

# Cells & Energy

## 4.1 Chemical Energy & ATP

# Objectives

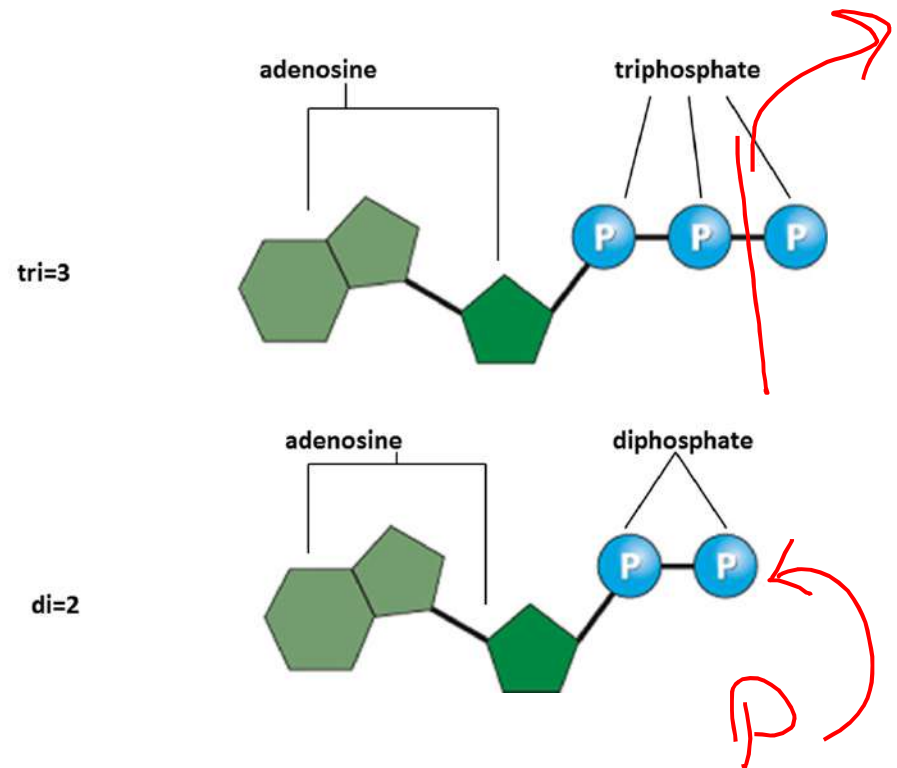
- Recognize the importance of ATP as an energy-carrying molecule
- Identify energy sources used by organisms

# Does the food we eat give us energy?

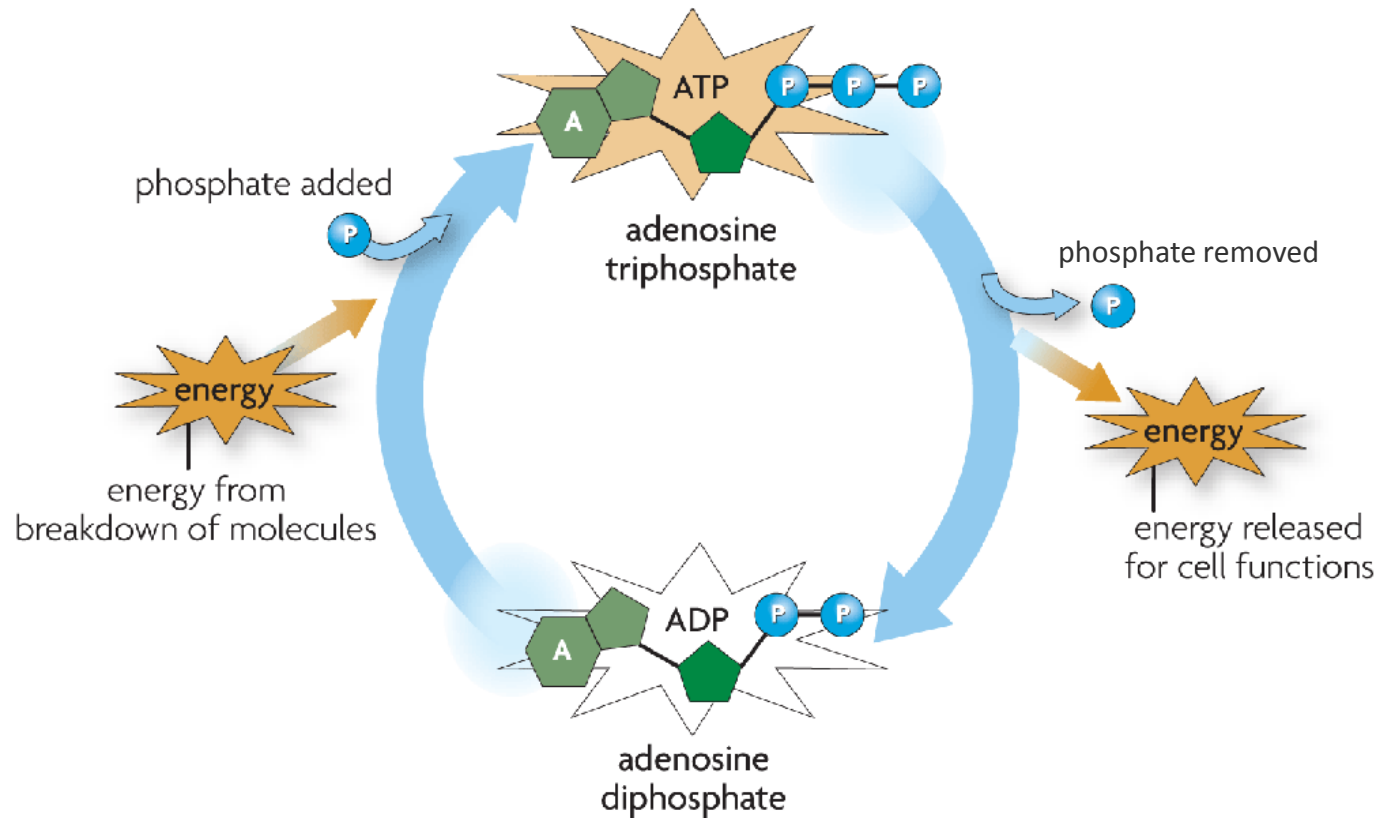
- Yes and No!
- Yes but not directly!
- Energy from food we eat is only usable after molecules are broken down by chemical reactions.

