BC351-Lecture 8
Metabolism: Bioenergetics

Terms:

- Metabolism
- Catabolism
- Anabolism
- 1st law of Thermodynamics
- ATP hydrolysis
- Dehydrogenation
- Reduction potential
- Phosphorylated intermediate
- redox reactions
- Oxidation
- Reduction
- Reducing agent
- Oxidizing agent
- Biochemical standard free energy
- Actual free energy

Principles:

1. An introduction to metabolism.
2. The conservation of energy in metabolism.
3. The relationship between equilibrium, free energy and standard free energy.
4. The free energy available in ATP hydrolysis and the way this energy is utilized.
5. REDOX reactions in carbon-based systems.

I. Metabolism Overview pgs. 25-26; 485-488

a. What is metabolism?

i.

ii. Two categories:

1. Catabolism.

a. Definition of catabolism:

i.

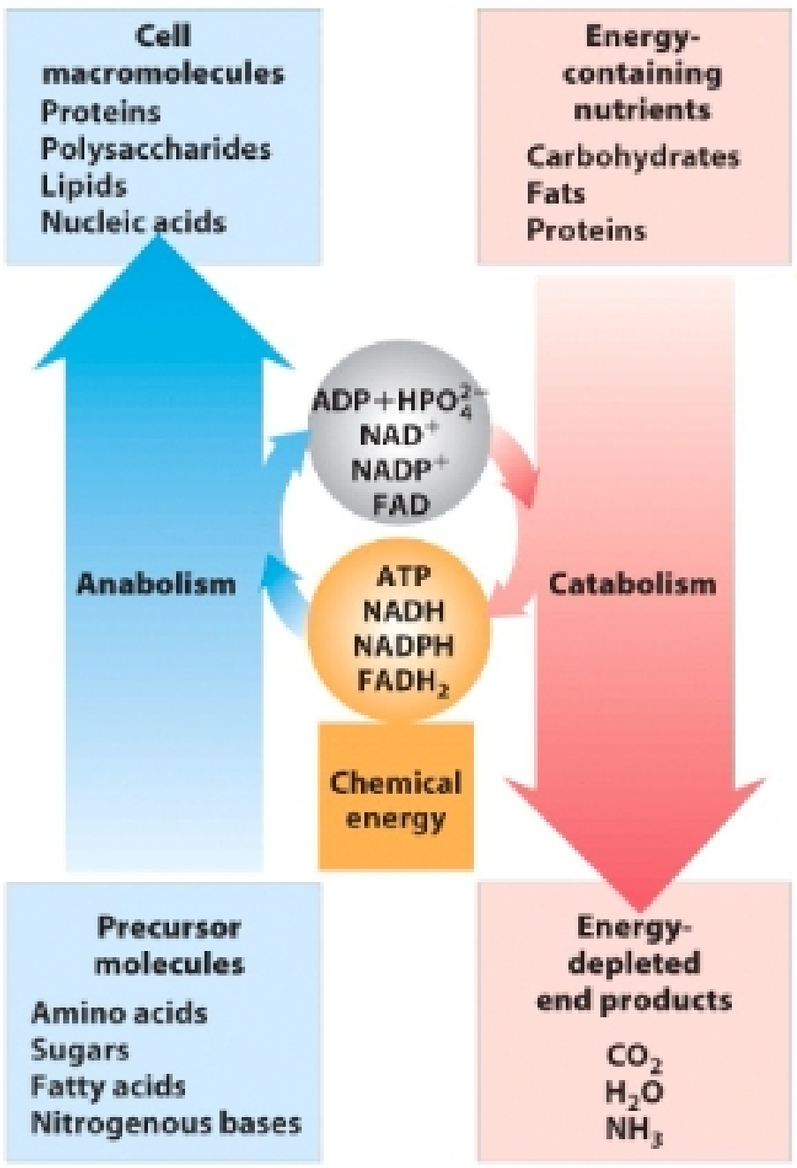
b. Converging towards acetyl-CoA

2. Anabolism

a. Definition of anabolism:

i.

