

## BIOENERGETICS

**$\Delta G$  Gibbs Free Energy** - maximum amount of useful work at constant T and P

**$\Delta G^{\circ}$  - biochemical standard state** Gibbs Free Energy; all concs = 1 M, partial P = 1 atm, but pH=7

**EXERGONIC REACTIONS** -  $\Delta G$  is negative, reaction can be used to do work

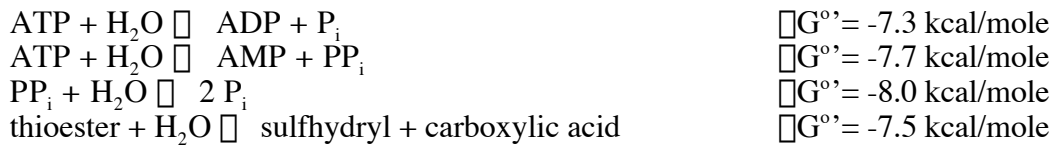
**ENDERGONIC REACTIONS** -  $\Delta G$  is positive, energy must be supplied for reaction to go

**REVERSIBLE REACTIONS** -  $\Delta G$  is small, ratio of [products]/[reactants] determine direction

**IRREVERSIBLE REACTIONS** -  $\Delta G$  is large, only direction is with negative  $\Delta G$

**REACTION COUPLING** - an exergonic reaction drives an endergonic reaction, both reactions have a common intermediate

**HIGH ENERGY BONDS** -coupled with catabolic reactions to save energy (condensation)  
-coupled with anabolic reactions to supply energy (hydrolysis)



### OXIDATION OF CARBOHYDRATES OR FATS IS HIGHLY EXERGONIC

Combustion of glucose  $\Delta G^{\circ} = -686$  kcal/mole  
Combustion of palmitic acid  $\Delta G^{\circ} = -2340$  kcal/mole

### OXIDATION OF REDUCED COENZYMES BY OXYGEN IS EXERGONIC

1/2 O <sub>2</sub> + 2H <sup>+</sup> + 2e <sup>-</sup> $\rightleftharpoons$ H <sub>2</sub> O	$\Delta G^{\circ} = -38$ kcal/mole
NADH/H <sup>+</sup> $\rightleftharpoons$ NAD <sup>+</sup> + 2H <sup>+</sup> + 2e <sup>-</sup>	$\Delta G^{\circ} = -15$ kcal/mole
FADH <sub>2</sub> $\rightleftharpoons$ FAD + 2H <sup>+</sup> + 2e <sup>-</sup>	$\Delta G^{\circ} = -10$ kcal/mole

### BIOSYNTHESIS OF LINKAGES BY CONDENSATION IS ENDERGONIC

Linkage	$\Delta G^{\circ}$ (kcal/mole)
Glycoside	4.0
Amide	4.8
Ester	4.7
Phosphoester	3.3