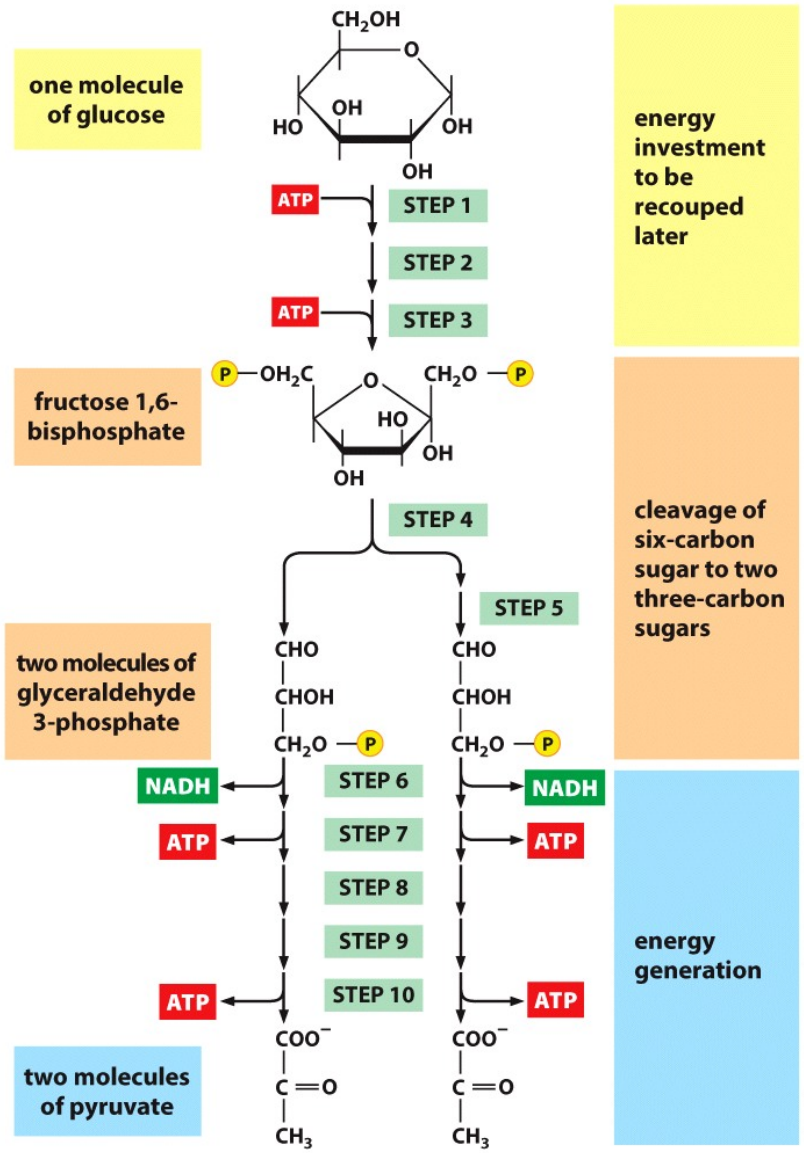
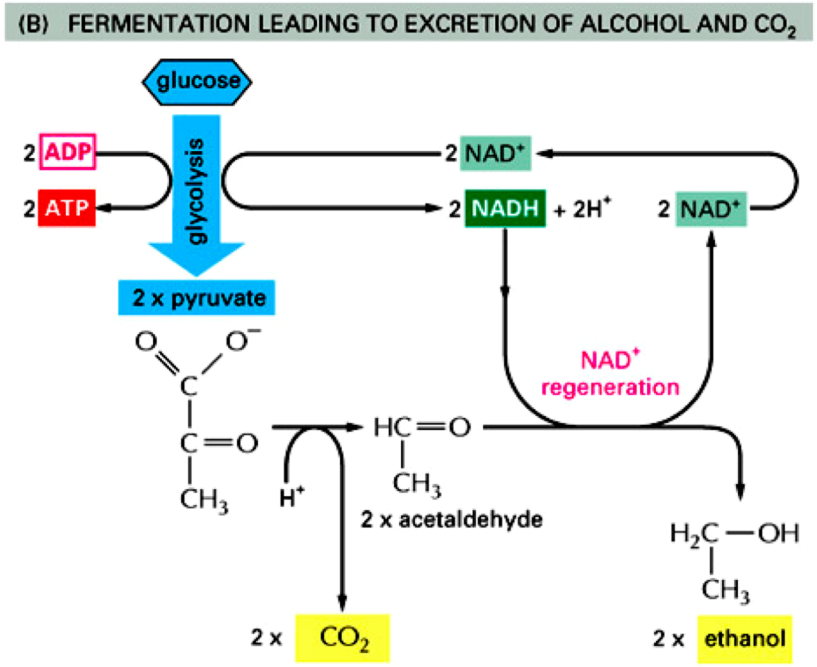


Figure 13-5 Essential Cell Biology, 4th ed. (© Garland Science 2014)

Glycolysis

input		output
1 glucose	→	2 pyruvate
2 ATP + 2 ADP + 2 P_i	→	4 ATP
2 NAD^+	→	2 NADH + H^+



Glycolysis : 10 steps

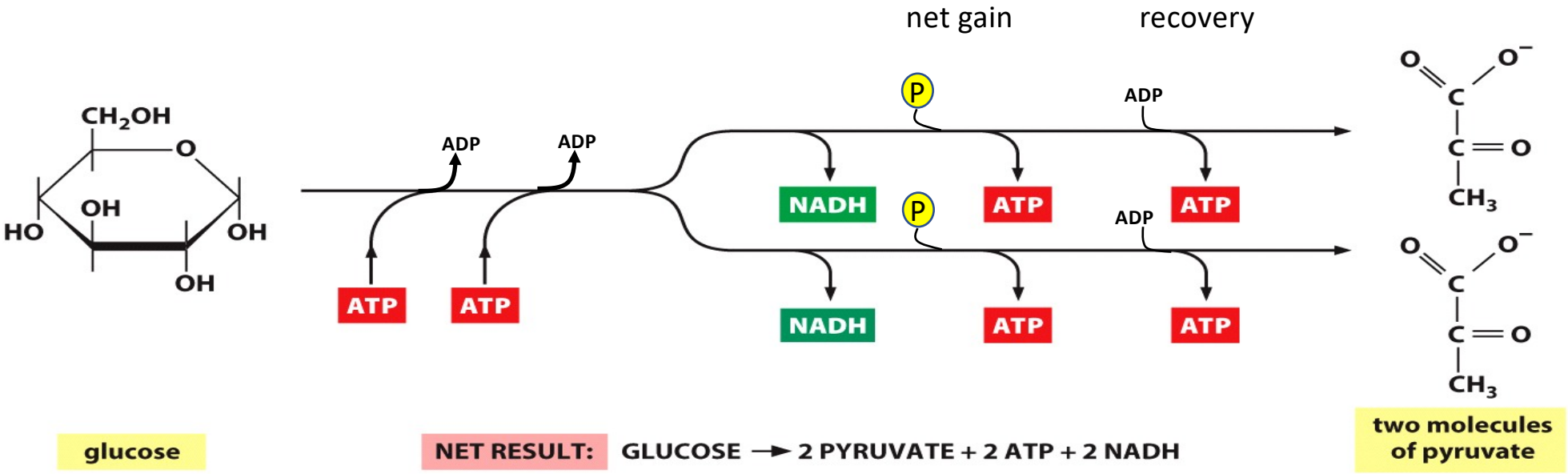
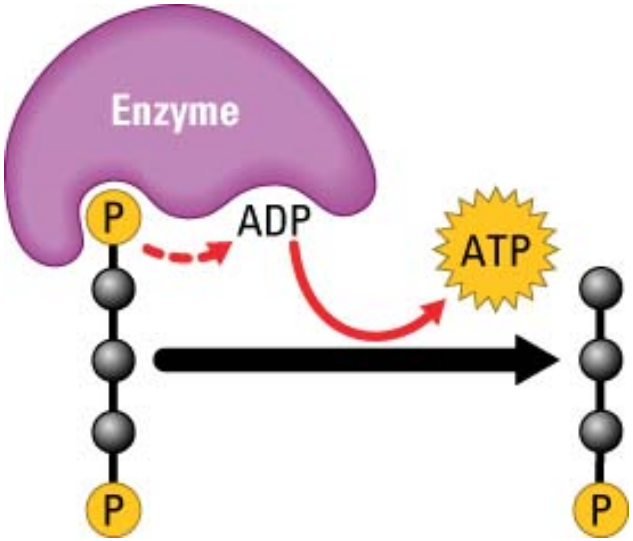


