Metabolismo Bacteriano

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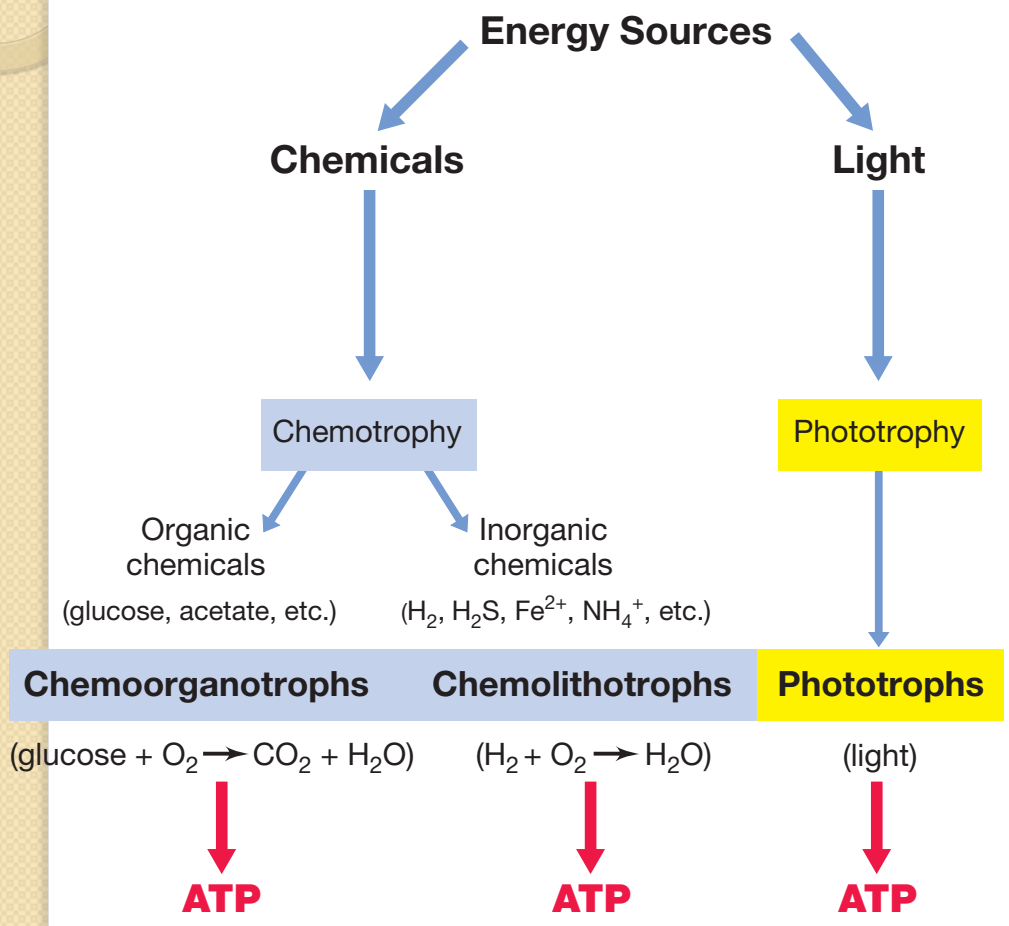
Diversidade Metabólica

Fonte de energia para produzir ATP



Fonte de Carbono

Autotróficos: CO_2

Heterotróficos: compostos orgânicos

Reações Químicas

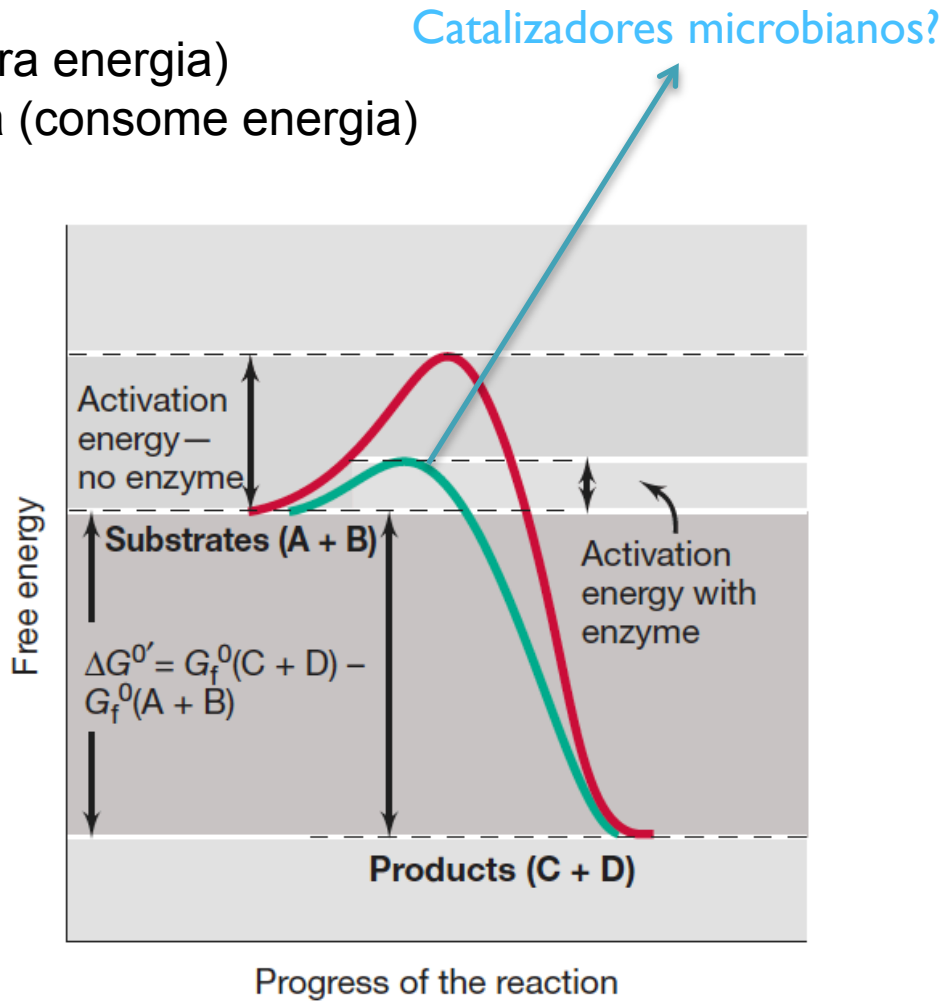
Energia Livre de Gibbs

< 0 Expontânia - exergônica (libera energia)
> 0 Não é favorável - endergônica (consome energia)

$$A + B \rightarrow C + D$$

$$\Delta G^{0\prime} = G_f^0[C + D] - G_f^0[A + B]$$

$$\Delta G = \Delta G^{0\prime} + RT \ln K$$



Condição Padrão: pH 7, 25 C, 1 ATP, 1M de sybstrato e produto

Chemical processes that form the basis of all cellular metabolism

- Enzyme-mediated catalysis
- Reaction coupling
- Energy harvesting by redox reactions
  - organic substrates
  - inorganic substrates
  - photochemical reactions
- Use of membranes to form charge gradients and chemical concentration

