SBI3U1 **CELLULAR RESPIRATION AND PHOTOSYNTHESIS**

INTRODUCTION

Two conditions must be met for life to continue.

(1) Matter must be constantly recycled (Fig. 2 on pg. 59, Fig. 3 on pg. 60)
- ie. (i) oxygen released by ***photosynthesis*** is used in ***cellular respiration***
  (ii) carbon dioxide and water released by cellular respiration is used in photosynthesis
  (iii) atoms and molecules in the bodies of living organisms are released into the environment for re-use by the action of decomposers (bacteria, worms, etc.)

Photosynthesis: $C_6H_{12}O_6 + 6H_2O$ + energy from light ---> $C_6H_{12}O_6 + 6H_2O + 6O_2$

Cellular Respiration (aerobic): $C_6H_{12}O_6 + 6O_2$ ---> $6CO_2 + 6H_2O$ + energy (36 ATP)

(2) Energy must be constantly supplied (Fig. 2 on pg. 59, Fig. 3 on pg. 60)
- ie. sunlight provides energy for plants (***autotrophs*** = make their own food) which perform photosynthesis and that energy is trapped in carbohydrates by the plants and released when animals (***heterotrophs*** = can't make their own food) eat the carbohydrates and perform cellular respiration

CELLULAR RESPIRATION

- includes all the chemical reactions that provide energy for life.
- carbohydrates are primary energy source (others used after carbohydrates used up).
- plants and animals perform cellular respiration.

(1) Production of ATP (Fig. 4 on pg. 63)
- ***adenosine triphosphate***: A-P-P-P (A = adenosine, P = phosphate group)
- as the bonds of glucose are broken, energy is released and stored in ATP
- ATP acts like a "battery" providing energy for chemical reactions, active transport etc. by donating a phosphate group
- the addition of a phosphate group to a any molecule is called ***phosphorylation***

Draw Fig. 4 on pg. 63:

(2) Processes of Cellular Respiration

- happens inside the cell and is a 3-step process:
  - (i) ***Glycolysis***
    - occurs in cytoplasm
    - breaks down glucose and produces ***2 ATP***
  - (ii) ***Krebs Cycle***
    - occurs in mitochondrion (in matrix)
    - continues breakdown of glucose and produces ***2 ATP***
  - (iii) ***Electron Transport System*** (see Fig. 6b on pg. 63)
    - occurs in mitochondrion (on cristae)
    - finishes breakdown of glucose, grabs electrons and passes them along a chain of molecules (called the electron transport system)
    - as electrons travel, more energy is released and used to make ***32 ATP***

(3) Types of Respiration

- if it requires oxygen it is called ***Aerobic Respiration***
- if it does NOT require oxygen it is called ***Anaerobic Respiration***

Aerobic Respiration

- in most plant and animal cells
- occurs by 3-step process (see steps above)
- presence of oxygen allows glucose to be FULLY broken down (oxidized)
- ***36 ATP*** made
- this is why you must breathe!!!

Anaerobic Respiration

- mostly a 1-step process
- glucose is not fully broken down (oxidized) since oxygen is lacking
- two types:
  - (i) ***Lactic Acid Fermentation***
    - in cytoplasm of human cells (ie. working muscles) when oxygen is lacking
    - glucose partially broken down to lactic acid, $C_3H_6O_3$
    - only ***2 ATP made***
    - lactic acid builds up and causes sore muscles
  - (ii) ***Alcoholic Fermentation***
    - in cytoplasm of yeast
    - glucose partially broken down to alcohol, C_2H_5OH, and CO_2
    - ***only 2 ATP made***
    - this is how beer, wine, etc. are made

Questions:

1. Draw Fig. 2 on pg. 59 and Fig. 3 on pg. 60.
2. How many ATP are produced by cellular respiration of 3 glucose molecules in the presence of oxygen? In the absence of oxygen?
3. In terms of ATP, why is the mitochondrion called the “powerhouse of the cell”?