Figure 13-4 Essential Cell Biology, 4th ed. (© Garland Science 2014)

Two ways to synthesize ATP



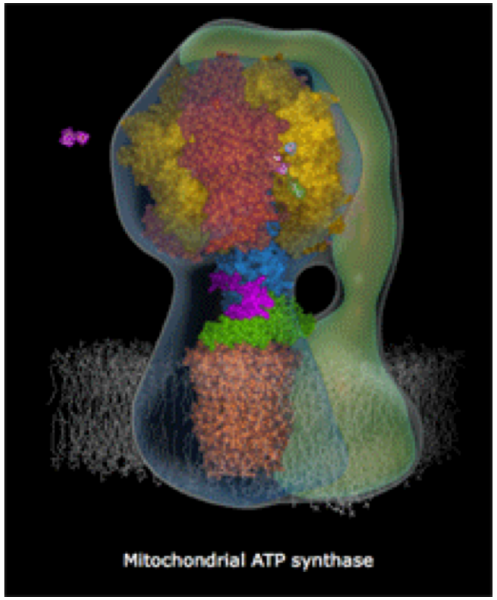
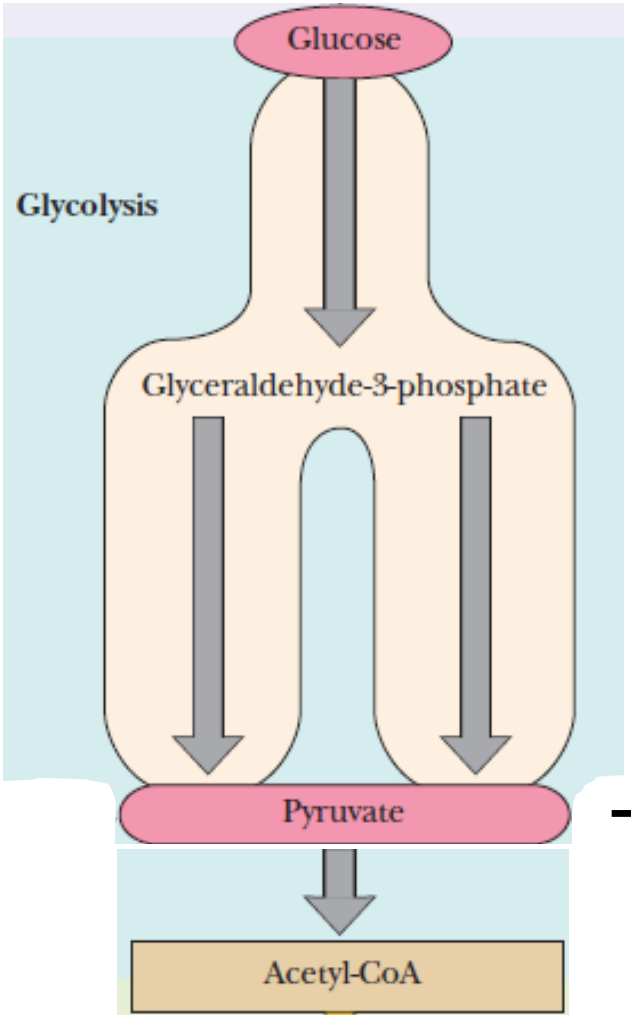


Figure 6.9 ATP synthesis by direct phosphate transfer.
Glycolysis generates ATP when enzymes transfer phosphate groups directly from fuel molecules to ADP.



6.24: David McIntyre.

2 types :

fermentation

when no O_2

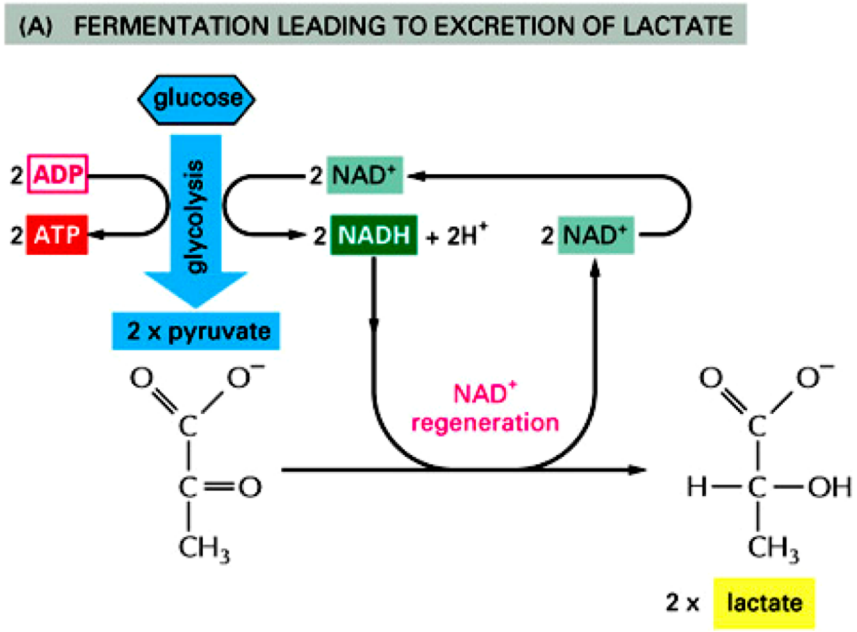
alcoholic fermentation

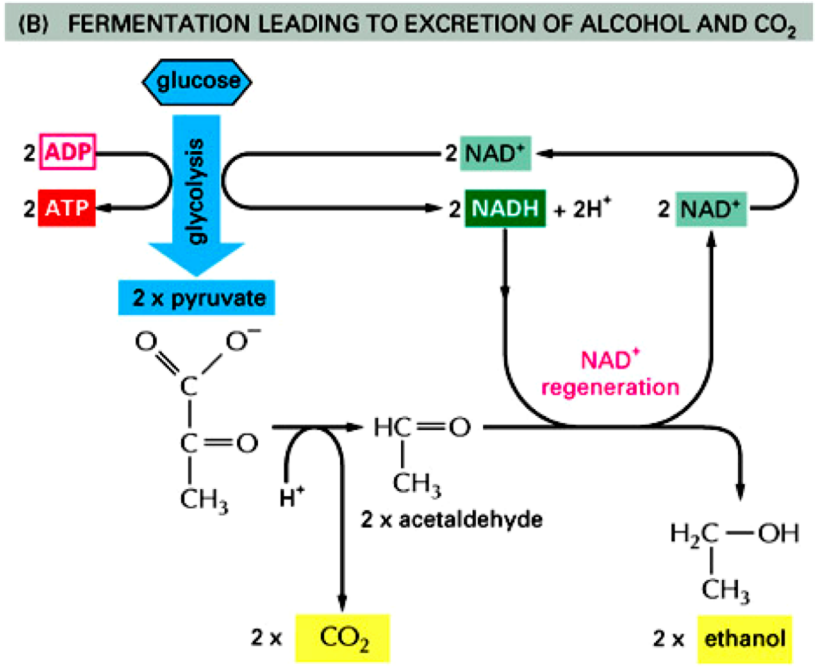
lactic fermentation

From Pyruvate: aerobic and anaerobic oxidation

Aerobic oxidation: Pyruvate + NAD^+ → acetyl-CoA + CO_2 + NADH + H^+
(in mitochondria)

Anaerobic oxidation: Pyruvate + NADH + H^+ → Lactate + NAD^+
(*Fermentation*) *(lactate bacteria)*
Pyruvate + NADH + H^+ → Ethanol + NAD^+ + CO_2
(yeast)