O papel do ATP no acoplamento de reações anabólicas e catabólicas

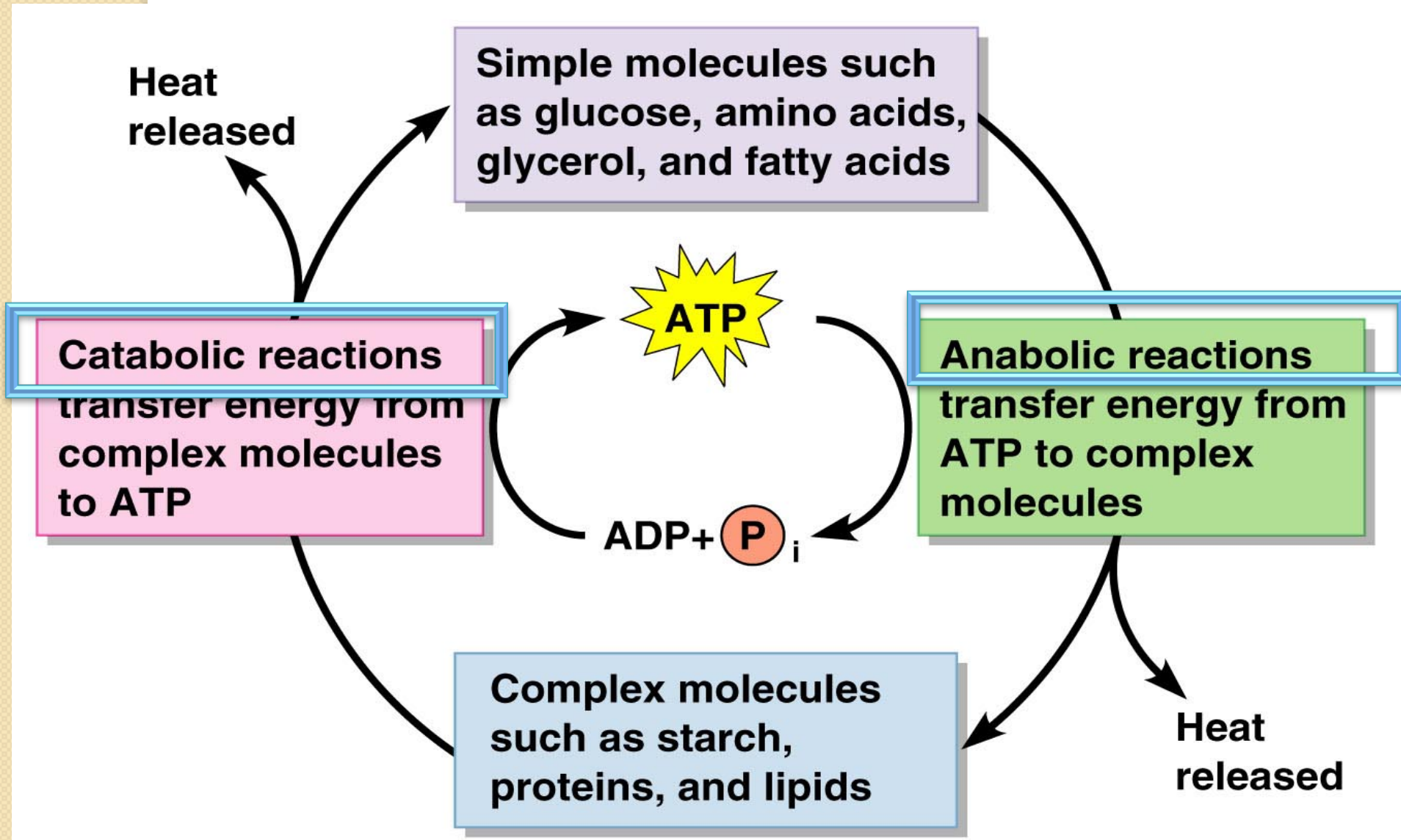
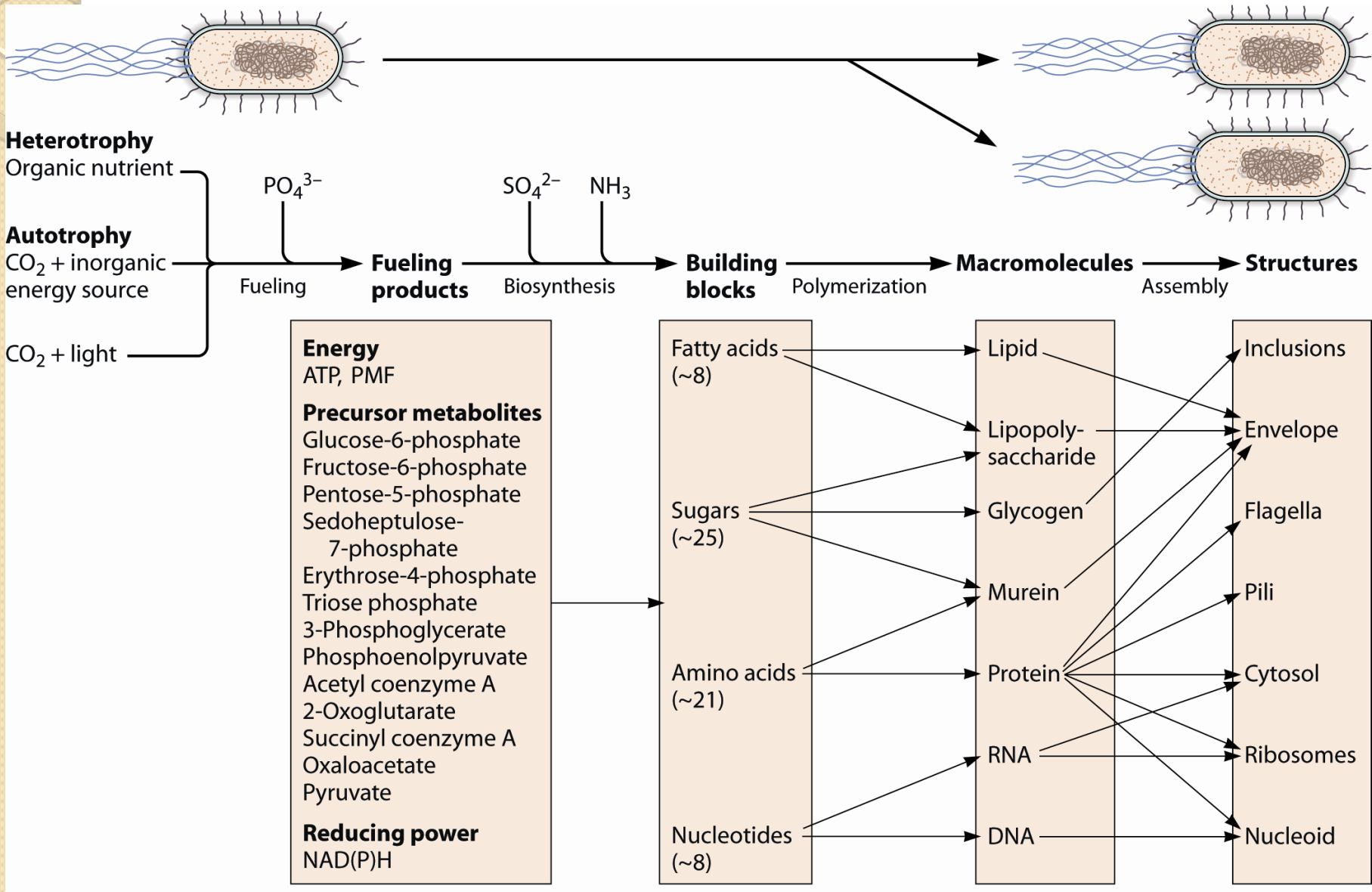


Table 5.2 Gene products of *Escherichia coli* associated with various metabolic processes

Functional category	No. of genes
Metabolism of small molecules	
Degradation and energy metabolism	316
Central intermediary metabolism	78
Broad regulatory function	51
Biosynthesis	
Amino acids and polyamines	60
Purines, pyrimidines, nucleosides, and nucleotides	98
Fatty acids	26
Metabolism of macromolecules	
Synthesis and modification	406
Degradation	69
Cell envelopes	168
Cell processes	
Transport	253
Other, e.g., cell division, chemotaxis, mobility, osmotic adaptation, detoxification, and cell killing	118
Miscellaneous	107
Total	1,894

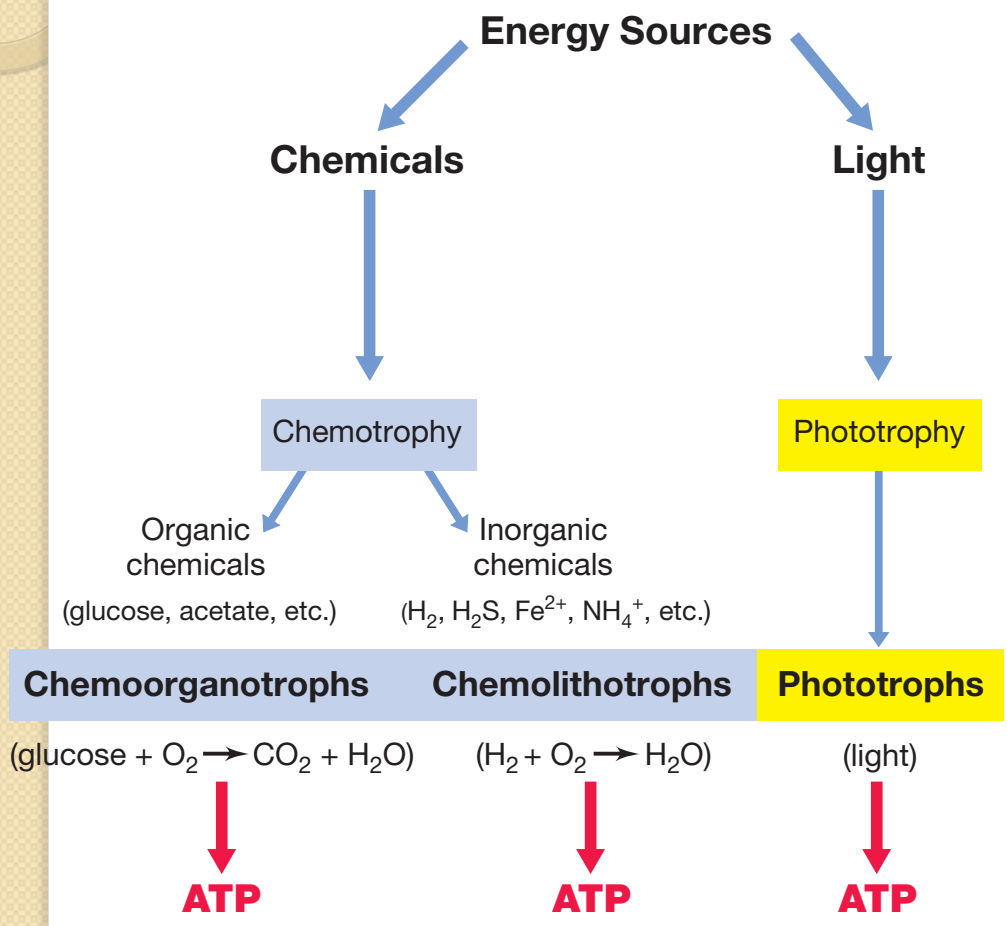
Em torno de 40 % das proteínas produzidas por um microorganismo

Metabolisto & Anabolisto Microbiano



Todo o Processo envolve Equilíbrio Redox: Oxidação e Redução

Fonte de energia para produzir ATP



Fonte de Carbono

Autotróficos: CO_2

Heterotróficos: compostos orgânicos

Reações Redox: Oxidação e Redução

Agente Redutor
Doa e-

Reação de oxidação

Reação de redução

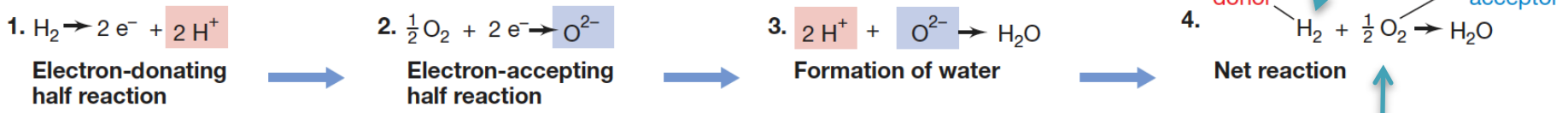
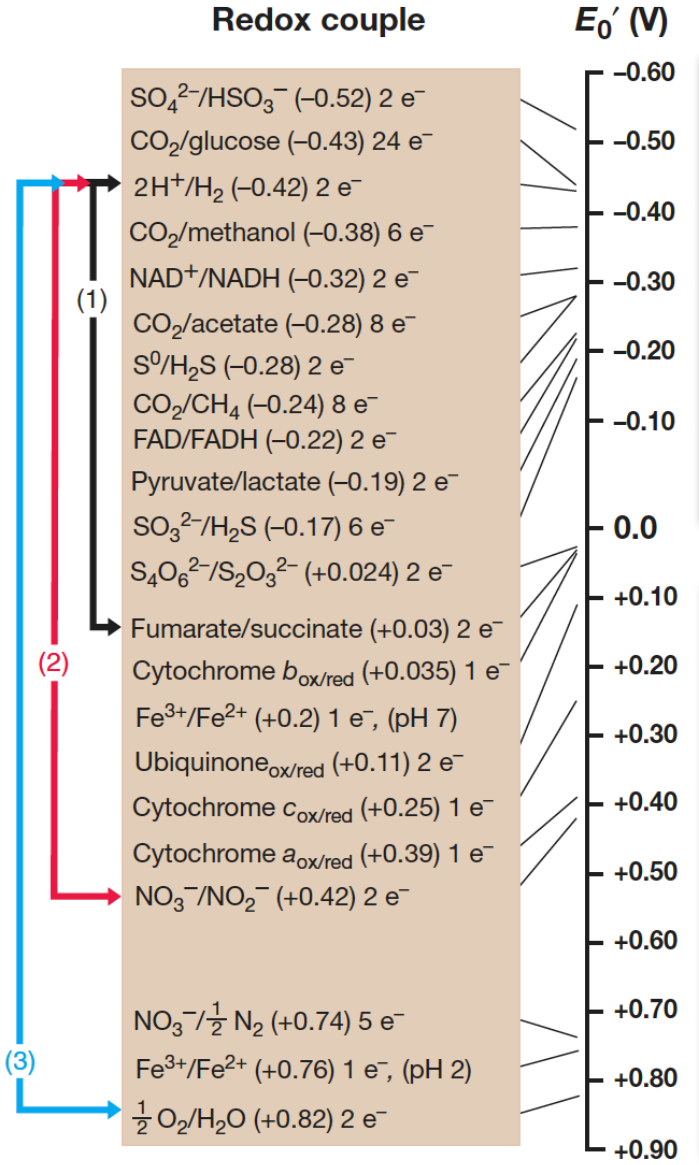


Figure 4.8 **Example of an oxidation–reduction reaction.** The formation of H_2O by reaction of the electron donor H_2 and the electron acceptor O_2.

