
Overview of Metabolism

CHEM 161

Spring, 2009

Unless otherwise noted, images are from
McKee and McKee, 4/e

Brief review of bioenergetics concepts

- Metabolism is a series of energy transformations
 - First Law of thermodynamics
 - Energy is neither created nor destroyed; it is transformed
 - Second Law of thermodynamics
 - Disorder in the universe is increasing
 - $\Delta S_{\text{system}} + \Delta S_{\text{surroundings}} > 0$
 - Free energy
 - The meaning of spontaneity, enthalpy and entropy
 - ΔG° and $\Delta G^{\circ'}$
 - ΔG and $\Delta G'$
 - Spontaneity versus rate
 - Catalysis, activation energy
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Cast of characters - ATP

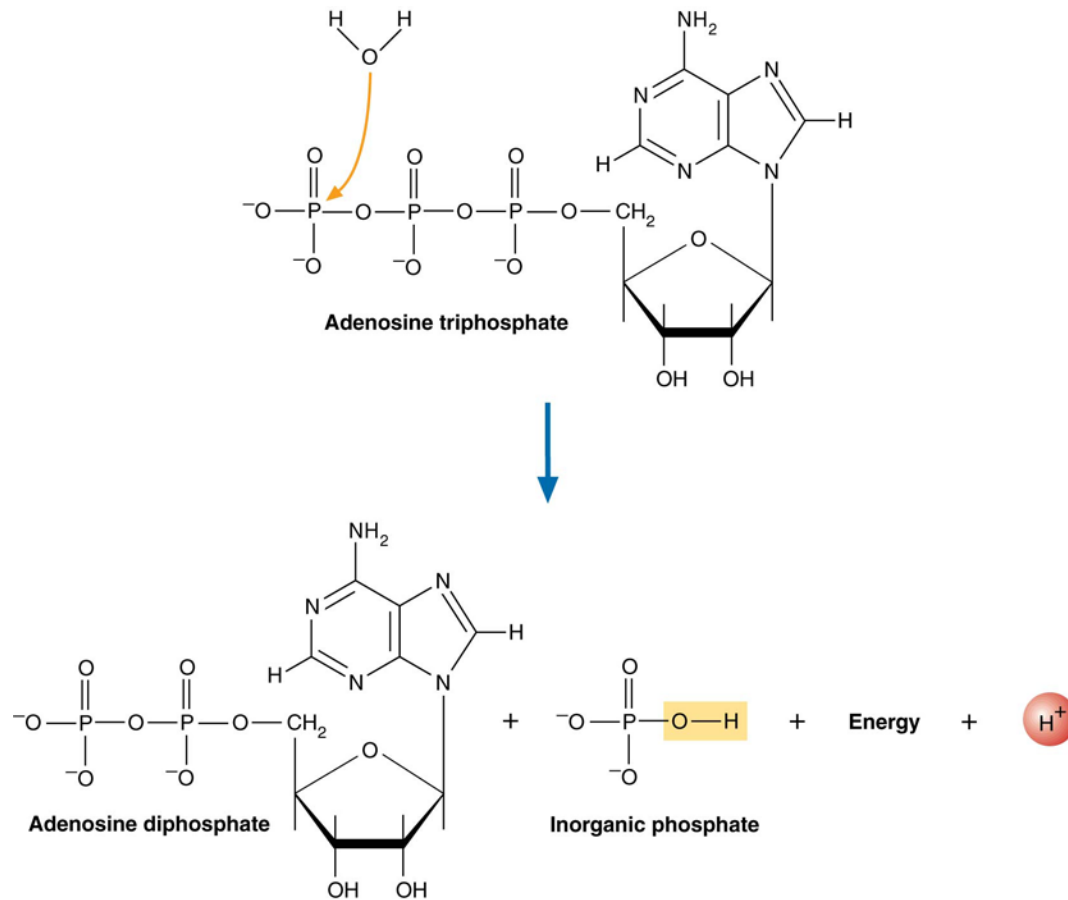


FIGURE 1.16
A Hydrolysis Reaction

- ATP is the currency of energy transformations
- ΔG° of ATP hydrolysis is -30.5 kJ/mol
- We eat to make ATP

