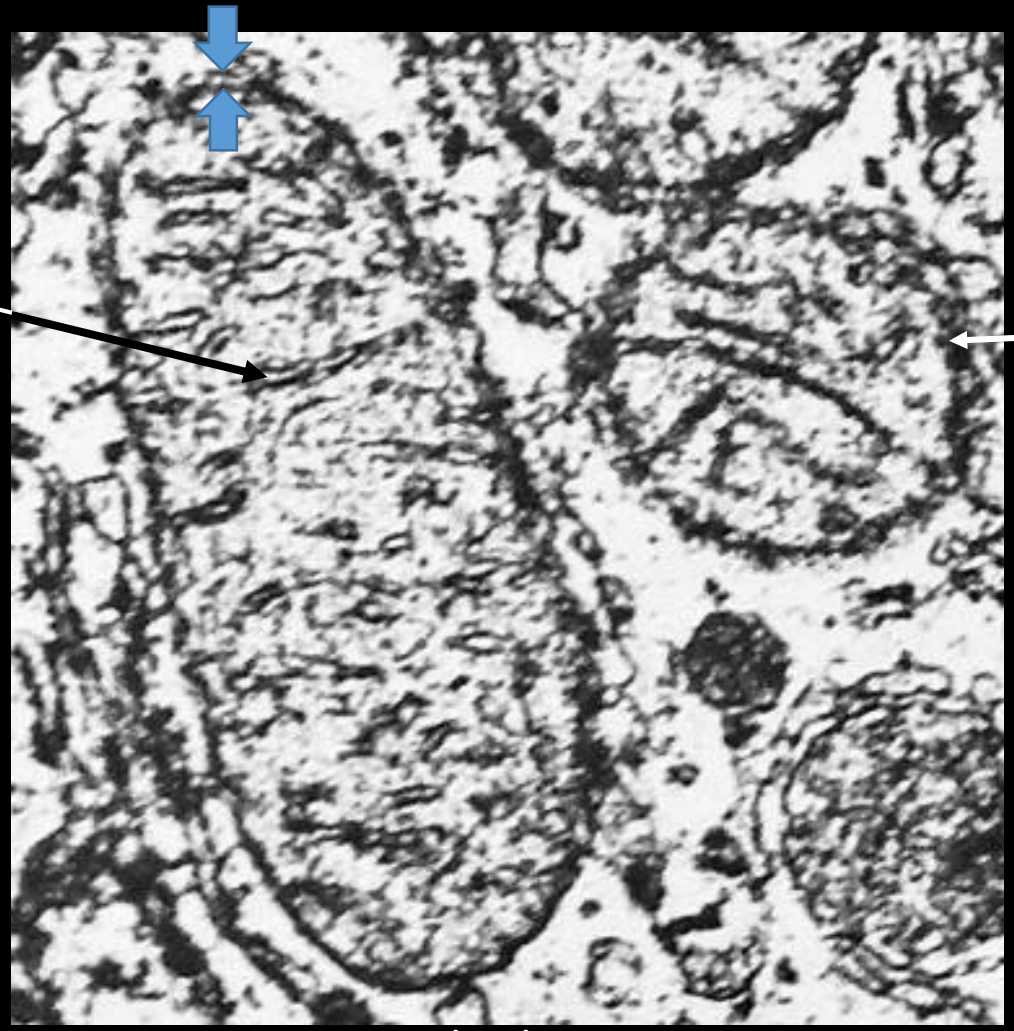
CELLULAR RESPIRATION



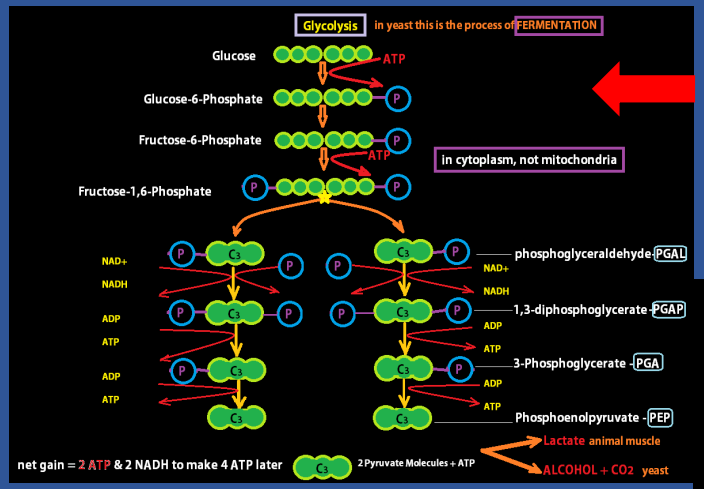
Cellular Respiration



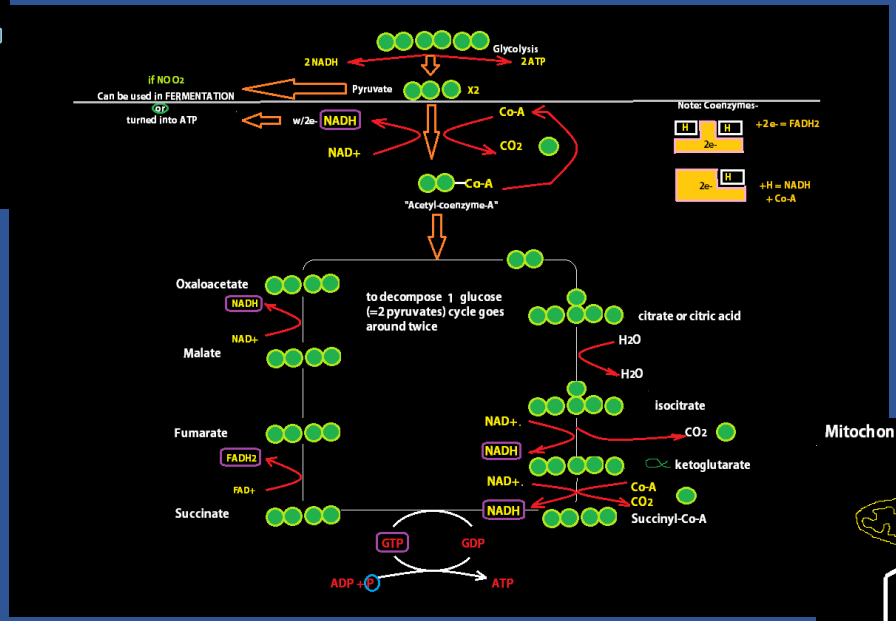
Cross Section

Longitudinal section

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$