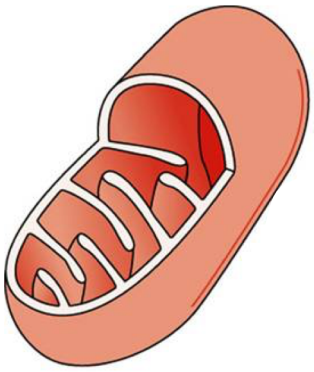




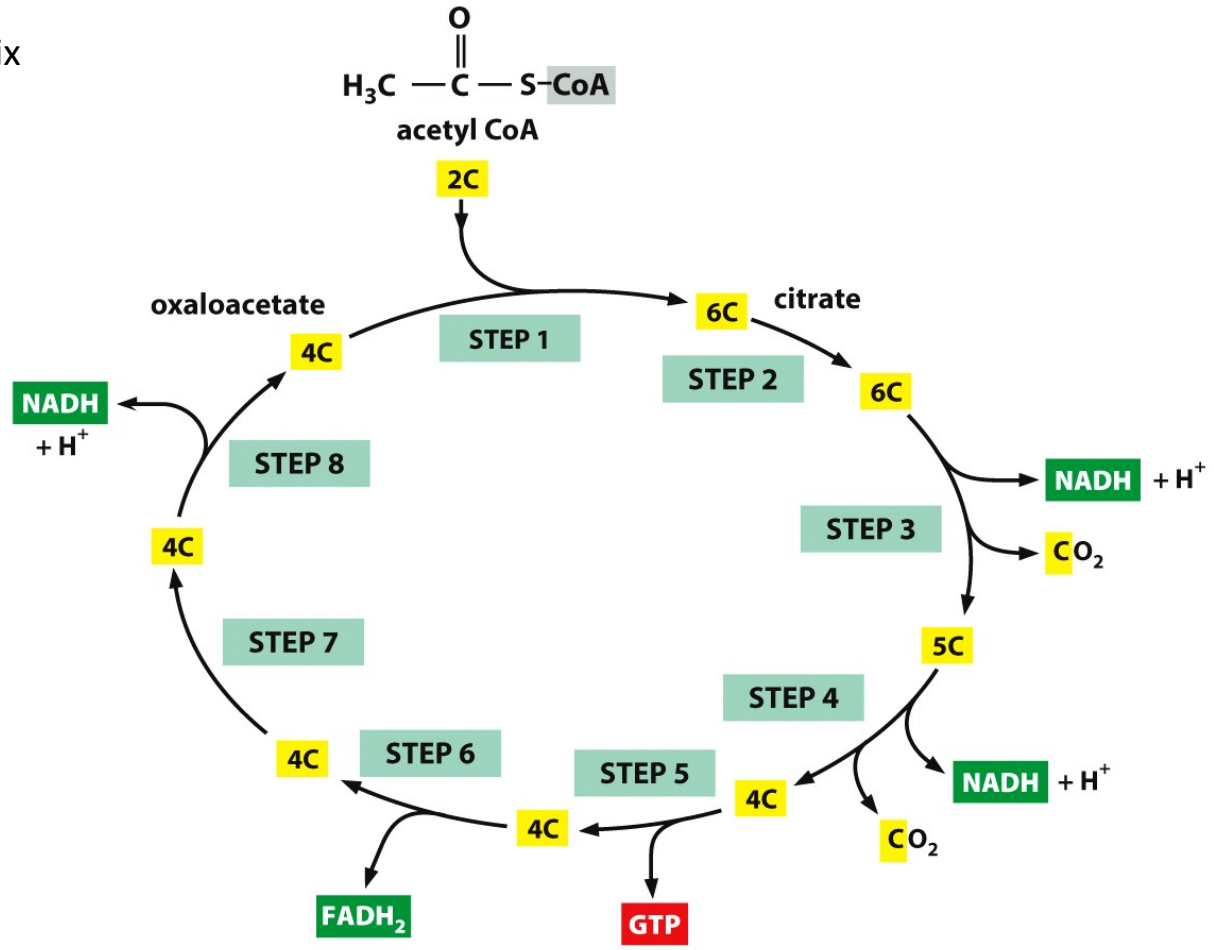
In the mitochondrion

Krebs-cycle (or: Citrate cycle)

in the matrix



Mitochondrion
(ATP synthesis)



NET RESULT: ONE TURN OF THE CYCLE PRODUCES THREE NADH, ONE GTP, AND ONE $FADH_2$, AND RELEASES TWO MOLECULES OF CO_2

Figure 13-12 Essential Cell Biology, 4th ed. (© Garland Science 2014)

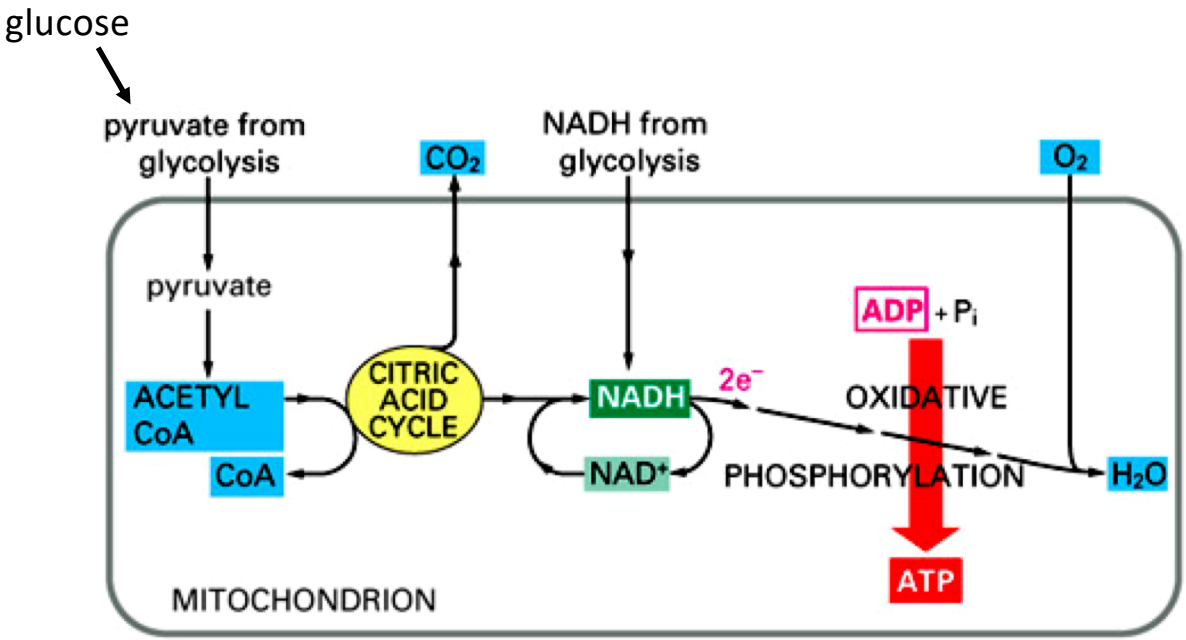
with each round:

3 NAD^+ → 3 NADH
1 GDP → 1 GTP
1 FAD → 1 $FADH_2$
2 CO_2

equivalence

1 ADP + 1 GTP → 1 ATP + 1 GDP

Oxidation of NADH is driving force for ATP synthesis.

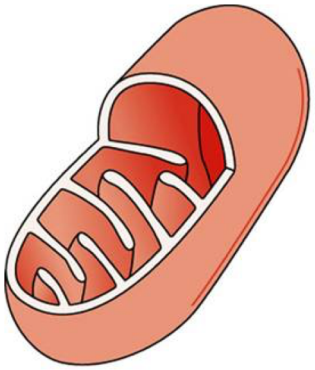


Oxidation of 1 glucose molecule:

2 ATP if only anaerobic fermentation (glycolysis)

32 ATP if glycolysis + Kreb's cycle/oxidative phosphorylation

Oxidative Phosphorylation across the mitochondria inner membrane



Mitochondrion
(ATP synthesis)

