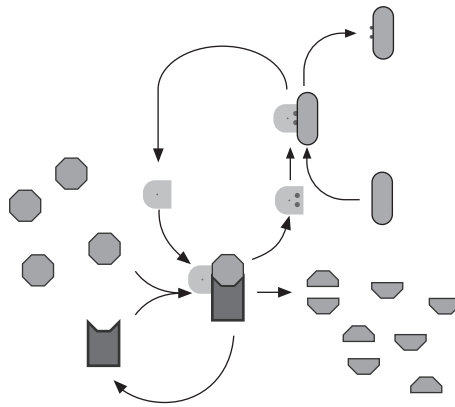


# Energy, Enzymes, and Coenzymes

An Introduction to the  
*Energetics of Life*  
in preparation for a discussion on  
*Cellular Respiration*



*By Noel Ways*

## Energy, Enzymes, and Coenzymes

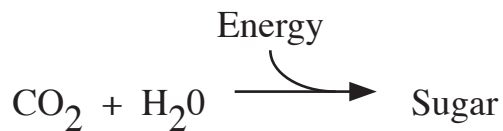
### 1. Introduction

#### A. Forms of Energy

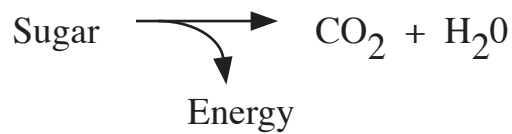
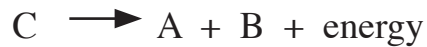
- i. Heat
- ii. Chemical Energy
- iii. Kinetic Energy

### 2. Reaction Concepts

#### A. Endergonic Reactions

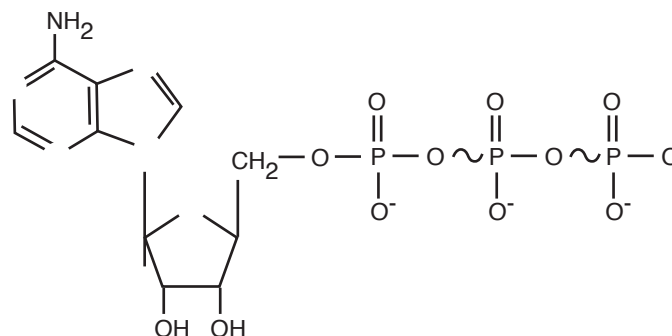


#### B. Exergonic Reactions



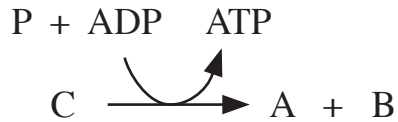
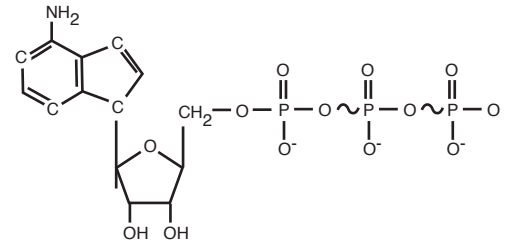
#### C. ATP (Adenosine Triphosphate) - Energy for living things

- High Energy Bonds (~)

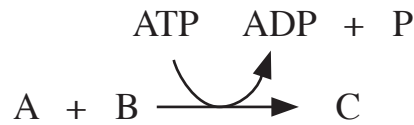


D. Coupled Reactions and the Transfer of energy *TO* ATP

i. **Substrate Level Phosphorylation**



Coupled Reactions and the Transfer of energy *FROM* ATP



E. Function of ATP: Cellular Work

- i. Drive Chemical Reactions
- ii. Transport
  - a. Example: ATP sodium pumps
- iii. Mechanical Work (ie., muscle contraction)

