BIOENERGETICS

ΔG Gibbs Free Energy - maximum amount of useful work at constant T and P

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

EXERGONIC REACTIONS - ΔG is negative, reaction can be used to do work

ENDERGONIC REACTIONS - ΔG is positive, energy must be supplied for reaction to go

REVERSIBLE REACTIONS - ΔG is small, ratio of [products]/[reactants] determine direction

IRREVERSIBLE REACTIONS - ΔG is large, only direction is with negative ΔG

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)

$ATP + H_2O \rightarrow ADP + P_i$	$\Delta G^{o'}$= -7.3 kcal/mole
$ATP + H_2O \rightarrow AMP + PP_i$	$\Delta G^{o'}$= -7.7 kcal/mole
$PP_i + H_2O \rightarrow 2\ P_i$	$\Delta G^{o'}$= -8.0 kcal/mole
thioester + $H_2O \rightarrow$ sulfhydryl + carboxylic acid	$\Delta G^{o'}$= -7.5 kcal/mole

OXIDATION OF CARBOHYDRATES OR FATS IS HIGHLY EXERGONIC

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

OXIDATION OF REDUCED COENZYMES BY OXYGEN IS EXERGONIC

$1/2\ O_2 + 2H^+ + 2e^- \rightarrow H_2O$	$\Delta G^{o'}$= -38 kcal/mole
$NADH/H^+ \rightarrow NAD^+ + 2H^+ + 2e^-$	$\Delta G^{o'}$= -15 kcal/mole
$FADH_2 \rightarrow FAD + 2H^+ + 2e^-$	$\Delta G^{o'}$= -10 kcal/mole

BIOSYNTHESIS OF LINKAGES BY CONDENSATION IS ENDERGONIC

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