ATP and phosphorylation

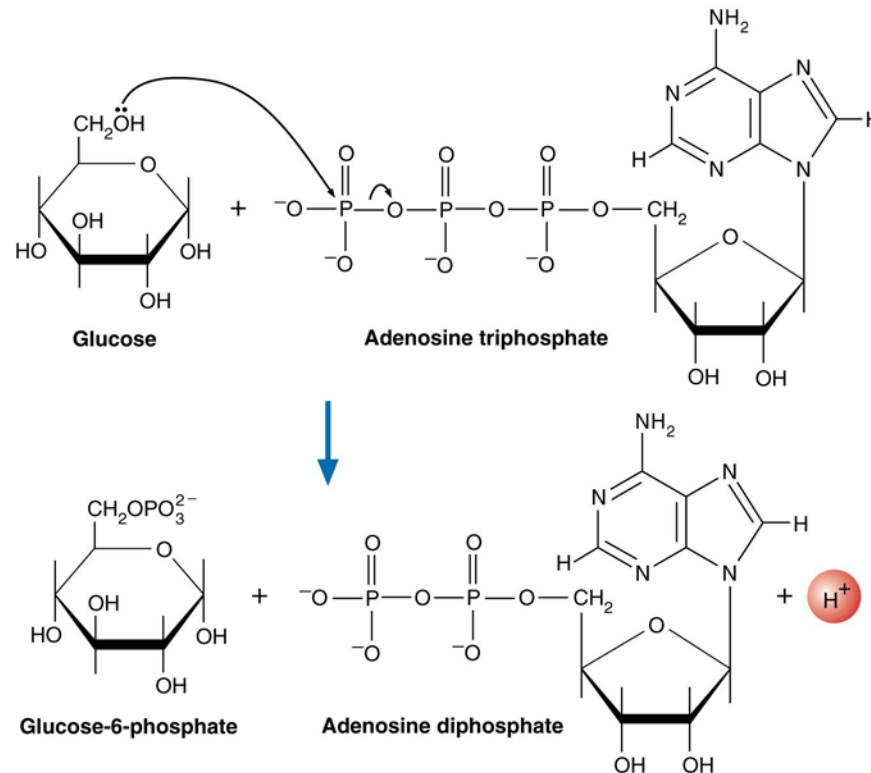
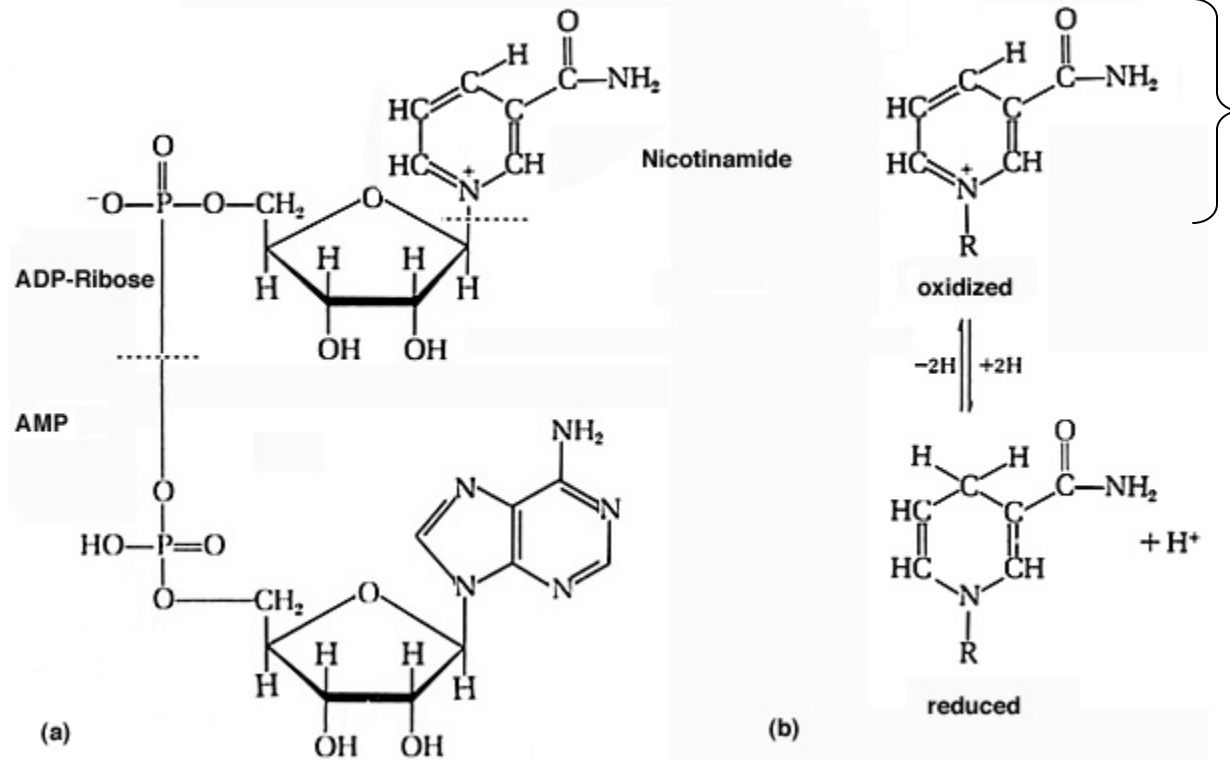