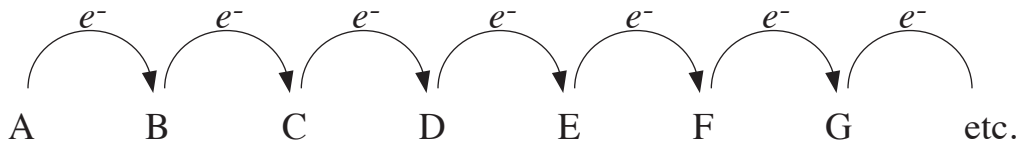
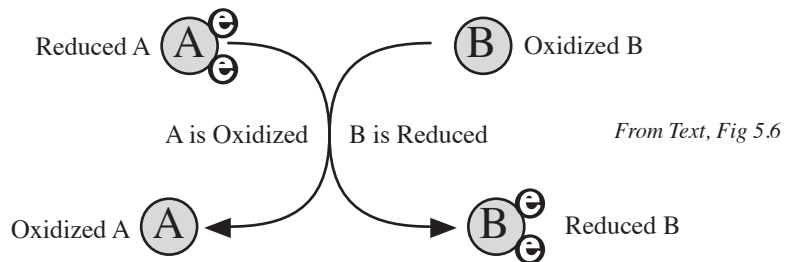
3. Metabolic Pathways

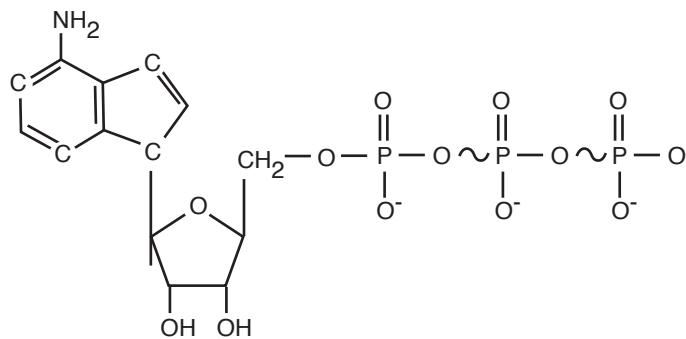
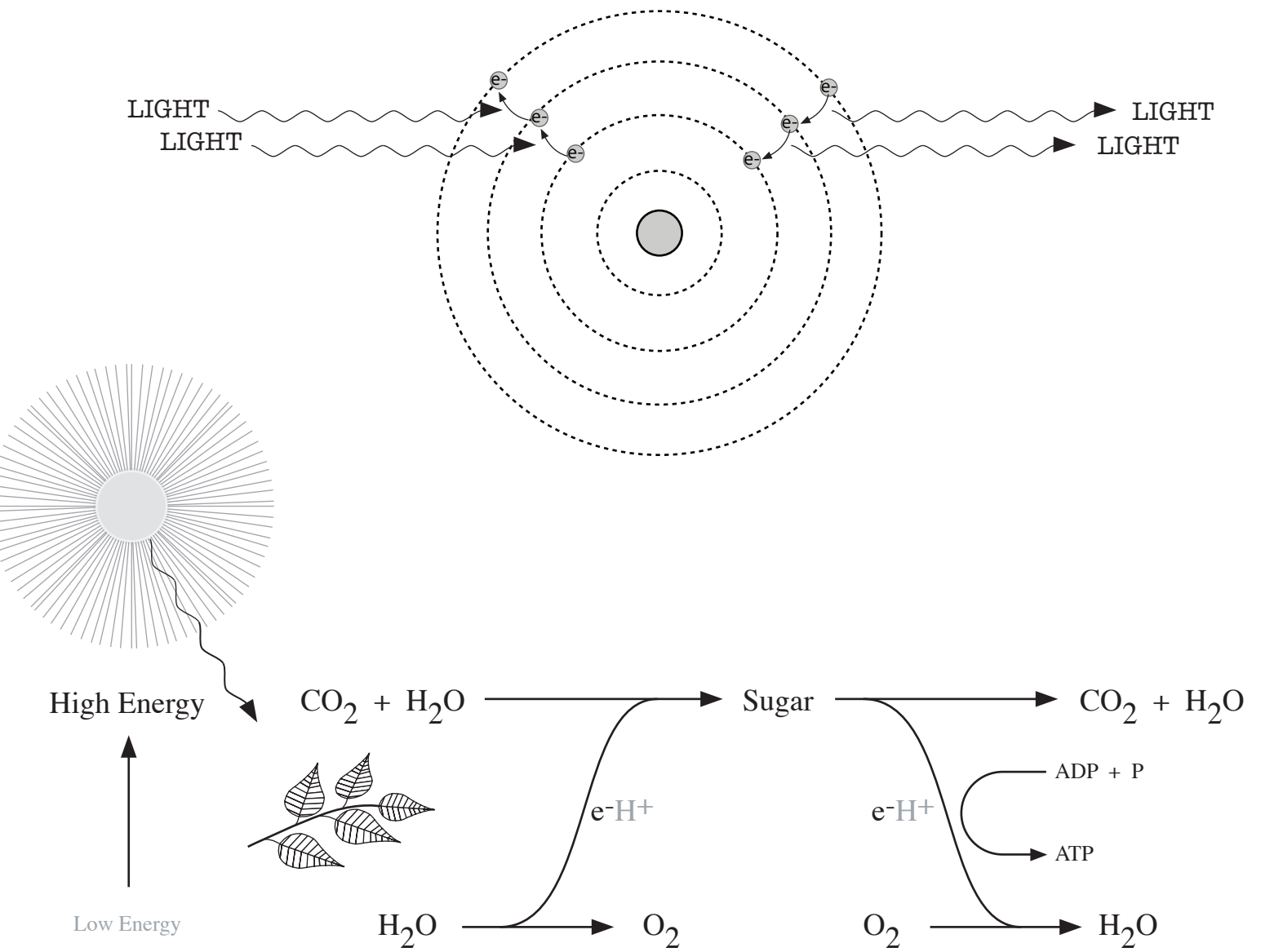


