

# Metabolism (from Ch. 5)

# Pre-Quiz

# Metabolism Pre-Quiz

Key for #1-2:

A. Photosynthesis

B. Cellular Respiration

C. Glycolysis

D. Entner-Doudoroff Pathway

E. Pentose-Phosphate Pathway

F. Fermentation

1. Which of these involves an electron transport chain? Choose all that apply.

2. ATP is produced during which of these processes? Choose all that apply.

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3. True or False: Enzymes are normally abundant and active, unless something happens to inhibit their function.

4. True or False: The term “metabolism” refers only to the breakdown (not synthesis) of complex materials.

5. True or False: Cellular respiration is always the most efficient way to produce ATP from sugars.

6. True or False: Organisms that do cellular respiration are “better adapted” and “more fit” than organisms that do not.

7. Which one of these biological themes is most evident in cellular respiration?

A. Natural selection

B. Endosymbiosis

C. Structure-function relationships

# Course objective

- “Be able to describe the physiology and genetic processes of microorganisms.”

# Catabolism vs. Anabolism

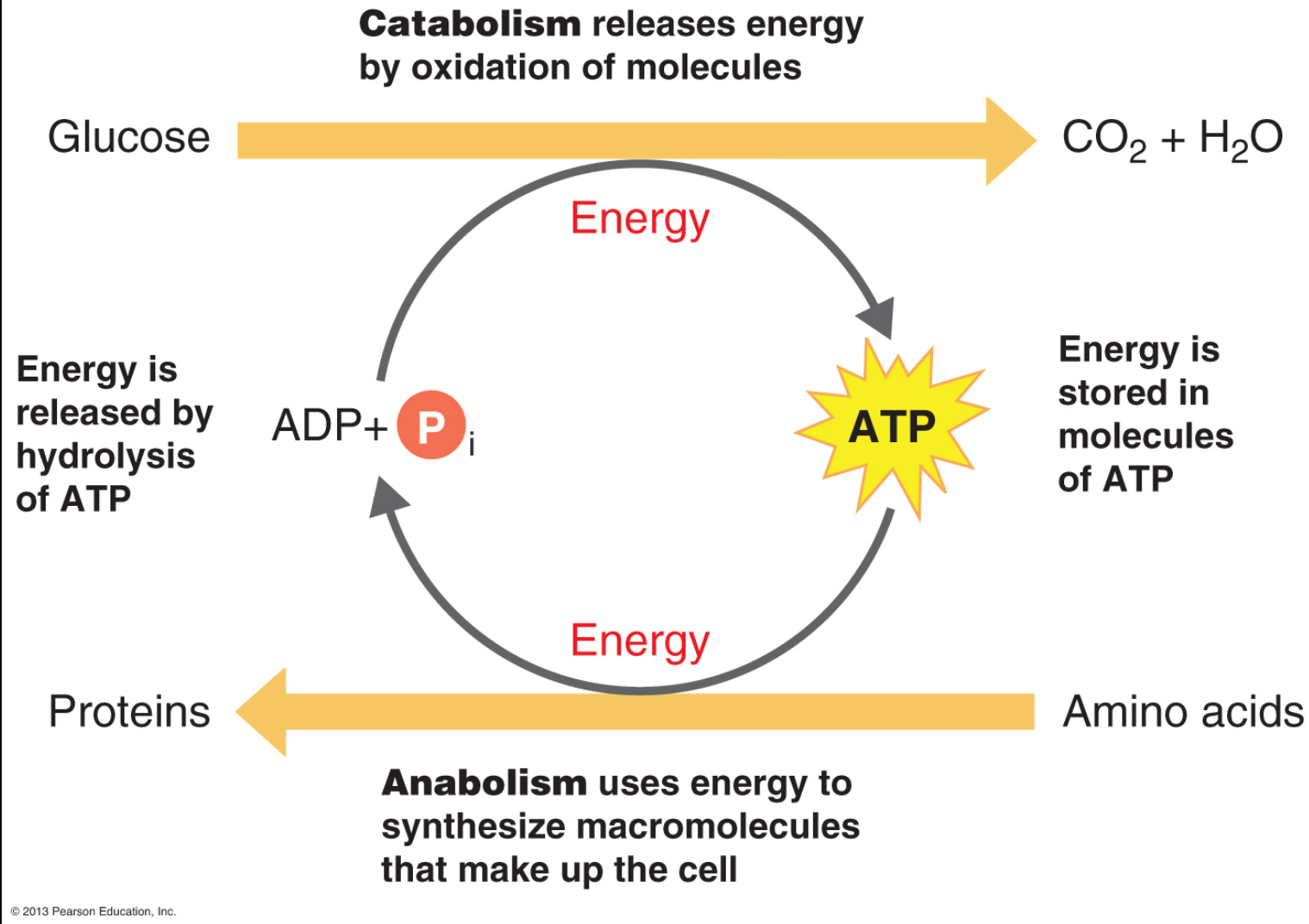


Fig. 5.1

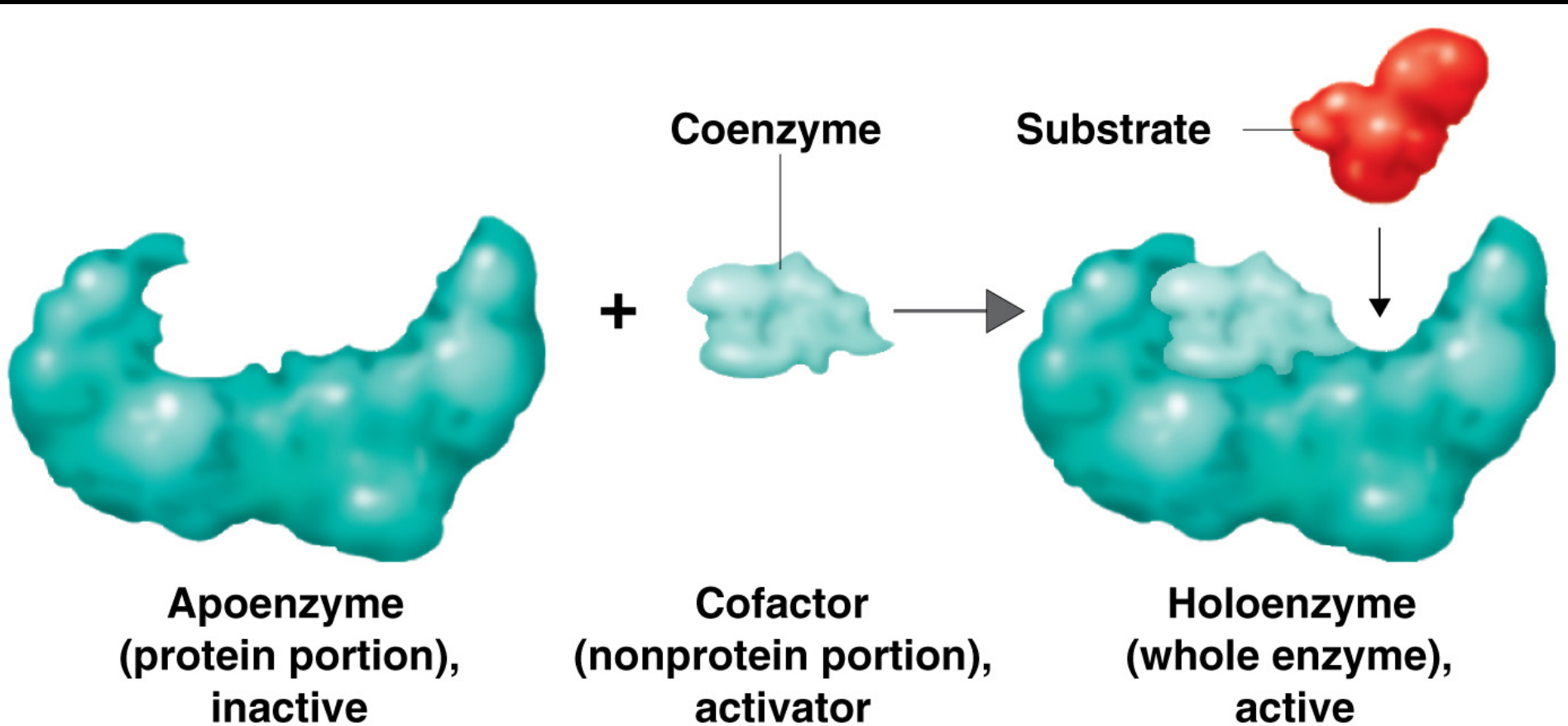
# Enzyme groups

**TABLE 5.1 Enzyme Classification Based on Type of Chemical Reaction Catalyzed**

<b>Class</b>	<b>Type of Chemical Reaction Catalyzed</b>	<b>Examples</b>
<b>Oxidoreductase</b>	Oxidation-reduction, in which oxygen and hydrogen are gained or lost	Cytochrome oxidase, lactate dehydrogenase
<b>Transferase</b>	Transfer of functional groups, such as an amino group, acetyl group, or phosphate group	Acetate kinase, alanine deaminase
<b>Hydrolase</b>	Hydrolysis (addition of water)	Lipase, sucrase
<b>Lyase</b>	Removal of groups of atoms without hydrolysis	Oxalate decarboxylase, isocitrate lyase
<b>Isomerase</b>	Rearrangement of atoms within a molecule	Glucose-phosphate isomerase, alanine racemase
<b>Ligase</b>	Joining of two molecules (using energy usually derived from the breakdown of ATP)	Acetyl-CoA synthetase, DNA ligase

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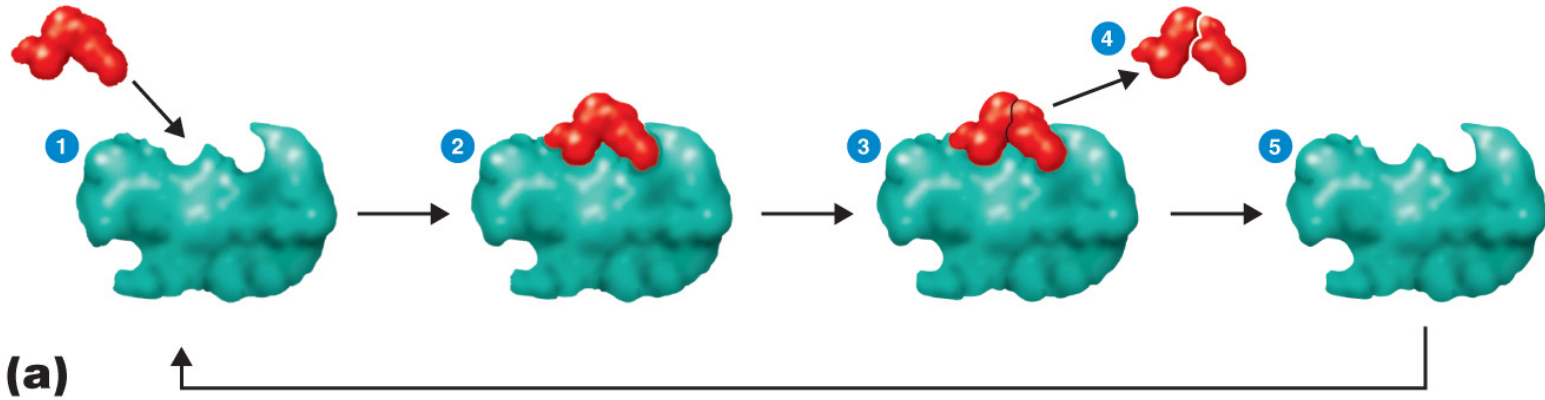
# Enzyme parts



