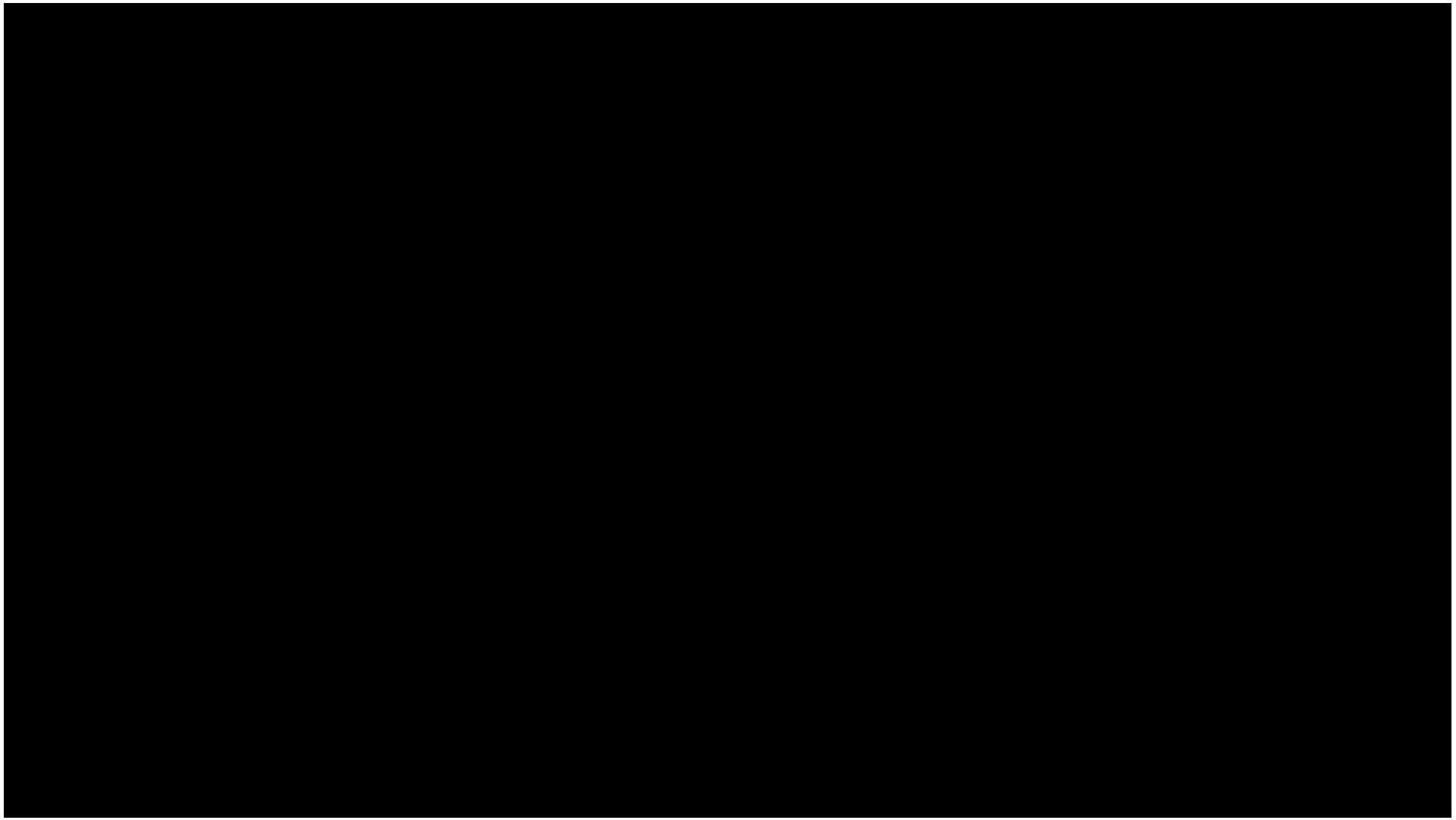
Fosforilação oxidativa

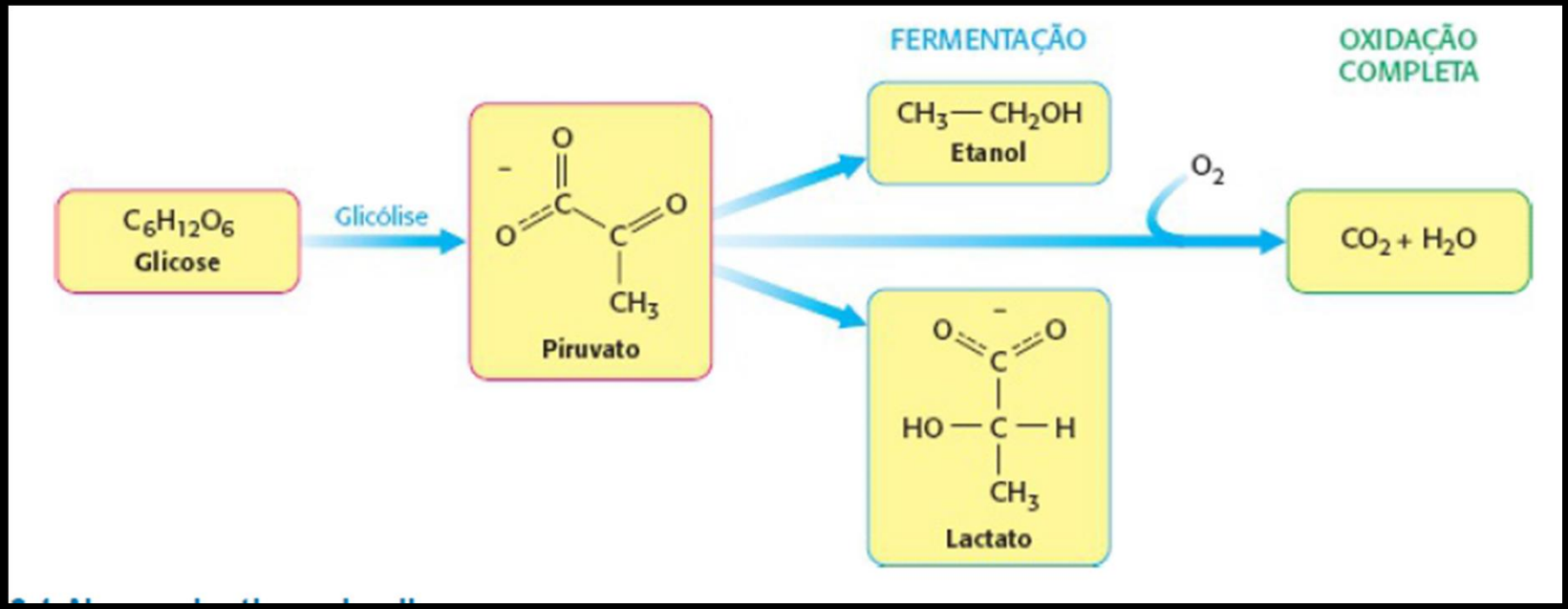
Ronaldo Bento Quaggio

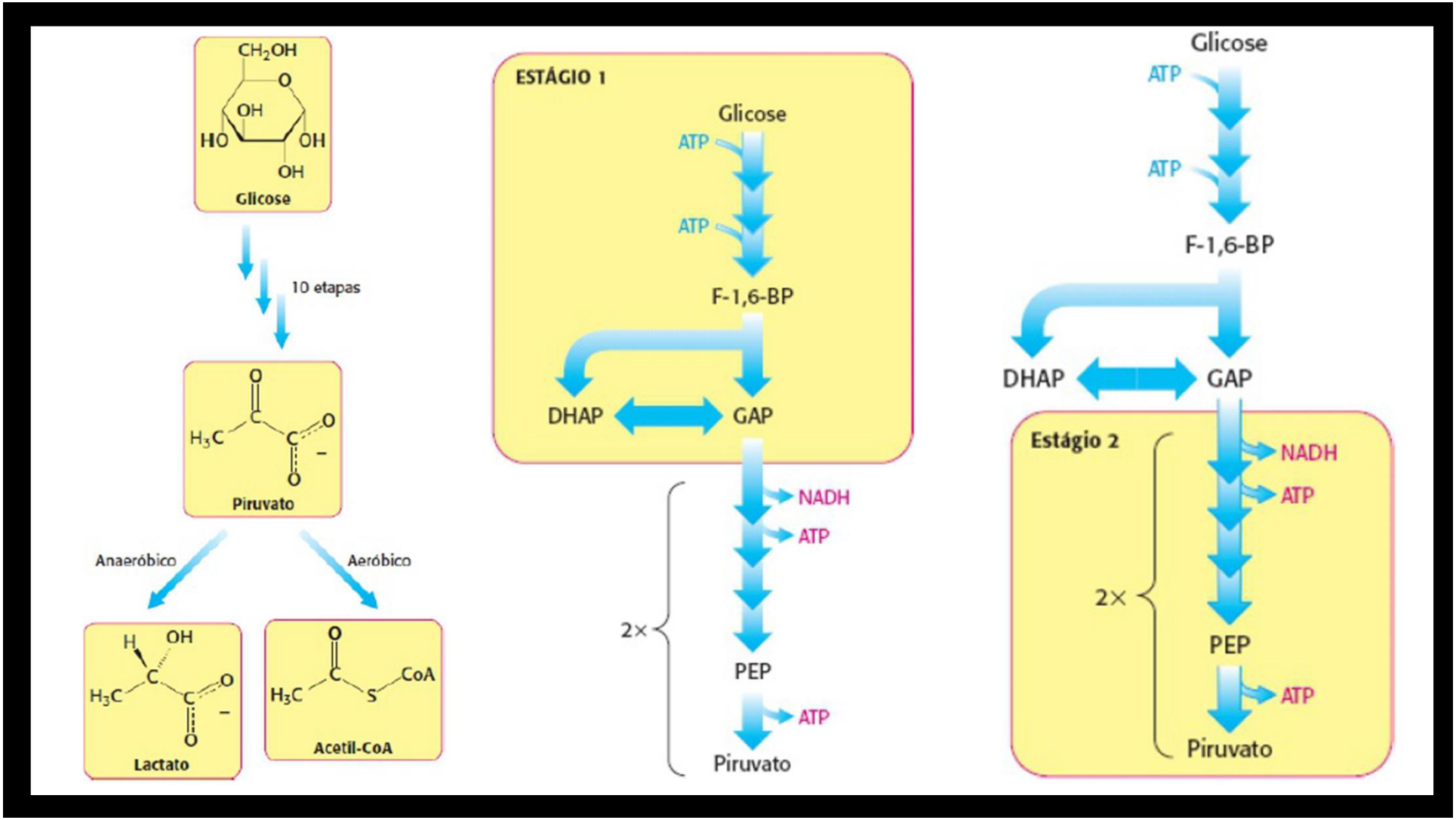
QBQ0204 - Bioquímica
Estrutura de Biomoléculas e Metabolismo

