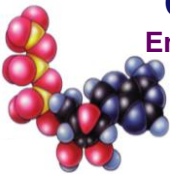
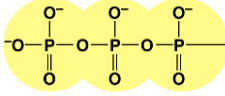
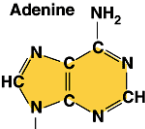


Chapter 6 Energy and ATP!

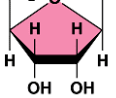




Phosphate groups






Adenine NH_2



Ribose




Energy needs of life



- Organisms are endergonic systems
 - ◆ What do we need energy for?
 - synthesis (biomolecules)
 - reproduction
 - active transport
 - movement
 - temperature regulation

Flow of energy through life


- Life is built on chemical reactions

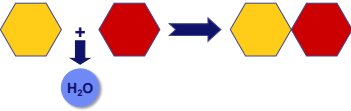
Chemical reactions of life

- Metabolism
 - ◆ forming bonds between molecules
 - dehydration synthesis
 - anabolic reactions
 - ◆ breaking bonds between molecules
 - hydrolysis
 - catabolic reactions

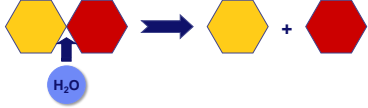


Examples

- dehydration synthesis

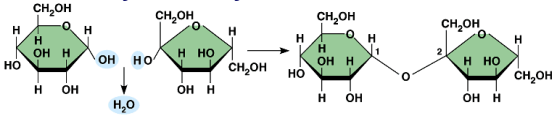


- hydrolysis

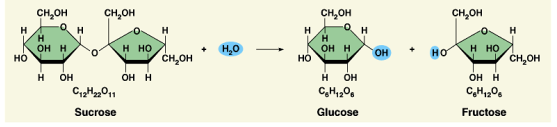


Examples

- dehydration synthesis



- hydrolysis



$\text{C}_{12}\text{H}_{22}\text{O}_{11}$ $\text{C}_6\text{H}_{12}\text{O}_6$ $\text{C}_6\text{H}_{12}\text{O}_5$
 Sucrose Glucose Fructose

Chemical reactions & energy

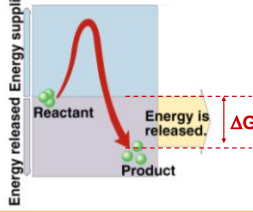
- Some chemical reactions **release energy**
 - exergonic
 - digesting polymers
 - hydrolysis = catabolism
- Some chemical reactions require **input of energy**
 - endergonic
 - building polymers
 - dehydration synthesis = anabolism

digesting molecules = less organization = lower energy state

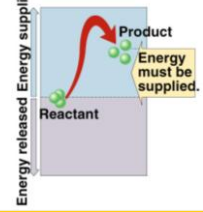
building molecules = more organization = higher energy state

Endergonic vs. Exergonic reactions

exergonic
energy released



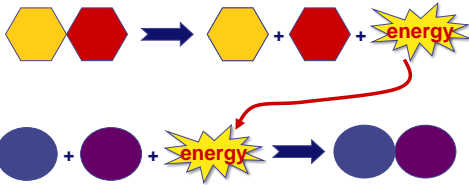
endergonic
energy invested



ΔG = change in free energy = ability to do work

Energy & life

- Organisms require energy to live
 - where does that energy come from?
 - often via coupling **exergonic reactions** (releasing energy) with **endergonic reactions** (needing energy)



Living economy

- Fueling the economy
 - eat high energy organic molecules (food)
 - break them down = **catabolism** (digest)
 - capture energy in form cell can use
- Need an **energy currency**
 - a way to pass energy around

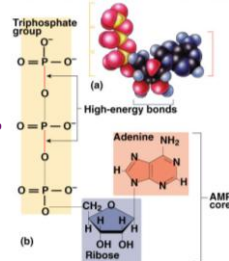
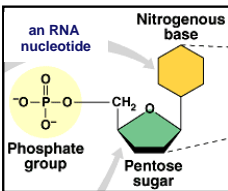


You'd have to run about **14 miles** to burn the calories from a pepperoni pizza.

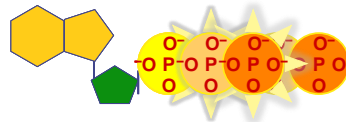
ATP

Adenosine Triphosphate

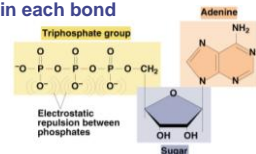
- modified nucleotide
 - adenine + ribose + P_i → AMP
 - AMP + P_i → ADP
 - ADP + P_i → ATP



Why does ATP store energy?



- Each P_i group more difficult to add
 - a lot of stored energy in each bond
 - most stored in 3rd P_i
 - ΔG = -7.3 kcal/mole
- Close packing of negative P_i groups
 - spring-loaded**



The instability of its P bonds makes ATP an excellent energy donor

How does ATP transfer energy?

- **Phosphorylation**
 - ♦ when ATP does work, it transfers its 3rd P_i to other molecules
 - ATP → ADP
 - releases energy
 - ♦ ΔG = -7.3 kcal/mole (-30kJ/mol)
 - it destabilizes the other molecule

An example of Phosphorylation...

- **Building polymers from monomers**
 - ♦ need ATP for energy & to take the water out

Kinases are enzymes involved with moving phosphate groups!

Another example of Phosphorylation...

- **The first steps of cellular respiration**
 - ♦ beginning the breakdown of glucose → ATP

ATP / ADP cycle

Can't store ATP for long periods

- too reactive
- transfers P_i too easily
- only short term energy storage
 - carbs & fats are long term energy storage

A working muscle recycles over 10 million ATPs per second

What's the point?
"The point is to make ATP!"

Any Questions??