Agente Oxidante
Recebe e-

Potencial de Oxidação

Mostra os bons receptores de e- E (V)>0



Péssimos receptores de e- Valores < 0 são bons agentes redutores (doadores de e-)

Ótimos receptores de e-

Valores > 0 são bons agentes oxidantes

(1) H_2 + fumarate → succinate $\Delta G^{0'} = -86$ kJ

(2) $H_2 + NO_3^- \rightarrow NO_2^- + H_2O$ $\Delta G^{0'} = -163$ kJ

(3) $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ $\Delta G^{0'} = -237$ kJ

Par Redox em Microorganismos

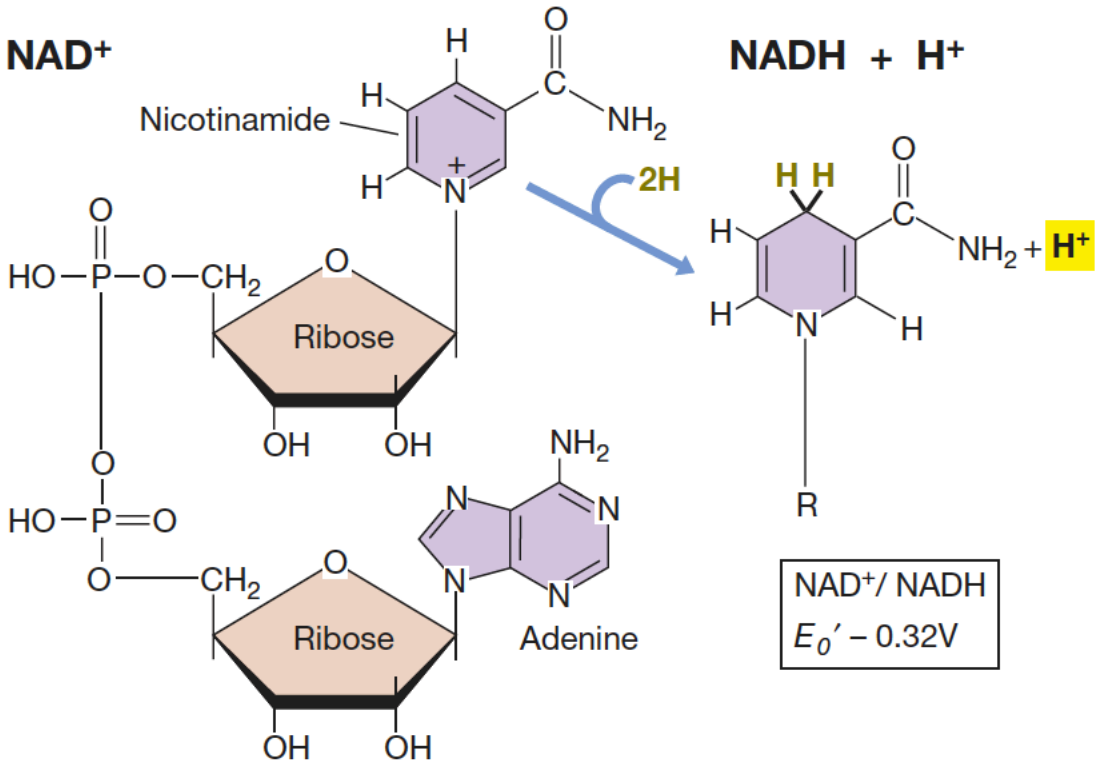


Figure 4.10 The oxidation–reduction coenzyme nicotinamide adenine dinucleotide (NAD^+). NAD^+ undergoes oxidation–reduction as shown and is freely diffusible. "R" is the adenine dinucleotide portion of NAD^+.

Temos outras moléculas, como NADP+ para NADPH

ATP : Molécula de alta Energia para ser usada no

FPM apenas ocorre no Processo de Respiração e Fotossíntese, mas não na fermentação

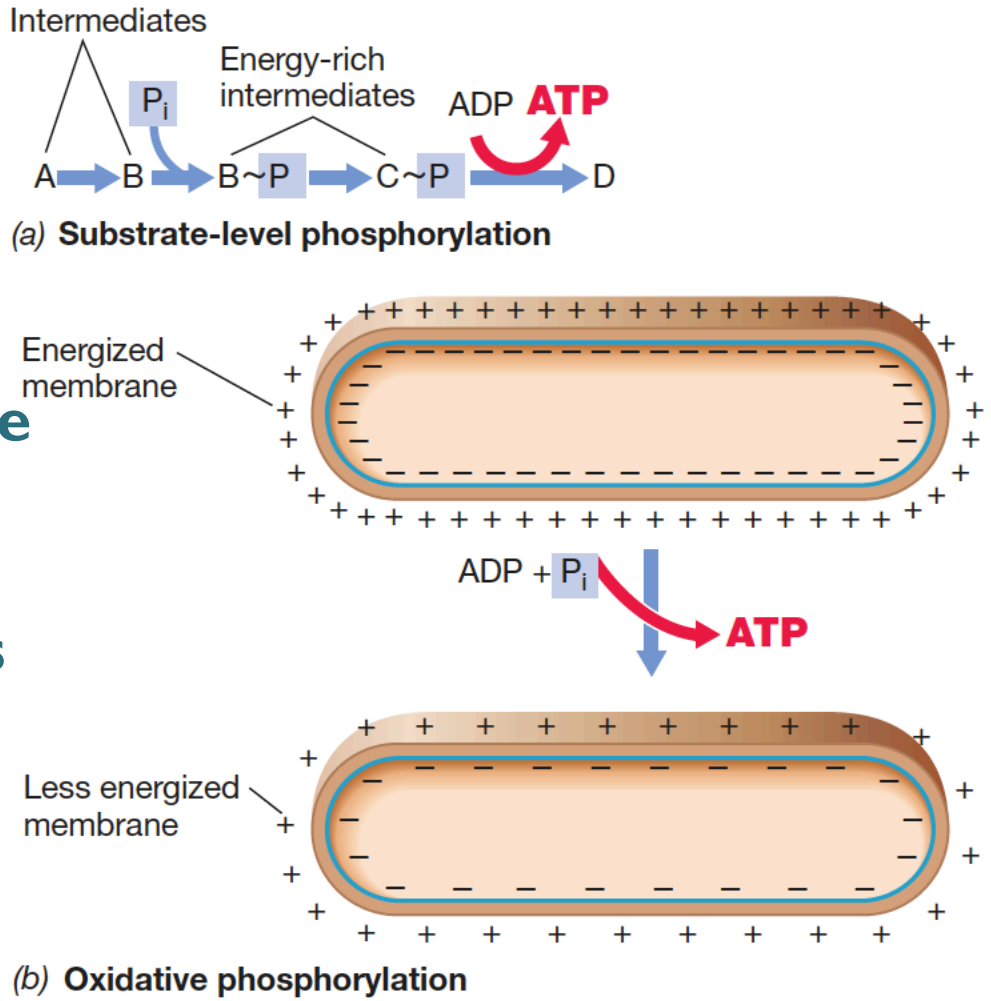


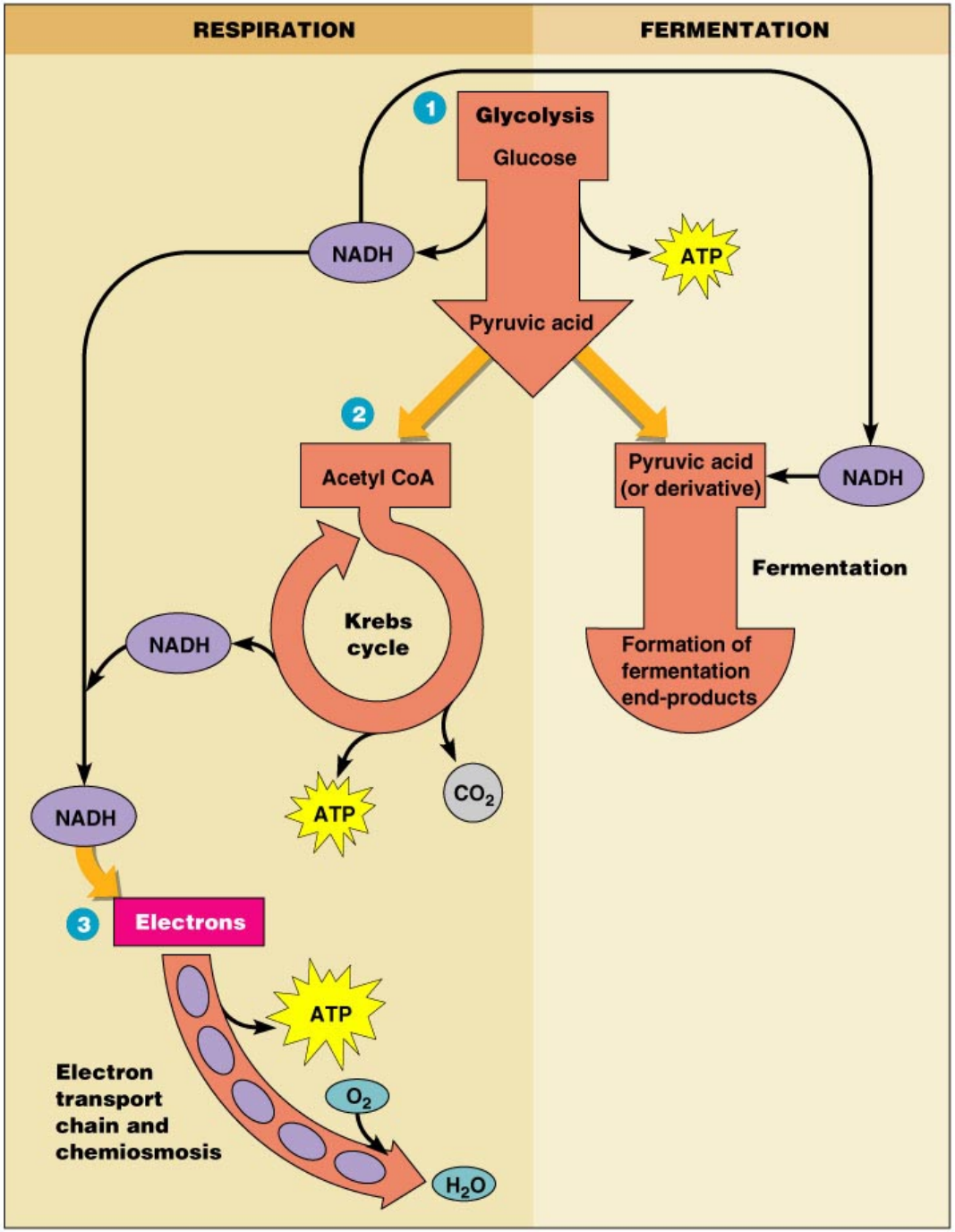
Figure 4.13 Energy conservation in fermentation and respiration. *(a)* In fermentation, substrate-level phosphorylation produces ATP. *(b)* In respiration, the cytoplasmic membrane, energized by the proton motive force, dissipates energy to synthesize ATP from ADP + P_i by oxidative phosphorylation.