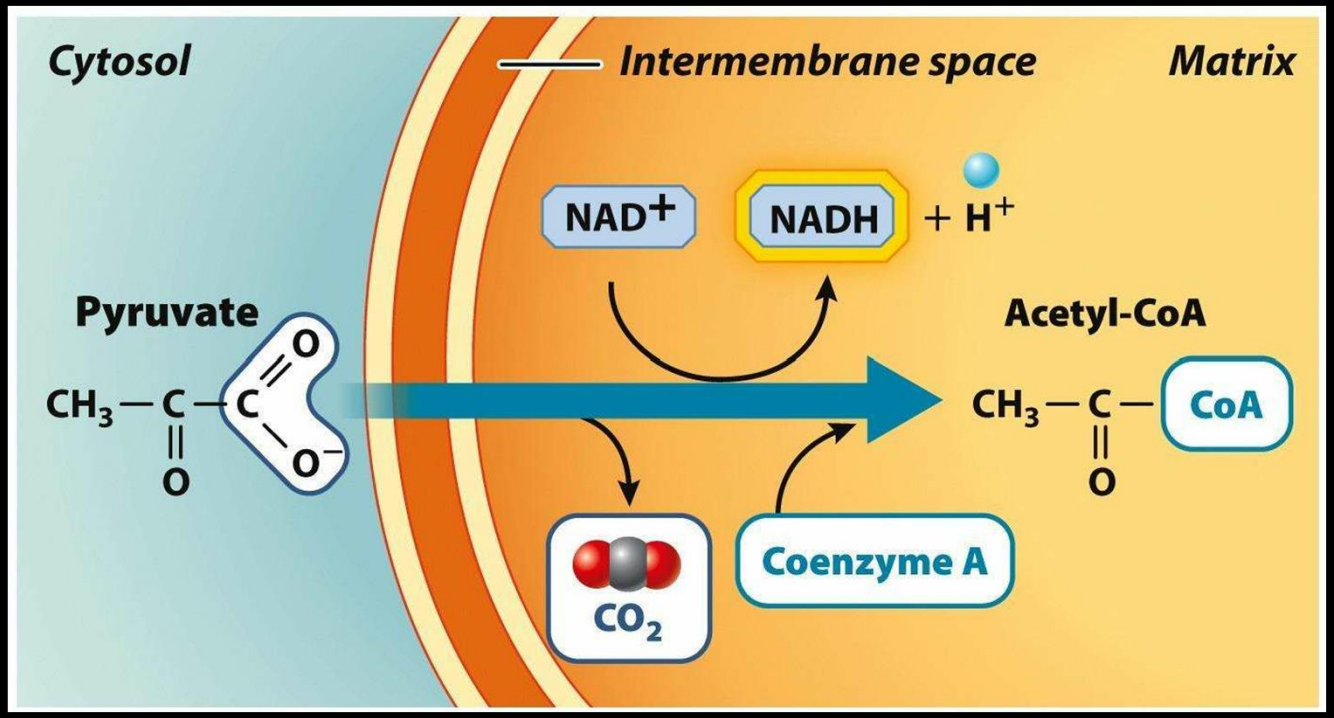


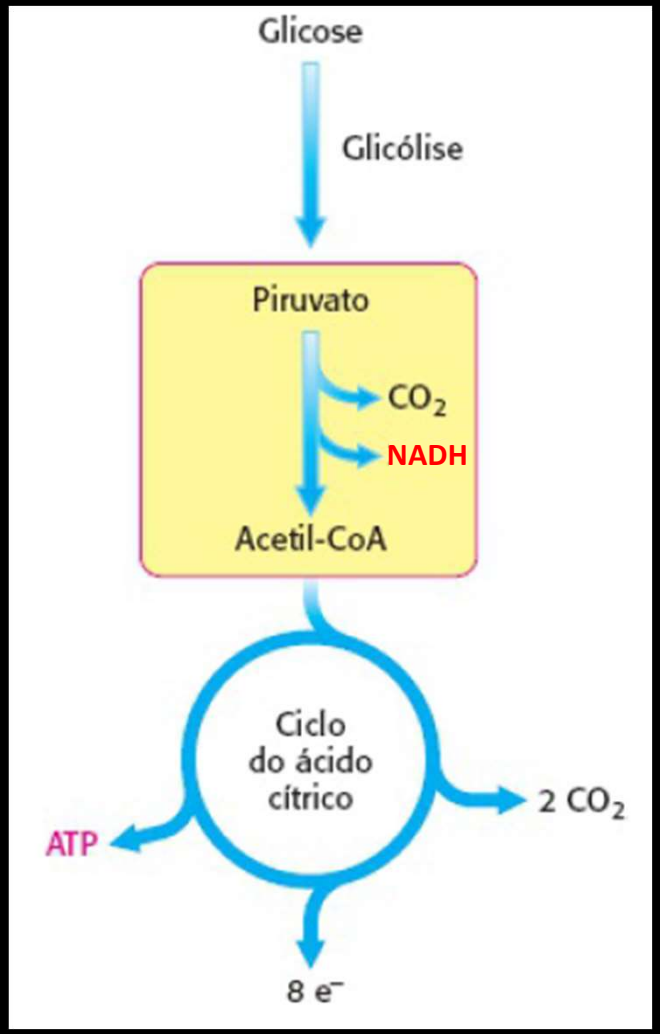
Uso diário de ATP	g ATP / g tecido
Coração	16,0
Cérebro	6,0
Rins	24,0
Fígado	6,0
Musculo Esquelético (repouso)	0,3
Musculo Esquelético (correndo)	23,6

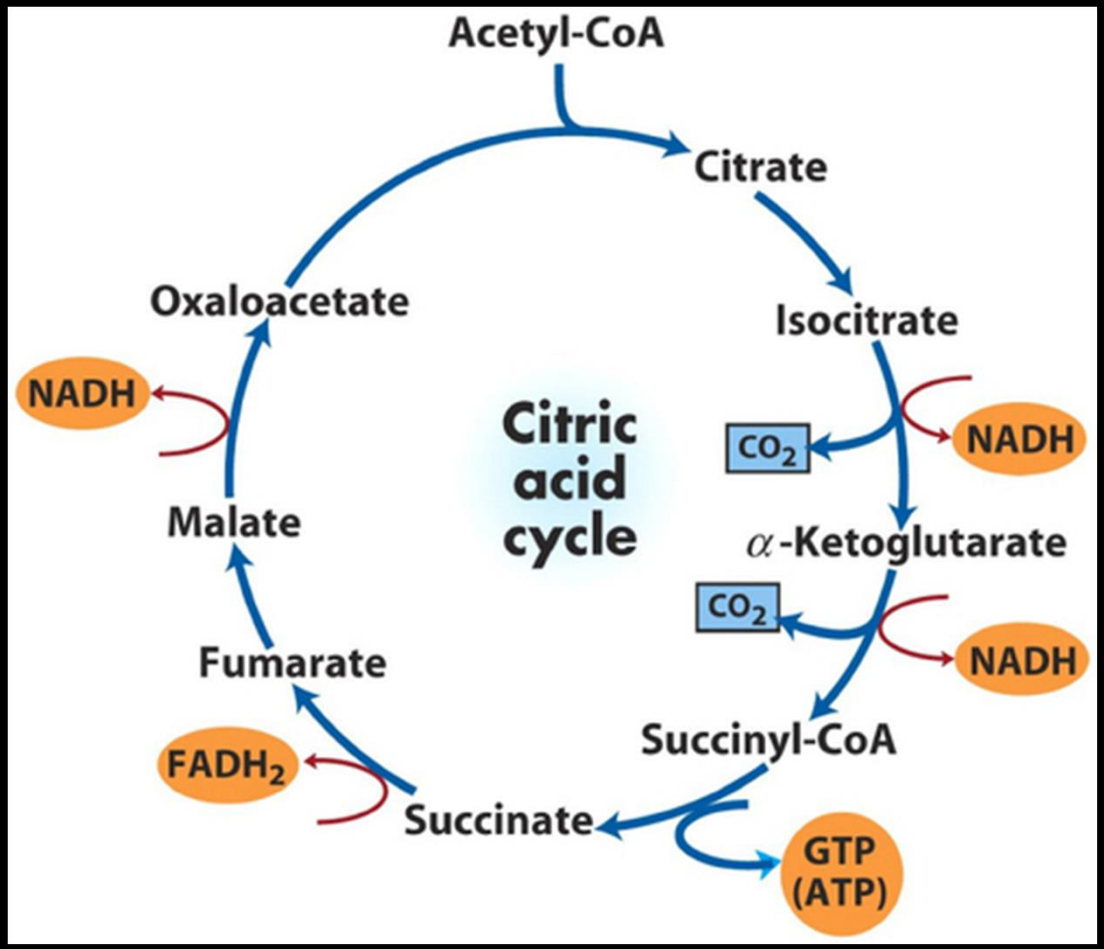
ATP - Curiosidades
Geralmente não é sintetizado *de novo*
Sempre obtido por reciclagem de ADP (quantidade de ATP + ADP permanece constante)
Quantidade total de ATP + ADP no organismo – 100g
Indivíduo em repouso – 40 kg de ATP em 24 horas
Esforço vigoroso – 0,5 kg/ minuto
Corrida de 2 h – 60 kg de ATP