4. Oxidation and Reduction (or Redox) Reactions

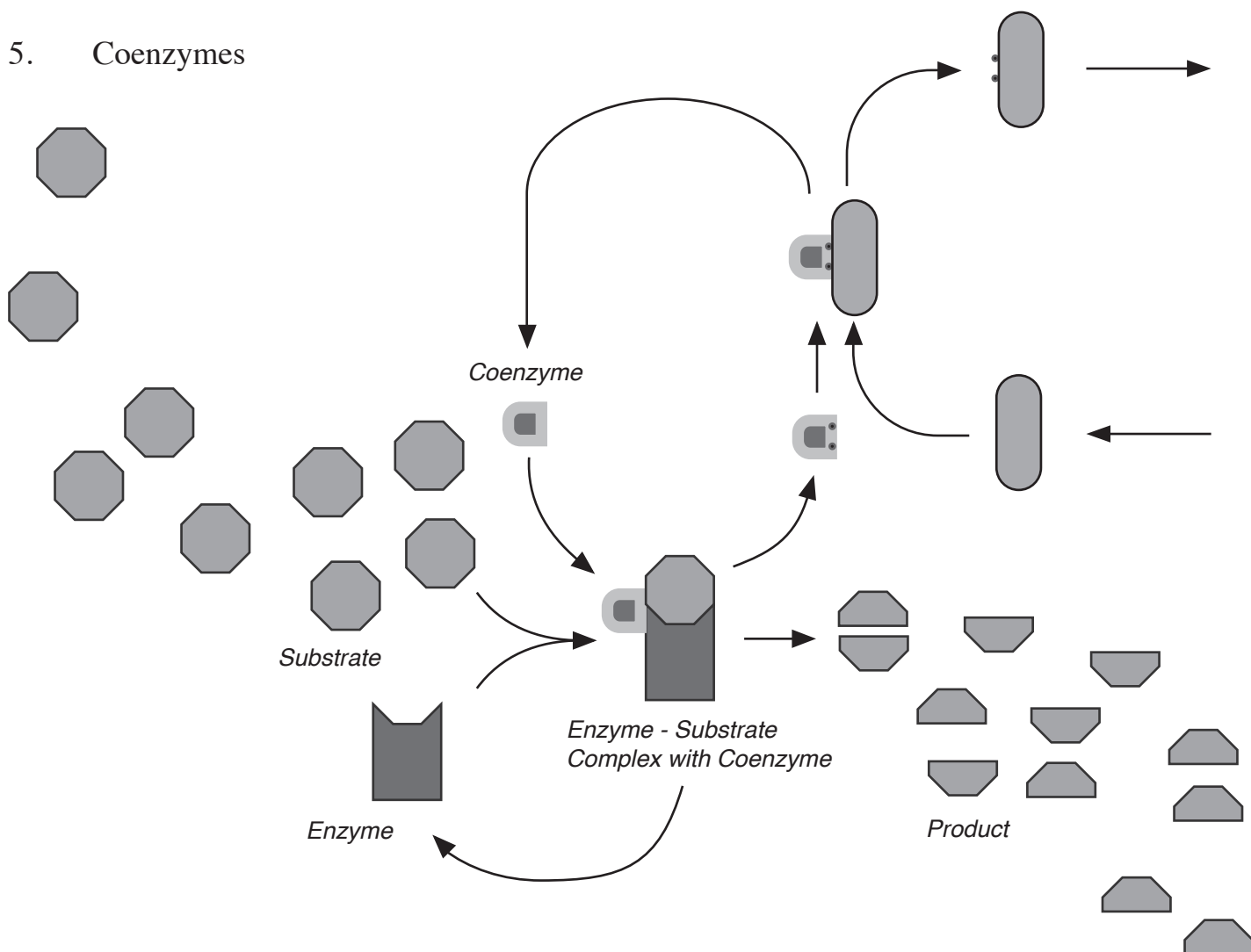
A. Definitions

- i. Oxidation
- ii. Reduction





5. Coenzymes



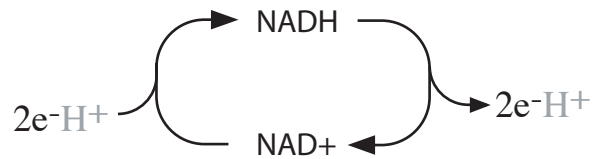
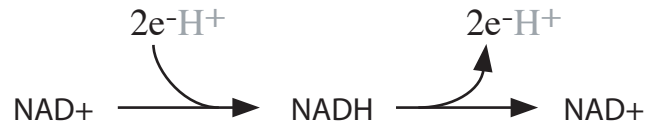
In the illustration above note, an enzymatic reaction is occurring: a substrate is combining with an enzyme to form an enzyme-substrate complex. As the configuration of the enzyme changes, this acts upon the substrate to create some product.

What is new, however, is the presence of a coenzyme. First, a coenzyme is not an enzyme - it does not catalyze a reaction. Instead, a coenzyme "helps" the enzyme by receiving something that results from the