AP BIOLOGY
CELLULAR ENERGETICS
ACTIVITY #1

NAME_____

DATE_____HOUR_____

ENERGY EXCHANGES

LAWS OF THERMODYNAMICS

First Law	Second Law
• Energy cannot be created or destroyed • Energy can be transferred and transformed	• Every energy transfer makes the universe more disordered • Entropy = measure of disorder • Whenever energy is transferred some is lost as heat • Amt of useful energy decreases whenever energy is transferred

PROBLEM

Living organisms are highly ordered; decrease entropy

Question: Do living organisms violate the 2nd law?

ANSWER

No

- Living organism is a closed system
- Must consider organism & environment
- Living organisms
  - ▶ Maintain highly ordered structure at expense of increased entropy of surroundings
  - ▶ Take in complex high energy molecules, extract energy, release simpler, low energy molecules (CO_2 and H_2O) and heat to environment

ENERGY EXCHANGES

ΔH = ΔG + TΔS

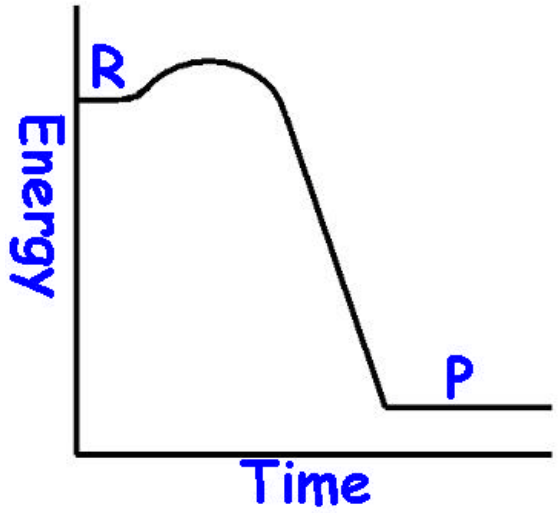
ΔH = change in enthalpy
= change in total energy
= heat of reaction

ΔG = change in free energy (Gibbs)
free energy is usable energy and available to do work

TΔS = energy lost to system
T = temperature in Kelvins
ΔS = change in entropy

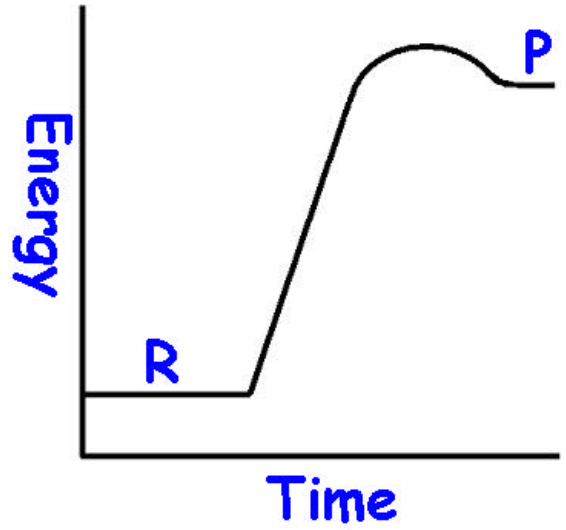
During every energy exchange (ΔH) some energy is available to do work (ΔG) and some is lost to the system (TΔS)

EXERGONIC REACTIONS



- Reactants have more energy than products
- More ordered to less
- Unstable to stable
- Downhill reaction
- Free energy released
- ΔG negative
- Spontaneous
- Examples
  Cellular respiration
  Digestion

ENDERGONIC REACTIONS



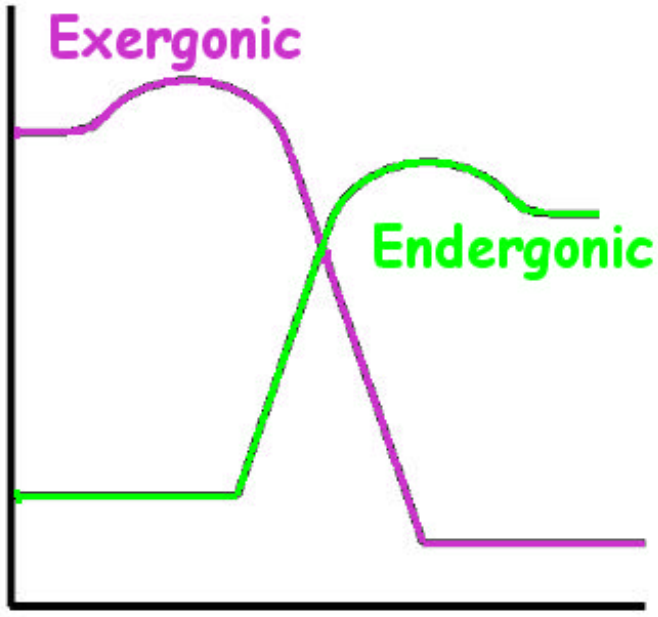
- Products have more energy than reactants
- Less ordered to more
- Stable to unstable
- Uphill reaction
- Free energy absorbed from surroundings
- ΔG positive
- Examples
  Photosynthesis
  Polymer synthesis