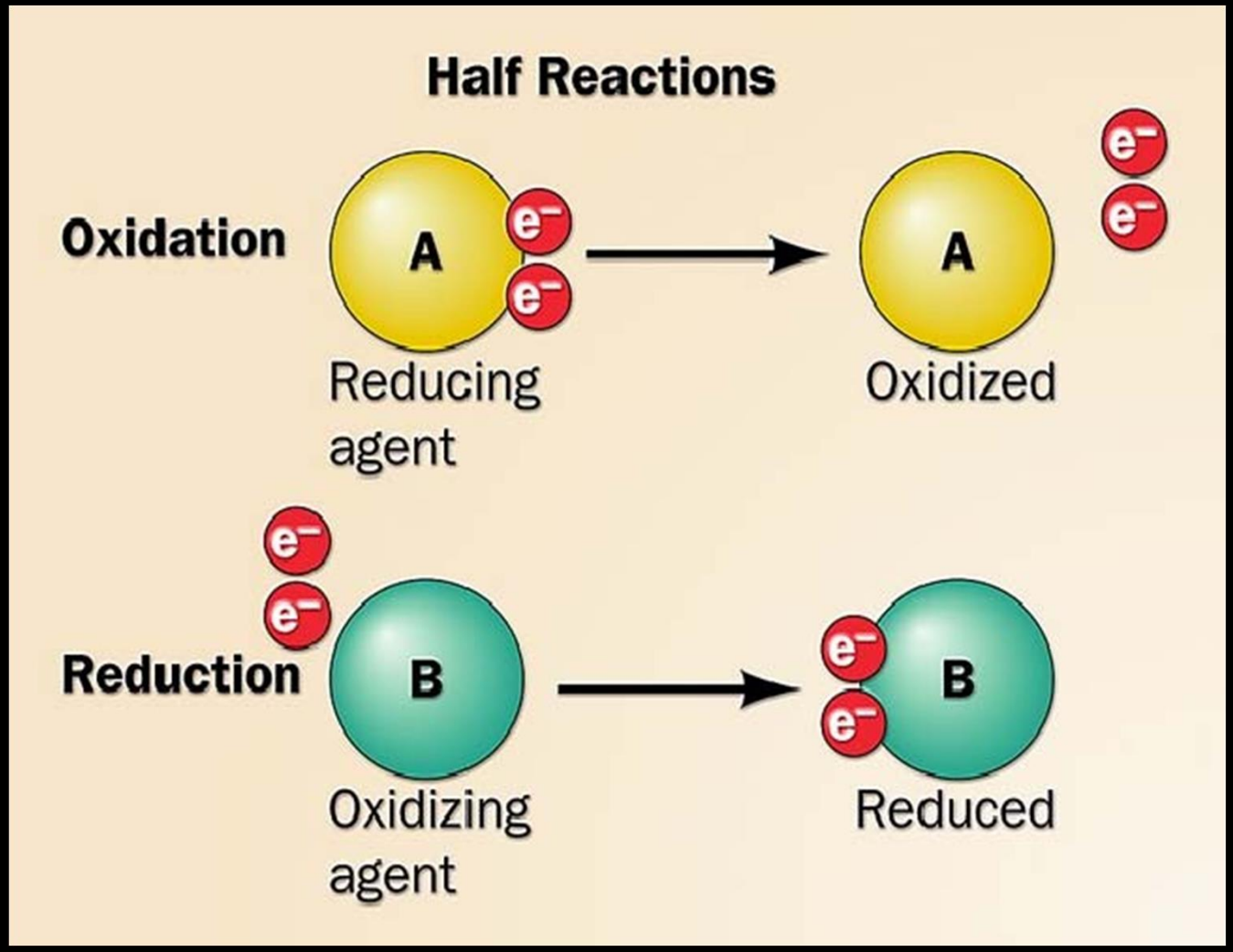

FERMENTAÇÃO
OXIDAÇÃO COMPLETA
$C_6H_{12}O_6$
Glicose
Glicólise
Piruvato
$CH_3 — CH_2OH$
Etanol
O_2
$CO_2 + H_2O$
Lactato