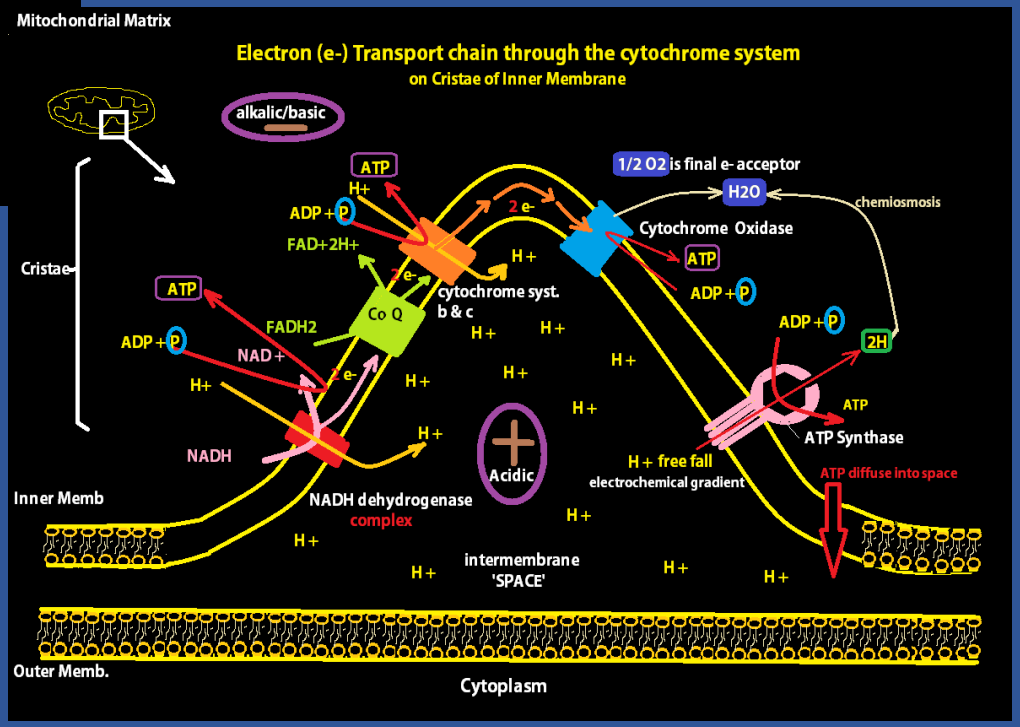
Glycolysis – occurs in cytosol of cells (cytoplasm) and when low/no O_2 levels occur in muscles, lactate is formed (the 'burn'). In yeast, it results in CO_2 & Alcohol (Fermentation): **Anaerobic Respiration**. Pyruvate (C_3) then passes to the Citric Acid Cycle.