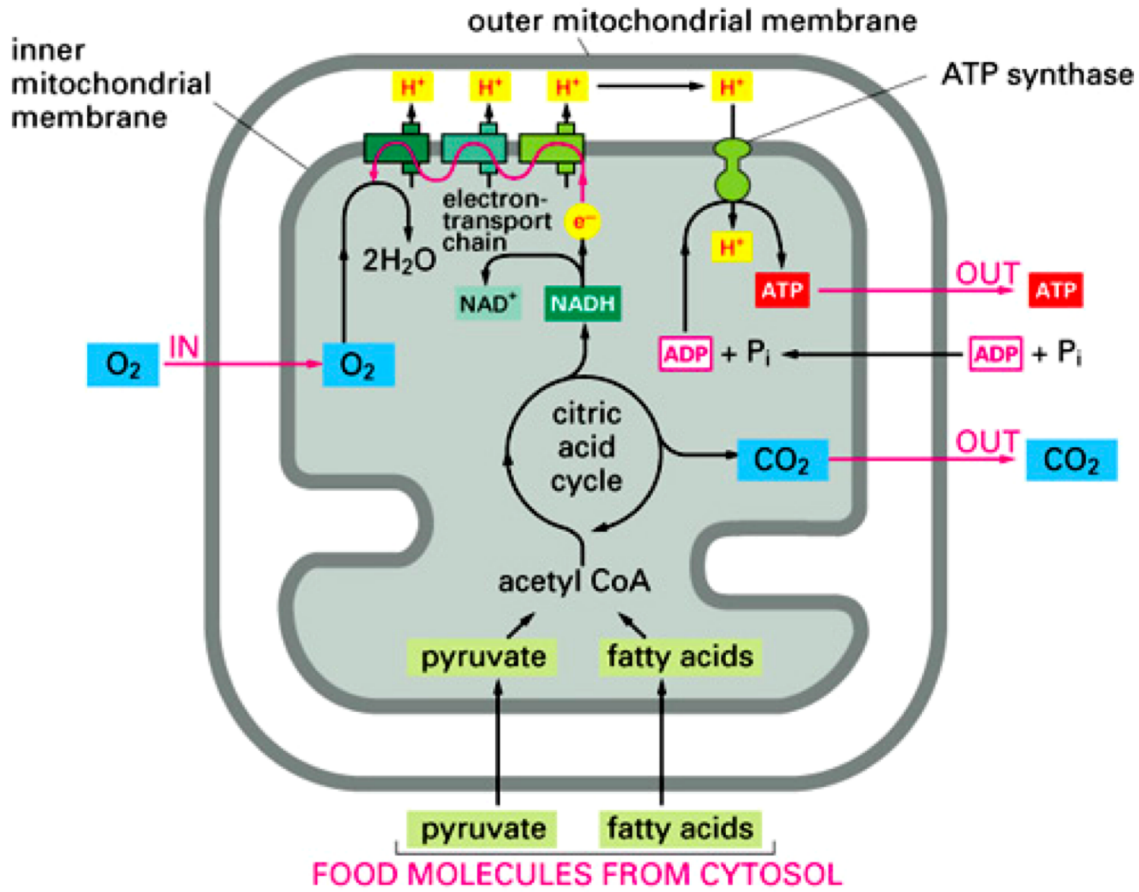
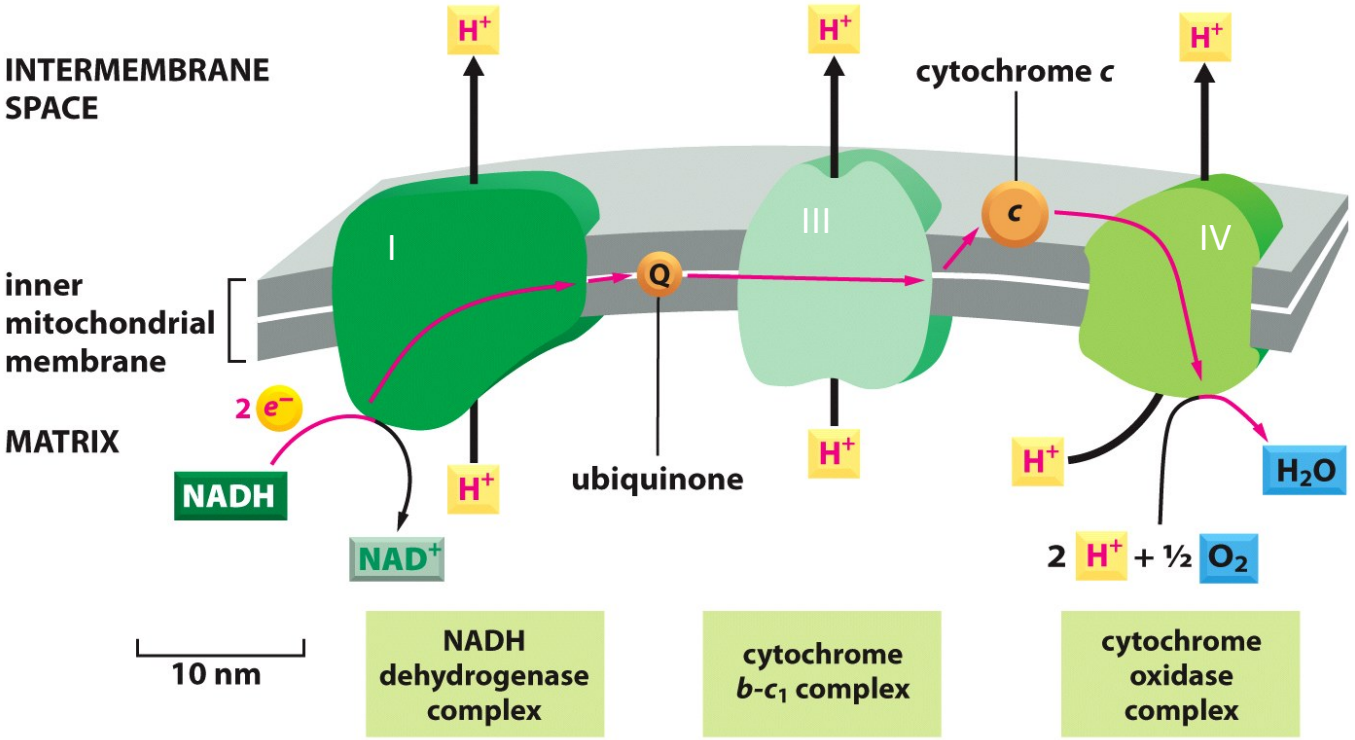


Figure 14-5 Essential Cell Biology, 2/e. (© 2004 Garland Science)

The Respiratory chain of electron carriers

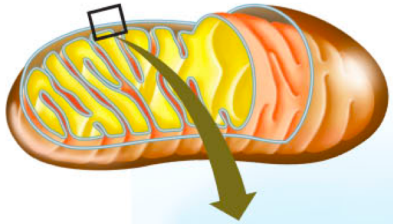


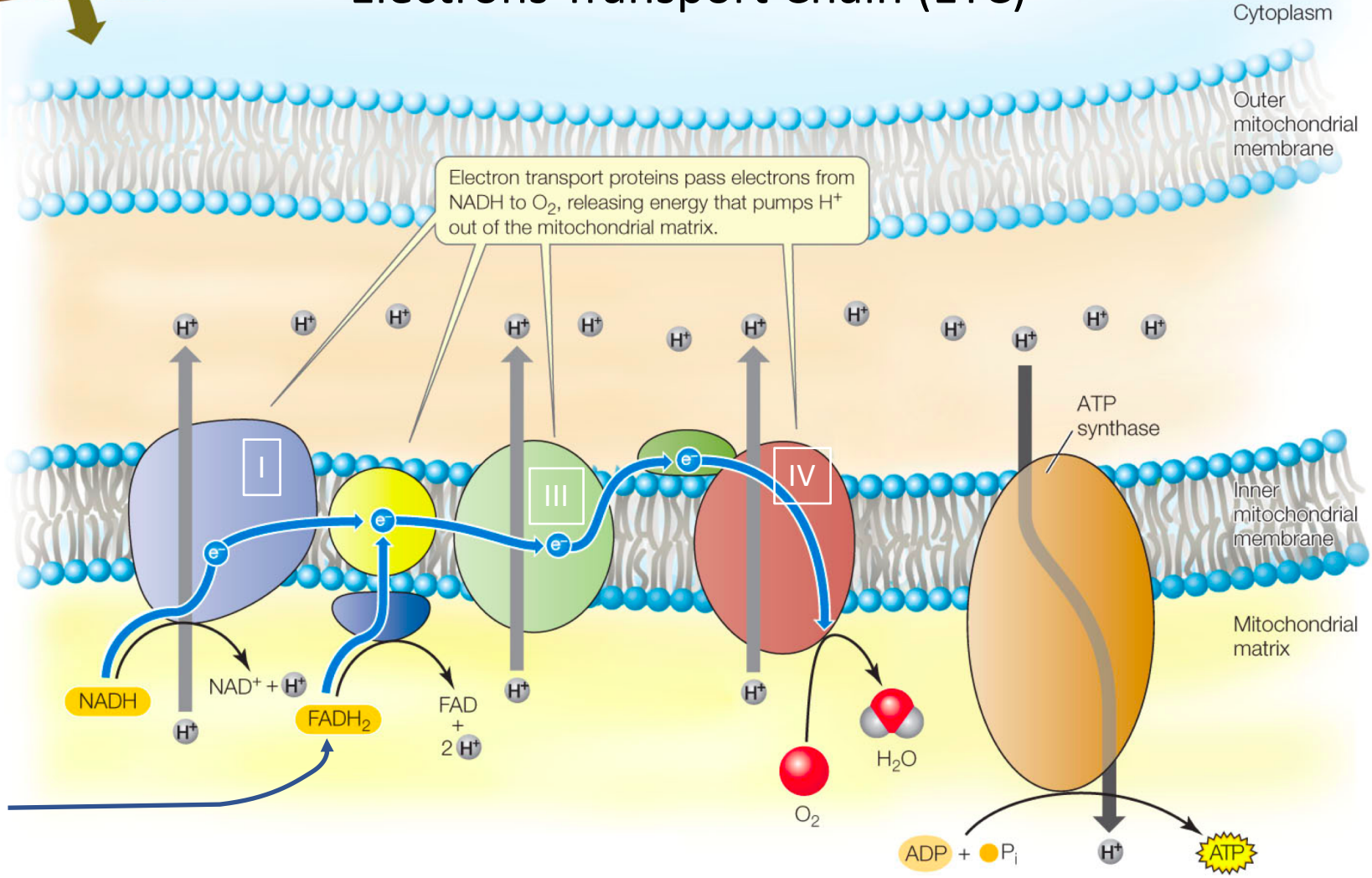
3 complexes of electron acceptors/donors
2 shuttles : ubiquinone cytochrome c