COUPLED REACTIONS

Energy released from exergonic reaction drives endergonic reaction

Exergonic Reaction
ΔG = max. work that can be done

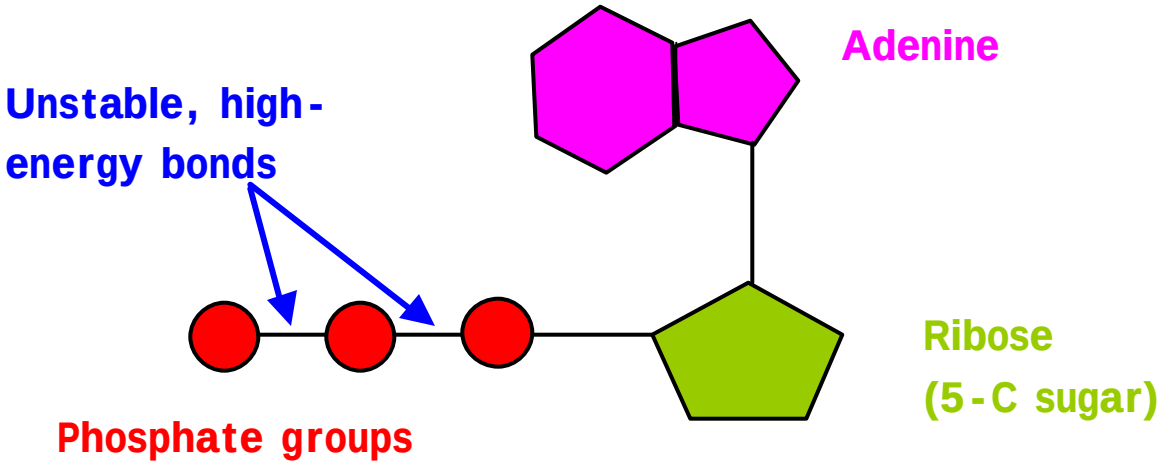
Endergonic Reaction
ΔG = min. work needed to drive reaction



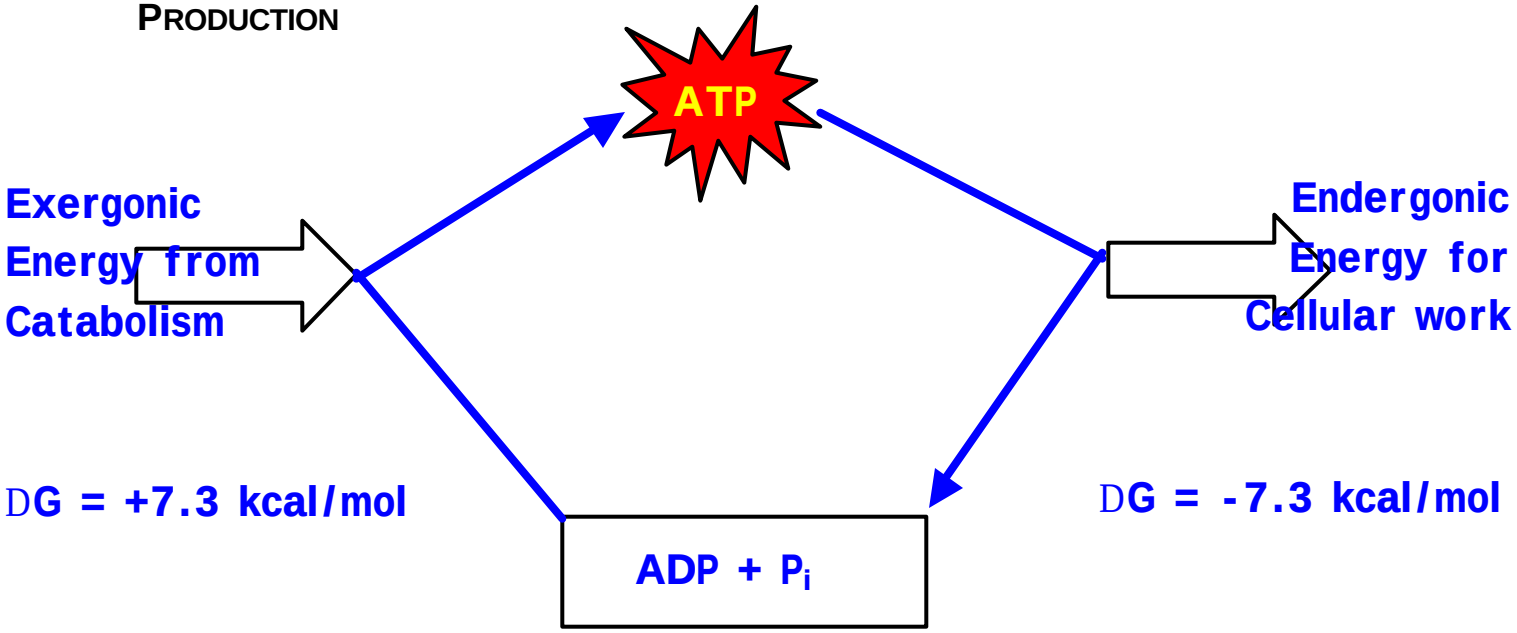
ATP

Adenosine triphosphate
Has unstable phosphate bonds

STRUCTURE



PRODUCTION



How ATP Does Work

Type of Work	Description
Mechanical	▶ Beating cilia ▶ Muscular contraction ▶ Movement
Transport	▶ Active transport ▶ Pumps (H+ and Na+/K+)
Chemical	▶ Endergonic reactions ▶ Polymerization

Coupled Reaction