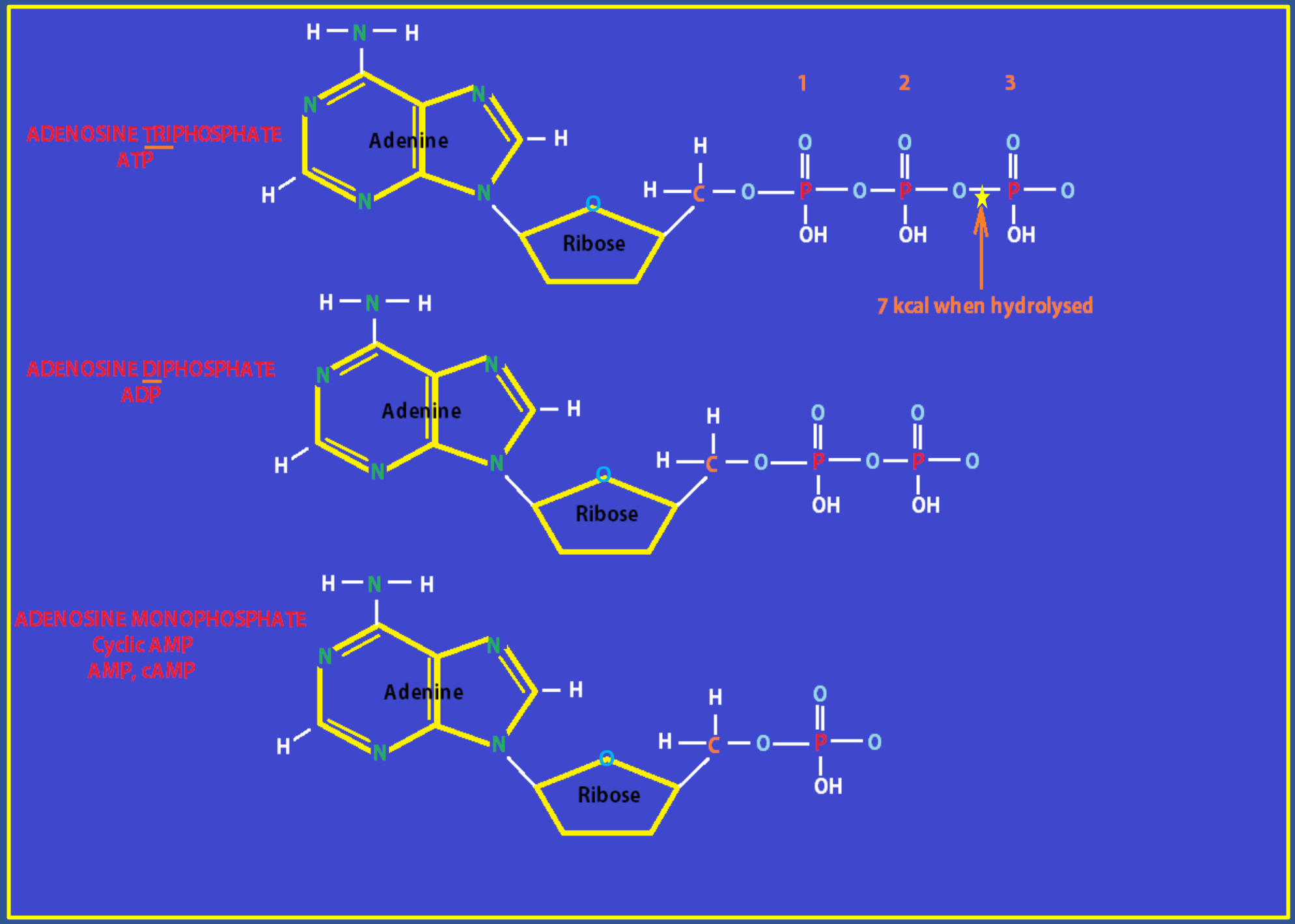


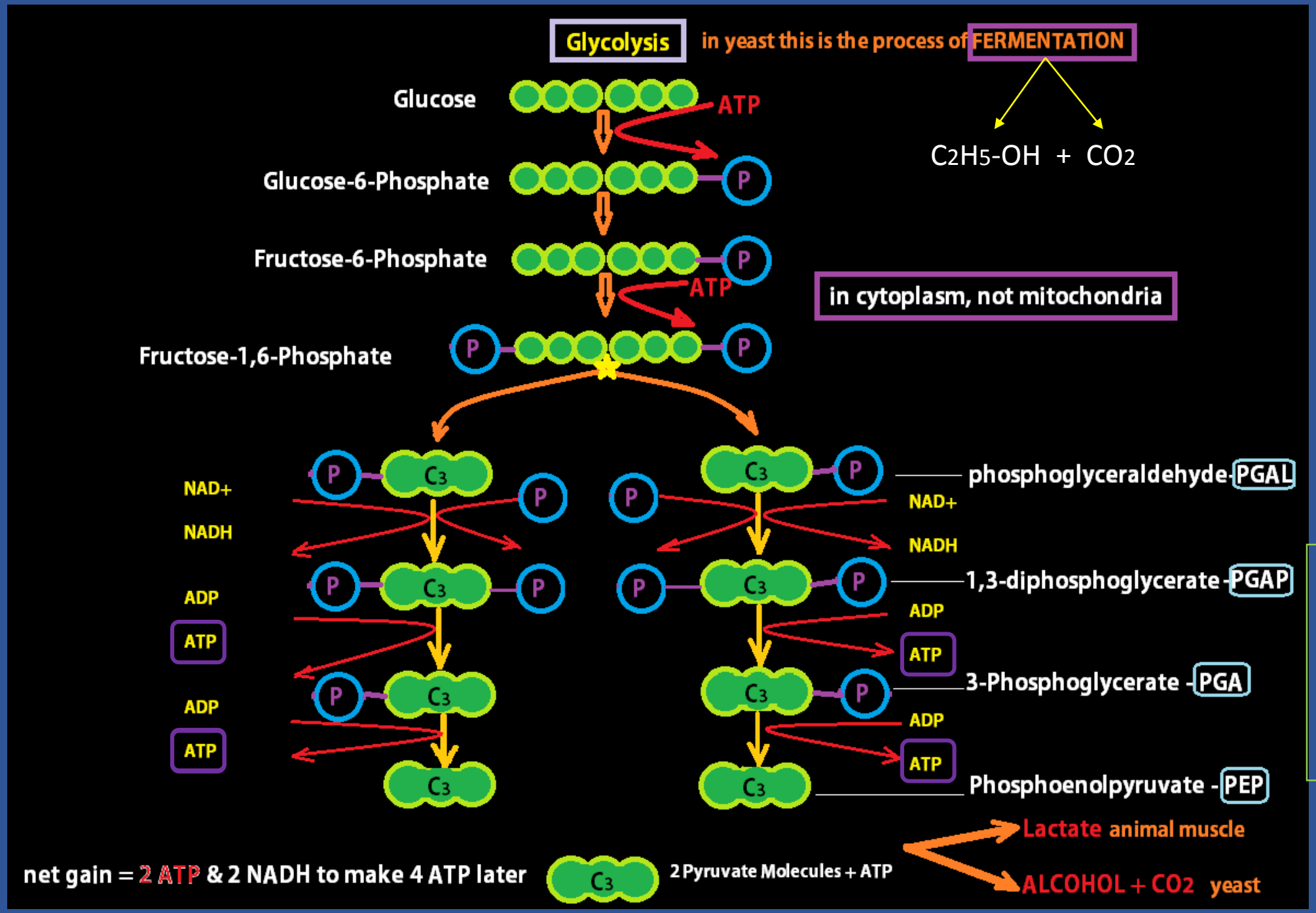
Krebs' (Citric Acid) Cycle – occurs in Matrix of Mitochondria – the purpose is to breakdown sugar (Pyruvate-**C3**) into smaller compounds releasing the energy in their **C-C** bonds and producing **CO_2** as a waste