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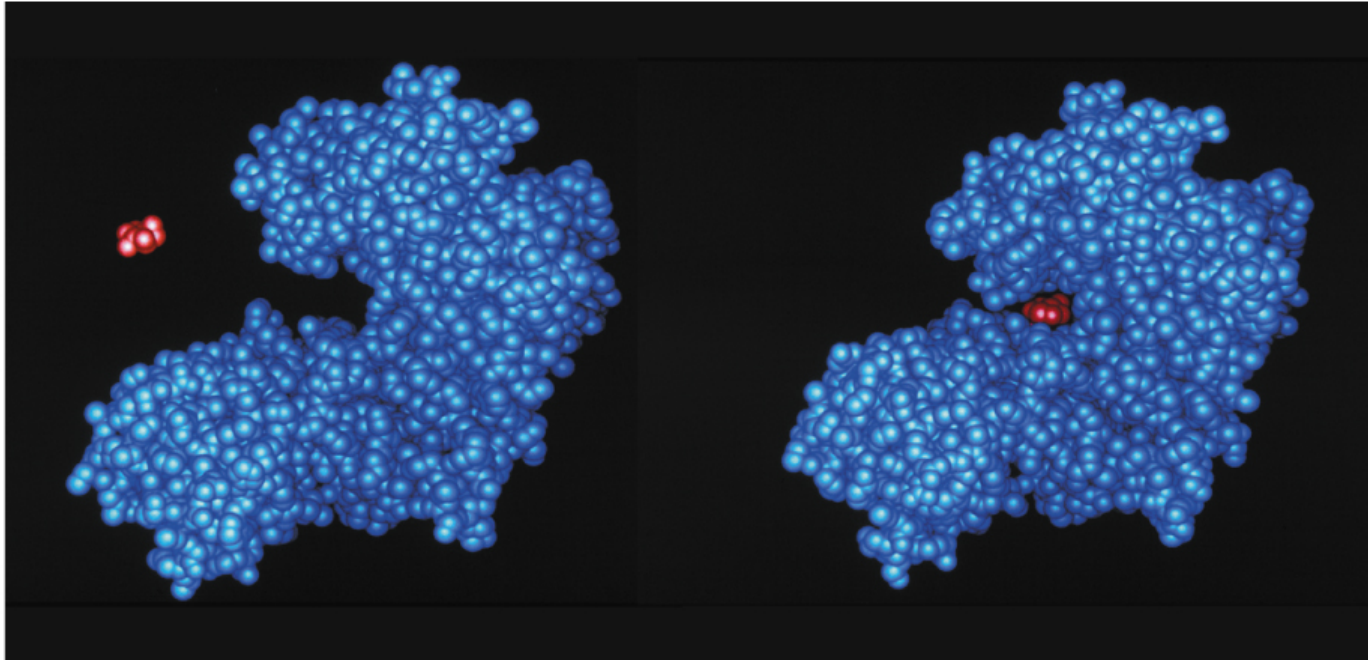
Fig. 5.3

# Enzyme activity



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(b)