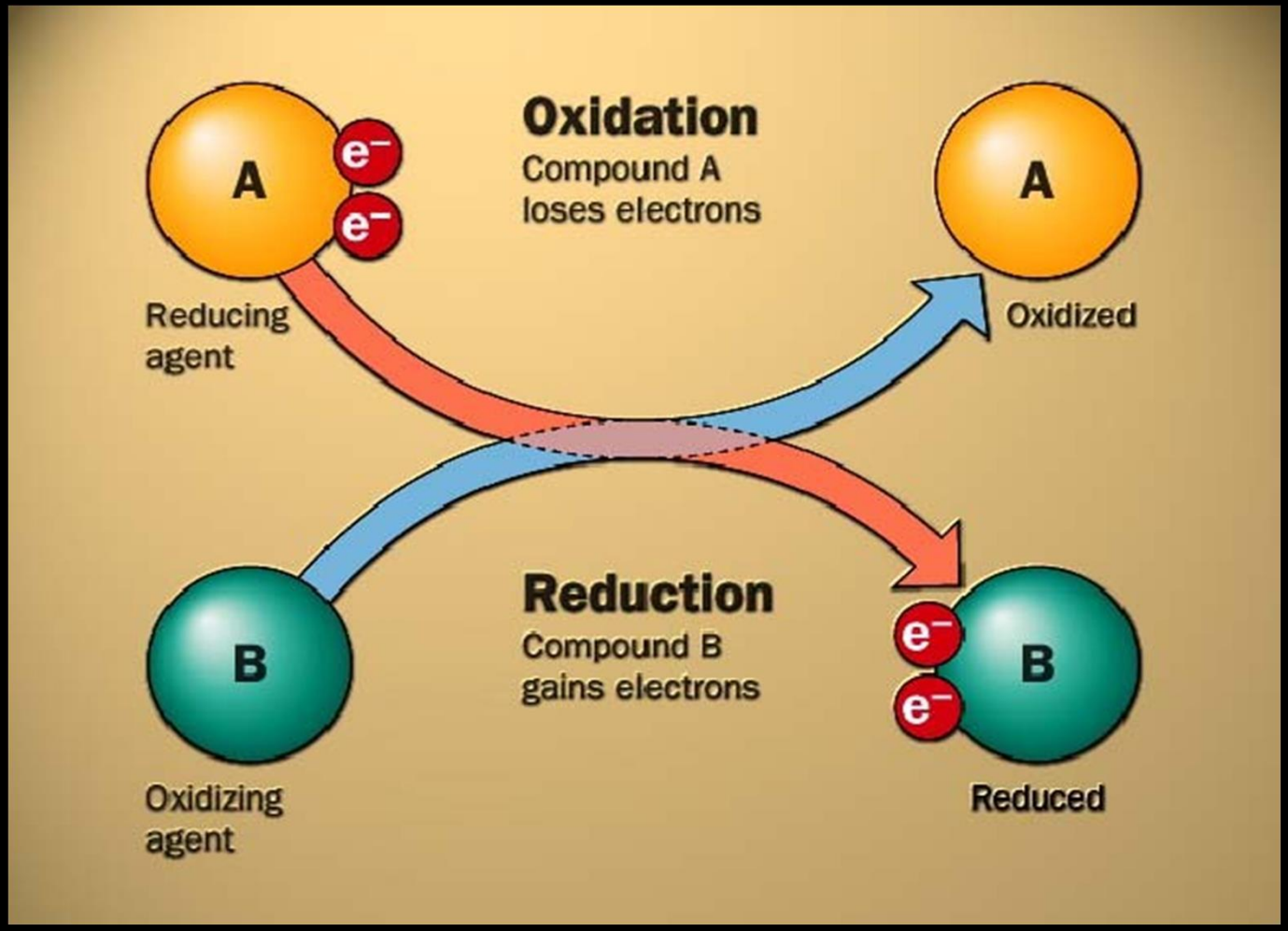

Glicose
10 etapas
Piruvato
Anaeróbico
Aeróbico
Lactato
Acetil-CoA
ESTÁGIO 1
Glicose
ATP
ATP
F-1,6-BP
DHAP
GAP
NADH
ATP
2×
PEP
ATP
Piruvato
Glicose
ATP
ATP
F-1,6-BP
DHAP
GAP
Estágio 2
NADH
ATP
2×
PEP
ATP
Piruvato

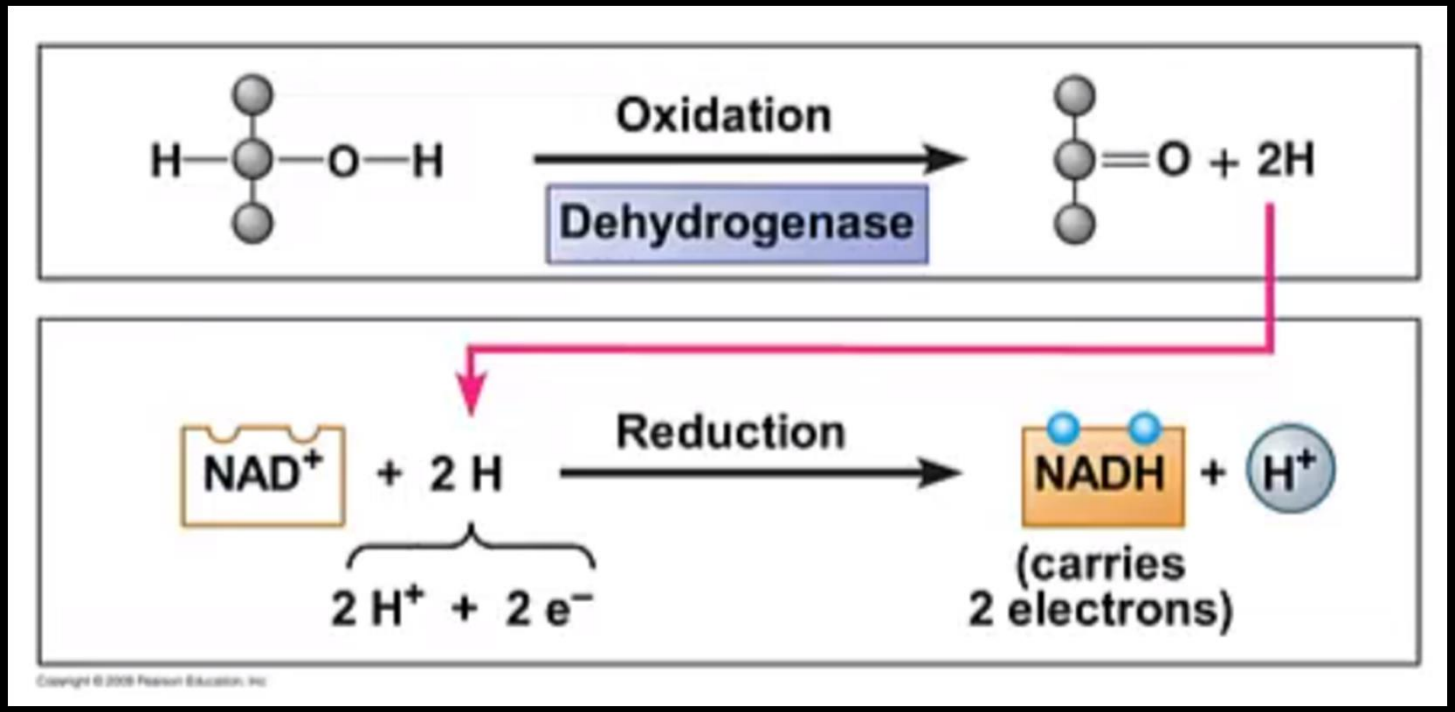

Cytosol
Intermembrane space
Matrix
NAD+
NADH
+ H+
Pyruvate
Acetyl-CoA
CoA
CO2
Coenzyme A