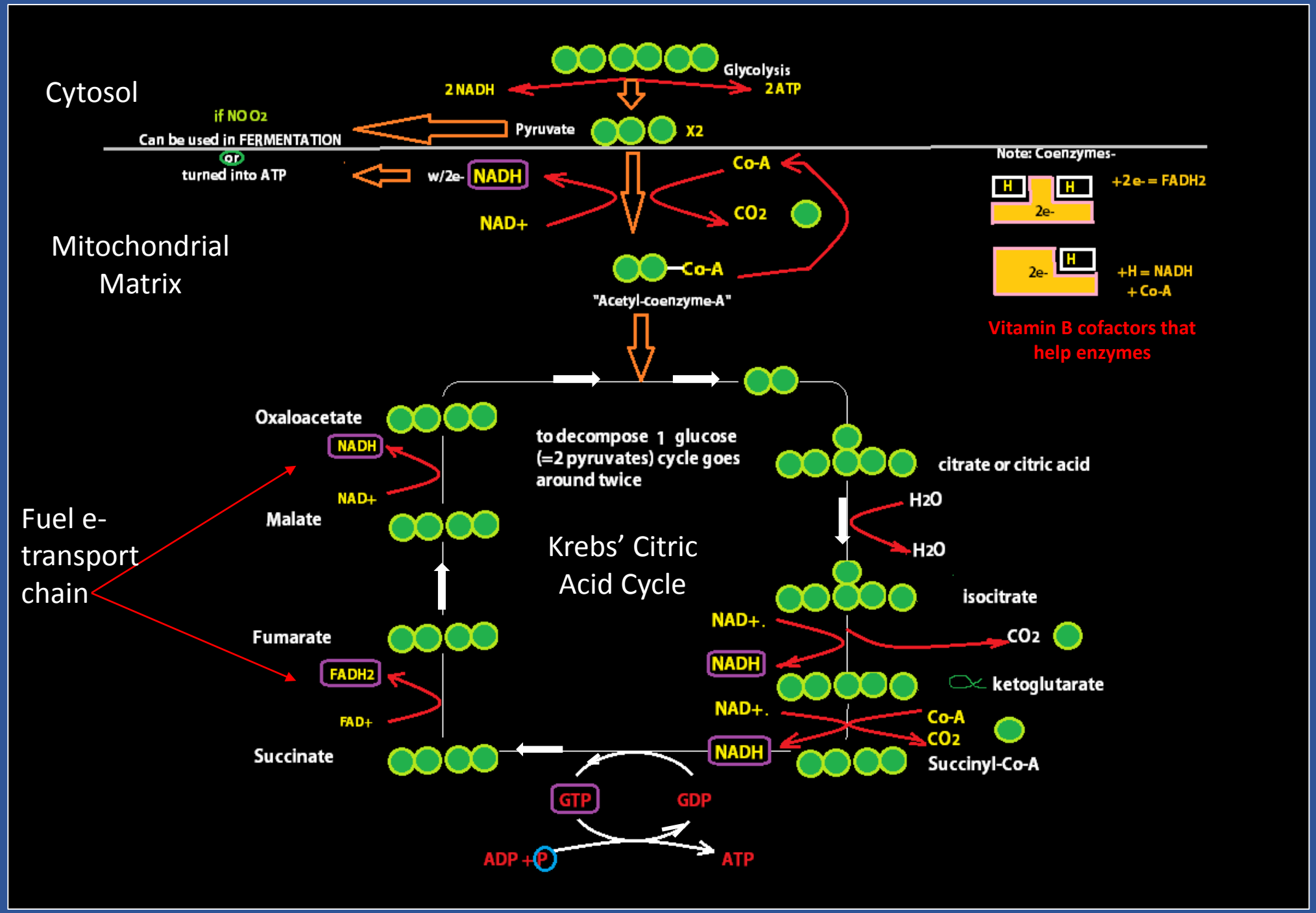
Aerobic Respiration

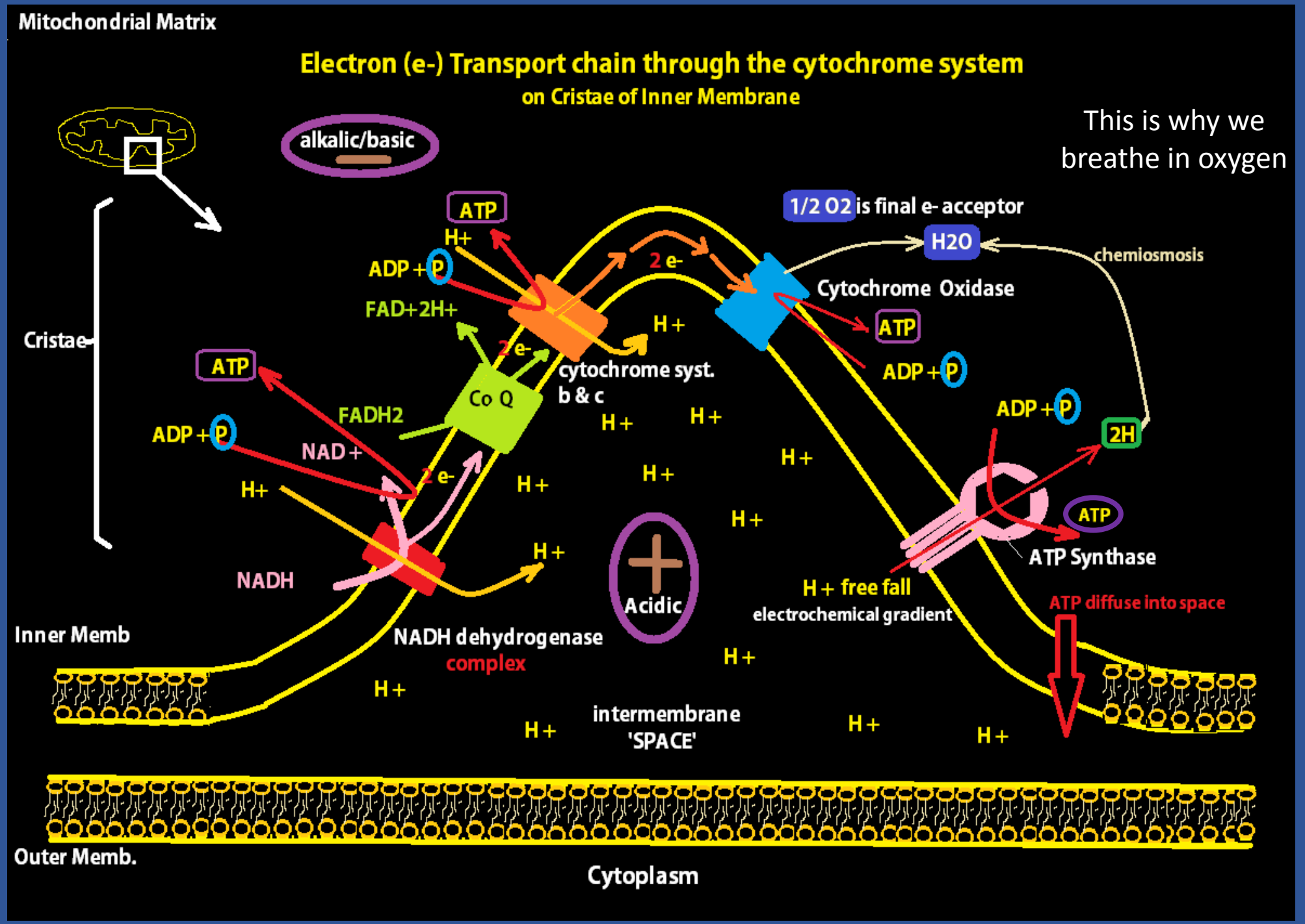
'e- Transport' uses e- to produce ATP, NADH & $FADH_2$ with the e- finally accepted by O_2 to form H_2O




ADENOSINE TRIPHOSPHATE
ATP
Adenine
Ribose
1
2
3
7 kcal when hydrolysed
ADENOSINE DIPHOSPHATE
ADP
Adenine
Ribose
ADENOSINE MONOPHOSPHATE
Cyclic AMP
AMP, cAMP
Adenine
Ribose