b. Diverging from acetyl-CoA



Part II figure 3
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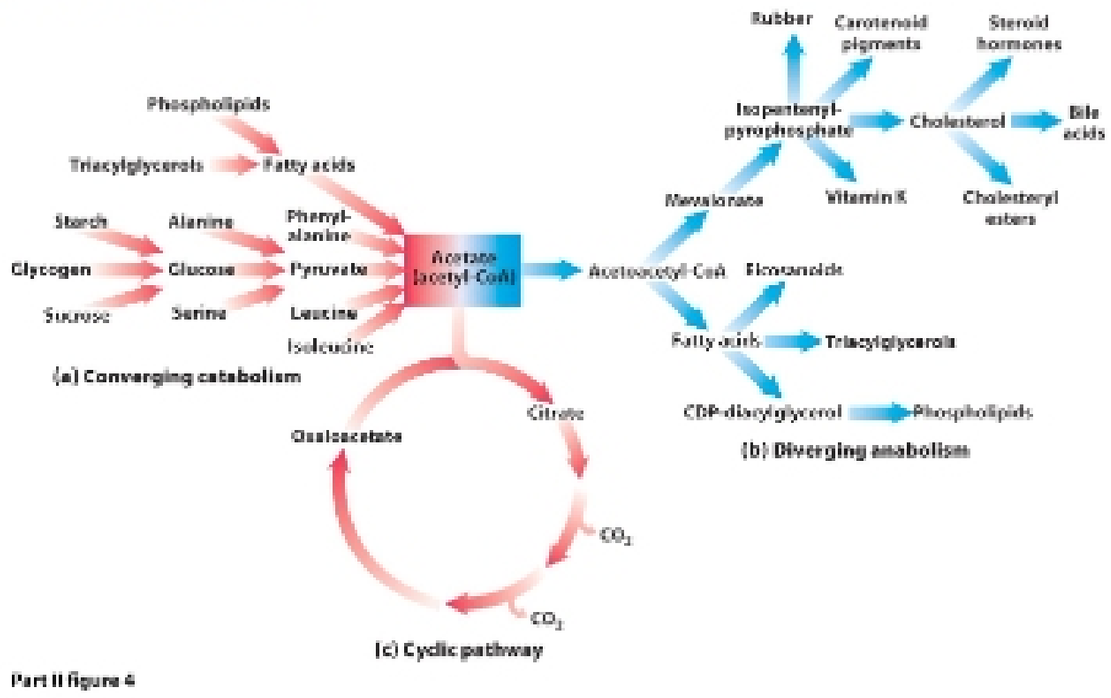


Part II figure 4

II. Energy Conservation. pgs. 22-24; 489-491

a. The 1st law of Thermodynamics:

i. What does the 1st law of thermodynamics state?

1.

ii. One of the most fundamental aspects of bioenergetics is the conservation of energy via small successive steps in metabolic pathways.

b. Transformation of energy in biology:

i. Nuclear energy found in the sun (Photons/heat).