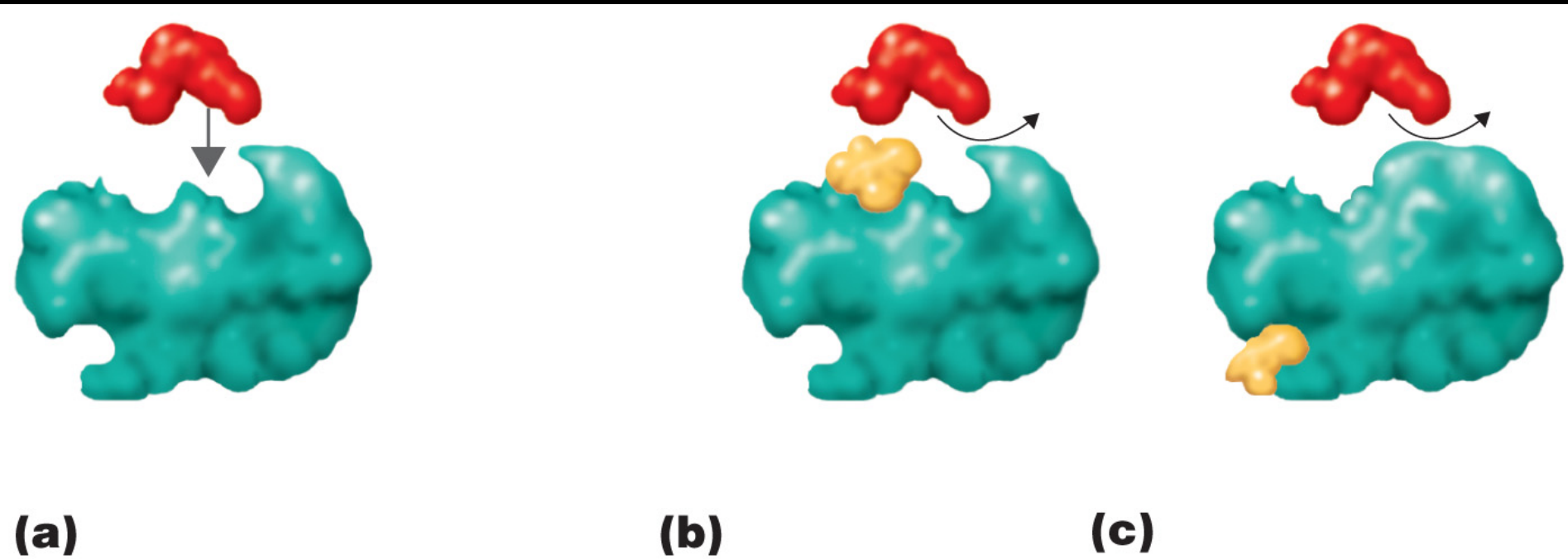


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Fig. 5.4



# Enzyme inhibition



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Fig. 5.7

# Enzyme inhibition

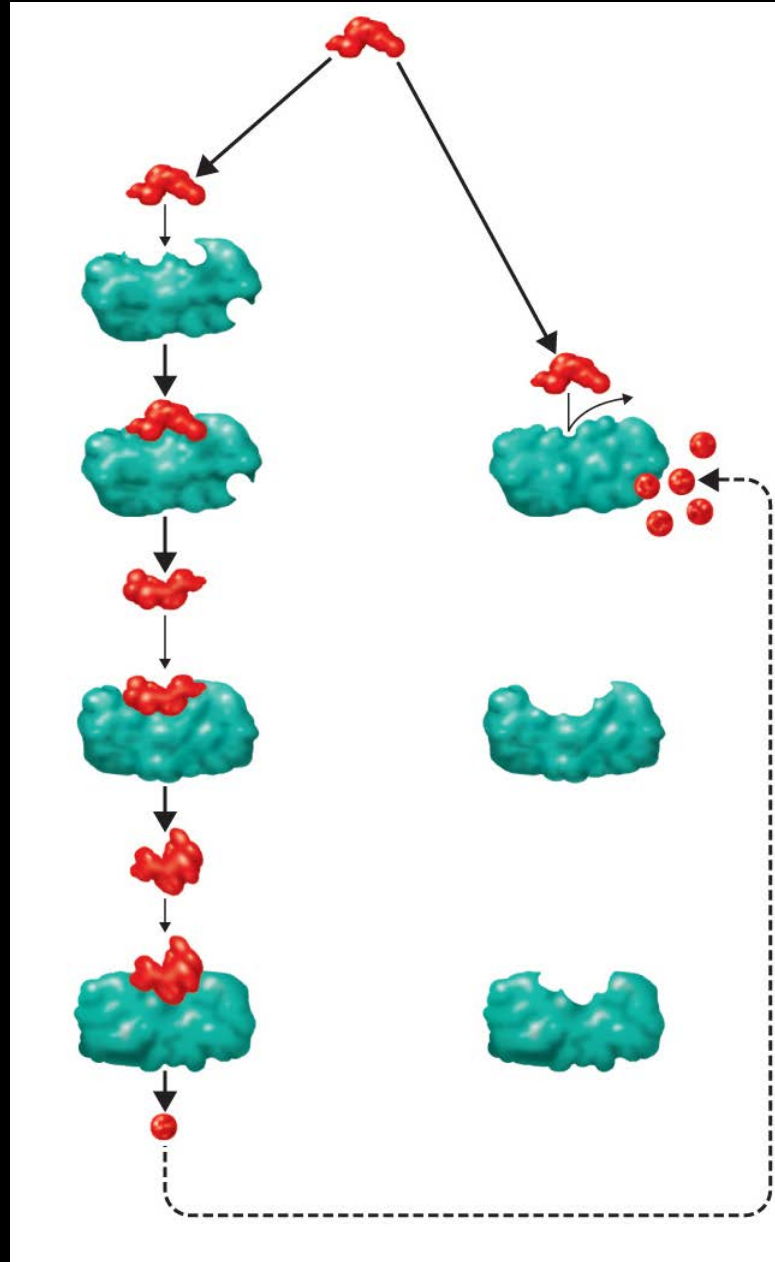
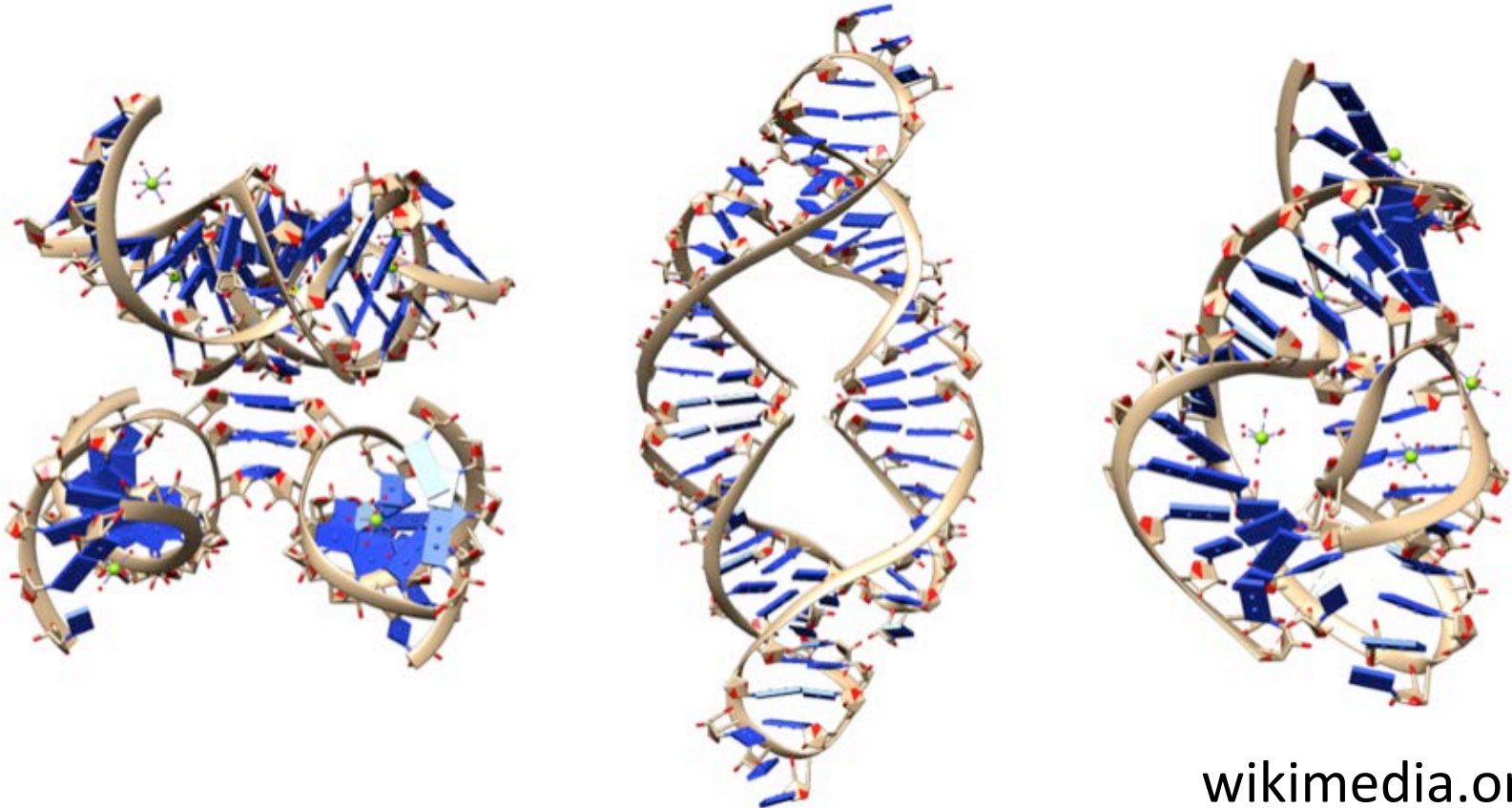
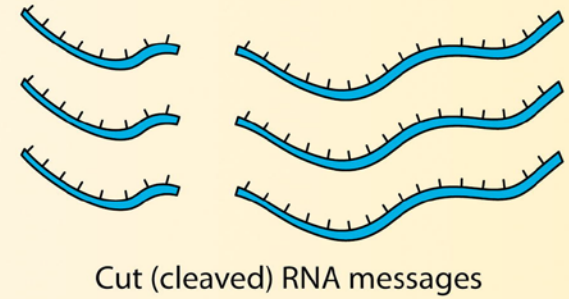
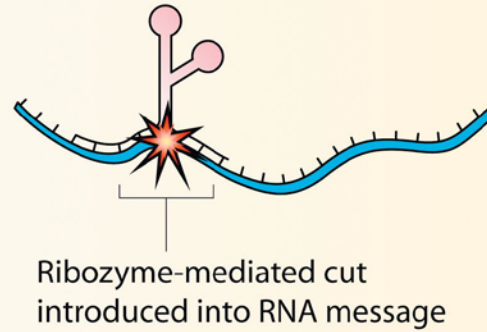
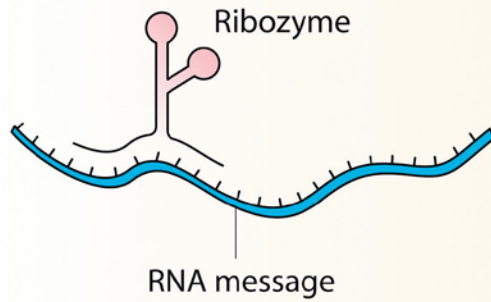
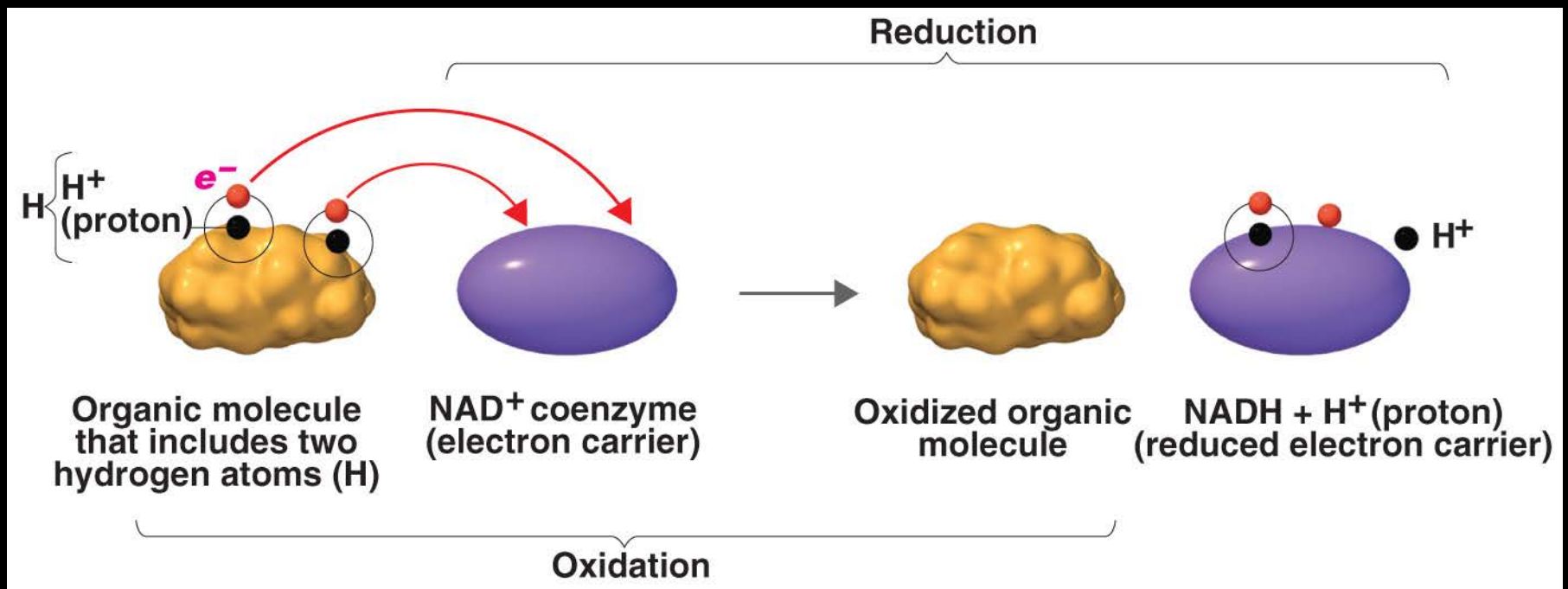
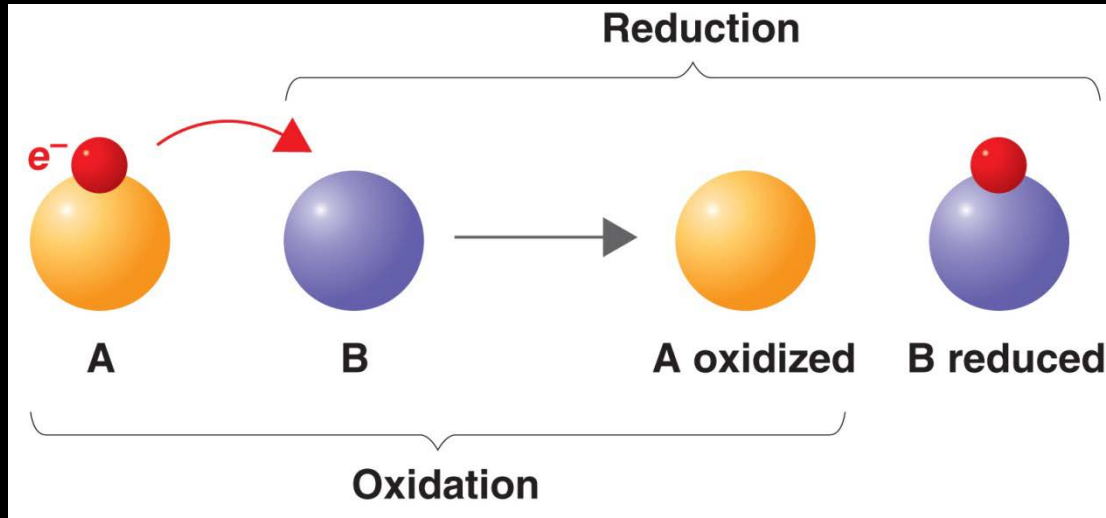