reaction. This could be a molecule or electrons. In this case, the coenzyme receives (possibly electrons) that will allow the reaction to proceed. If the coenzyme does receive electrons, then it is said to be reduced. After the electrons have been passed on, the coenzyme is oxidized, and it is ready to accept more electrons.

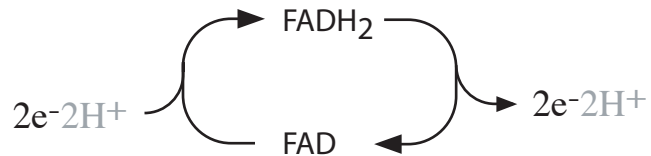
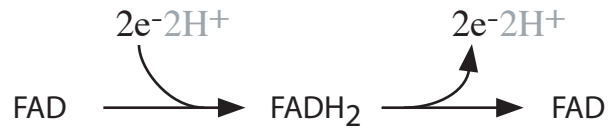
A coenzyme is reused.

6. Coenzymes used for Electron Transport

A. NAD / NADH (Nicotinamide Adenine Dinucleotide)



B. FAD / FADH<sub>2</sub> (Flavine Adenine Dinucleotide)



7. Coenzymes for Transport of Acetyl Groups (To be covered Later)

A. Coenzyme A (CoA) (To be covered Later)