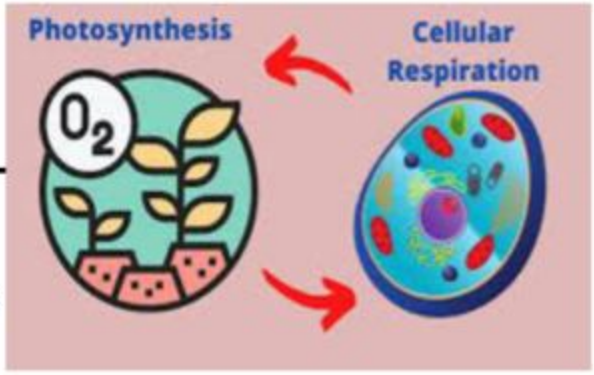
NOTES 2.4

Chapter 2 - Cell Structure and Function
Lesson 4 - Cells and Energy



Cells both store and use energy.

During photosynthesis, plants capture the energy from sunlight and store it in the form of carbohydrates (sugars & starches). When cells need energy, they break down these carbohydrates to release energy.

In humans, after you eat a meal your body stores some of the carbohydrates; however, most are converted into glucose (sugar).

Cellular Respiration

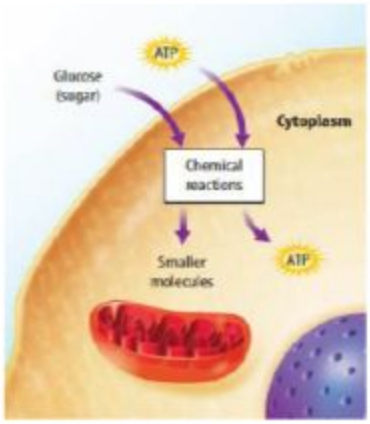
When cells need energy, they break down glucose in a continual process called **cellular respiration**

Q: What is cellular respiration?
A: a series of chemical reactions that convert the energy in food into a usable fc energy called ATP

ATP stands for **adenosine triphosphate**.
Both **breathing** and maintaining your **heartbeat** require ATP.
Some organisms, such as bioluminescent jellyfish and fireflies even use ATP to produce light!

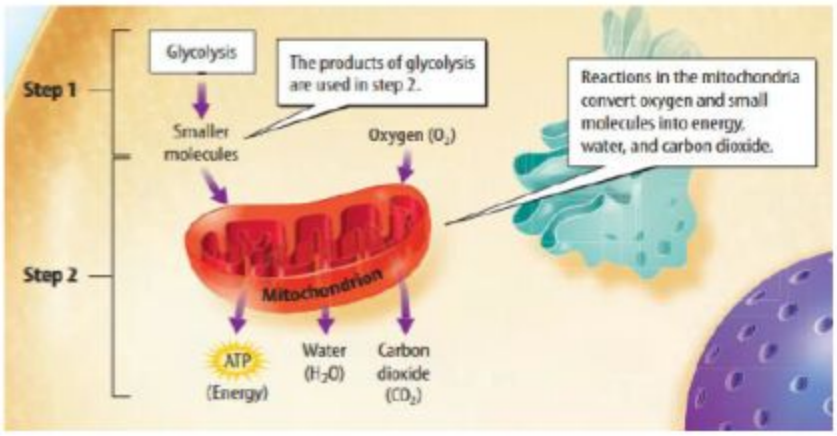
Cellular Respiration takes place in **2** cell parts –

of the cell - in the **cytoplasm** and the **mitochondria**



Step 1 –

- takes place in the **cytoplasm**
- called **glycolysis** - where glucose molecules are broken down into smaller molecules



Step 2 –

- takes place in the **mitochondria**
- requires **oxygen**
- produces some ATP
- releases waste as

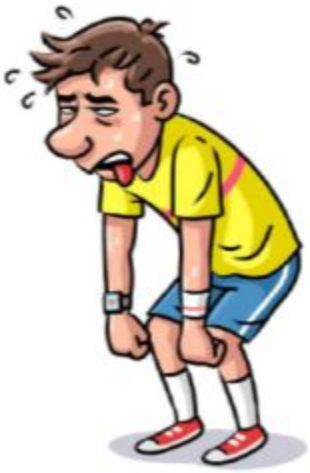
Cellular Respiration

$C_6H_{12}O_6$ glucose + 6 O_2 oxygen → 6 H_2O water + 6 CO_2 carbon dioxide + ATP energy

reactants — produce or yield — products

NOTE – a # that occurs before a chemical formula stands for the # of molecules of each substance & a **subscript** stands for the # of atoms of each element in a chemical formula.