Fermentação ocorre para açucares mas não para ácidos Graxos (muito reduzidos para serem fermentados)

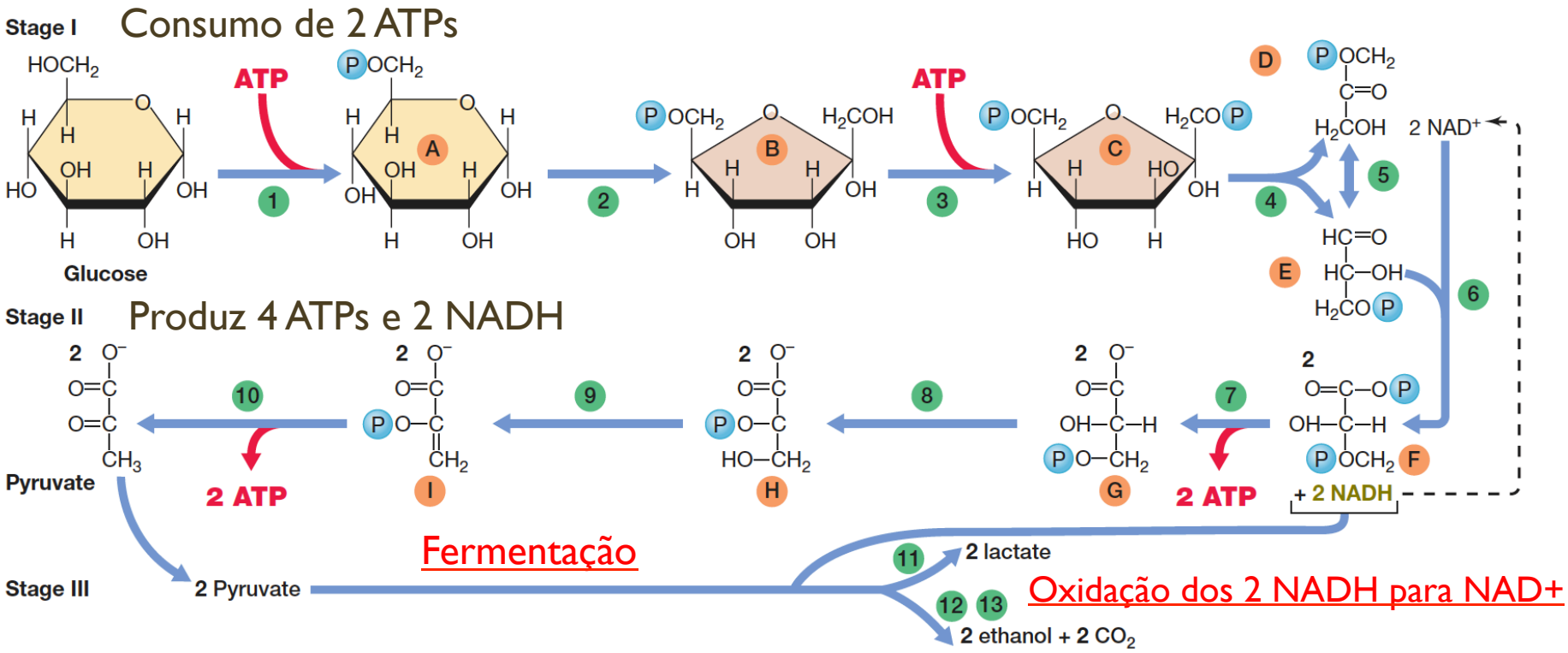
Table 5.4 Some cellular activities requiring energy

Cellular activity
Growth related
Entry of nutrients
Biosynthesis of building blocks
Polymerization of macromolecules
Modification and transport of macromolecules
Assembly of cell structures
Cell division
Growth independent
Motility
Secretion of proteins and other substances
Maintenance of metabolite pools
Maintenance of turgor pressure
Maintenance of cellular pH
Repair of cell structures
Sensing the surroundings
Communication among cells

Fermentação e Respiração, Qual é a diferença?



Glicólise – Produz 2 moléculas de ATP



Intermediates

- A Glucose 6-P
- B Fructose 6-P
- C Fructose 1, 6-P
- D Dihydroxyacetone-P
- E Glyceraldehyde-3-P
- F 1, 3-Bisphosphoglycerate
- G 3-P-Glycerate
- H 2-P-Glycerate
- I Phosphoenolpyruvate

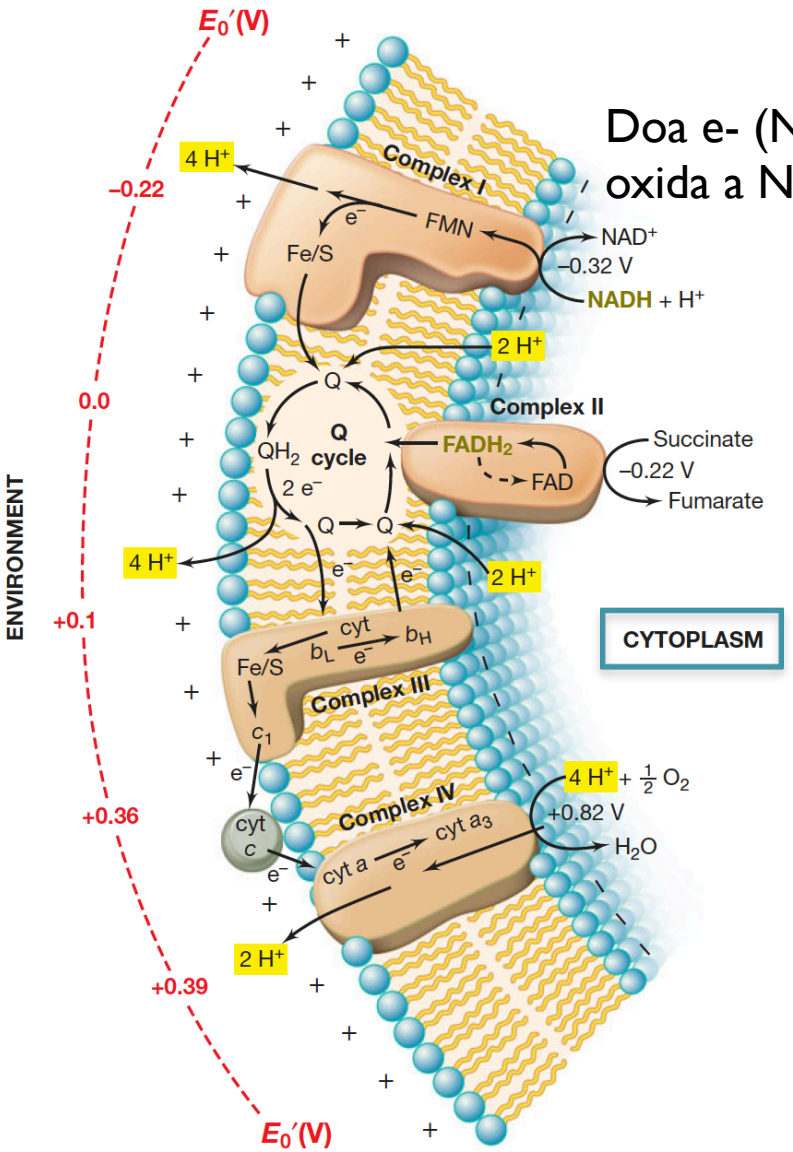
Enzymes

1. Hexokinase
2. Isomerase
3. Phosphofructokinase
4. Aldolase
5. Triosephosphate isomerase
6. Glyceraldehyde-3-P dehydrogenase
7. Phosphoglycerokinase
8. Phosphoglyceromutase
9. Enolase
10. Pyruvate kinase
11. Lactate dehydrogenase
12. Pyruvate decarboxylase
13. Alcohol dehydrogenase

Energetics

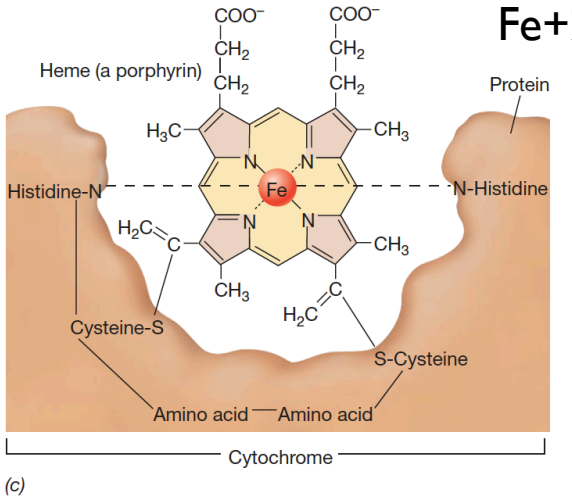
Yeast	Glucose → 2 ethanol + 2 CO_2	−239 kJ
Lactic acid bacteria	Glucose → 2 lactate	−196 kJ

Respiração: FPM e Cadeia de elétrons na membrana



Doa e- (NADH oxida a NAD+)

Fe+2 para Fe+3 + e-

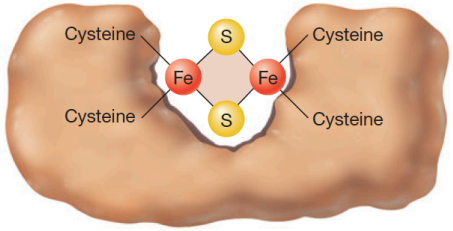


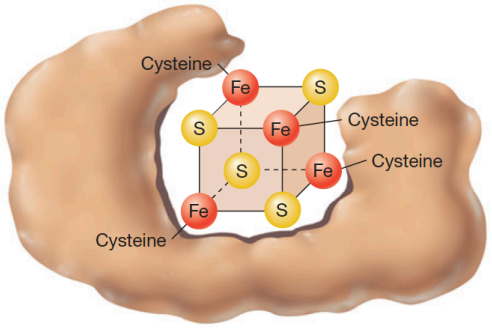
1- Processo de Oxidação de NADH/ FADH2 cria diferença de potencial pq?