FIGURE 1.15
Example of Nucleophilic Substitution

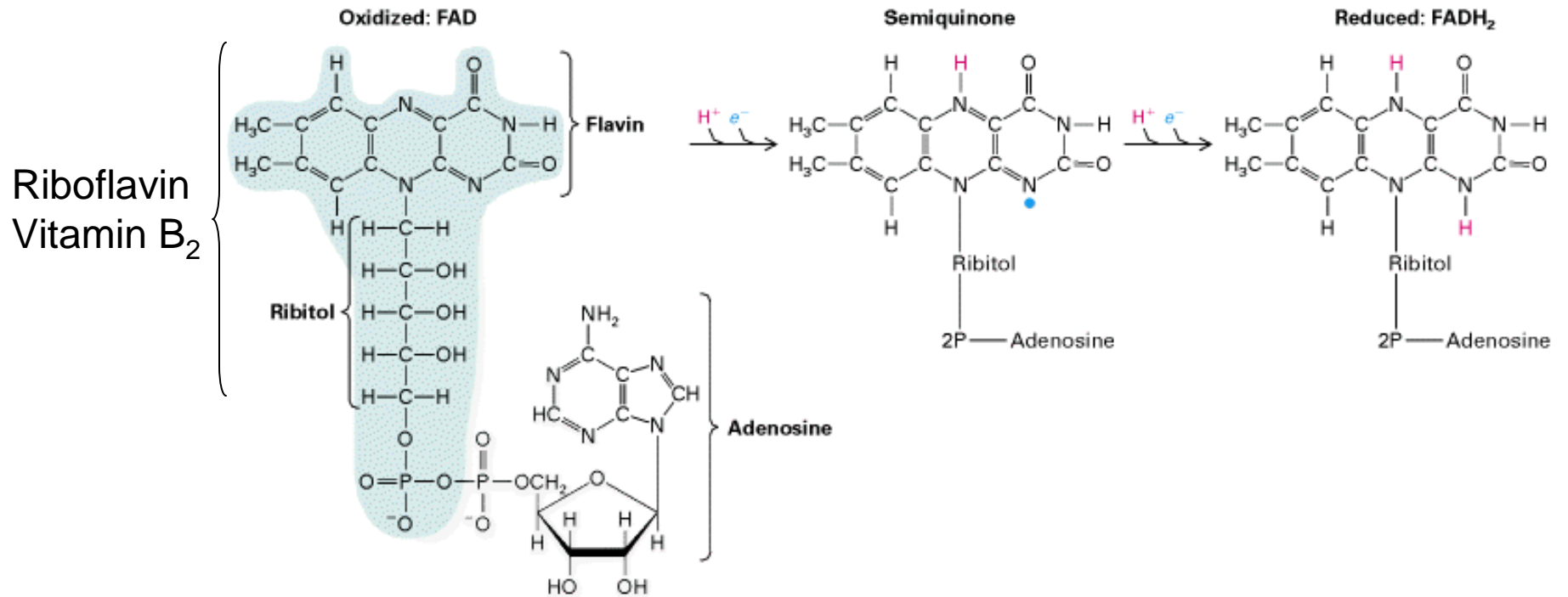
Cast of characters - NAD



Niacin =
Vitamin B₃

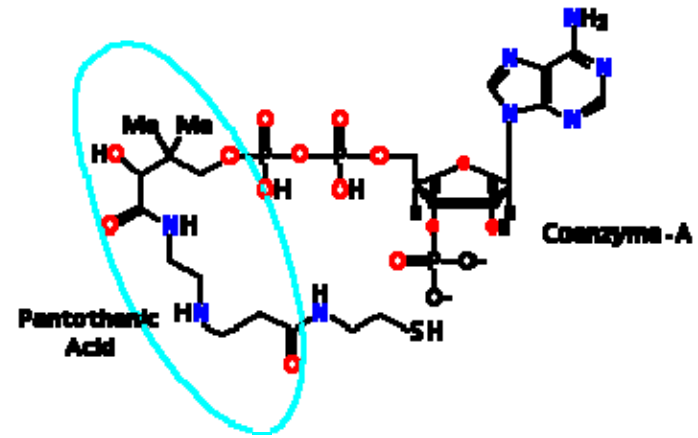
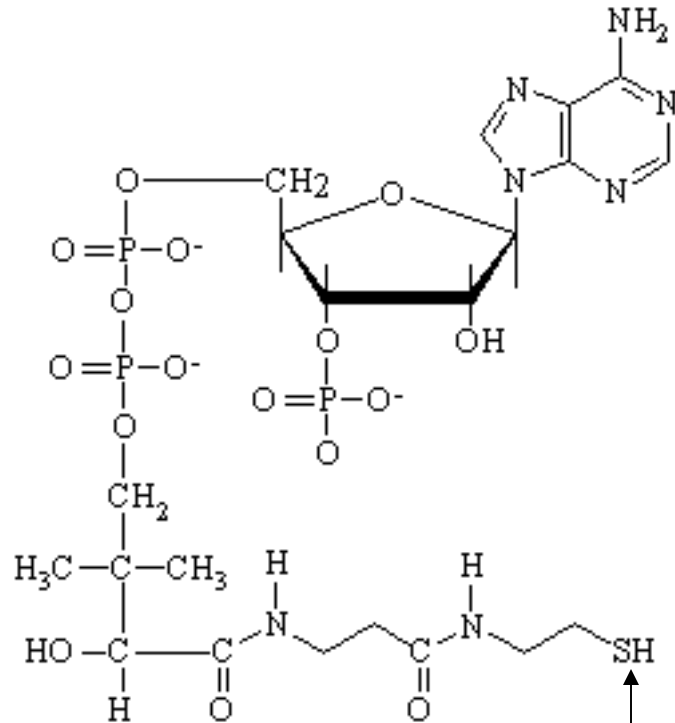
<http://bioinfo.bact.wisc.edu/themicrobialworld/NAD.jpg>

Cast of characters - FAD



http://www.chusa.jussieu.fr/disc/bio_cell/docs_Anim/P1%20Documents%20M%E9tabolisme/FAD%20structure.gif

Cast of characters – Coenzyme A



Pantothenic acid = Vitamin B₅

Reacts with carboxylic acid derivatives to yield high energy thioester bonds

Vitamins

	Vitamins	Daily Value	
Terpene	Vitamin A as beta carotene IU/oz	5000 IU	
	Vitamin C mg/oz	60 mg	
Steroid	Vitamin D3 IU/oz	400 IU	
Terpene	Vitamin E as d-alpha tocopherol IU/oz	30 IU	
	Vitamin B1 mg/oz	1.5 mg	Thiamine
	Vitamin B2 mg/oz	1.7 mg	Riboflavin
	Vitamin B6 mg/oz	2 mg	Pyridoxamine
	Vitamin B3 mg/oz	20 mg	Niacin
	Folic Acid mcg/oz	400 mcg	
	Vitamin B12 mcg/oz	6 mcg	Cobalamin
	Biotin mcg/oz	300 mcg	
	Pantothenic Acid mg/oz	10 mg	Vitamin B ₅

Reaction types

■ Major reaction types

- Nucleophilic substitution
- Elimination
- Addition
- Isomerization
- Redox

■ Enzyme classes

- Transferases and Hydrolases
 - Lyases
 - Ligases
 - Isomerases
 - Oxidoreductases
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Oxidation states of carbon

■ 1 C molecules:

- Methane (-4)
- Methanol (-2)
- Formaldehyde (0)
- Formic acid (+2)
- Carbon dioxide (+4)

■ By functional group

- Alkanes
 - Alkenes
 - Alcohols
 - Aldehydes and ketones
 - Acids
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