at the end: onto oxygen -> water

ΔG of electron transport chain: used to pump H^+ across inner membrane
-> electrochemical gradient

Electrons Transport Chain (ETC)





Kreb's cycle :

3 NADH

1 $FADH_2$

Electrochemical H^+ gradient is created

"energy store" due to charge gradient

"energy store" due to concentration gradient

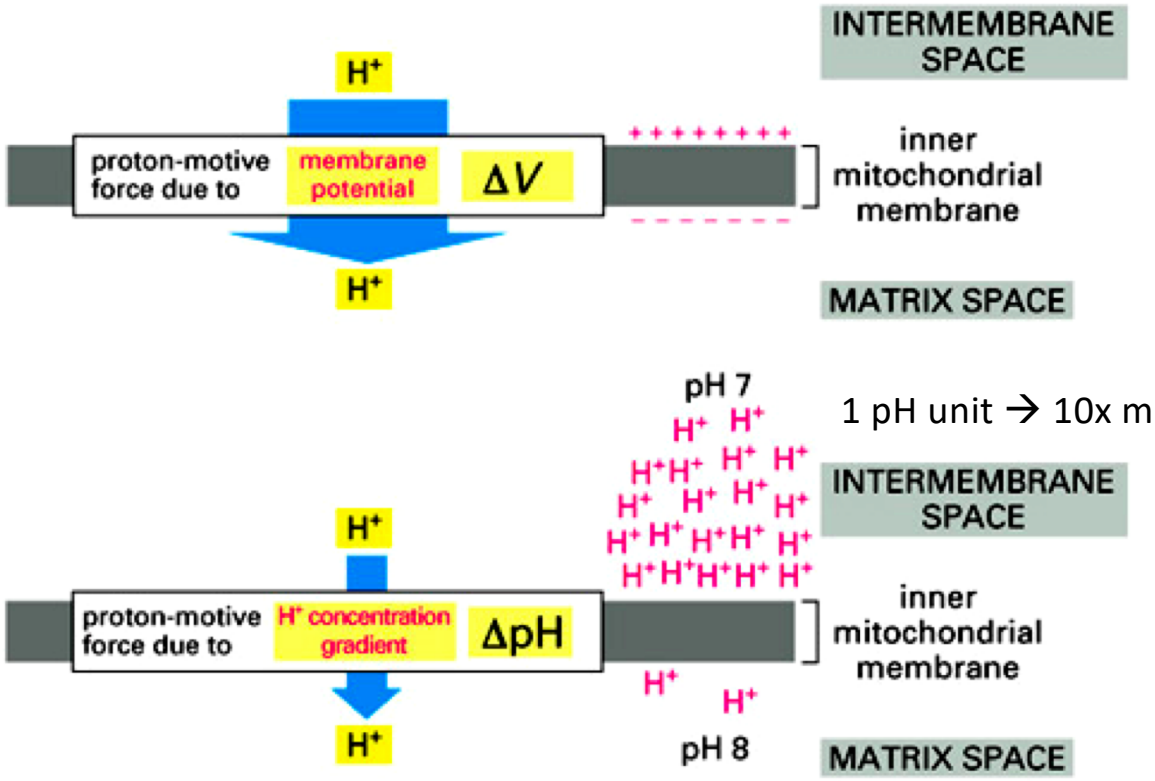
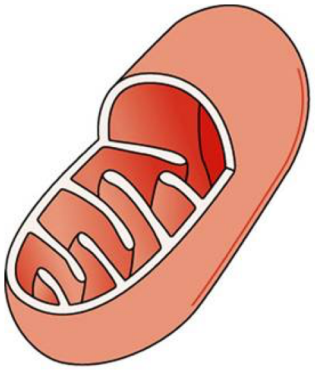
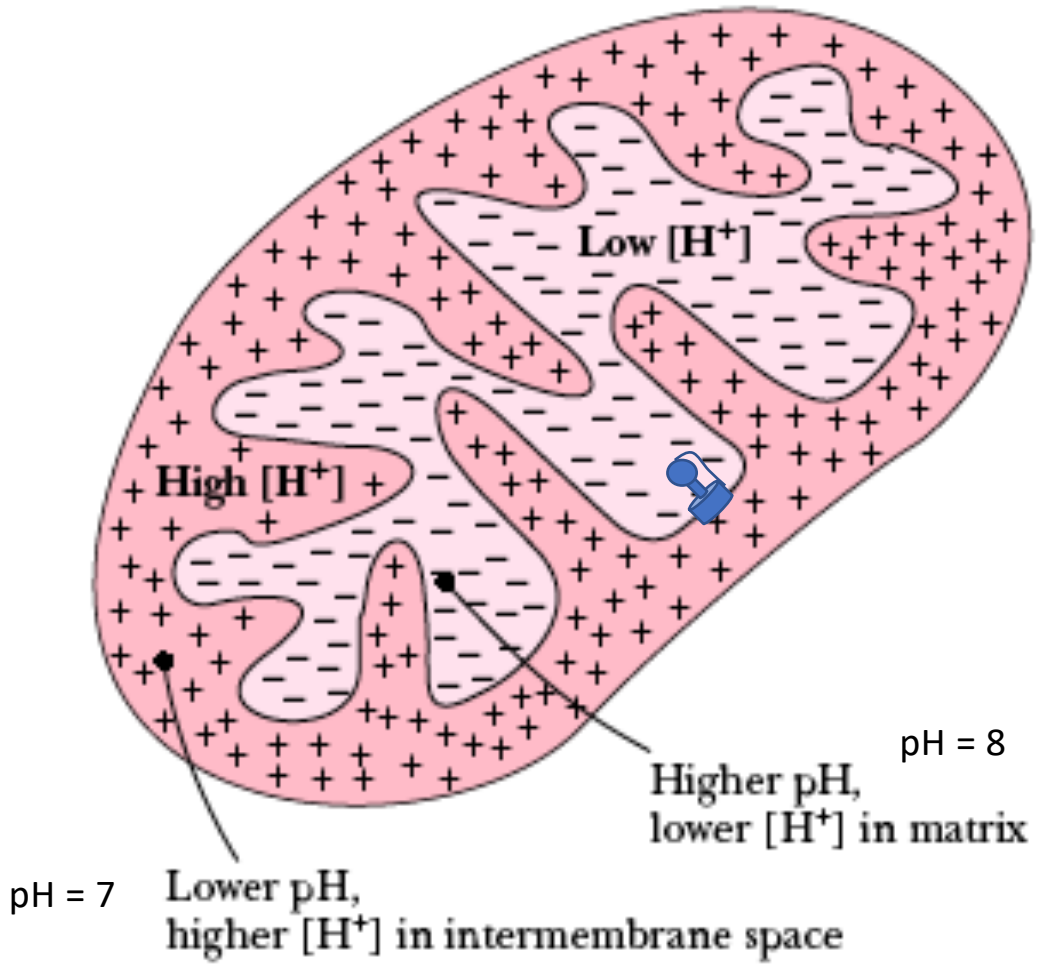


Figure 14-12 Essential Cell Biology, 2/e. (© 2004 Garland Science)

