

Advanced Cell Biology. Lecture 9

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Outline

Activated carriers

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Activated carriers

Pre-exam review

Previous final question: the answer

Reaction $X \rightleftharpoons Y$ is on the stage of equilibrium.

$$K = 1, [X] = 2 \text{ mole/l}$$

What is $[Y]$?

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Reaction $X \rightleftharpoons Y$ is on the stage of equilibrium.

$$K = 1, [X] = 2 \text{ mole/l}$$

What is $[Y]$?

- ▶ $K = \frac{[X]}{[Y]}$
- ▶ $1 = \frac{2}{[Y]}$
- ▶ $[Y] = 2 \text{ mole/l}$

- ▶ Used for temporarily storage of energy
- ▶ Have high diffusion rates
- ▶ Processes with carriers have two steps: (a) activation and (b) condensation

Activation and condensation

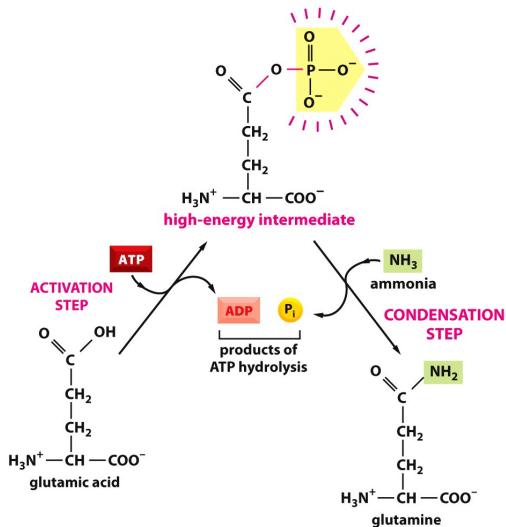
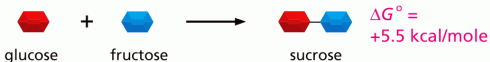


Figure 3-33b Essential Cell Biology 3/e (© Garland Science 2010)

- ▶ Two linked reactions: either oxidizing of something + carrier synthesis
- ▶ Or carrier destruction + synthesis of something (e.g., polymer from monomers)

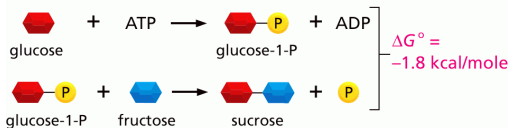
Single and coupled reactions

SINGLE REACTION



NET RESULT: will not occur!

COUPLED REACTION



NET RESULT: Sucrose is made in a reaction driven by the hydrolysis of ATP.

ATP often joins two molecules

- ▶ To join A and B, ATP usually acts as intermediate:
- ▶ $A + \text{ATP} \rightarrow A\text{--O--P}O_3 + \text{ADP}$
- ▶ $B\text{--H} + A\text{--O--P}O_3 \rightarrow A\text{--B} + P_i$

- ▶ Both are derivatives of adenine transferring electrons with associated protons (or simply H)
- ▶ They are active redox molecules
- ▶ NADH typically works in catabolic reactions like cell respiration
- ▶ NADPH works mostly in anabolic reactions like synthesis of DNA or synthesis of cholesterol

NADPH in cholesterol synthesis

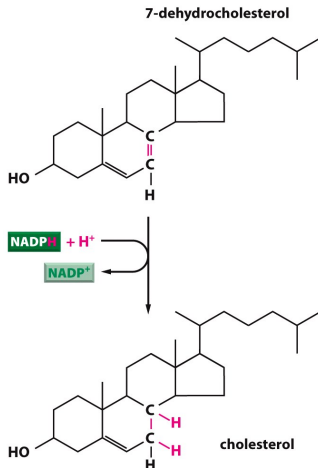
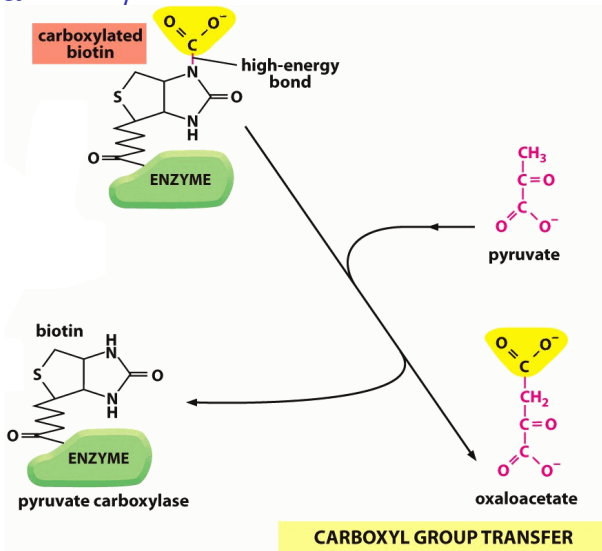