Doa e- e H+

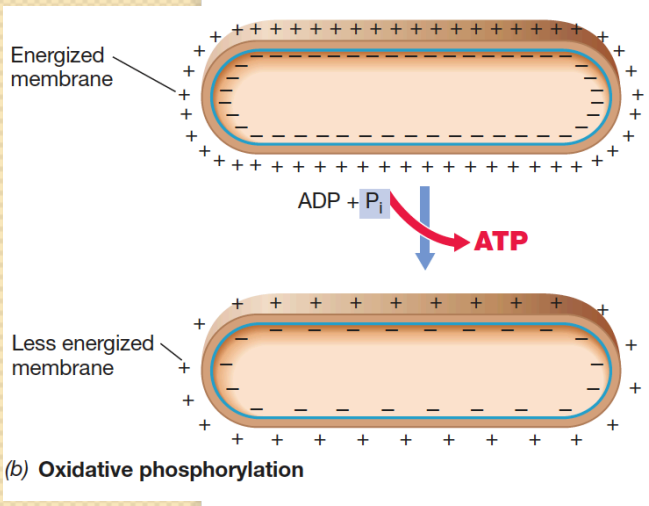
2- O2 recebe os e- e

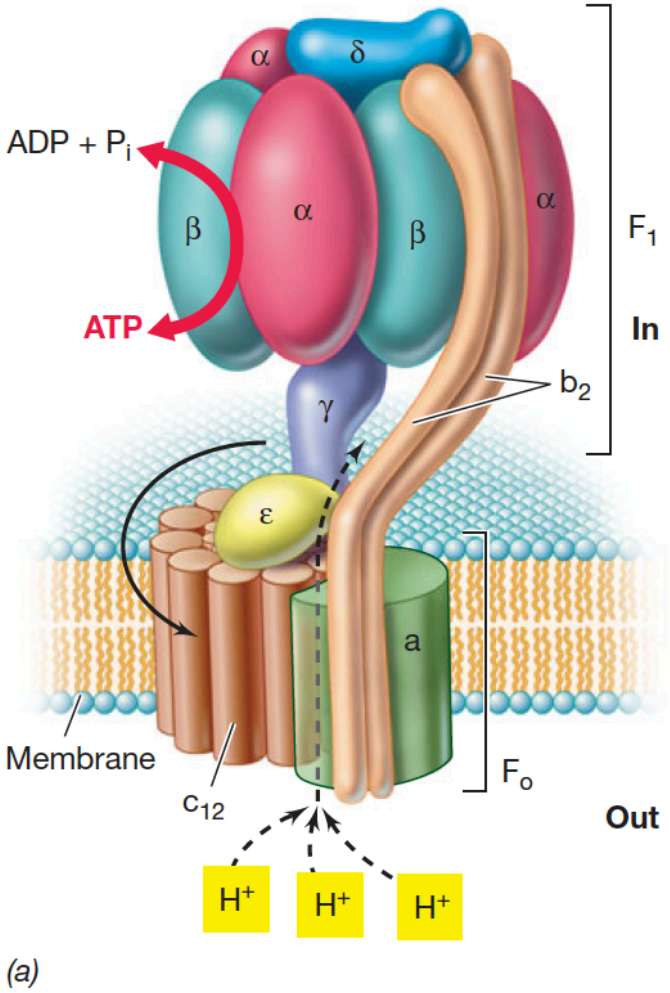
Doa e H+





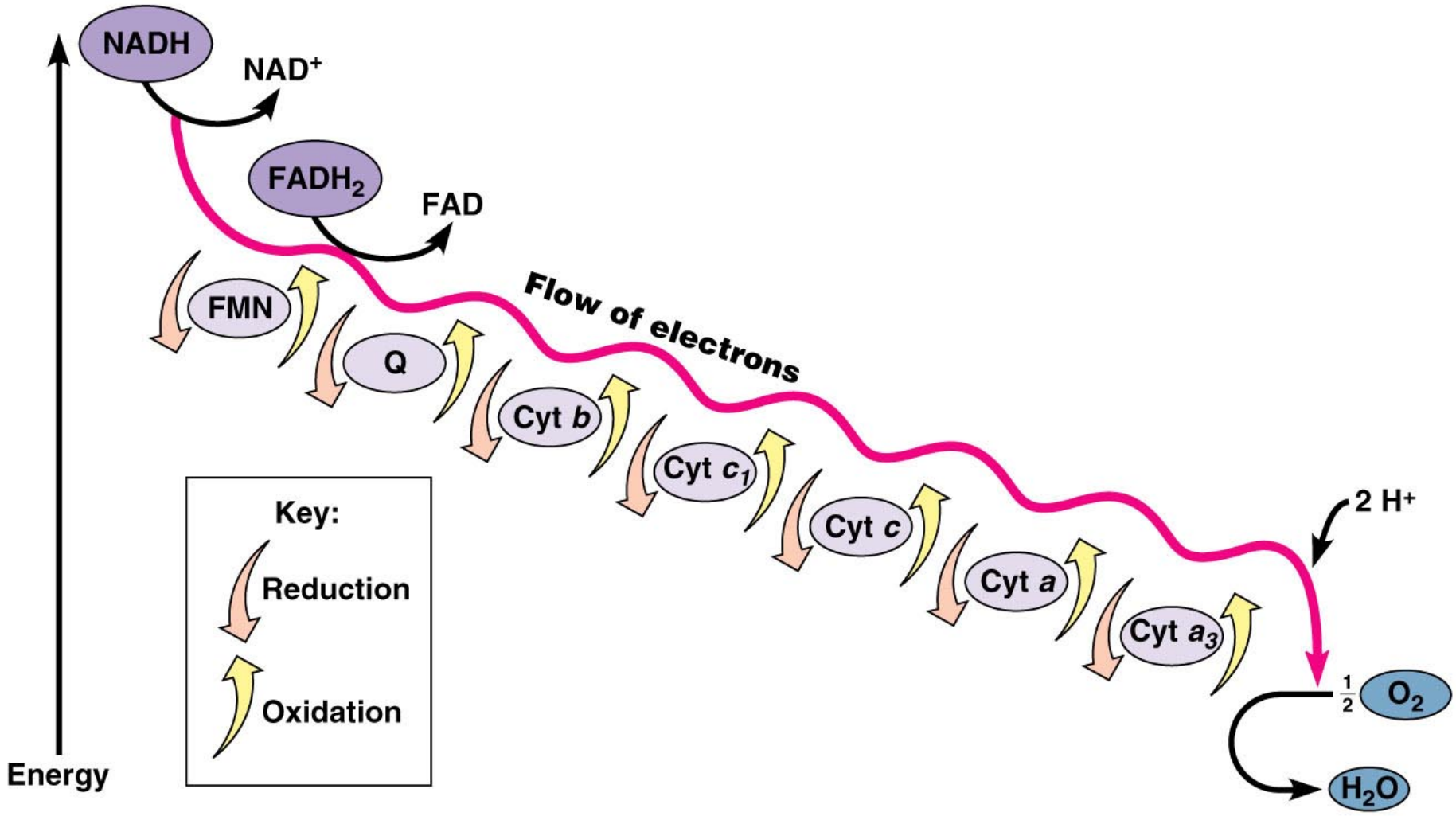
Respiração: FPM e Cadeia de elétrons na membrana



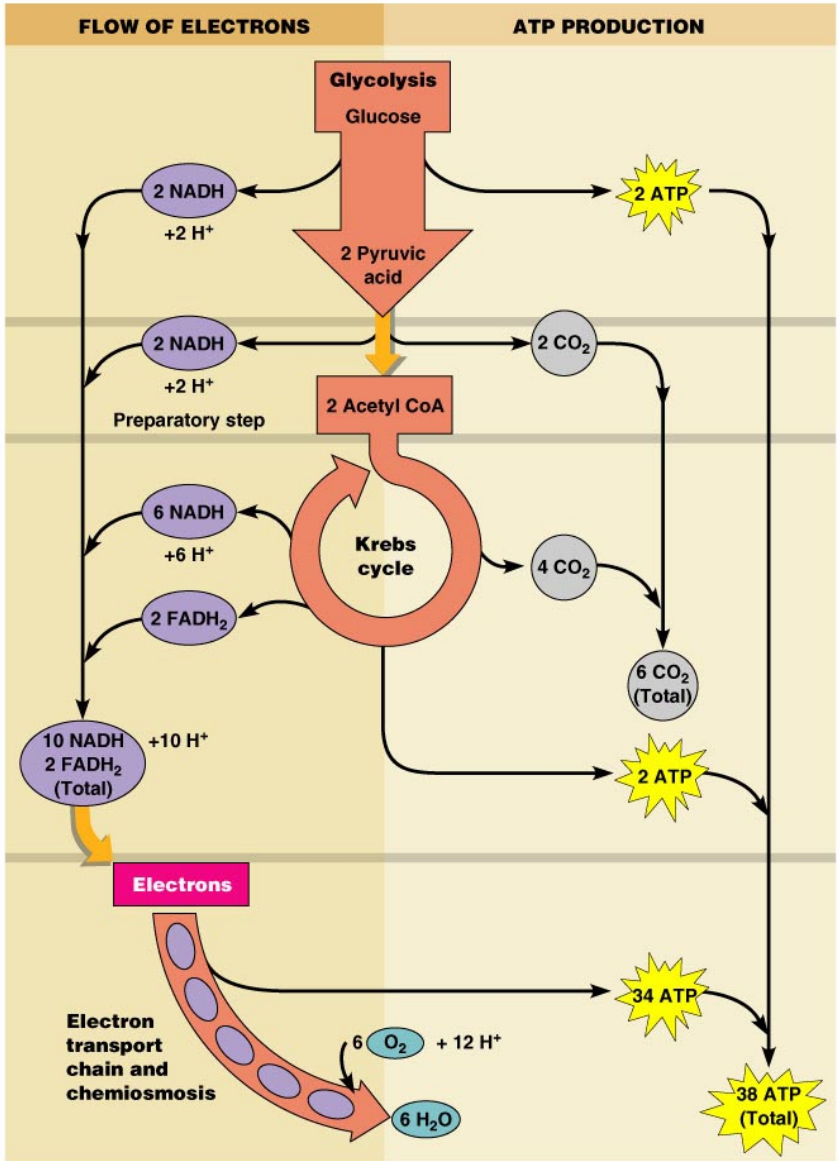


ATP sintetase usa a diferença de potencial na membrana (como se fosse uma bateria) para geral ATP