Fig. 5.8

# Ribozymes



# Redox reactions (figs. 5.9, 5.10)



# Generation of ATP

# Overview of cell resp. + fermentation

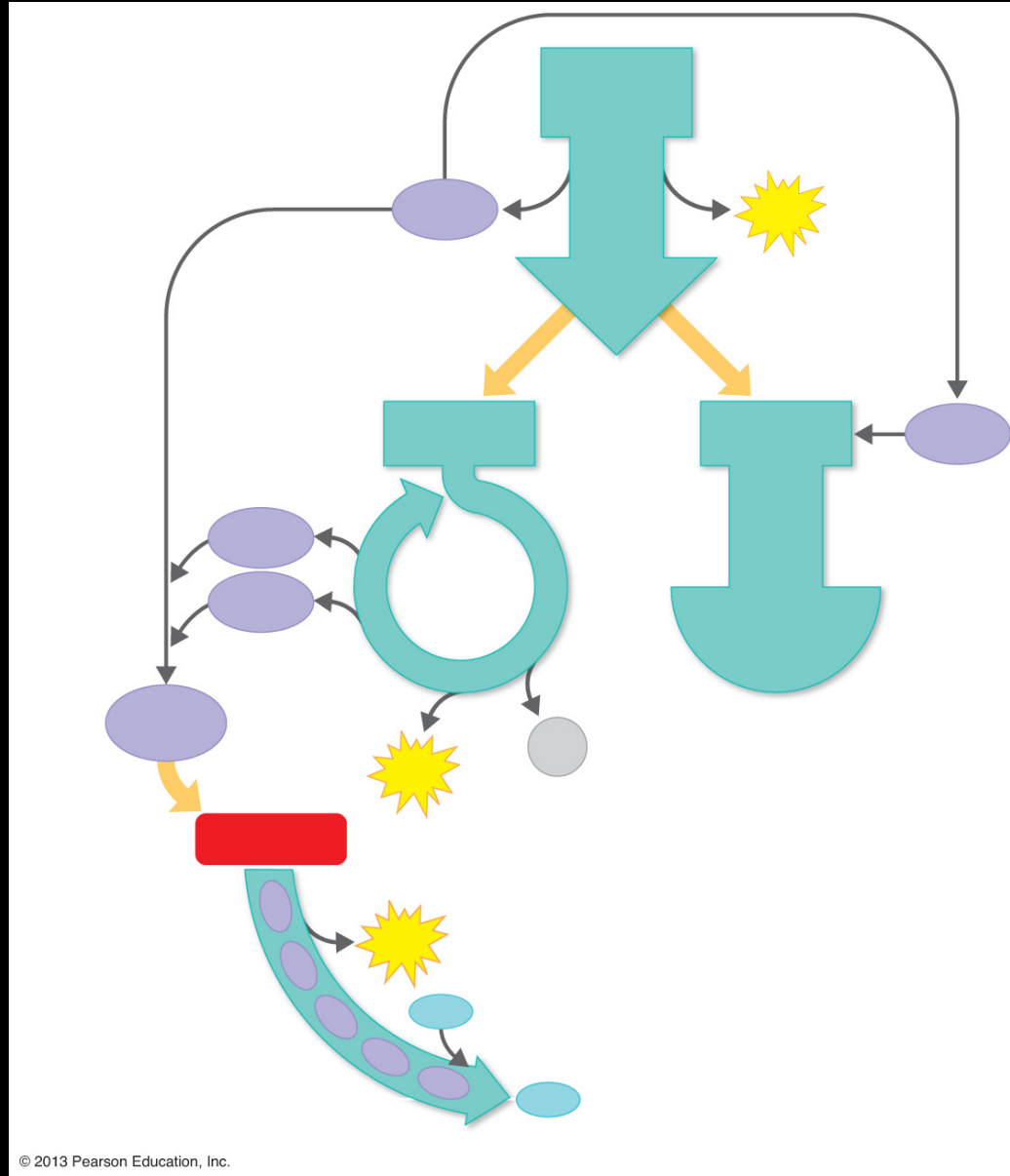


Fig. 5.11



# Electron Transport Chain

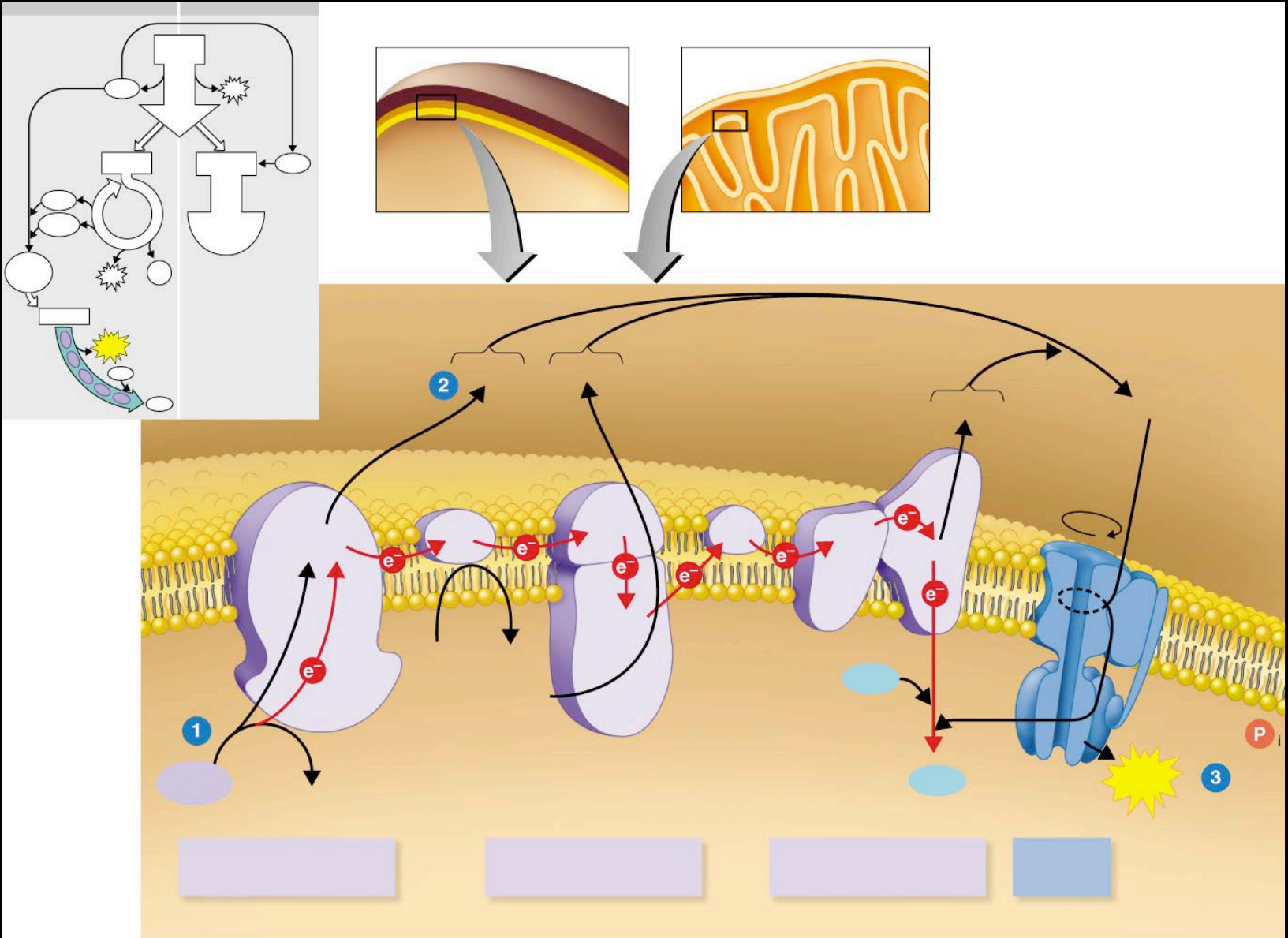
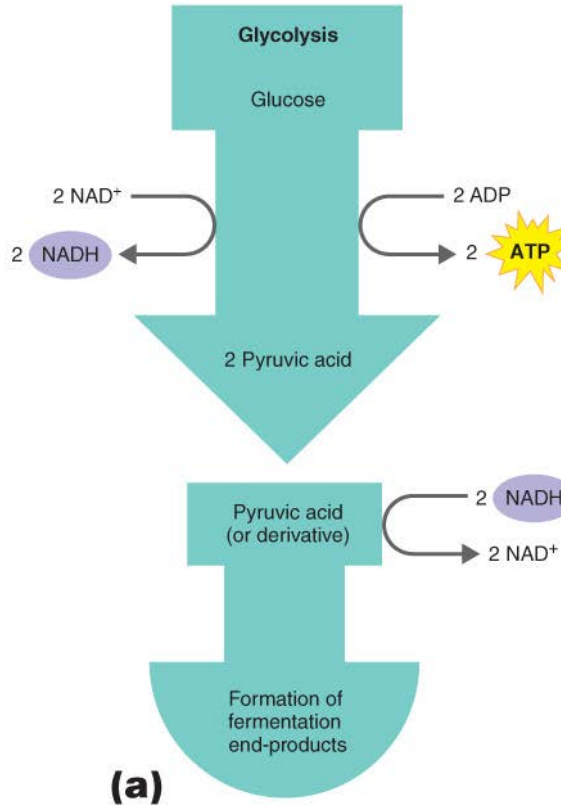
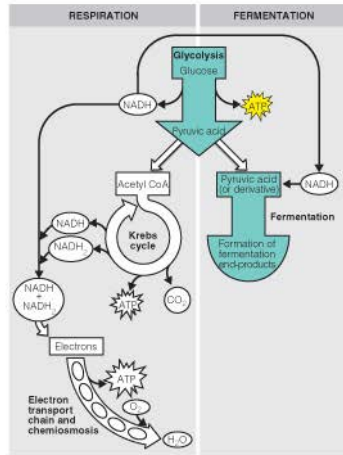


Fig. 5.16

# Products of fermentation



	Pyruvic acid					
Organism	<i>Streptococcus, Lactobacillus, Bacillus</i>	<i>Saccharomyces</i> (yeast)	<i>Propionibacterium</i>	<i>Clostridium</i>	<i>Escherichia, Salmonella</i>	<i>Enterobacter</i>
Fermentation end-product(s)	Lactic acid	Ethanol and CO <sub>2</sub>	Propionic acid, acetic acid, CO <sub>2</sub> , and H <sub>2</sub>	Butyric acid, butanol, acetone, isopropyl alcohol, and CO <sub>2</sub>	Ethanol, lactic acid, succinic acid, acetic acid, CO <sub>2</sub> , and H <sub>2</sub>	Ethanol, lactic acid, formic acid, butanediol, acetoin, CO <sub>2</sub> , and H <sub>2</sub>