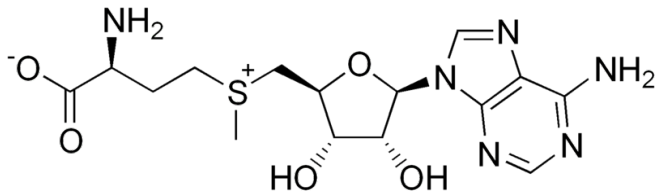
Figure 3-35 Essential Cell Biology 3/e (© Garland Science 2010)

- ▶ FAD: transfers hydrogen like NADH/NADPH
- ▶ CoA (or Acetyl-CoA): transfers acetyl group ($\text{CH}_3\text{--COOH}$)
- ▶ Biotin: carboxyl group (--COOH)
- ▶ S-Adenosyl methionine (SAM, SAmE): methyl group (--CH_3)
- ▶ Uridine diphosphate glucose (UDP-glucose): whole glucose molecules

Biotin, vitamin B₇



SAMe, S-Adenosyl methionine



- ▶ Normally, $\text{ATP} \rightarrow \text{ADP} + \text{P}_i$ reaction has $\Delta G^\circ \approx -13$ kcal/mole
- ▶ Some endoenergetic reactions need more
- ▶ The alternative way: $\text{ATP} \rightarrow \text{AMP} + \text{P}_i\text{-P}_i$ (pyrophosphate) + 26 kcal/mole of energy

Pyrophosphate

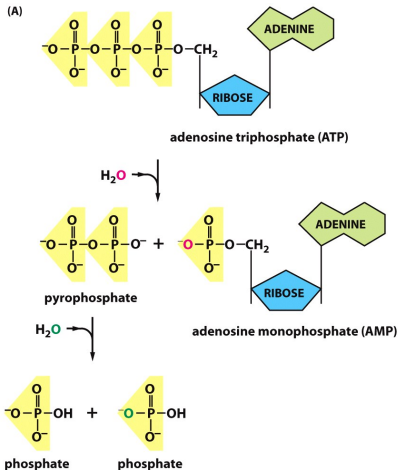
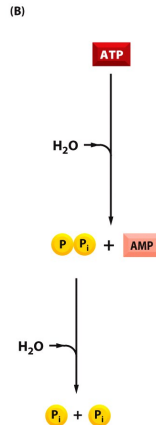


Figure 3-40 Essential Cell Biology 3/e (© Garland Science 2010)



- ▶ All organisms are composed of cells
- ▶ Cells reproduce themselves
- ▶ All cells arise by reproduction from previous cells

- ▶ Electron microscope can only work with dead cells
- ▶ Eukaryotic cells are “cells of second level” where part of organelles (mitochondria, chloroplasts) originated from different prokaryotic

- ▶ There are five main biogenic elements: carbon (C), hydrogen (H), oxygen (O), nitrogen (N) and phosphorus (P)
- ▶ Ionic and covalent bonds are inter-atomic, hydrogen and hydrophilic bonds are inter-molecular
- ▶ Organic chemistry is a chemistry of carbon

- ▶ Carbohydrates are aldo- or keto- polyalcohols and their polymers
- ▶ Most of them are using as structural molecules or sources of energy

- ▶ Lipids are extremely diverse; the only character uniting them is their hydrophobic behavior
- ▶ Main groups of lipids: fats and oils, membrane lipids and steroids

- ▶ Amino-acids are “two-faced” zwitterions
- ▶ Since amino acids are dramatically diverse, they produce infinite numbers of protein 2D and 3D structures
- ▶ There are 20 (+2) standard amino acids classifying in 9 groups

- ▶ Nucleic acids are composition of five purin/pyrimidin bases, ribose/deoxyribose and phosphoric acid
- ▶ DNA has “envelope”, “core” and two grooves
- ▶ There are multiple nucleotide derivatives

- ▶ All metabolic reactions need energy
- ▶ Some reactions are **endoenergetic** ($\Delta G > 0$, some are **exoenergetic** ($\Delta G < 0$)
- ▶ On the stage of equilibrium, all reactions at +37°C have $\Delta G^\circ = -1.42 \log K$

- ▶ Activated carriers are used in endoenergetic reactions
- ▶ Activated carriers may transfer phosphate or different organic groups



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What is the difference between NADH and NADPH?

For Further Reading



A. Shipunov.

Advanced Cell Biology [Electronic resource].

2011—onwards.

Mode of access: [http:](http://)

[//ashipunov.info/shipunov/school/biol_250](http://ashipunov.info/shipunov/school/biol_250)



B. Alberts et al.

Essential Cell Biology. 3rd edition.

Garland Science, 2009.

Chapters 1–3.