Glycolysis
in yeast this is the process of FERMENTATION
Glucose
ATP
Glucose-6-Phosphate
Fructose-6-Phosphate
ATP
Fructose-1,6-Phosphate
C2H5-OH + CO2
in cytoplasm, not mitochondria
NAD+
NADH
ADP
ATP
ADP
ATP
NAD+
NADH
ADP
ATP
ADP
ATP
phosphoglyceraldehyde-PGAL
1,3-diphosphoglycerate-PGAP
3-Phosphoglycerate -PGA
Phosphoenolpyruvate -PEP
Lactate animal muscle
ALCOHOL + CO2 yeast
net gain = 2 ATP & 2 NADH to make 4 ATP later
2 Pyruvate Molecules + ATP
H H
H C – C - OH
H H
C2H5OH
Ethanol
C2
OH


Cytosol
Glycolysis
2 NADH
2 ATP
if NO O2
Can be used in FERMENTATION
or
turned into ATP
Pyruvate
X2
w/2e-
NADH
NAD+
Co-A
CO2
Co-A
"Acetyl-coenzyme-A"
Mitochondrial Matrix
Note: Coenzymes-
H
H
2e-
+2 e- = FADH2
2e-
H
+H = NADH + Co-A
Vitamin B cofactors that help enzymes
Oxaloacetate
NADH
NAD+
Malate
to decompose 1 glucose (=2 pyruvates) cycle goes around twice
citrate or citric acid
H2O
H2O
Fuel e- transport chain
Krebs' Citric Acid Cycle
isocitrate
NAD+.
CO2
NADH
ketoglutarate
Fumarate
FADH2
FAD+
NAD+.
Co-A
CO2
Succinate
NADH
Succinyl-Co-A
GTP
GDP
ADP + P
ATP


Mitochondrial Matrix
Electron (e-) Transport chain through the cytochrome system
on Cristae of Inner Membrane
This is why we breathe in oxygen
alkalic/basic
ATP
H+
ADP + P
FAD+2H+
2 e-
H +
1/2 O2 is final e- acceptor
H2O
chemiosmosis
Cytochrome Oxidase
ATP
ADP + P
Cristae
cytochrome syst. b & c
Co Q
FADH2
NAD +
H+
NADH
ADP + P
2H
ATP
ATP Synthase
Acidic
H + free fall
electrochemical gradient
ATP diffuse into space
Inner Memb
NADH dehydrogenase
complex
intermembrane
'SPACE'
Outer Memb.
Cytoplasm

Summary

{Glucose contains 3,800 calories or 3.8 kilocalories}

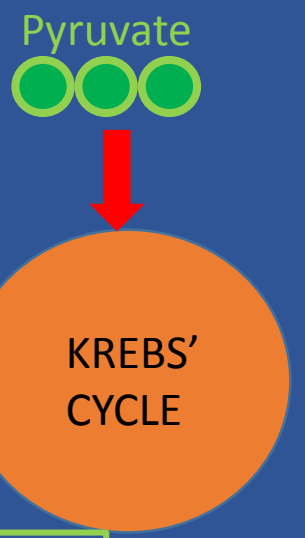
1- Glycolysis in Cytoplasm: 2 ATP → 2 ATP
2 NADH → 4 ATP

2- Pyruvate enters Krebs' Cycle in Mito Matrix
2 turns

2 NADH → 6 ATP
2 GTP → 2 ATP
6 NADH → 18 ATP
2 $FADH_2$ → 4 ATP

36 ATP

e- transport chain on cristae



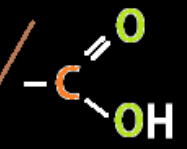
36 ADP + P

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

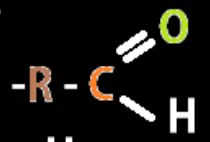
36 ATP

Functional Groups

1- Hydroxyl ('Alcohol') -OH — sugars

2- Carboxyl -COOH /  — sugars, fats, amono acids

3- Ketone  — sugars

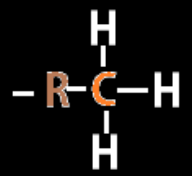
4- Aldehyde  — sugars

5- Amine (Amino)  — amino acids

6- Sulfhydryl R–SH — amino acids

7- Phosphate 

— phospholipids, nucleotides, nucleic acids

8- Methyl  — fats, oils, waxes