# Chemical Energy

- All cells use chemical energy carried by ATP
  - Transfers E f/ breakdown of food molecules to cell processes.
- Energy stored in ATP released when phosphate group is removed f/ the molecule
- ATP → ADP + Energy
- ADP can become ATP by adding a phosphate group but not a simple process.
- Large complex group of proteins needed to do it.
  - If one protein faulty- ATP not produced.



# ATP ↔ ADP Cycle



# Food & ATP

- Food doesn't contain ATP your cells can use
- 1<sup>st</sup> food must be digested
- Breakdown into smaller molecules to make ATP
- # calories in food related to ATP molecules made but not directly

## # ATP Molecules Produced Depends on Type of Molecule

- Carbs- most commonly broken down to ATP- glucose breaks down to make 36 Atp
- Lipids store most energy (80% E in body); yields most ATP
- Proteins-store same amount of E as carbs but less likely broken down to make ATP
- (b/c amino acids cells breakdown ATP are needed to build proteins more than energy)

MOLECULE	ENERGY
Carbohydrate	4 calories per mg
Lipid	9 calories per mg
Protein	4 calories per mg

# Not All Organisms Rely on Sun for Energy Source

- Some organisms live near hydrothermal vents releasing sulfides- can serve as chemical energy source.
- Chemosynthesis process by which some organisms use chemical energy instead of light energy to make energy-storing carbon-based molecules.
  - Still need ATP for energy
  - Make their own food just raw materials differ f/ photosynthesis.





# Overview of Photosynthesis

## 4.2 Notes

# Photosynthesis Overview

- Some organisms = producers
  - Produce source of chemical energy for themselves & others
- Photosynthesis: process that captures energy f/ sunlight to make sugars that store chemical energy.
  - Therefore energy for almost all organisms (directly or indirectly) begins w/ sunlight

# Photosynthesis Overview

- Plants absorb visible light for photosynthesis
- Chlorophyll- a molecule in chloroplasts that absorbs some of energy in visible light.
  - Plants have chlorophyll a & chlorophyll b
  - Absorb mostly red & blue wavelengths of visible light
  - Neither absorbs green light
    - Other light absorbing molecules that absorb green light but not a lot.
  - Green color of plants comes f/ reflection of light's green wavelength by chlorophyll.

# Photosynthesis Overview

- Photosynthesis occurs in chloroplasts
  - Most chloroplasts in leaf cells
- 2 main parts of chloroplasts needed for photosynthesis: grana & stroma
  - Grana: stacks of coin-shaped membrane enclosed compartments called thylakoids
    - Contain chlorophyll, other light-absorbing molecules & proteins
  - Stroma- fluid surrounding grana inside a chloroplasts

# Light-Dependent Reactions

- Takes place w/in, across membrane of thylakoids
- $H_2O$  + sunlight needed
- 1. Chlorophyll absorbs energy f/ sunlight
  - Energy transferred along thylakoid membrane
  - $H_2O$  molecules broken down
  - $O_2$  released
- 2. E carried along thylakoid membrane transferred to molecules that carry E (such as ATP)

# Light-Independent Reactions

- Use E f/ Light-dependent rxns (LDR) to make sugars
- Occur in stroma of chloroplasts
- CO<sub>2</sub> molecules needed
- 3. CO<sub>2</sub> added to a cycle of chem. Rxns to build larger molecule. E f/ LDR used
- 4. molecules of simple sugars formed (usually glucose)
  - Stores some of E that was captured f/ sunlight

# Photosynthesis Overview

- $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- Multiple arrows show photosynthesis has many steps
- LDR need only one molecule  $\text{CO}_2$  at time + 6-carbon sugar comes f/ rxn that combines 2-3 carbon sugars
- Enzymes are also needed
- Plants need simple sugars to build starch + cellulose molecules.
  - Plants need photosynthesis for growth + development