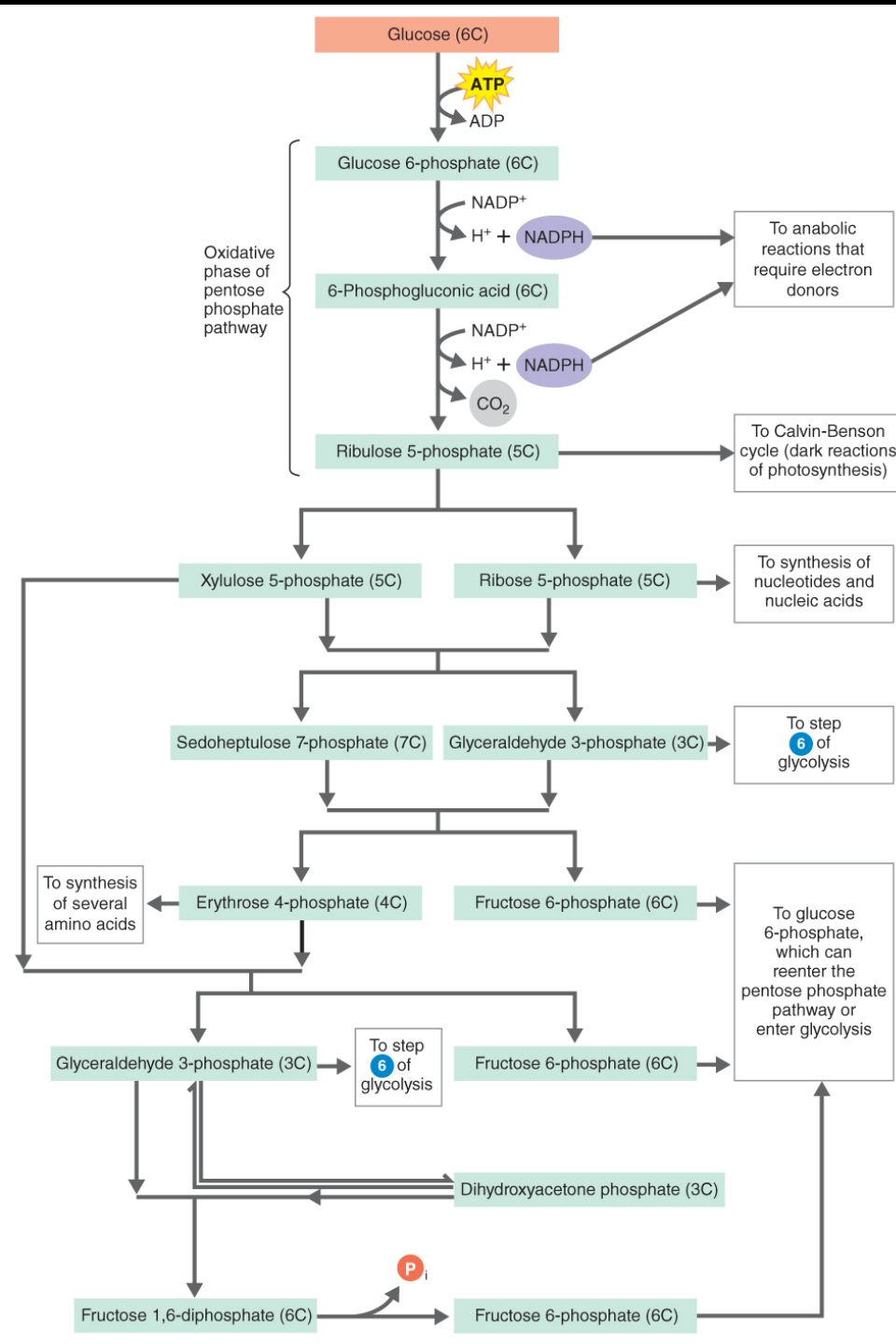
Fig. 5.18



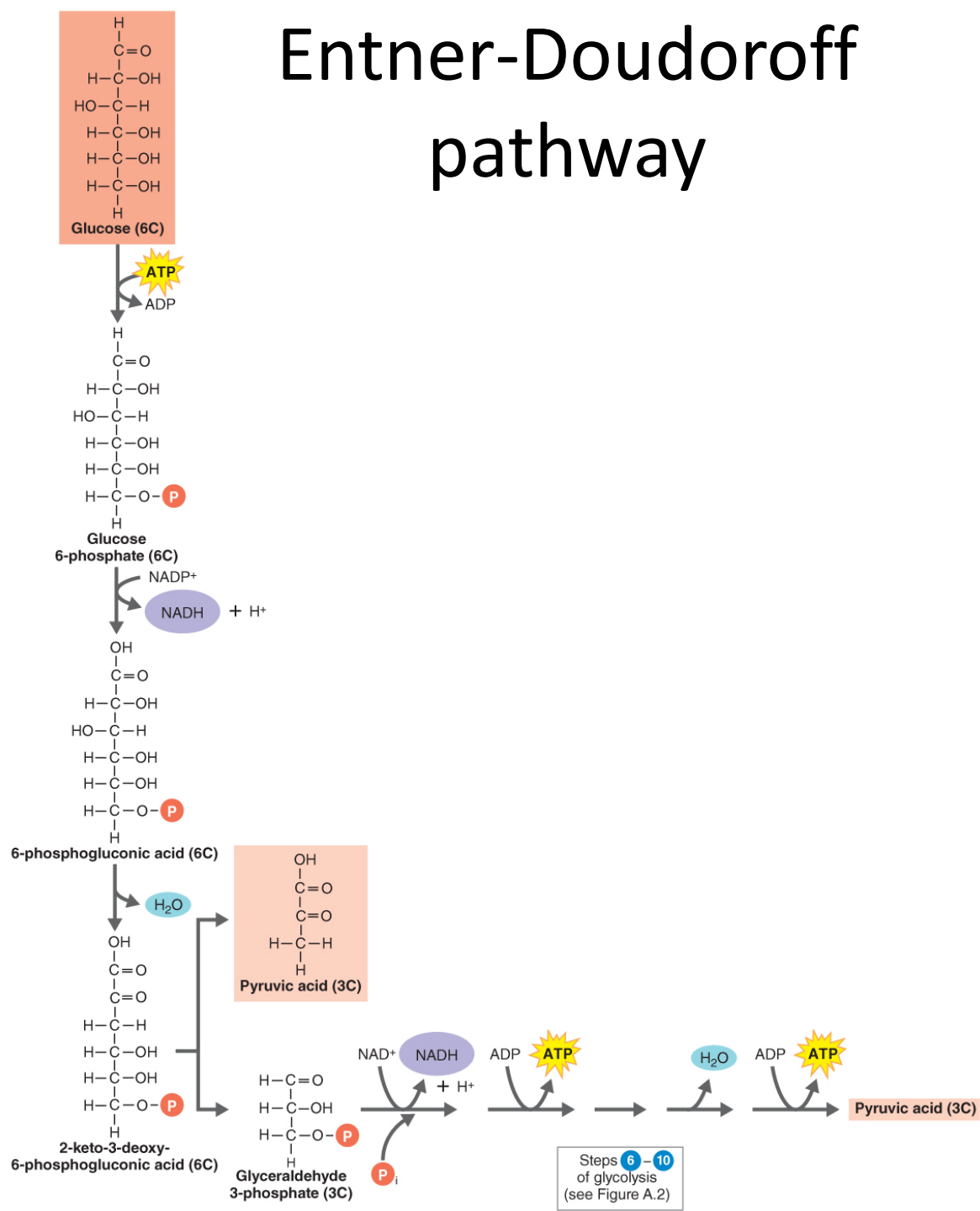
# Variations within cell resp.

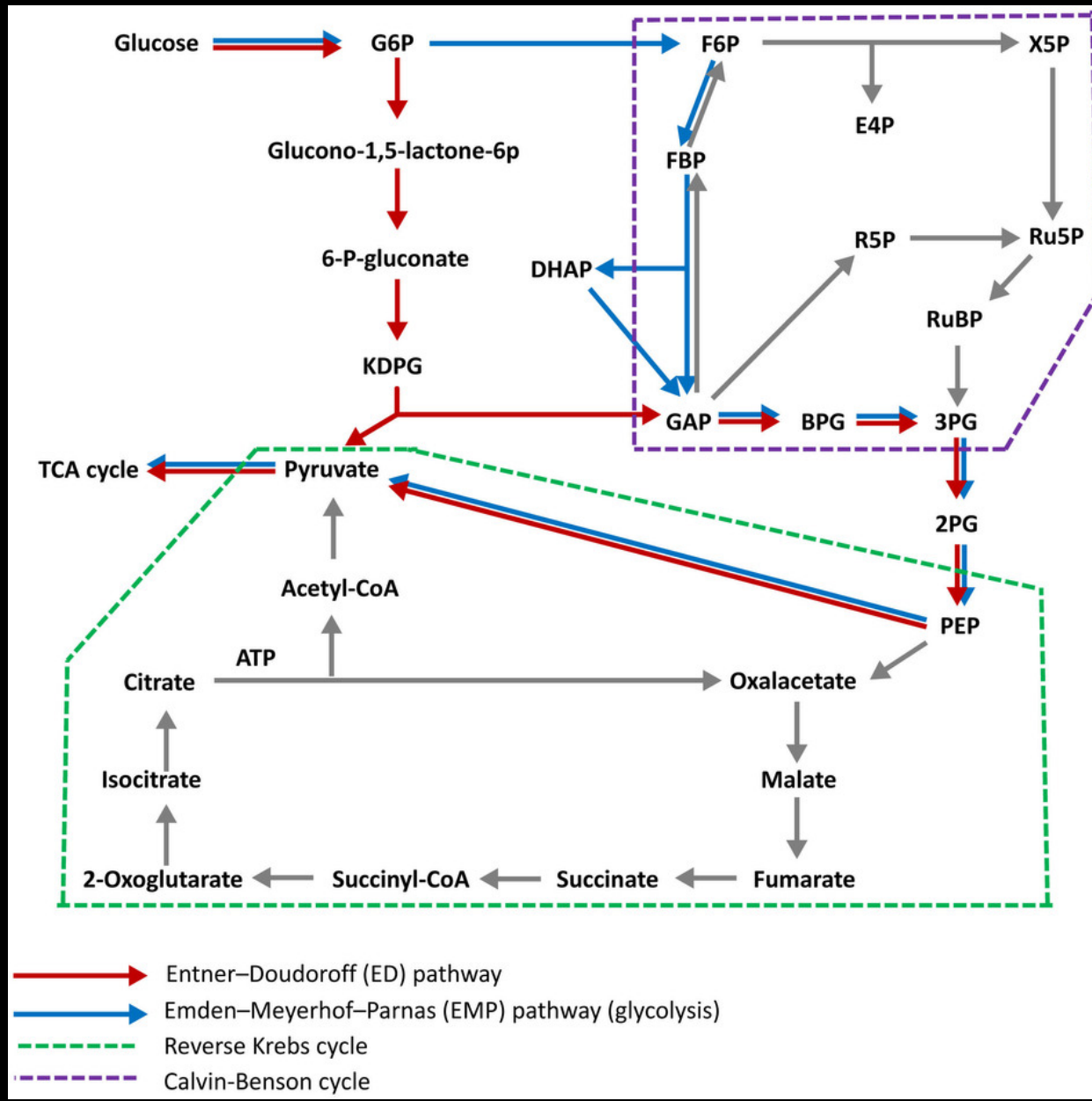
- Glycolysis
- Pentose-phosphate pathway
- Entner-Doudoroff pathway

# Pentose phosphate pathway



# Entner-Doudoroff pathway





# Other starting points

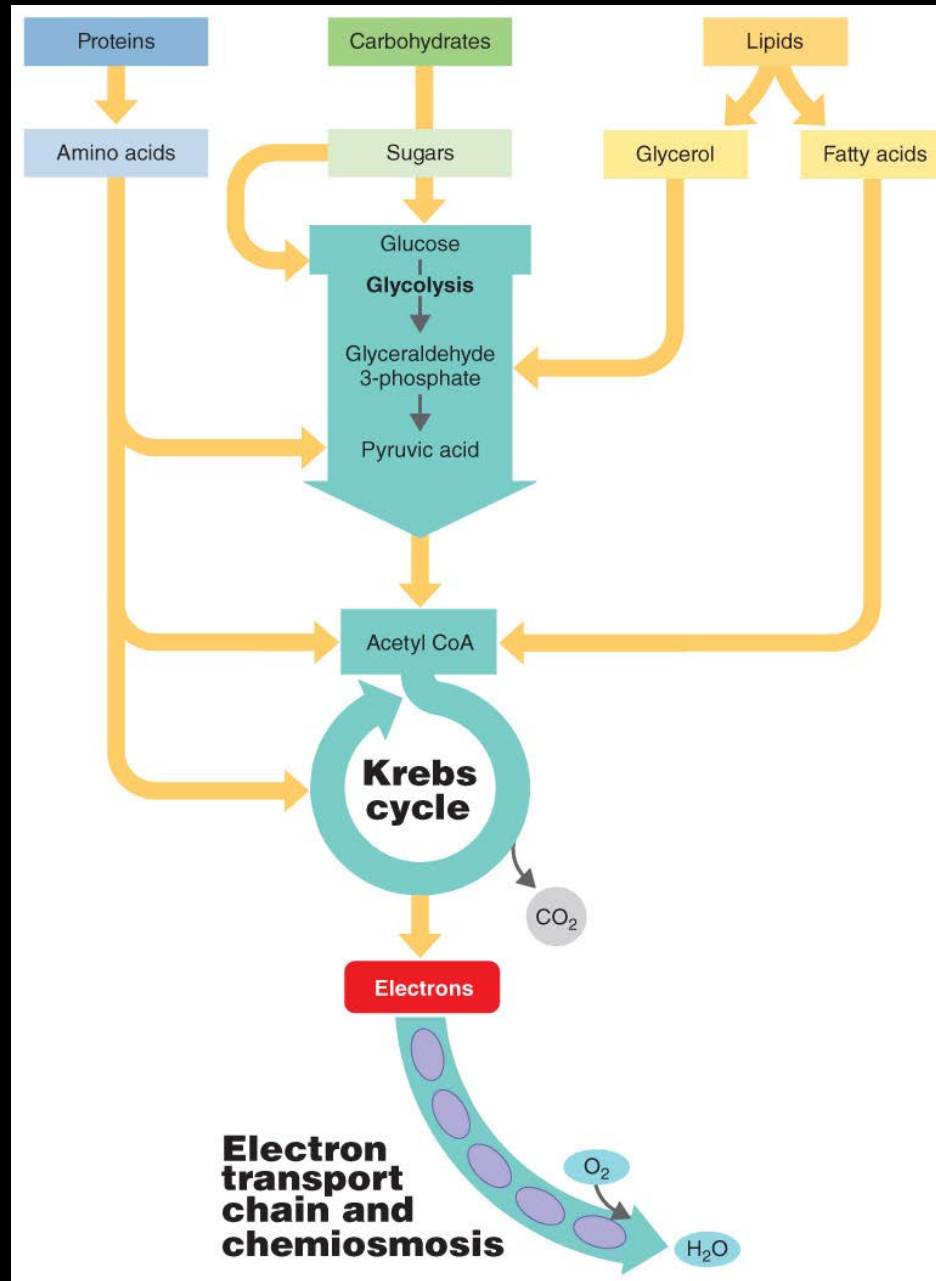
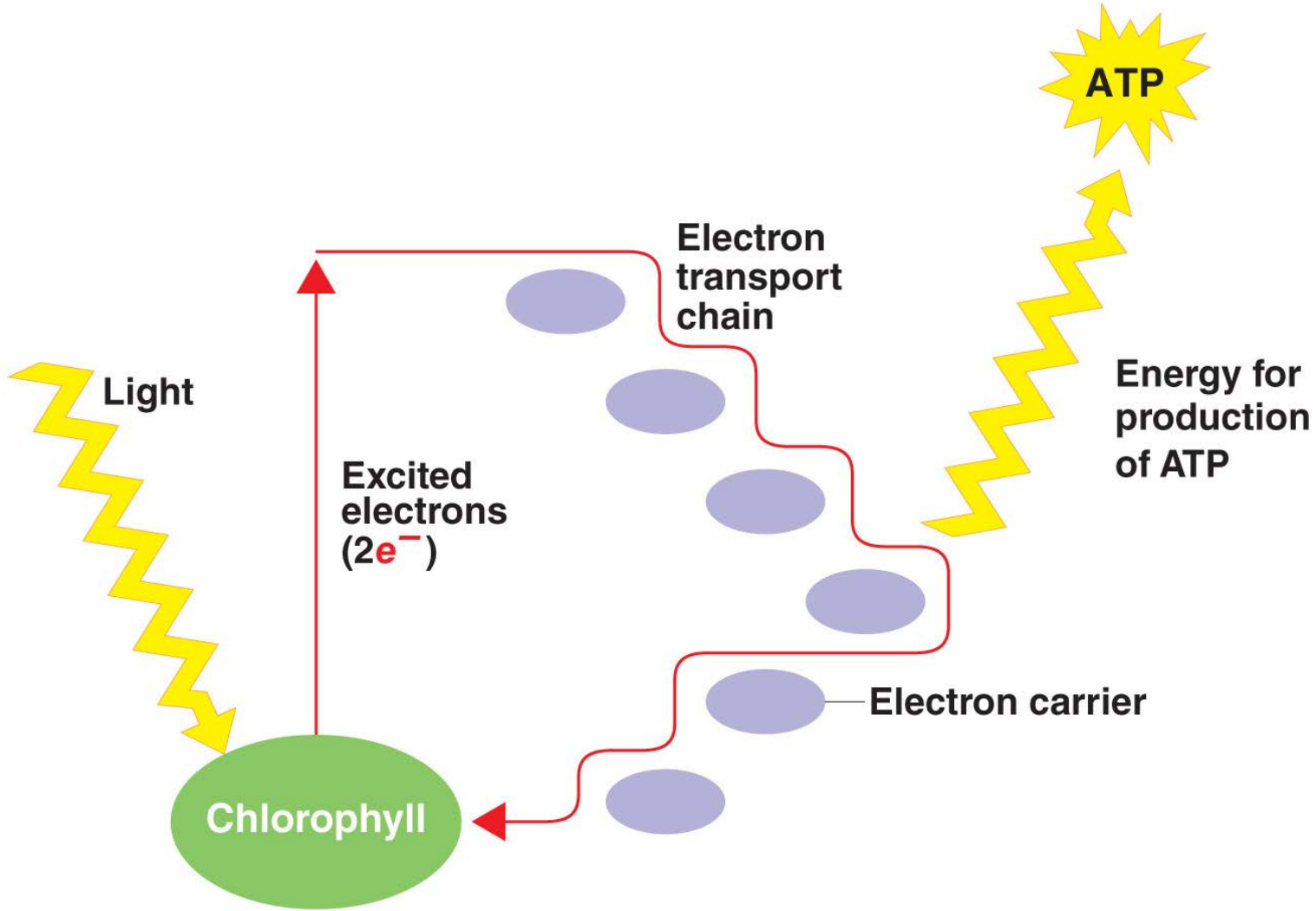