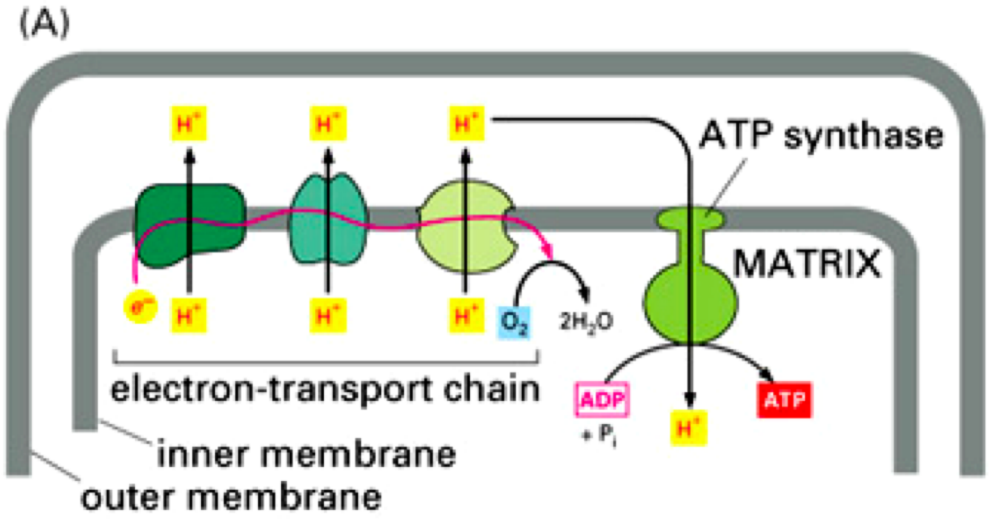


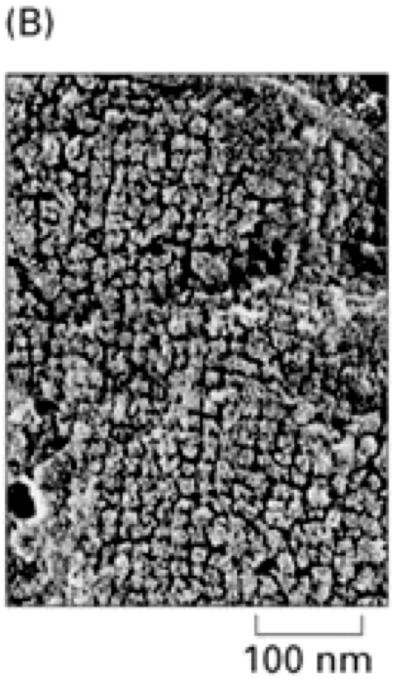
Mitochondrion
(ATP synthesis)

Electron transport drives H^+ out and creates an electrochemical gradient



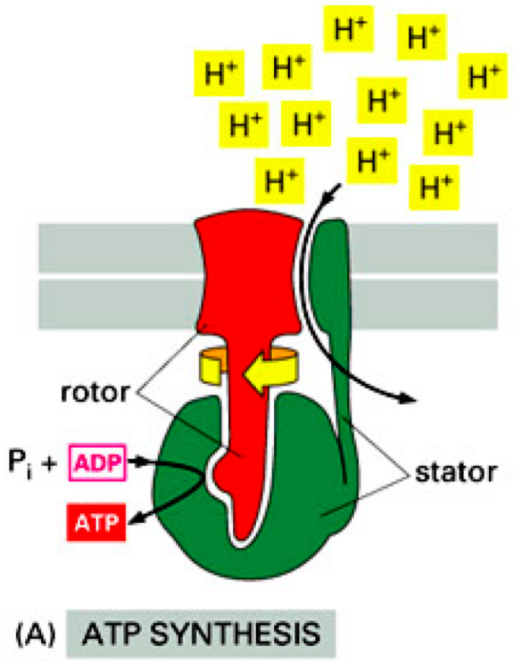
Energy stored in H^+ gradient is used for ATP synthesis

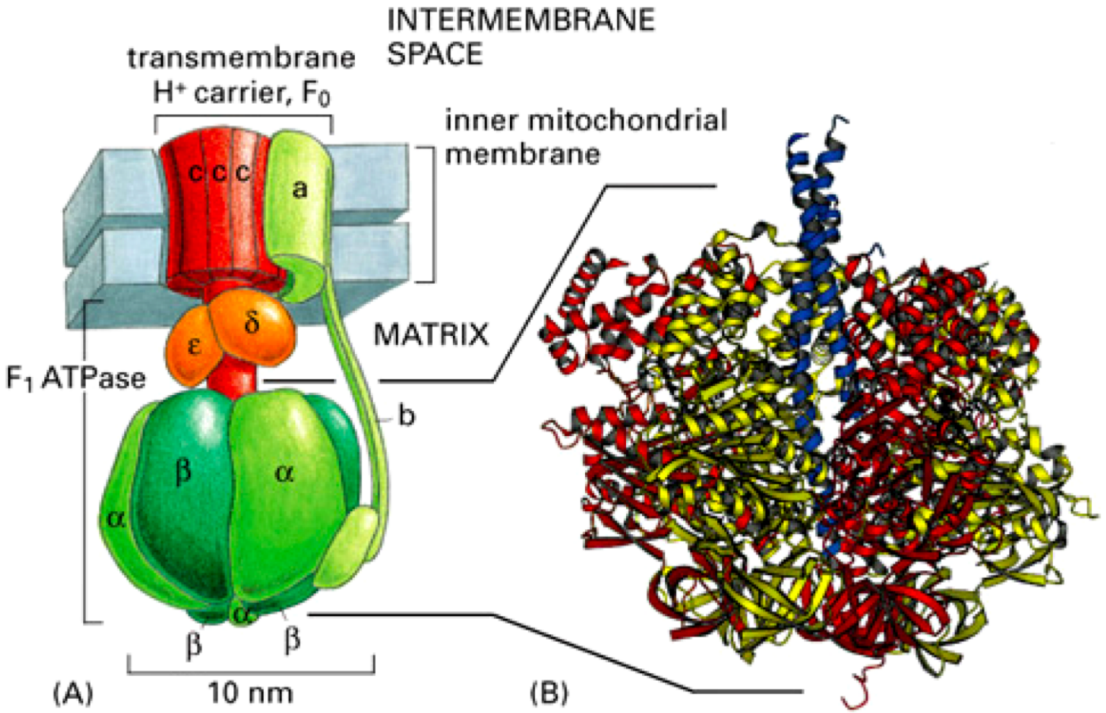




The inner membrane is covered with proteins

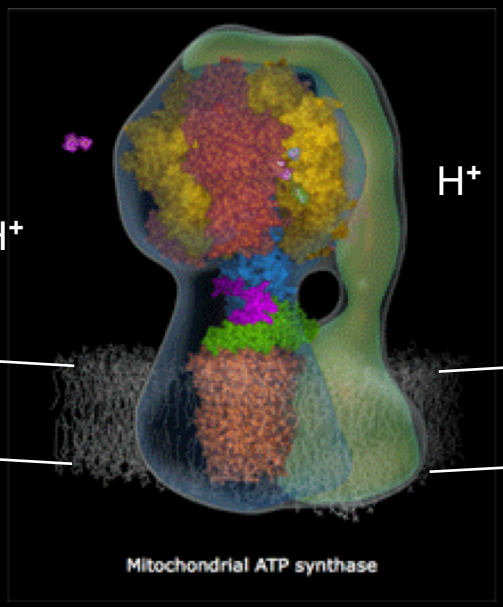
The mitochondrial ATP synthase





- rotor domain turns due to proton flow ->mechanical energy
- drives synthesis of ATP
- 100 ATP molecules per second
- flow of 4 protons needed per ATP