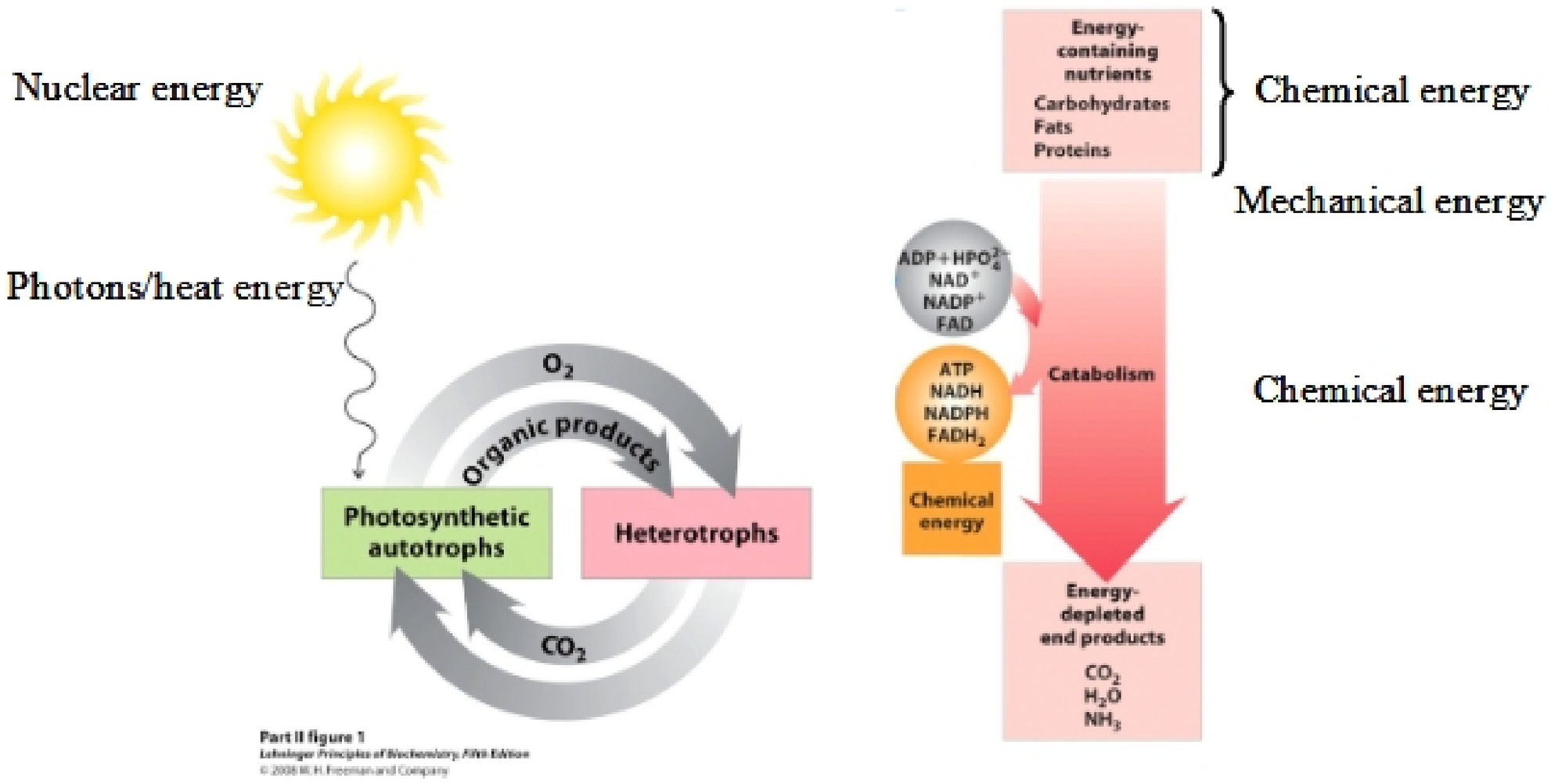
ii. Plants convert photons/heat to chemical energy.

iii. This chemical energy is consumed by heterotrophs.

1. Undergoes lots of different chemical conservation steps:

2. These steps lead to the production of an electrochemical gradient which is then converted to mechanical energy which is used to produce ATP!

a. These last steps will be the topics of LN 9-12.



Part II figure 1
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c. The 2nd law, entropy and equilibrium pgs. 491-493

i. The 2nd law of thermodynamics states:

1. The entropy of the universe is ALWAYS increasing.

ii. Equilibrium remember is:

1. The point in a chemical reaction where forward and reverse rates are equal AND:

2. Where the free energy of the system has been minimized.

a. At this point entropy has been maximized for the system and surroundings.

3. SO…According to the 2nd law of thermodynamics all chemical/physical processes have a driving force to reach equilibrium BECAUSE equilibrium is where entropy of the system has been maximized.

iii. What does this have to do with metabolism?

1. Living systems have to avoid this maximal entropic state.

a. They have to be FAR from equilibrium

b. How is this accomplished?

III. Free-energy pgs. 491-495

a. Biochemical standard free energy:

i. Definition:

1.