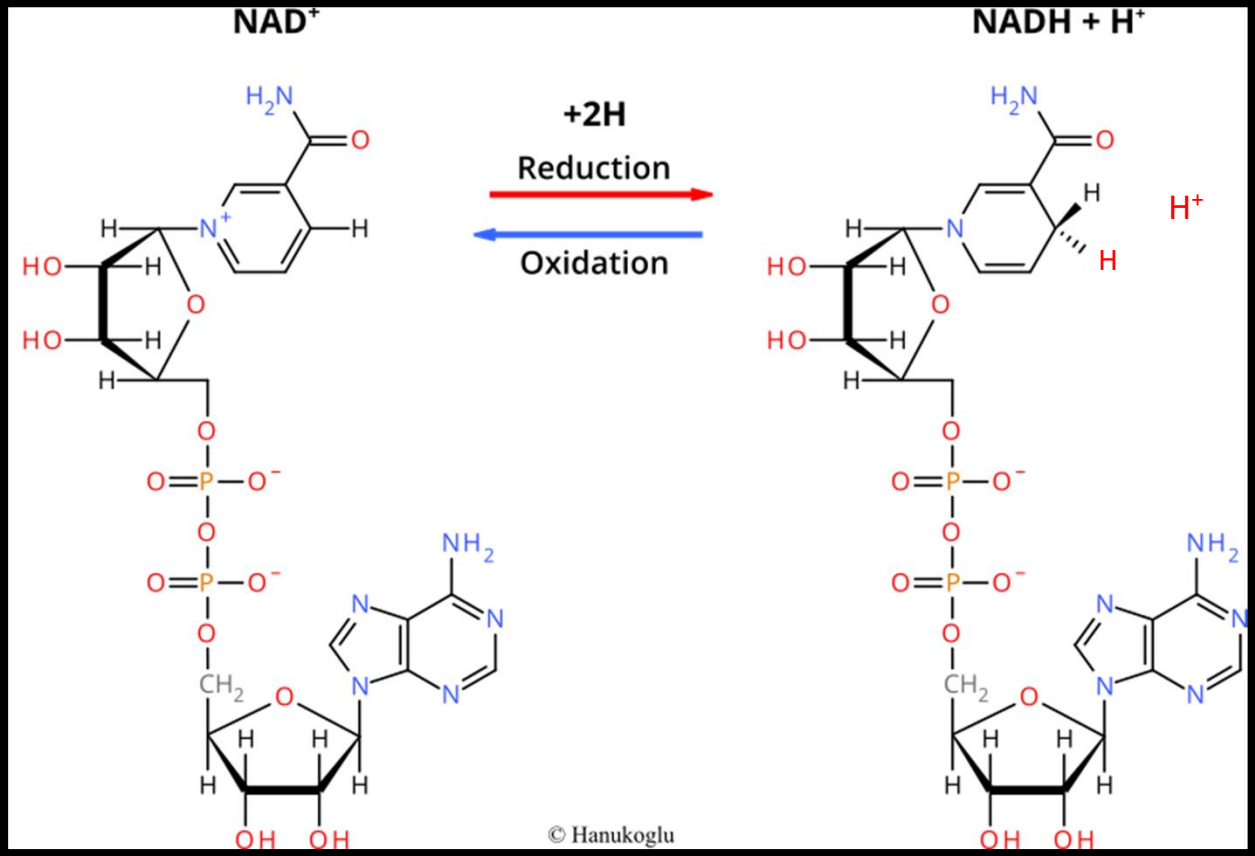

Glicose
Glicólise
Piruvato
CO_2
NADH
Acetil-CoA
Ciclo do ácido cítrico
2 CO_2
ATP
8 e^-

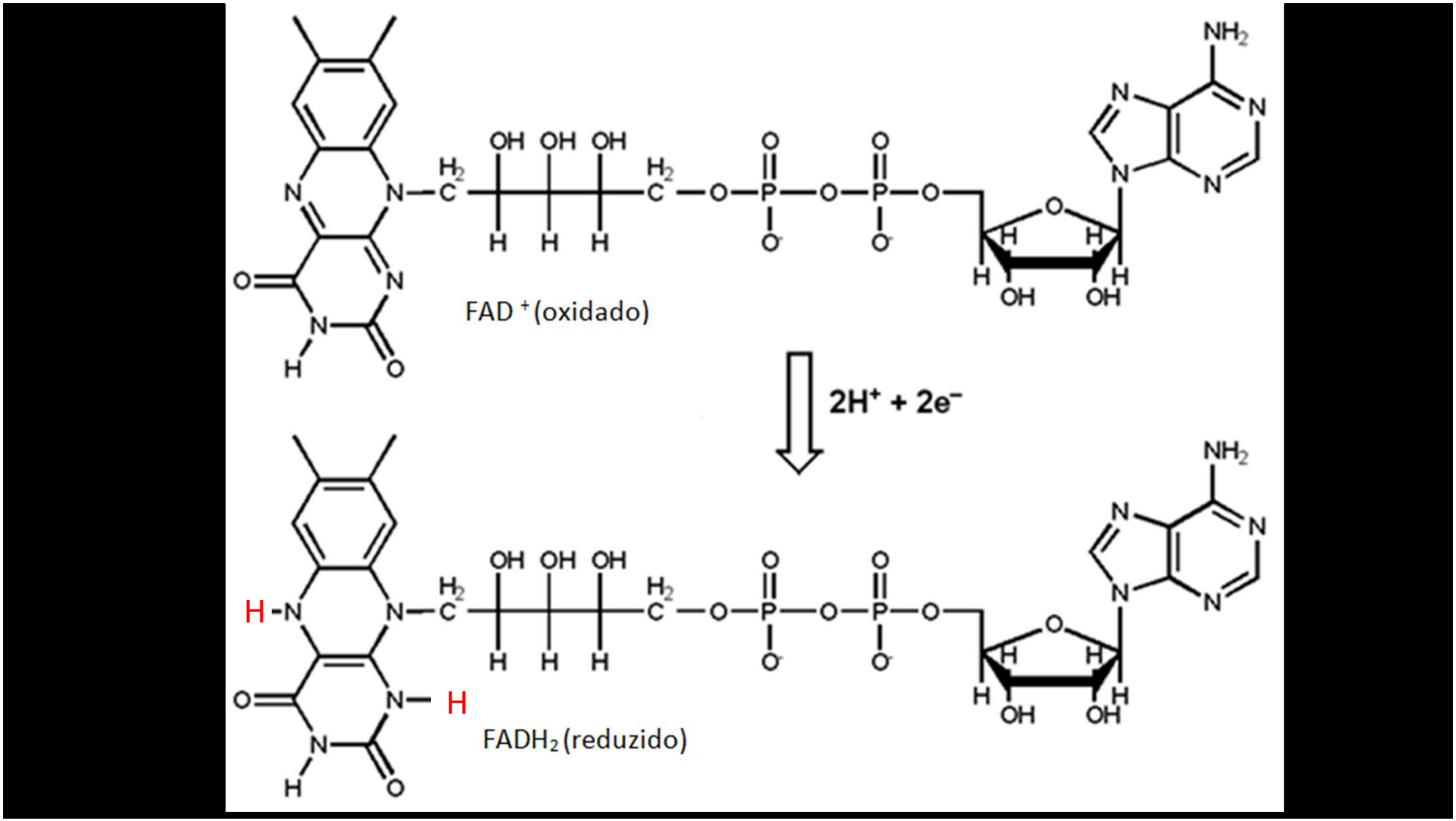

Acetyl-CoA
Citrate
Isocitrate
NADH
CO_2
α-Ketoglutarate
CO_2
NADH
Succinyl-CoA
GTP
(ATP)
Succinate
$FADH_2$
Fumarate
Malate
NADH
Oxaloacetate
Citric
acid
cycle


Half Reactions
Oxidation
A
e⁻
e⁻
A
e⁻
e⁻
Reducing agent
Oxidized
e⁻
e⁻
Reduction
B
e⁻
e⁻
B
Oxidizing agent
Reduced


Oxidation
Compound A
loses electrons
A
e⁻
e⁻
Reducing
agent
A
Oxidized
Reduction
Compound B
gains electrons
B
Oxidizing
agent
e⁻
e⁻
B
Reduced


H—O—H
Oxidation
Dehydrogenase
O + 2H
NAD+
+ 2 H
Reduction
NADH
+
H+
2 H+ + 2 e−
(carries
2 electrons)

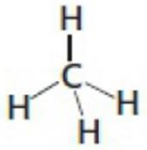
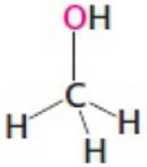
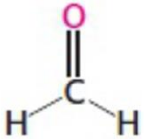
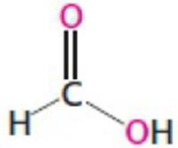