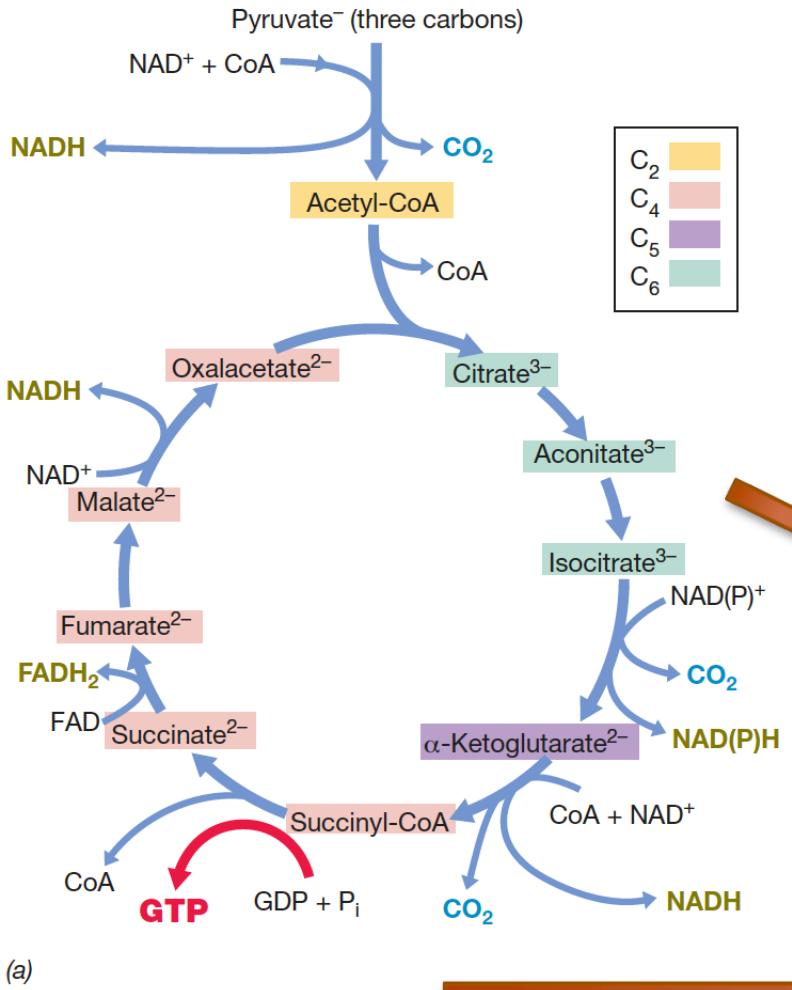
Respiração: FPM e Cadeia de elétrons na membrana

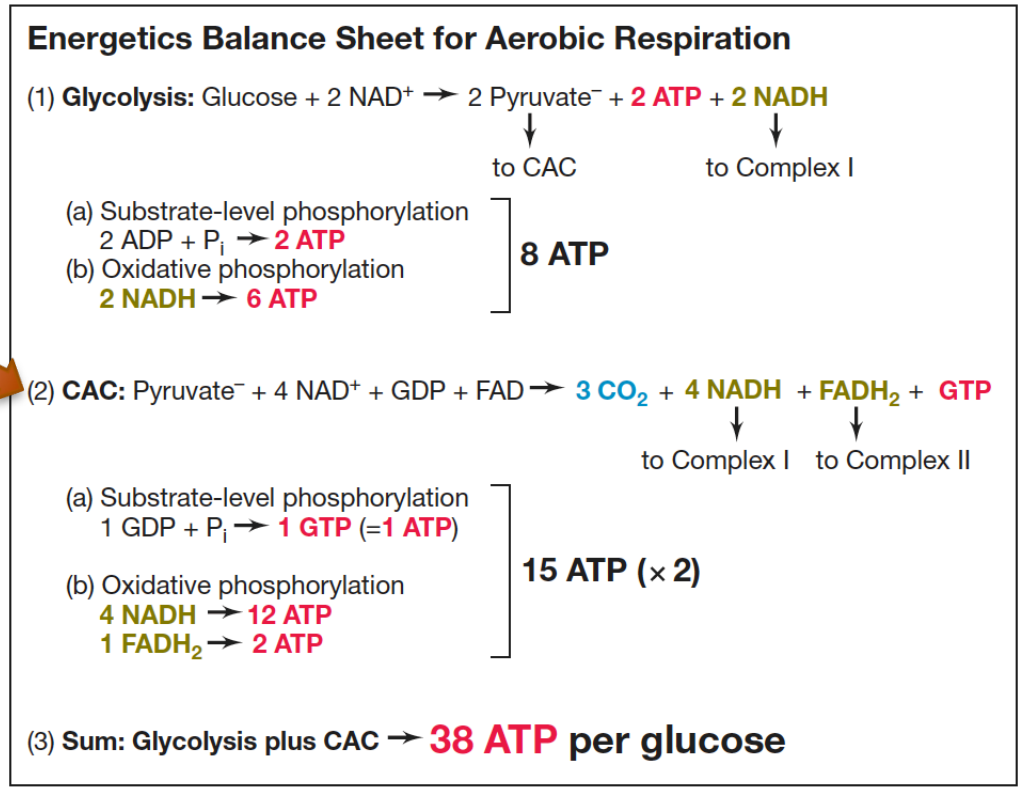


Respiração – Após a Glicólise – CAC (Ciclo do Ácido Cítrico)



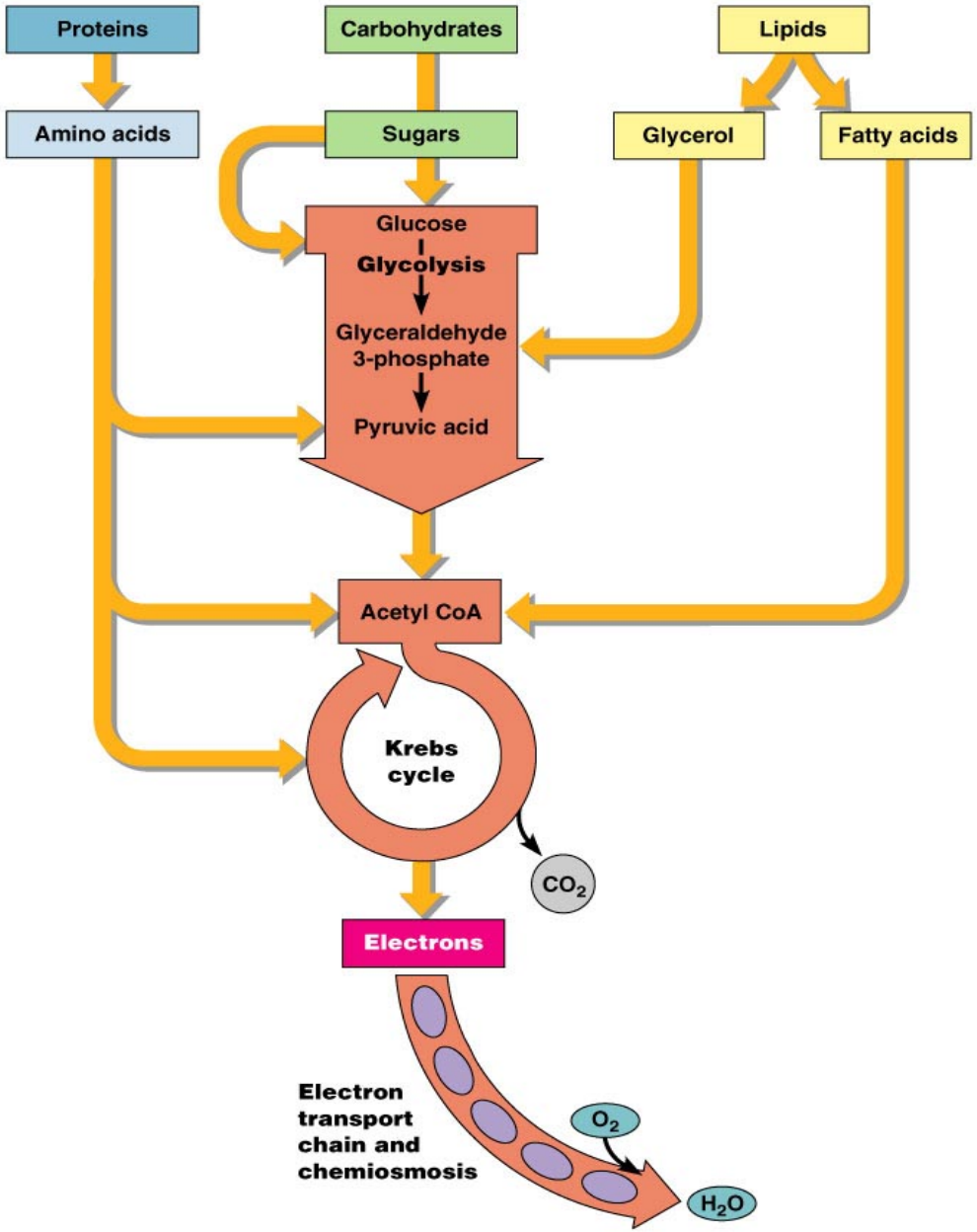
CAC (Ciclo do Ácido Cítrico) = 15 ATPs/Piruvato



