

Unit 3: Bioenergetics

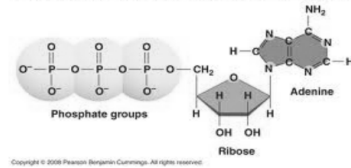
Lesson 1: ATP and Cellular Respiration (8.1, 9.1,9.2, 9.3)

I. 8.1 Energy and Life

A. Chemical Energy and ATP (Adenosine triphosphate)

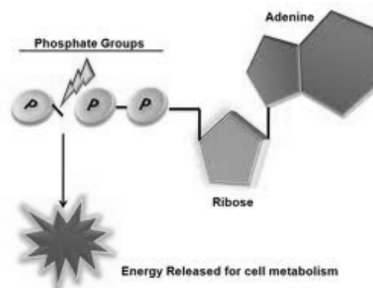
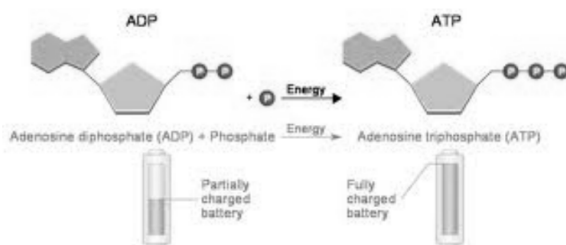
1. Energy is the ability to do work
 - a. energy affects matter
2. Energy comes in many forms:
 - a. light (radiant)
 - b. chemical (food): stored in chemical bonds
 - c. mechanical (motion)
 - d. heat : Unusable form of energy
 - e. electrical: moving electrons or other charged particles (ions)
3. ATP: the compound cells use to store and release energy
 - a. consists of a nitrogen base (adenine), a 5-carbon sugar (ribose) and three phosphate groups

(a) ATP consists of three phosphate groups, ribose, and adenine.

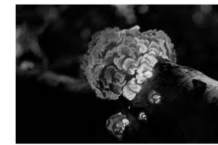
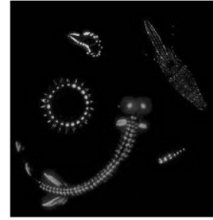


4. Storing and Releasing energy

- a. ADP (adenosine diphosphate) is similar to ATP with one less phosphate
 - *when cells have extra energy they can store the energy by adding a phosphate group to ADP to form ATP
 - * The energy in Glucose or Fat can be used to add the phosphates to ADP to create ATP. One glucose has enough energy to make 30 ATP molecules! One triglyceride (fat) can make 126!
 - *ADP is like a re-chargable battery that needs recharging
- b. Cells can release energy from ATP by breaking the bond between the 2nd and 3rd phosphate group. (forming ADP)
 - *the released energy is used to run the cell (metabolism)



5. Cells use Biochemical Energy for:
- Active Transport: Na/K Pumps
 - contracting muscle fibers
 - making proteins like insulin and glucagon
 - produce light (lightening bugs, jellyfish)
 - making sound



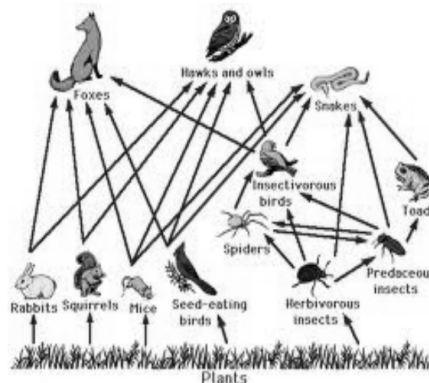
6. Do cells store energy as ATP?
- cells only have small amounts of ATP
 - Food, like sugar and fats, need to be present in the cell so ATP can be produced as it is needed

B. Heterotrophs and Autotrophs

1. Where do living cells get the food to make ATP?
- heterotrophs: organisms that must eat other organisms
 - *They can eat plants directly (herbivore)
 - * They can eat other organisms that eat plants (carnivore, insectivore)



- autotrophs: organisms that make their own food
 - *photosynthesis or chemosynthesis
 - **Photosynthesis: Turns $CO_2 + H_2O$ and Sunlight Into Glucose and O_2
 - *Plants (land) and Phytoplankton (water) provide food for all of the other organisms that live in the ecosystem
 - *most all energy stored in food comes from the sun
 - **Chemosynthesis: turns other chemicals into food. Occurs where there is NO sunlight (deep sea, caves, swamp mud, inside organisms)
 - **Bacteria (Archea)
- Food webs describe how energy moves through organisms in an area



II. Chemical Energy and Food (9.1 Cellular Respiration: An Overview)

A. Where do organisms get energy?

1. Autotrophs: use photosynthesis or chemosynthesis to make energy-rich food (carbohydrates)
2. Heterotrophs: from food (eat whole or parts of other organisms)
 - a. food molecules release chemical energy when their bonds are broken

B. Where does the Chemical energy in food come from? How is it measured?

1. Nutrients from food can be organized into 6 Groups:
 - a. Carbohydrates (sugar and starch), lipids (fats and oils), protein, vitamins (A, C, D, E, K, B's), minerals (K+, Ca+, Fe+) and Water
 - b. only Carbs, proteins and fats/oils contain chemical energy that can be used to make ATP
 - c. Energy in food is measured in Calories.
 - *1 Calorie = 1000 calories (calorie is the amt of heat needed to increase the temp of 1g of water 1°C)
 - d. Carbs (sugar and starch) and Proteins have 4 Cal/g
Fats/Oils have 9 Cal/g

C. Analyzing Data

Analyzing Data MATH

You Are What You Eat

Organisms get energy from the food they eat, but the energy contained in foods varies greatly. Most foods contain a combination of proteins, carbohydrates, and fats. One gram of protein or a carbohydrate such as glucose contains roughly 4 Calories. One gram of fat, however, contains about 9 Calories. The accompanying table shows the approximate composition of one serving of some common foods.

1. **Interpret Data** Per serving, which of the foods included in the table has the most protein? Which has the most carbohydrates? Which has the most fat?
2. **Calculate** Approximately how many more Calories are there in 2 slices of bacon than there are in 3 slices of roasted turkey? Why is there a difference?
3. **Calculate** Walking at a moderate pace consumes around 300 Calories per hour. At that rate, how many minutes would you have to walk to burn the Calories in one chocolate bar? (*Hint*: Start by calculating the number of Calories consumed per minute by walking.)

Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

Amount Per Serving

Calories 250 **Calories from Fat** 110

% Daily Value*

Total Fat 12g 18%

 Saturated Fat 3g 15%

 Trans Fat 3g

Cholesterol 30mg 10%

Sodium 470mg 20%

Potassium 700mg 20%

Total Carbohydrate 31g 10%

 Dietary Fiber 0g 0%

 Sugars 5g

Protein 5g

Vitamin A 4%

Vitamin C 2%

Calcium 20%

Iron 4%

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total fat	Less than	65g	80g
Sat fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Food	Protein (g)	Carbohydrate (g)	Fat (g)
Apple, 1 medium	0	22	0
Bacon, 2 slices	5	0	6
Chocolate, 1 bar	3	23	13
Eggs, 2 whole	12	0	9
2% milk, 1 cup	8	12	5
Potato chips, 1.5 chips	2	14	10
Skinless roasted turkey, 3 slices	11	3	1