NAD+
NADH + H+
+2H
Reduction
Oxidation
H+
© Hanukoglu

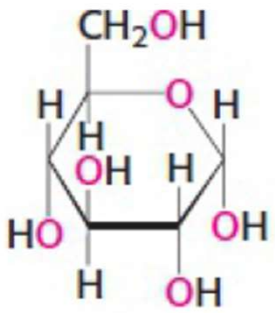

FAD + (oxidado)
2H+ + 2e−
FADH2 (reduzido)

Carreadores Ativados do Metabolismo
Carreador ativado de fosfato **ADP / ATP**
Carreadores ativados de elétrons para a oxidação de substratos **NAD+ / NADH** **FAD / FADH2** **FMN / FMNH2**
Carreador ativado de elétrons para biossínteses redutoras **NADP+ / NADPH**
Carreador ativado de fragmentos de dois carbonos **CoA / Acetil-CoA**

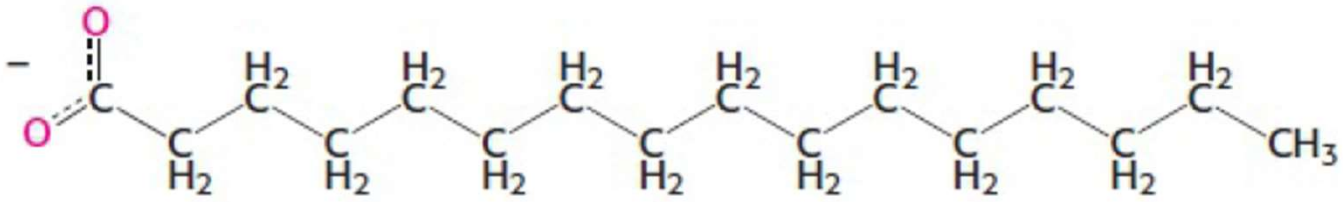
Energia livre da oxidação de compostos monocarbonados.

Mais energia → Menos energia

	 Metano	 Metanol	 Formaldeído	 Ácido fórmico	 Dióxido de carbono
$\Delta G'_{\text{oxidação}}$ (kJ mol^{-1})	−820	−703	−523	−285	0
$\Delta G'_{\text{oxidação}}$ (kcal mol^{-1})	−196	−168	−125	−68	0