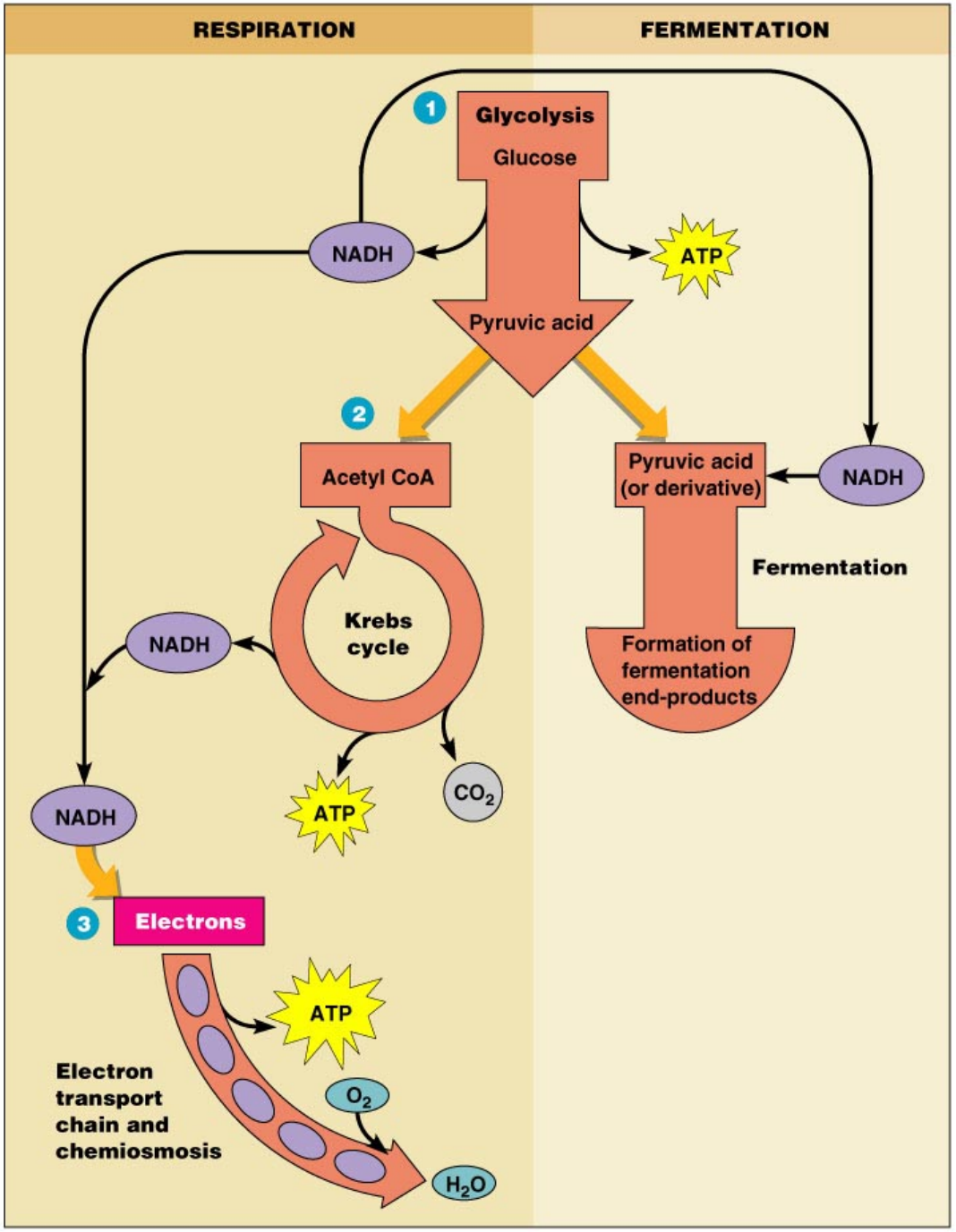


Moedas de energia (Cadeia de Transporte de elétrons)
1 NADH = 3 ATP
1 FADH = 2 ATP