ATPsynthase

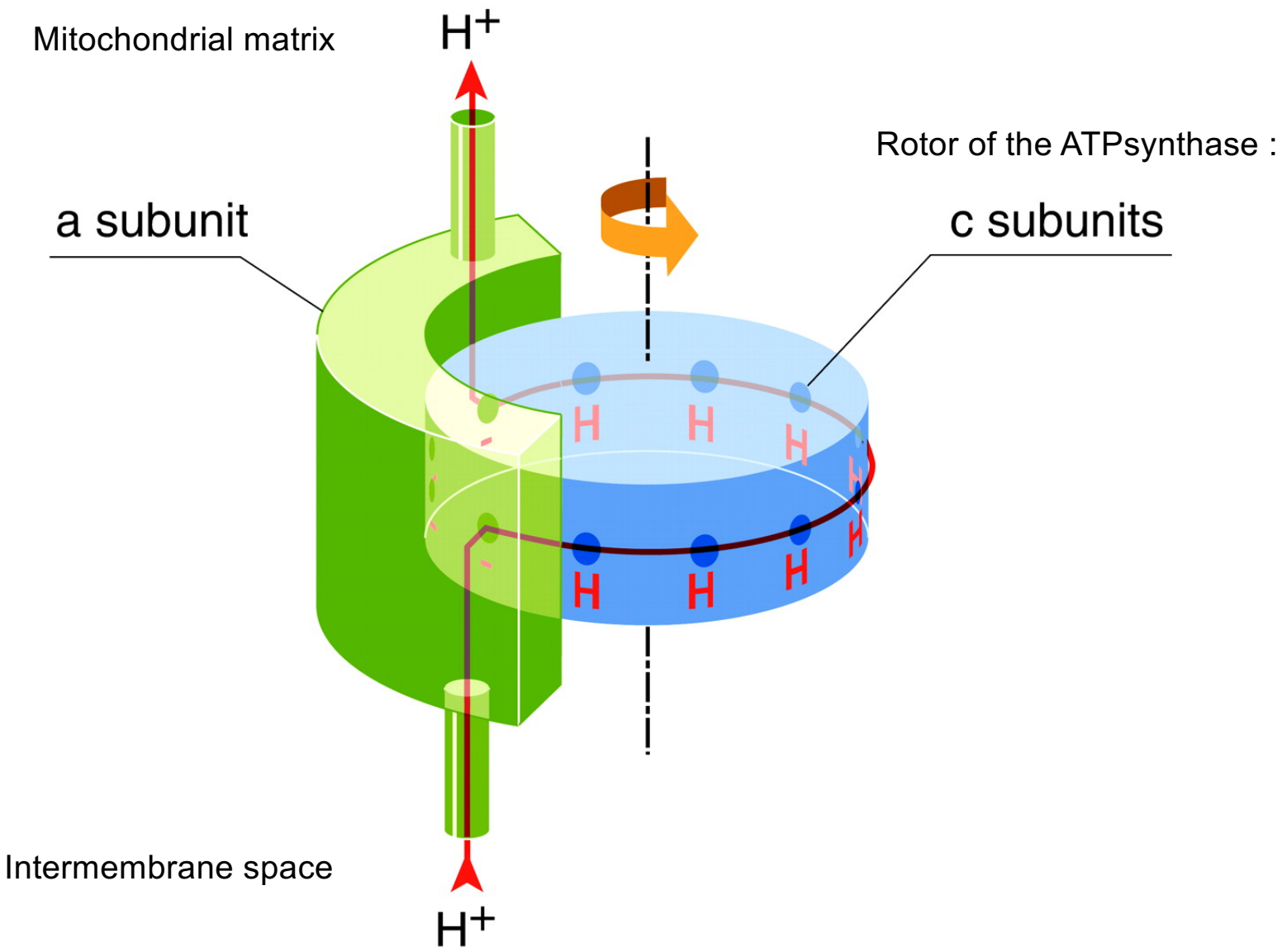


H+ H+ H+

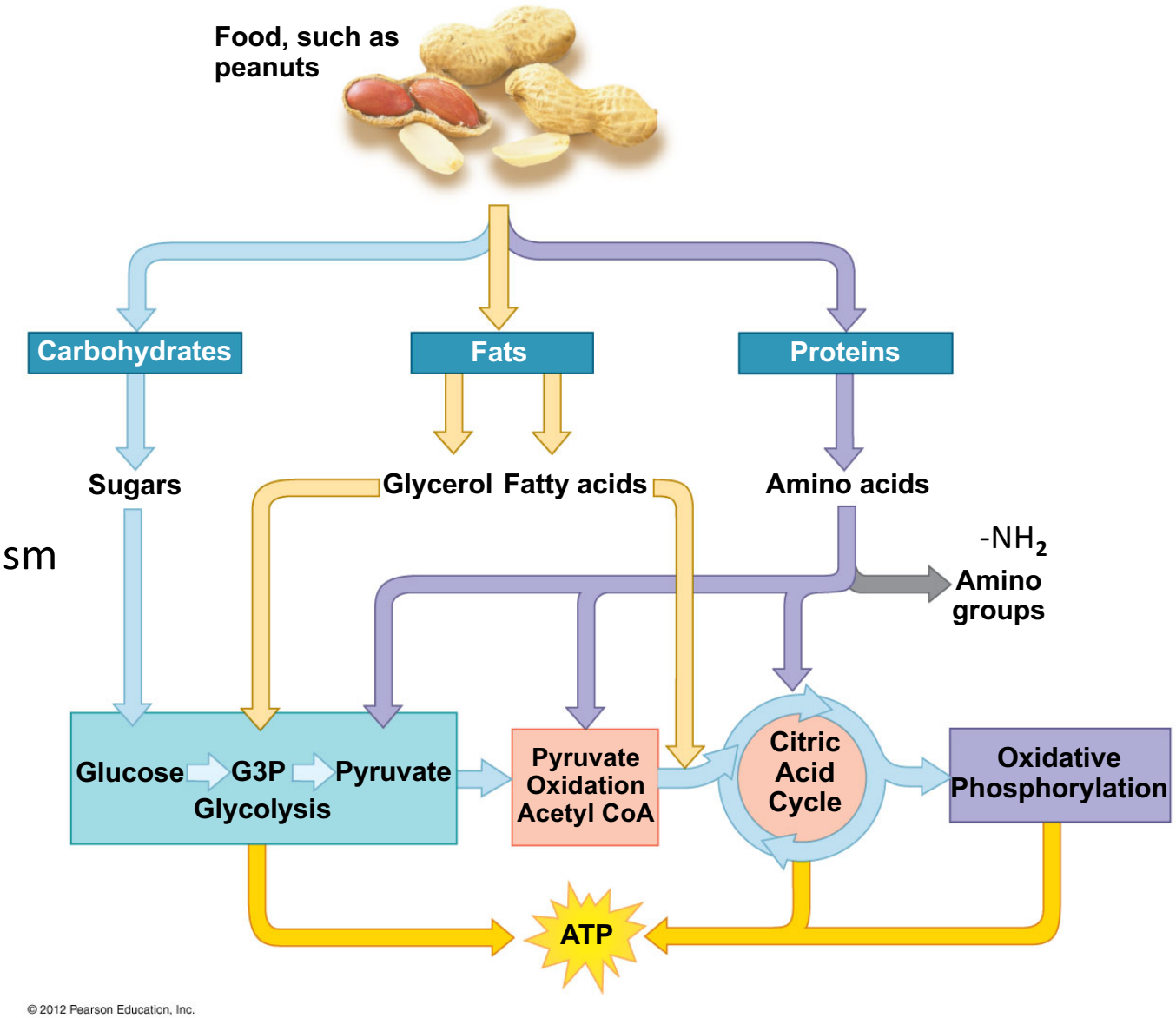
Mitochondrial matrix

Intermembrane space

H+ H+ H+ H+ H+ H+ H+ H+ H+ H+ H+ H+ H+ H+ H+

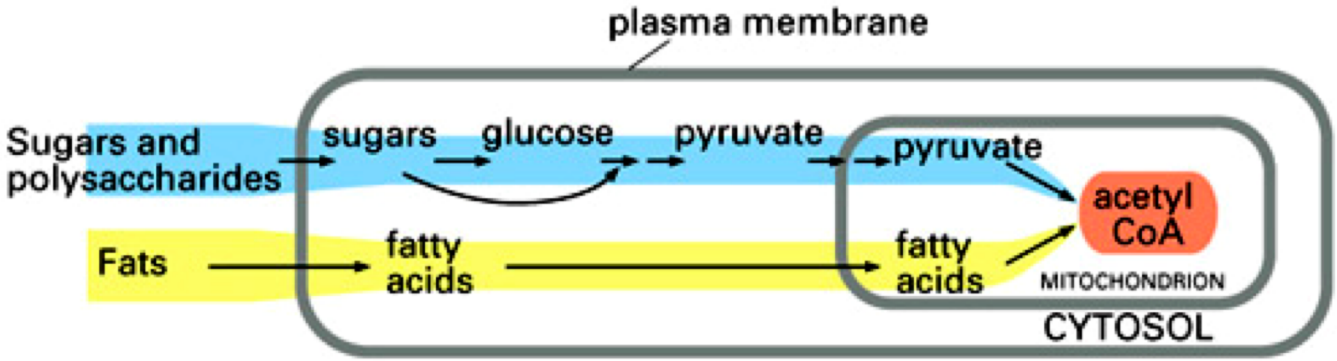

Mitochondrial matrix
H+
Rotor of the ATPsynthase :
a subunit
c subunits
H
H
H
H
H
H
H
H
Intermembrane space
H+