Glicose

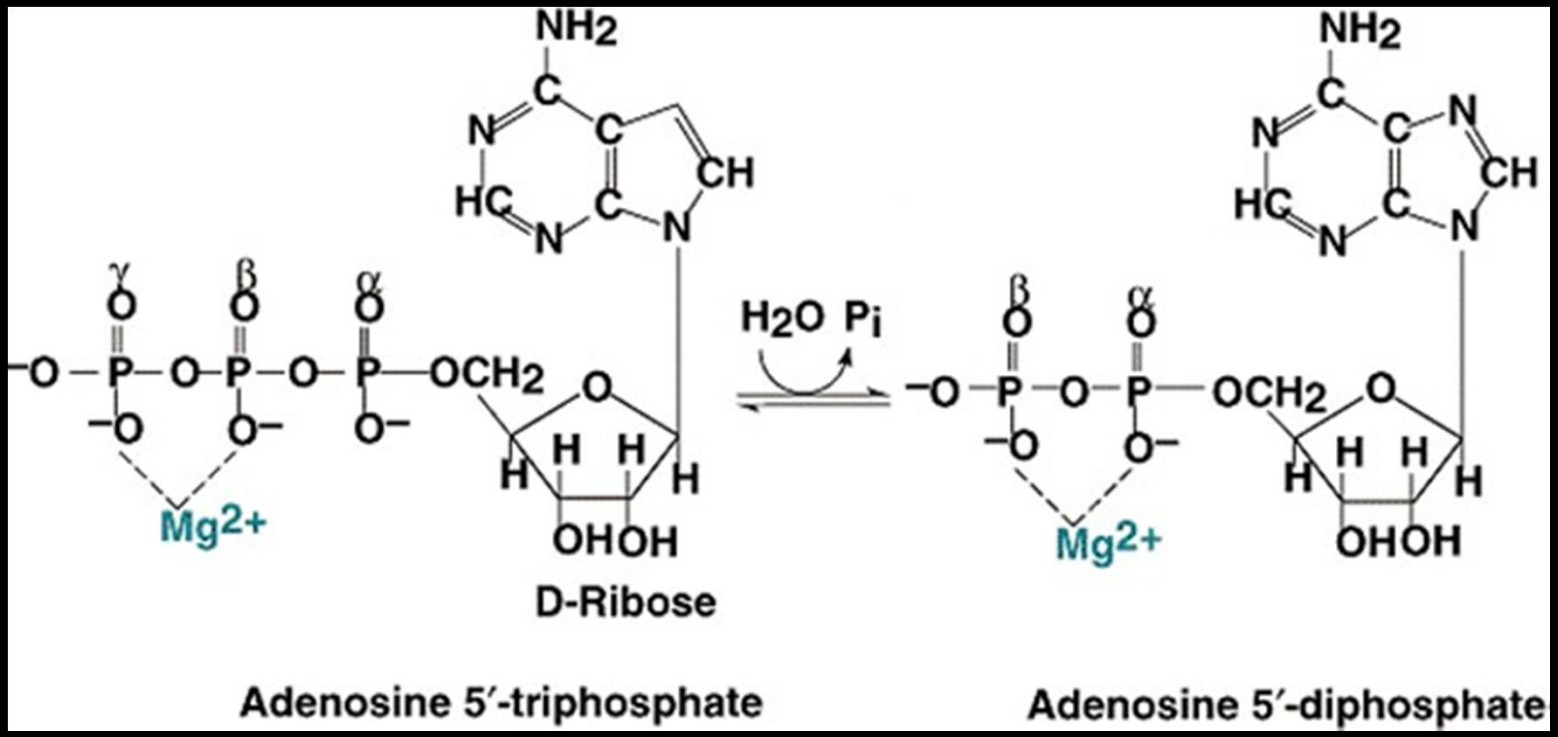


Ácido graxo

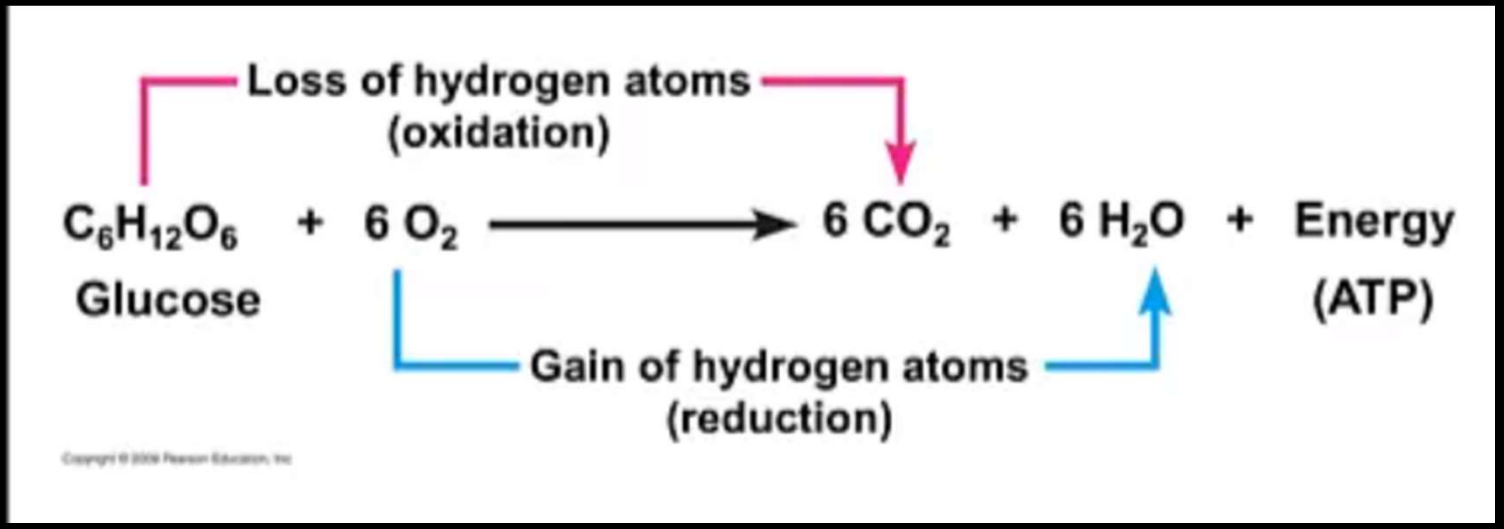
$\Delta G^{0'}$ -2.840 kJ/mol
-686 kcal/mol

$\Delta G^{0'}$ -9.770 kJ/mol
-2.338 kcal/mol

Utilização da Energia do ATP



ΔG°′ = –30,5 kJ mol–1 (–7,3 kcal mol–1)



Glicose

$\Delta G^{0\prime}$

-2.840 kJ/mol

-686 kcal/mol

ATP

$\Delta G^{0\prime}$

-30,5 kJ/mol

-7,3 kcal/mol

→ 93 ATP

Oxidação Completa da Glicose

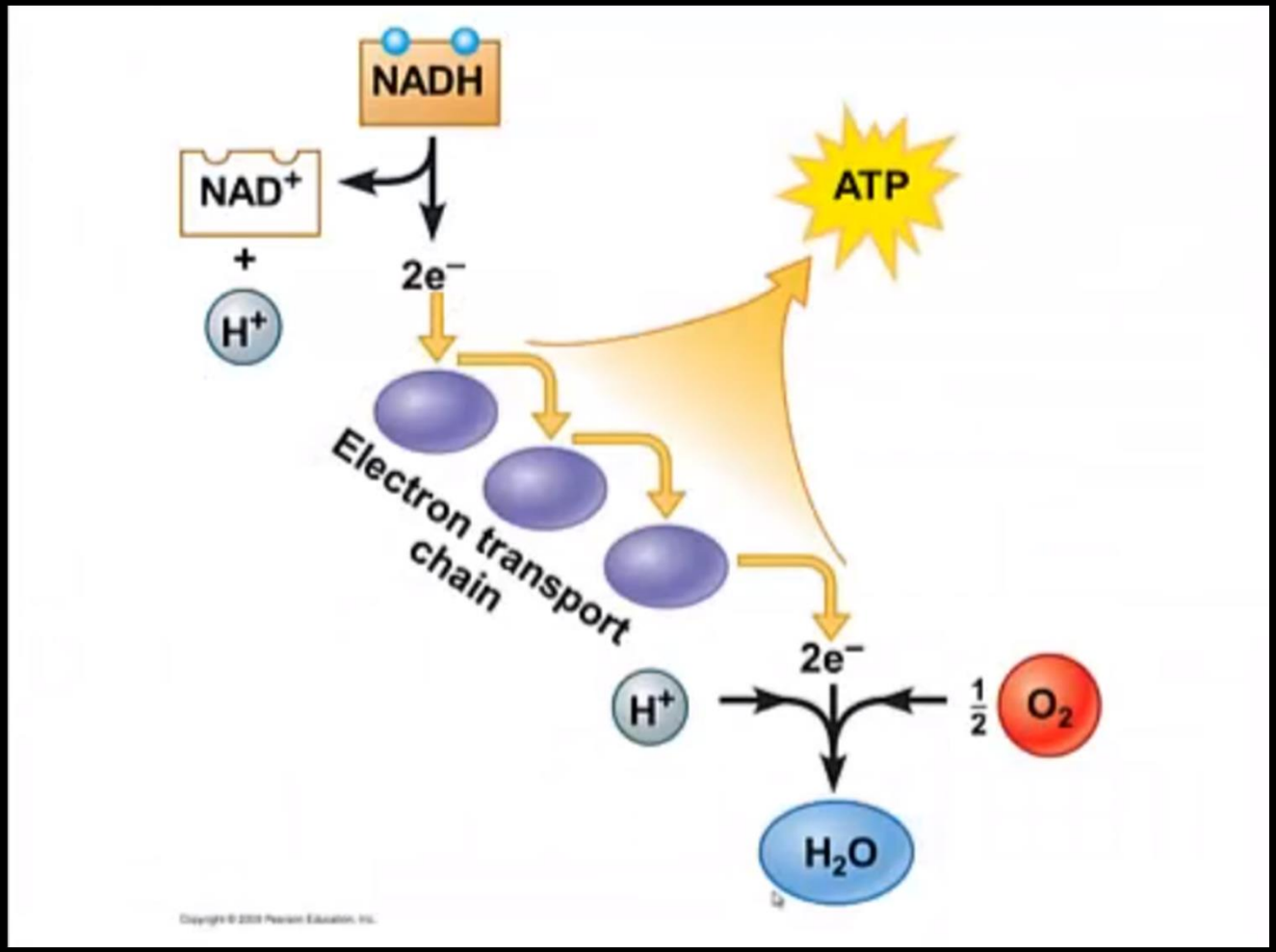
$C_6H_{12}O_6 + 6\ O_2 +$ $\quad\longrightarrow\quad$ $6\ CO_2 + 6\ H_2O$

$36\text{-}38\ ADP + 36\text{-}38\ P_i$ $\quad\longrightarrow\quad$ $+\ 36\text{-}38\ ATP$

Via Glicolítica gastou: 1 glicose, 2 ADP, 2 P_i, 2 NAD^+
gerou: 2 ATP, 2 NADH

Formação de Acetil-CoA gastou: 2 NAD^+
gerou: 2 CO_2, 2 NADH

Ciclo Ac. Cítrico gastou: 6 NAD^+, 2 FAD, 2 GDP, 2 Pi, 2 AcCoA
gerou: 4 CO_2, 6 NADH, 2 $FADH_2$, 2 GTP


NADH
NAD+
+
H+
2e−
ATP
Electron transport chain
2e−
H+
1/2
O2
H2O