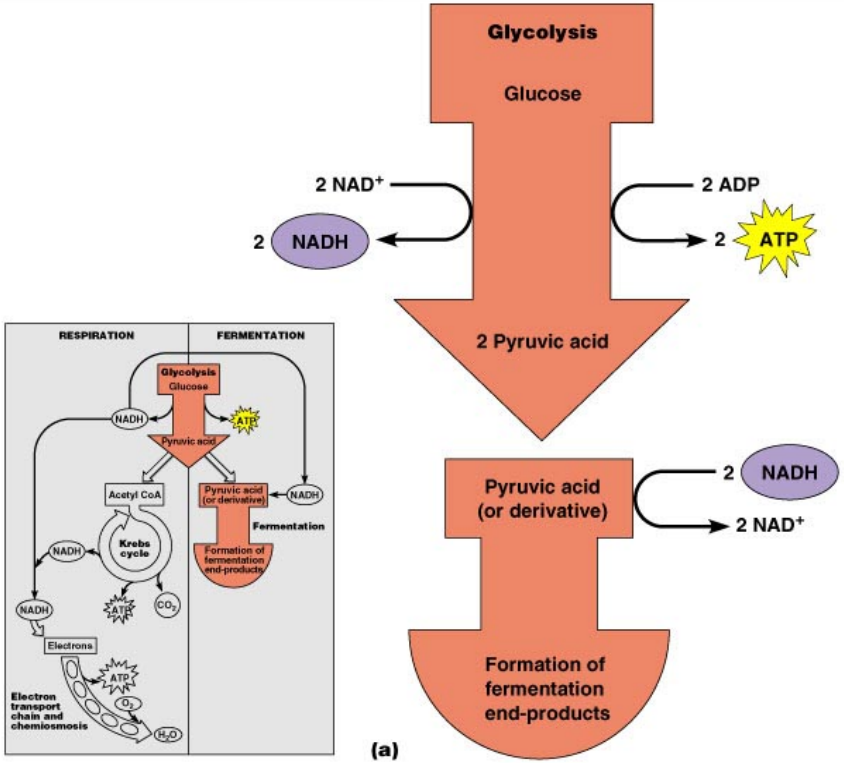
Catabolism of organic food molecules

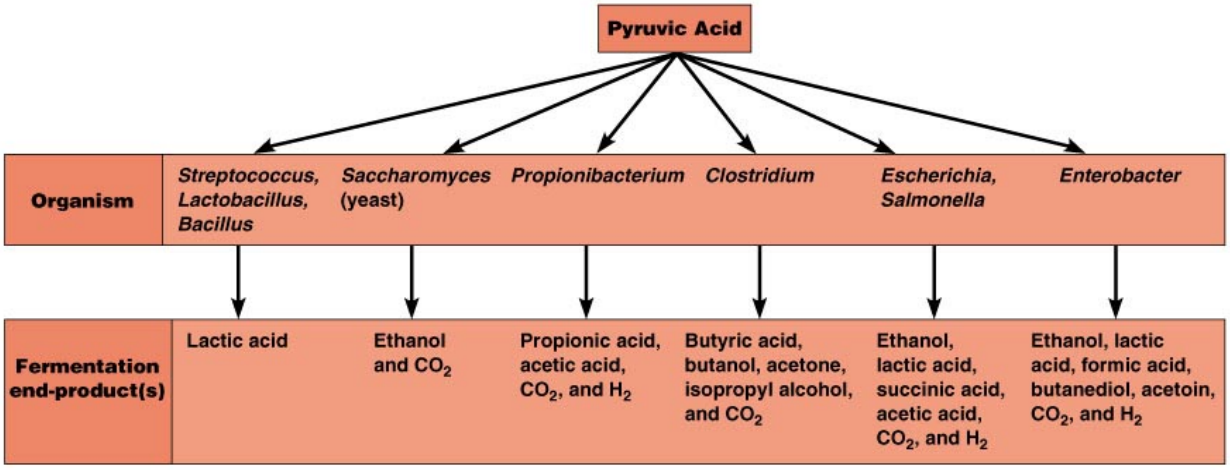


Revisão: Respiration and fermentation

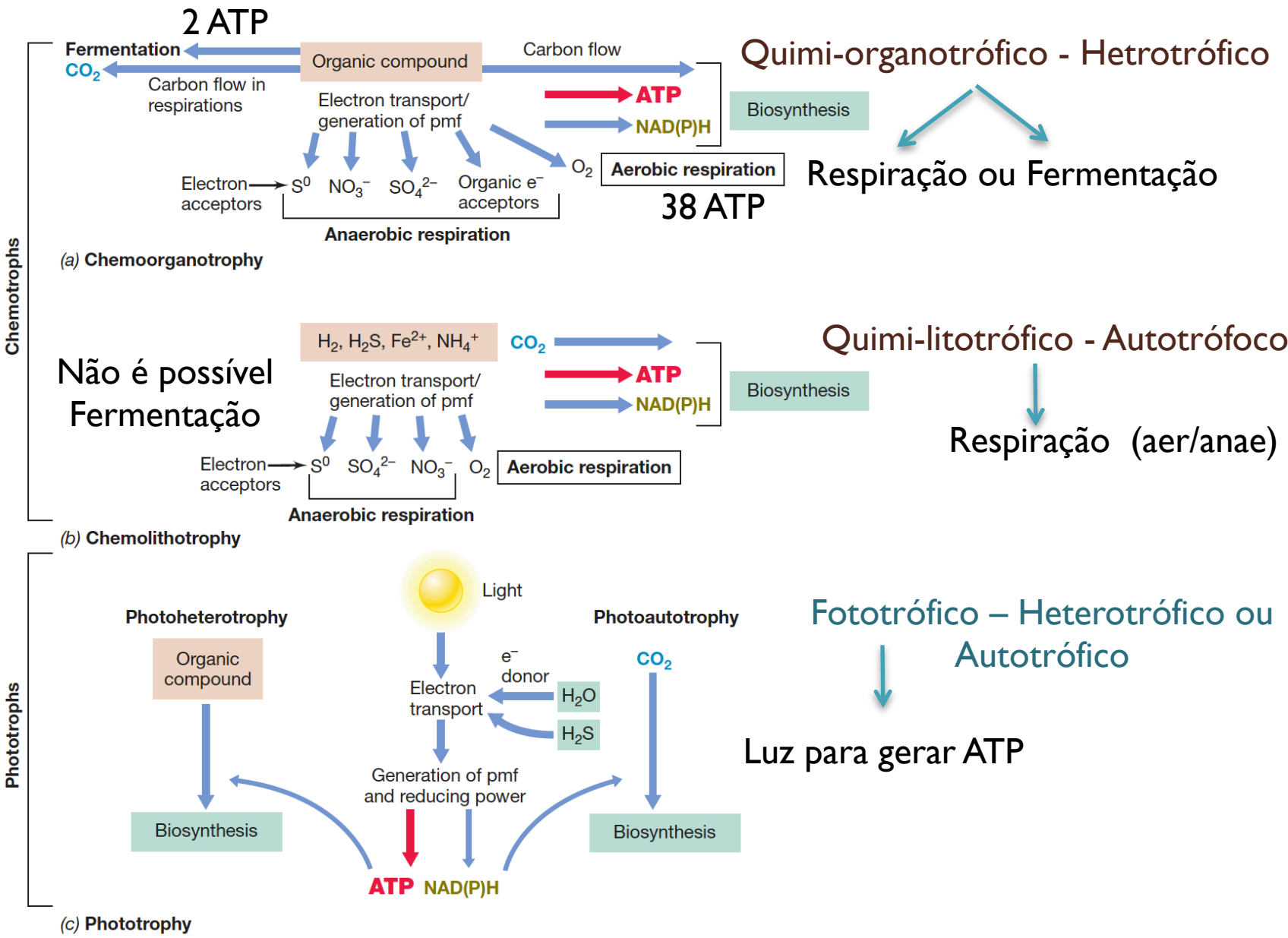


Diferentes Produtos provindos da Fermentação

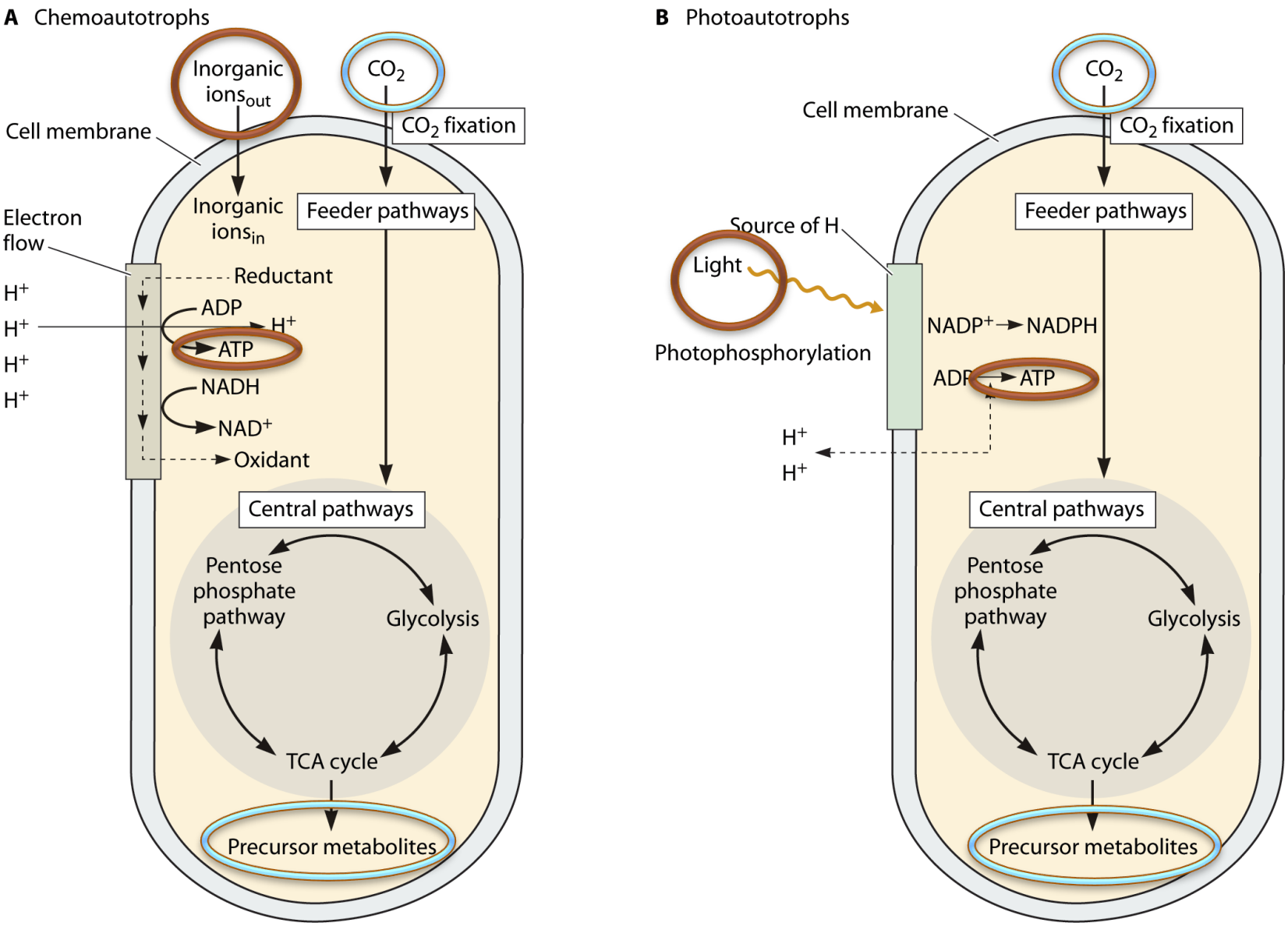




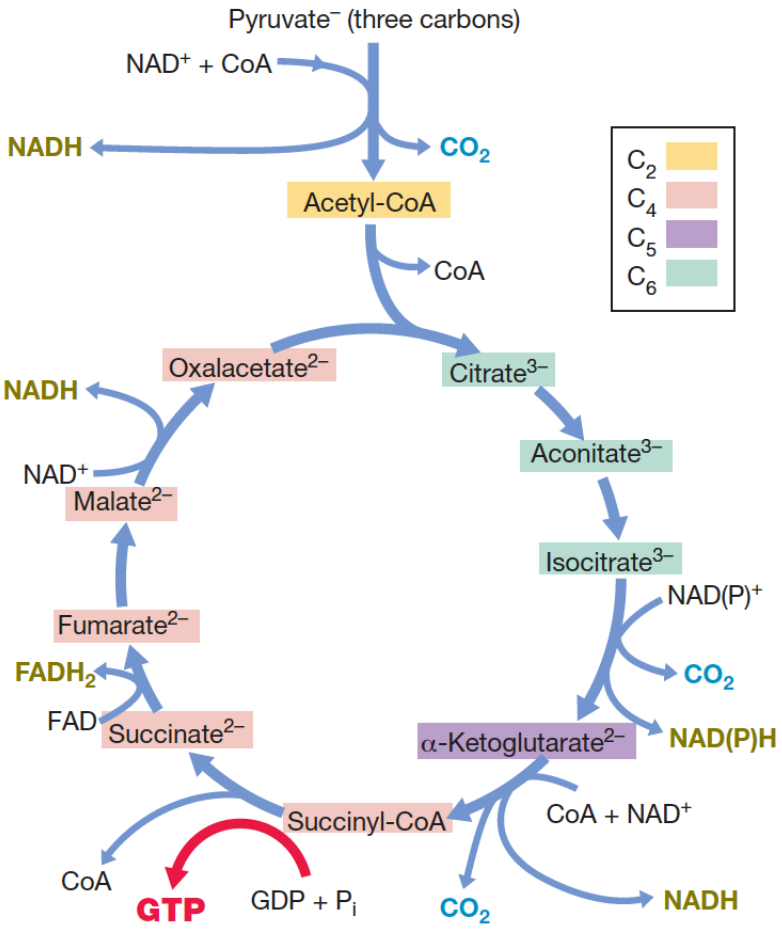
Diversidade Catabólica em Microrganismos



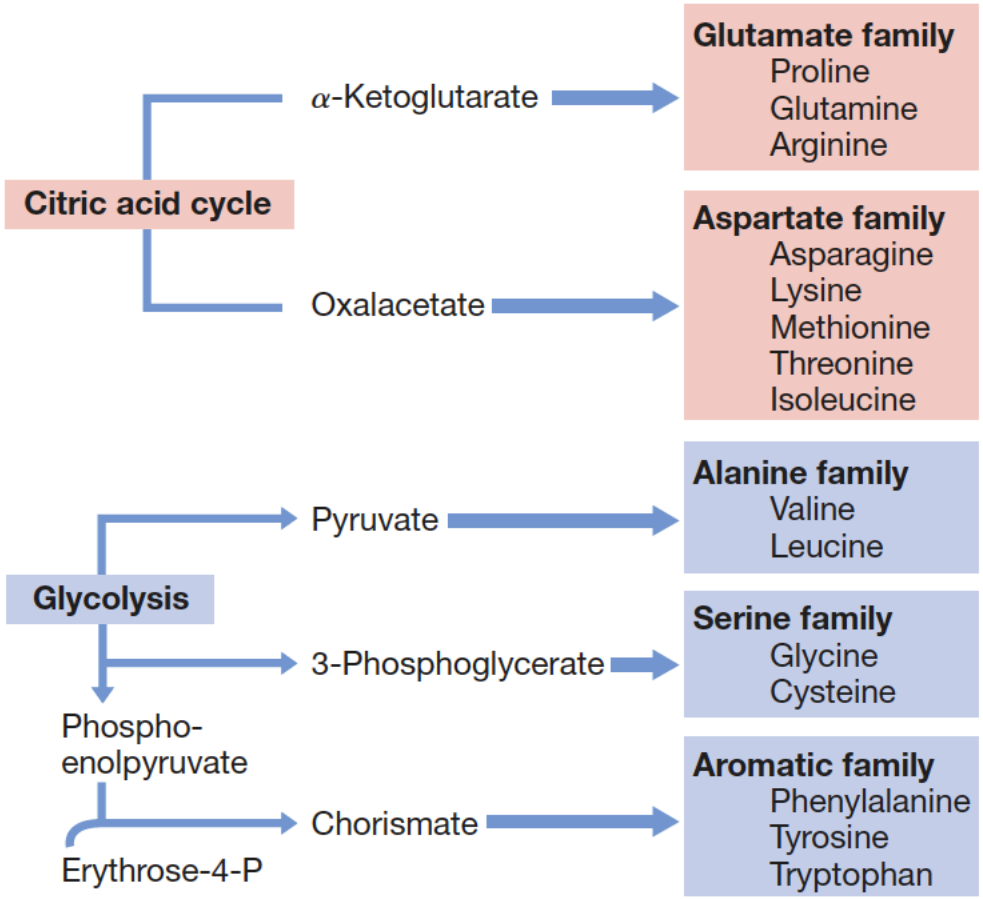
Exemplos de Autotóficos



Anabolismo – Consumo de ATP - Sintese



Sintese de Aminoácidos



Anabolismo – Sintese de DNA/RNA e Lipídios