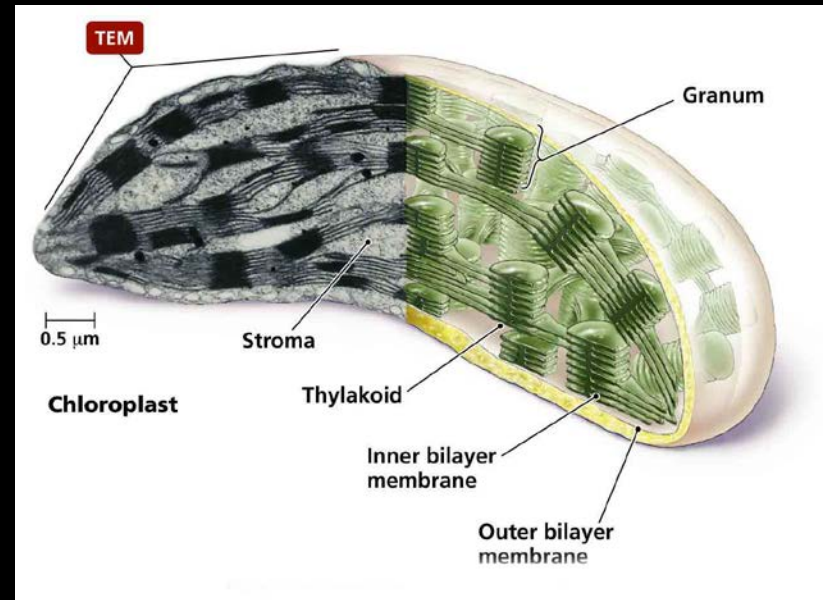
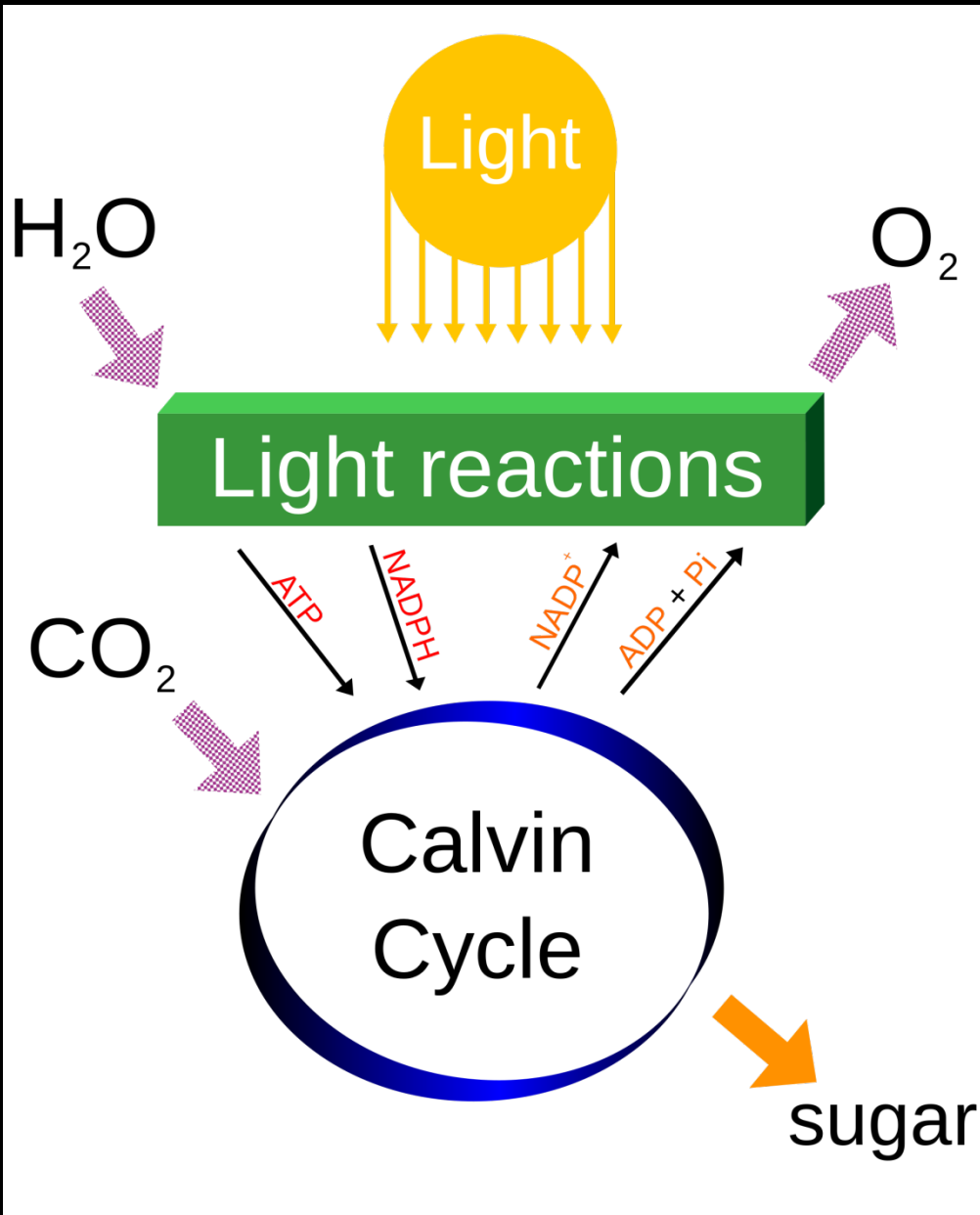
Fig. 5.21