Fermentation



Have you ever felt out of breath after exercising? Sometimes, as you exercise, there is not enough oxygen in your cells to make ATP through cellular respiration. When this happens, cells obtain chemical energy by

fermentation

Q: What is fermentation?
A: a reaction that cells can use to obtain energy from food that does not require energy

There are 2 types of fermentation –

1. **Alcoholic Fermentation** — $C_6H_{12}O_6$ glucose → ATP energy + CO_2 carbon dioxide + alcohol

- occurs when yeast or other single-celled organism breaks down sugars
- produces alcohol, carbon dioxide and a little energy
- important to bakers and brewers (bread & beer); yeast

2. **Lactic-Acid Fermentation** — $C_6H_{12}O_6$ glucose → ATP energy + lactic acid

- takes place in your body
- when cells lack oxygen needed by muscles they produce lactic acid
- makes you feel weak, tired & sore
- bacteria and fungi can use to produce cheese, yogurt, & sour cream

Q: Which muscles in a runner have the potential to produce the most lactic acid?

Photosynthesis

Q: Where does the energy that we require for daily activities such as running for exercise come from?

A: believe it or not... the sun!

Animals and humans use the sun to produce energy to conduct cell processes needed to live.

But what about plants?

Plants use the energy from the sun to make their own food in a process known as **photosynthesis**

Q: What is photosynthesis?
A: a series of chemical reactions that plants and some organisms use to capture light energy and make food (glucose) & give off oxygen

There are  stages of photosynthesis in plants –

1. Plants capture the sun's energy in sunlight.
   - occurs in the leaves & other green parts of the plant known as **chloroplasts**
   - produce **chlorophyll** which absorbs light like a "solar cell"

Q: What is chlorophyll?
A: the main pigment found in the chloroplasts of plants; **green**

Q: Where in a plant, would cells with the most chloroplasts be found?

2. Plants use the sun's energy to make food.
   - the cell uses the captured energy to produce sugars (glucose)
   - requires 2 materials – H_2O & CO_2
   - H_2O from the soil is taken in by the plants' roots
   - CO_2 from the atmosphere is taken in by the **stomata**

Q: What are stomata?
A: small openings on the underside of leaves; like pores on skin; take in H_2O & CO_2 and release O_2

So, how does photosynthesis work?

Photosynthesis is a chemical reaction that reacts water, carbon dioxide & sunlight to produce oxygen & sugars.

Photosynthesis

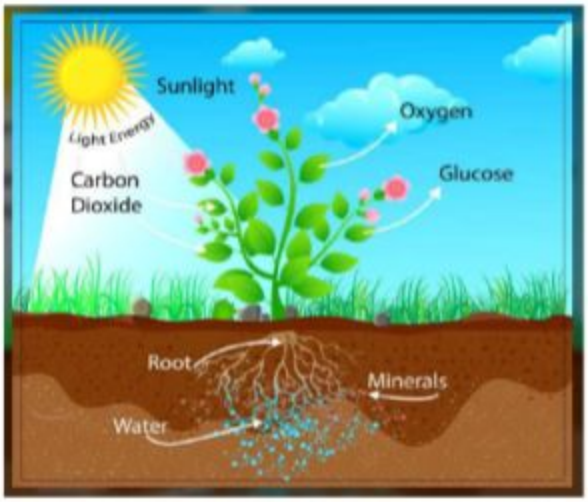
$$6\ CO_2 \text{ carbon dioxide} + 6\ H_2O \text{ water} \xrightarrow{\text{light energy}} C_6H_{12}O_6 \text{ glucose} + 6\ O_2 \text{ oxygen}$$

reactants — produce or yield — products

NOTE – a # that occurs before a chemical formula stands for the # of molecules of each substance & a **subscript** stands for the # of atoms of each element in a chemical formula.

Q: What happens to the products of photosynthesis?

1. Glucose can be...
   - used as food
   - broken down to release energy
   - converted into cellulose (the main substance in the walls of plant cells)
   - stored for later use
2. Oxygen is released into the atmosphere through the stomata on leaves



☑ Heterotrophs (humans & animals) depend on autotrophs (plants) to produce oxygen & food (sugars & glucose).

☑ Nearly all the oxygen in the Earth's atmosphere was produced by living things through the process of photosynthesis.

Q: Do you notice anything similar about the equation for photosynthesis?

A: YES! The process of photosynthesis is the opposite of respiration!

Together, these  processes form a cycle that keeps the levels of oxygen and carbon dioxide constant in the atmosphere!

Review

The easiest way to remember these processes is that they form a cycle. What one gives off the other takes in!