Study in details glucose metabolism



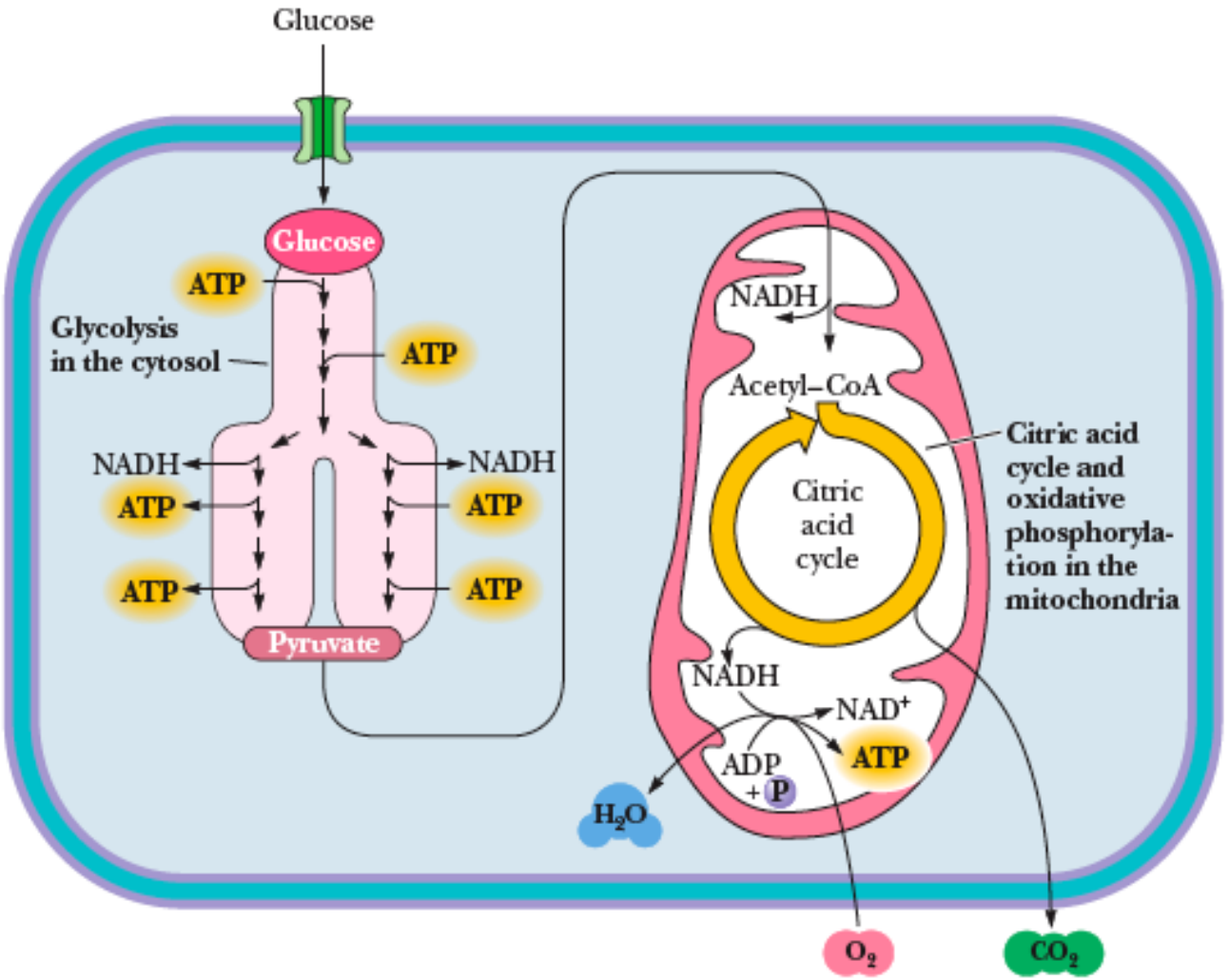
Metabolism of fat:

-> Both sugars and fat are broken down into acetyl-CoA

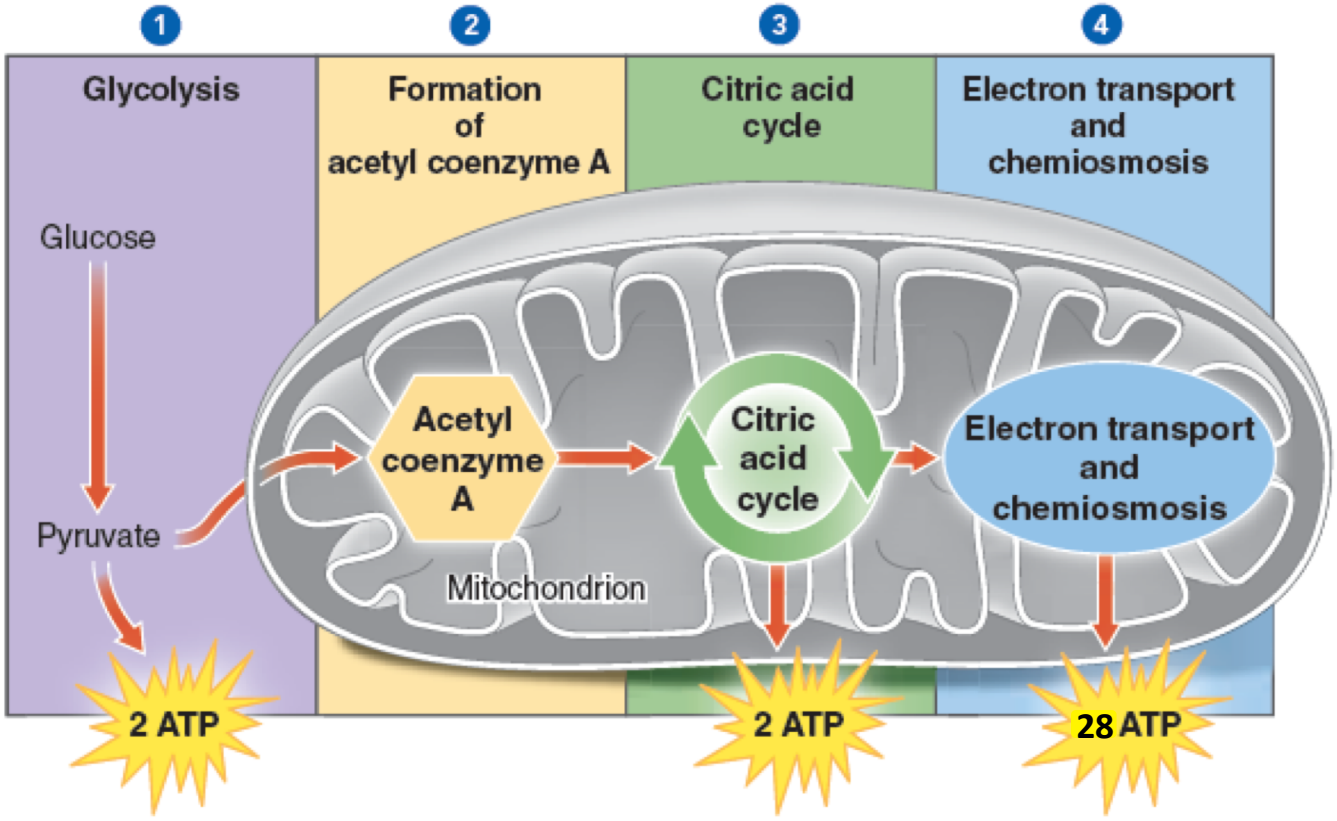


Summary

ATP production from fuel (glucose)



Summary


1
2
3
4
Glycolysis
Formation of acetyl coenzyme A
Citric acid cycle
Electron transport and chemiosmosis
Glucose
Pyruvate
Acetyl coenzyme A
Citric acid cycle
Electron transport and chemiosmosis
Mitochondrion
2 ATP
2 ATP
28 ATP