# Photosynthesis



**(a)** In Photosystem I  
Cyclic photophosphorylation

# Photosynthesis



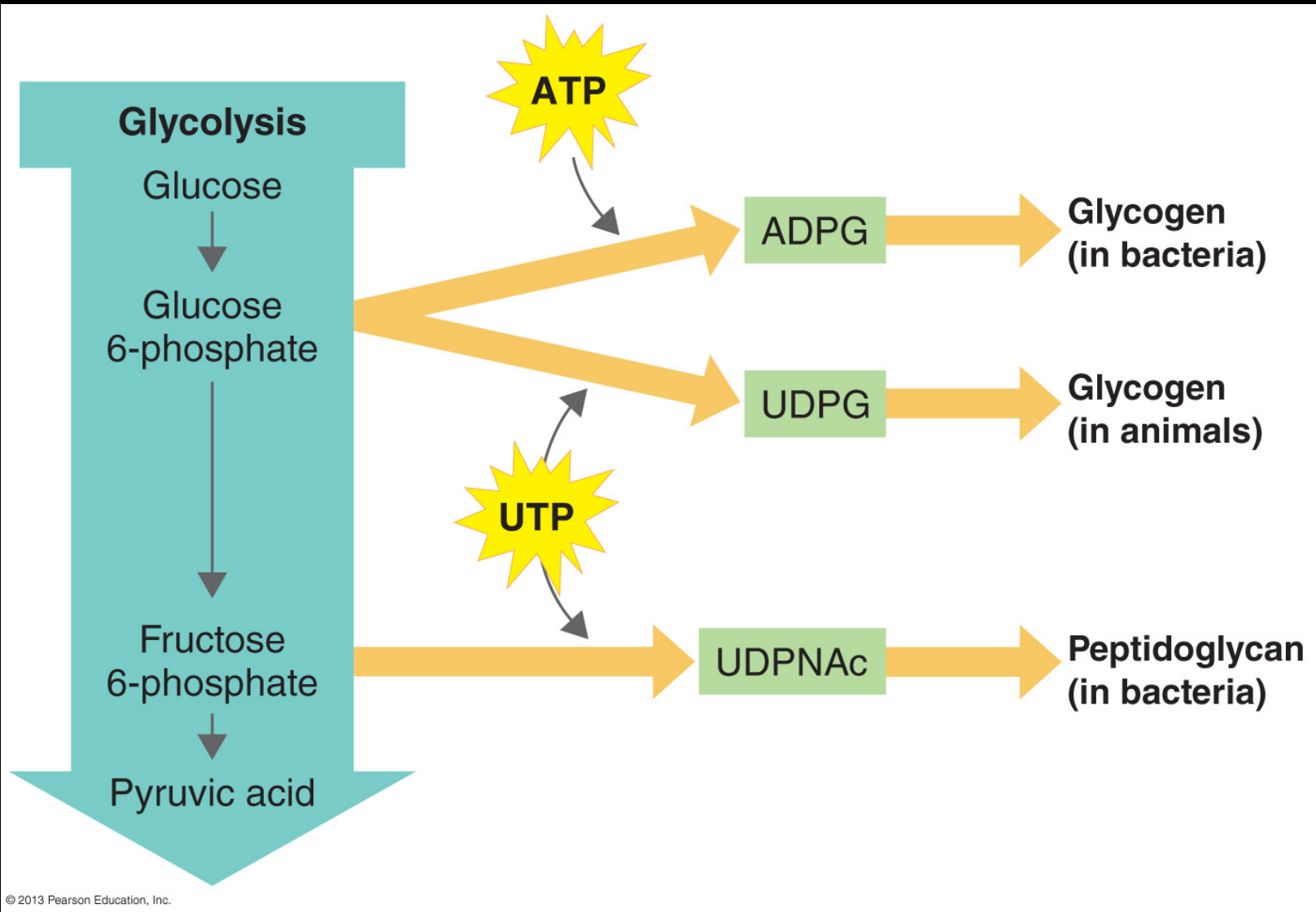


Fig. 5.29



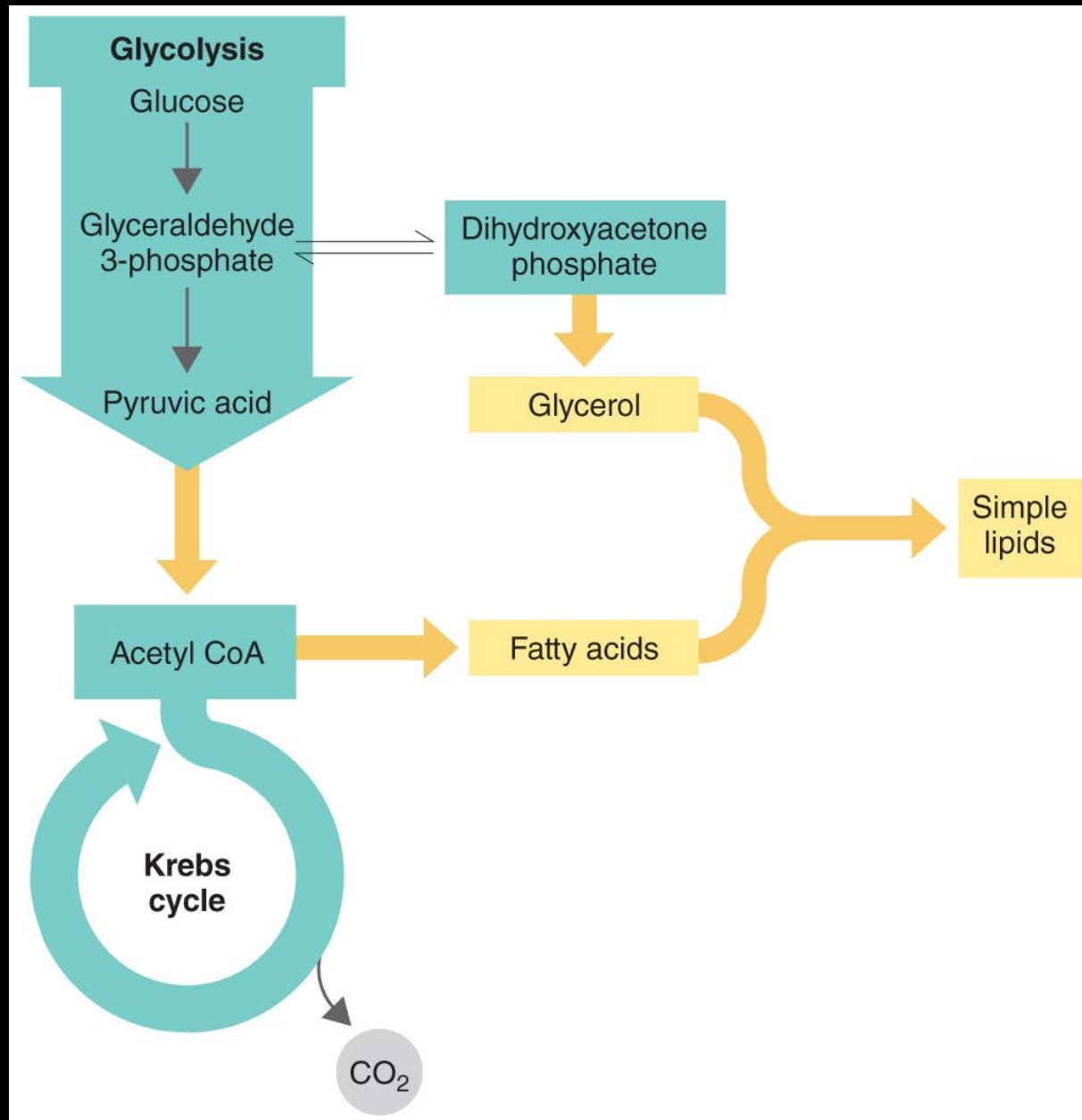
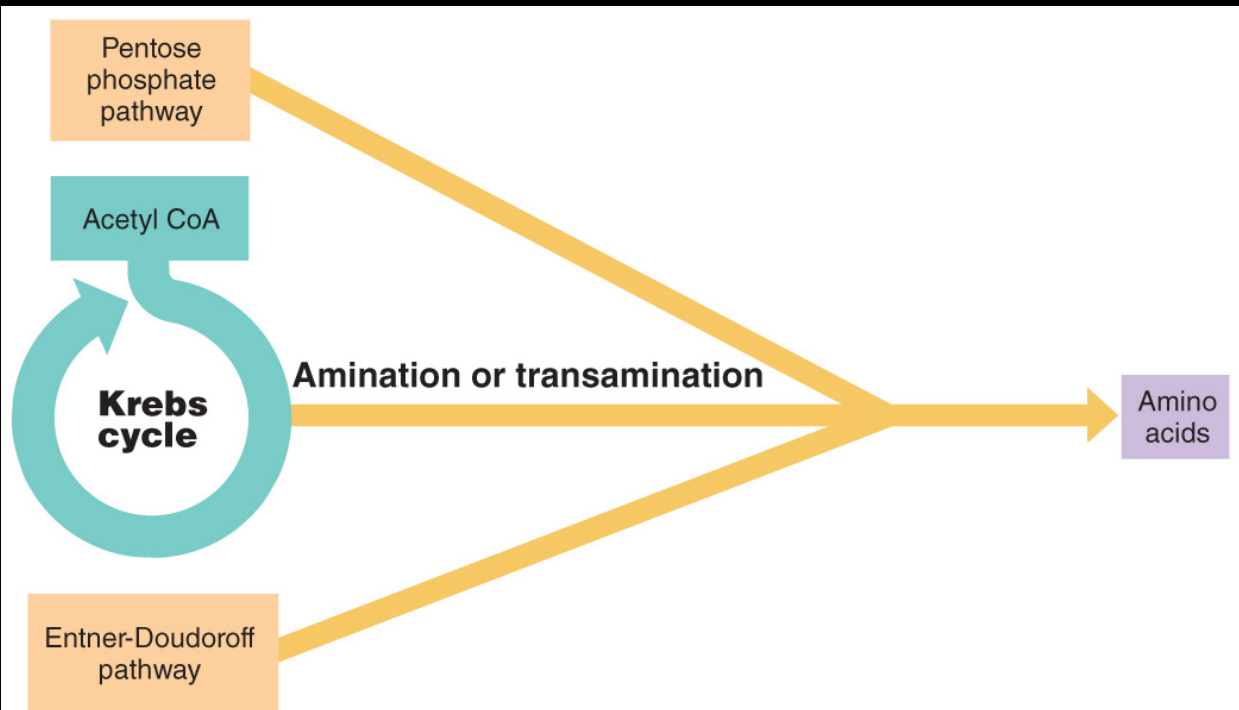
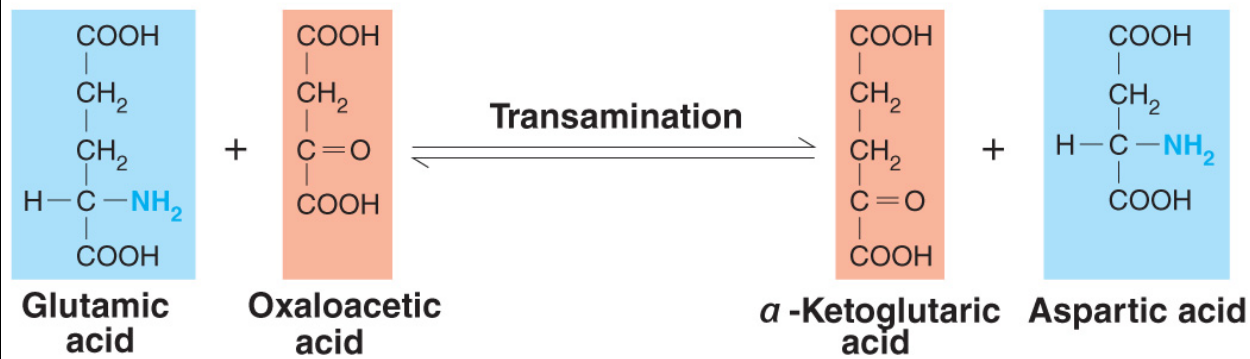


Fig. 5.30



**(a) Amino acid biosynthesis**



**(b) Process of transamination**

Fig. 5.31

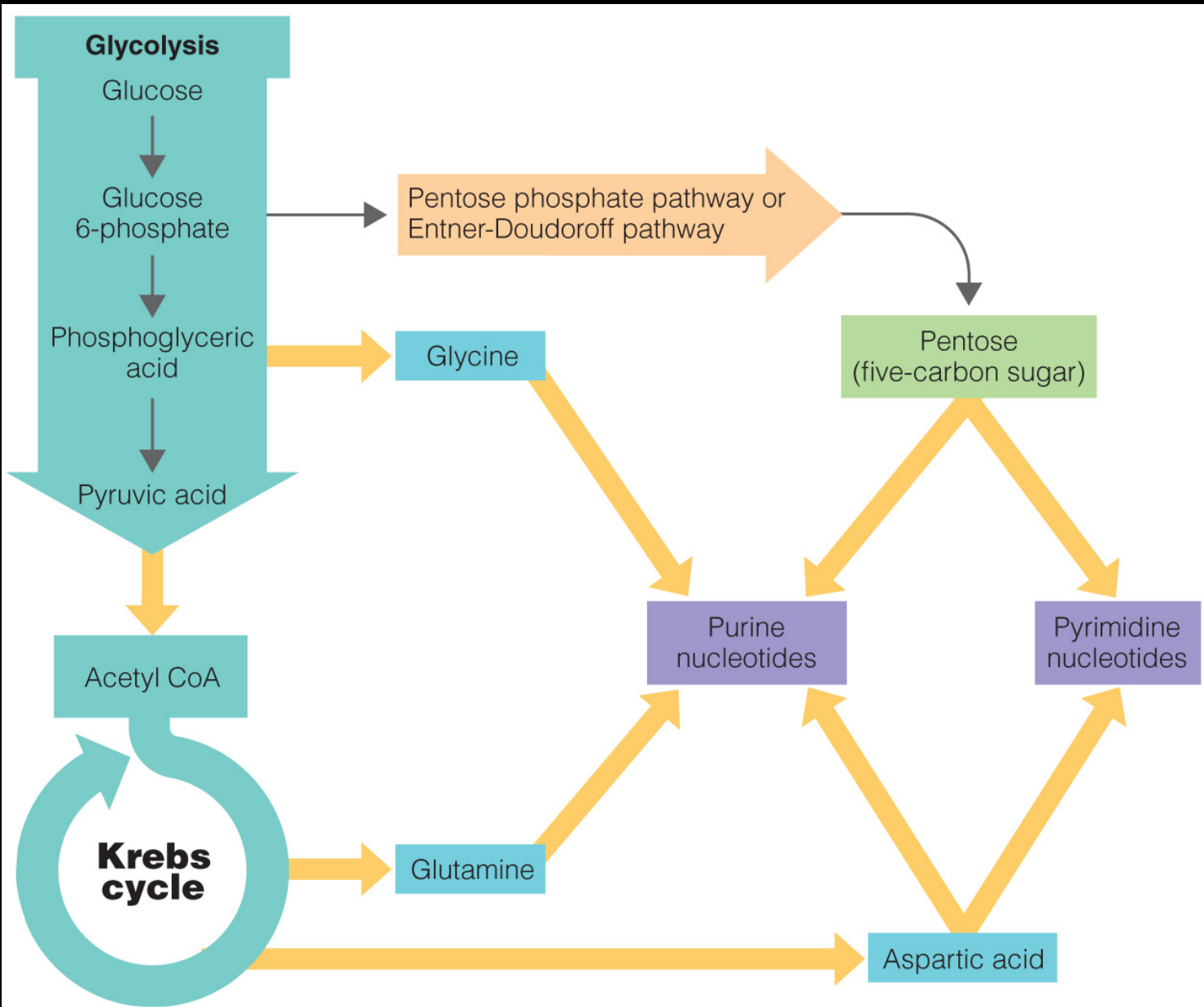


Fig. 5.32

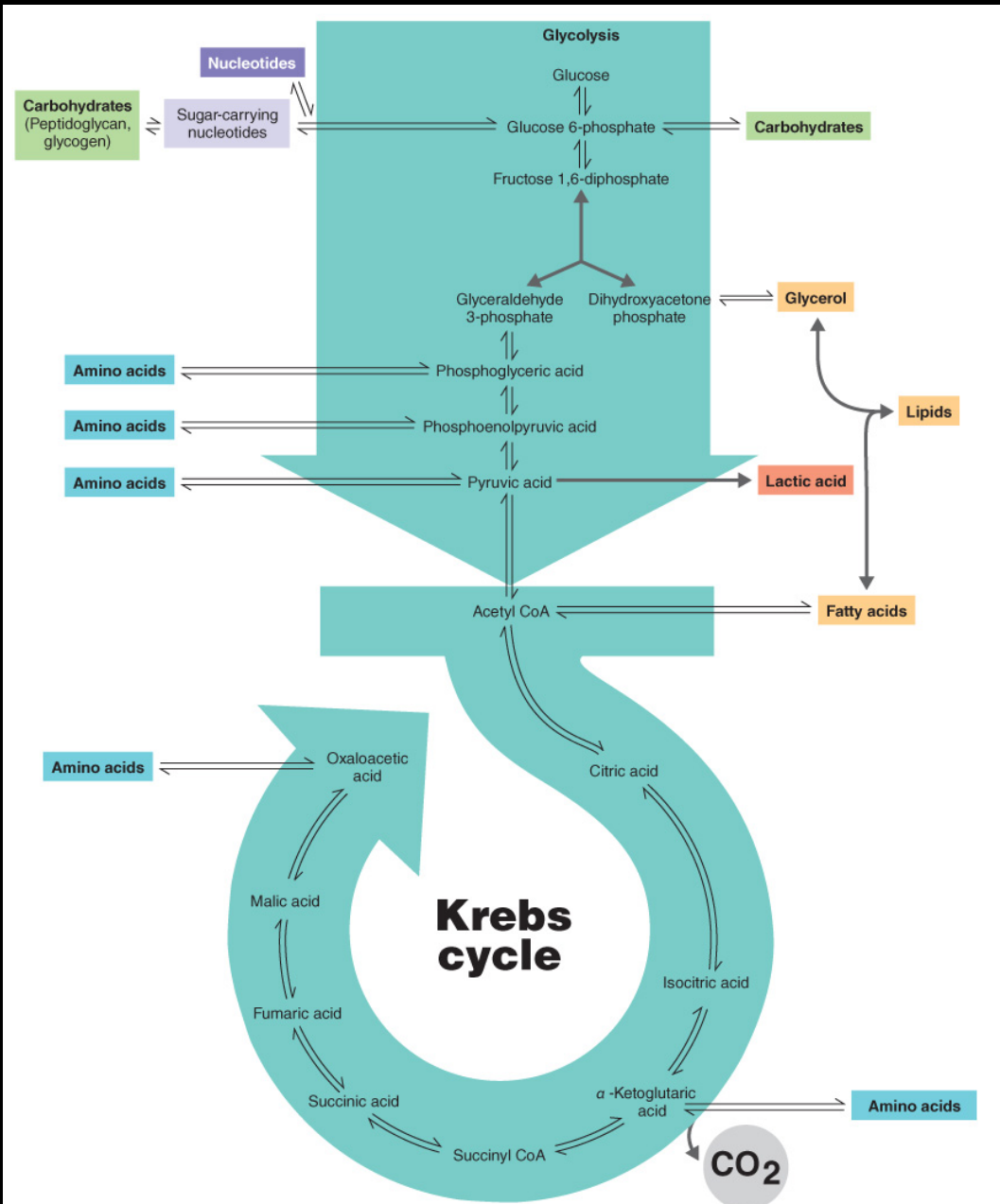
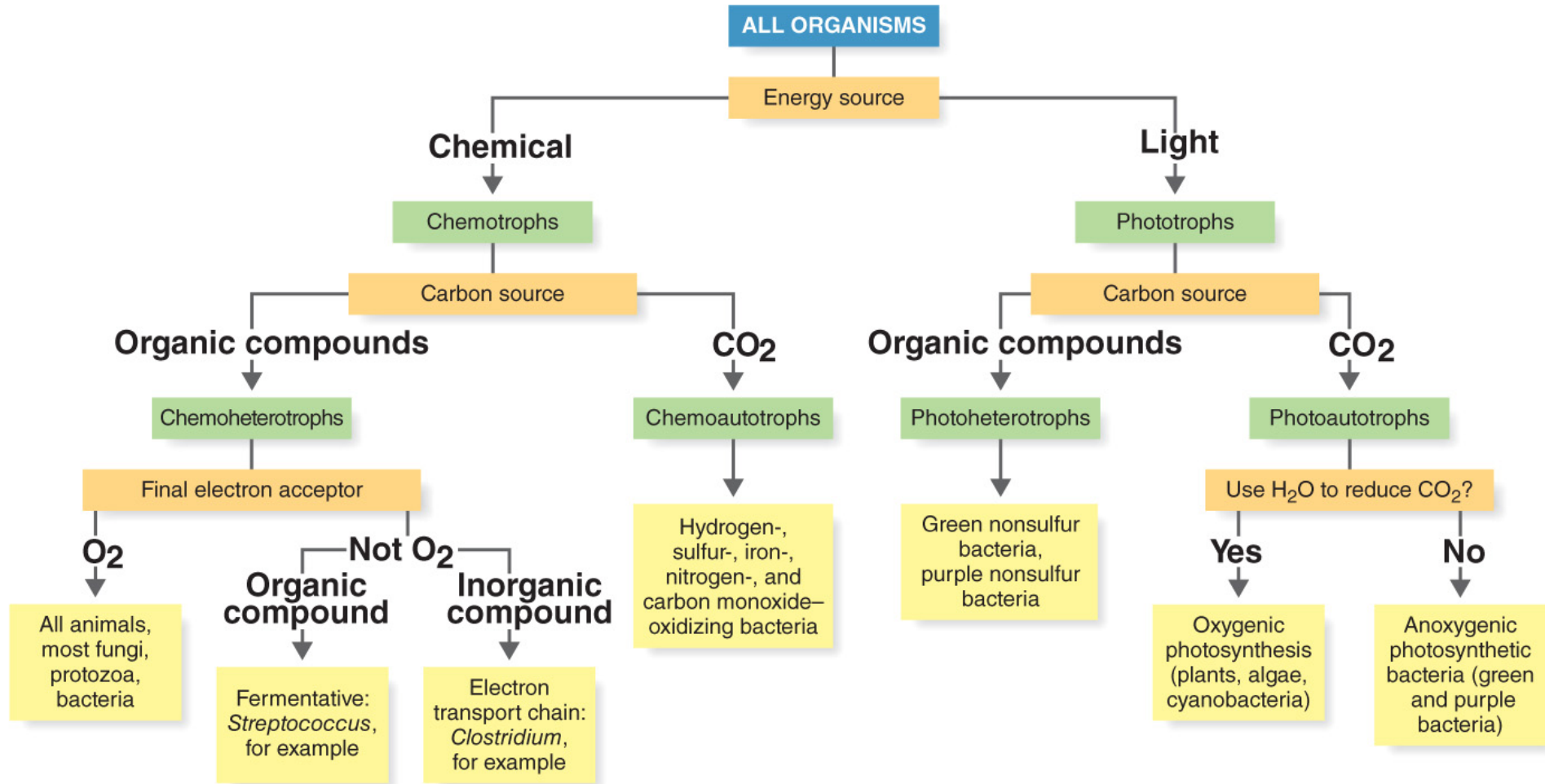


Fig. 5.33

# Metabolism types



# Metabolic Pathways poster

[www.Biochemical-pathways.com](http://www.Biochemical-pathways.com)



# Part 1 Metabolic Pathways



Roche Biochemical Pathways  
4th Edition, Part 1 - Editor: Gerhard Michal

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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**Carbohydrate Metabolism**  
Acidic Carbohydrate Derivatives

**Carbohydrate Metabolism**  
Inositol

**Carbohydrate Metabolism**  
Pentoses and Pentose Cycle

**Amino Acid Metabolism**  
Histidine

**Carbohydrate Metabolism**  
Di- and Polysaccharides

**Carbohydrate Metabolism**  
Amino Sugar Derivatives

**Amino Acid Metabolism**  
Serine, Threonine, Cysteine, Methionine

**Amino Acid Metabolism**  
Lysine

**Bacterial Metabolism**  
Penicillin, Cephalosporin

**Bacterial Metabolism**  
Butanol/Butyrate, Fermentation

**Carbohydrate Metabolism**  
Nucleotide Sugars

**Bacterial Metabolism**  
Methane Oxidation

**Carbohydrate Metabolism**  
Pyruvate Turnover

**Citrate and Glyoxalate Cycle**

**Tetrapyrrole Metabolism**  
Porphyrins, Cobalamin

**Tetrapyrrole Metabolism**  
Heme, Cytochromes, Chlorophyll

**Carbohydrate Metabolism**  
Glycolysis and Gluconeogenesis

**C1-Metabolism**

**Lipid Metabolism**  
Glyco- and Phospholipids

**Lipid Metabolism**  
Fatty Acids

**Amino Acid Metabolism**  
Urea Cycle

**Amino Acid Metabolism**  
Glutamate, Proline, Hydroxyproline

**Nucleotide Metabolism**  
Pyrimidines

**Bacterial Metabolism**  
Methanogenesis

**Lipid Metabolism**  
Sphingolipids

**Bacterial Metabolism**  
Alkane Oxidation

**Amino Acid Metabolism**  
Leucine, Isoleucine, Valine

**Lipid Metabolism**  
Carotenoids and Isoprenoids

**Steroid Metabolism**  
Mineralocorticoids and Glucocorticoids

**Steroid Metabolism**  
Phytosteroles

**Steroid Metabolism**  
Androgens and Estrogens

**Cofactors and Vitamins**  
Coenzyme A

**Steroid Metabolism**  
Cholesterol Synthesis

# Metabolic pathways

# Penicillin

