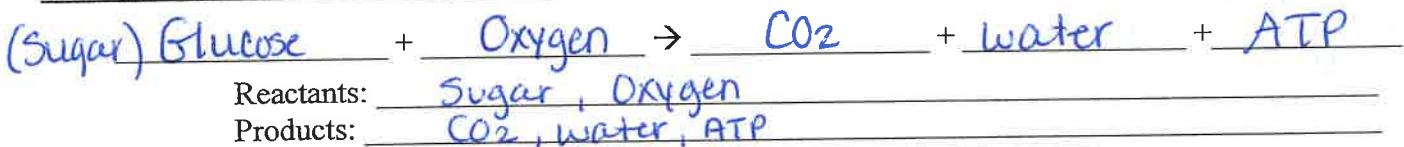


CELLULAR RESPIRATION NOTES

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- Weakness is a feeling triggered by lack of energy
- You feel tired when you are hungry because food serves as a source of energy
- Food provides living things with the chemical building blocks they need to grow and reproduce
- Organisms get the energy they need from food
- Living organisms obtain energy by breaking down food molecules during cellular respiration
- Calorie the amount of energy needed to raise the temperature of 1 gram of water 1 degree Celsius.
- Energy stored in proteins, lipids, and Carbs varies because they differ in their chemical structures and energy storing bonds
- Carbs & proteins contain about 4 Calories of energy per gram
- Lipids contain about 9 Calories of energy per gram
- Cells do not simply burn food and release energy as heat instead they break down food gradually

Cellular Respiration: the process that releases energy from food in the presence of O₂

The Equation of Cellular Respiration

Cellular Respiration captures the energy from food in 3 stages:

1. Glycolysis
2. Krebs Cycle
3. Electron Transport Chain (ETC)

There are 2 types of respiration:

AEROBIC RESPIRATION: needs O₂

ANAEROBIC RESPIRATION: does NOT need O₂

Cellular Respiration occurs in the organelle called the mitochondria

So what are the steps of Cellular Respiration...

GLYCOLYSIS (First set of reactions)

- Means sugar breaking
- Glucose is broken down in the cytoplasm
- It is anaerobic which means it does not need oxygen
- This is an enzyme-assisted process that will break down glucose into pyruvate (pyruvic acid)
- 2 ATP are needed to start Glycolysis
- Glucose is made of 6 carbons
- It is broken down by ATP into 2 3-carbon compounds
- This converts the 3-carbon compound into pyruvate (pyruvic acid) and produces 4 ATP
- The end result of Glycolysis is
 - the Net gain of 2 ATP
 - 2 pyruvates
 - 2 NADH are produced (they are electron energy carriers need to make more ATP)

KREBS CYCLE (Second stage)

- Oxygen is present thus this is called aerobic respiration
- This occurs in the mitochondria of eukaryotes
 - Prokaryotes do not have mitochondria - where would it happen? cytoplasm
- In this stage the pyruvate is converted many different types of molecules
- This cycle is completed 2 times since there were 2 pyruvates
- The end result of Krebs Cycle is
 - 8 NADPH (electron energy carrier)
 - 2 FADH₂ (electron energy carrier)
 - 2 ATP
 - 6 CO₂ (which is exhaled from the body)

ELECTRON TRANSPORT CHAIN (Third Stage)

- most of the ATP is produced in this process
- NADH & FADH₂ release H⁺ ions to create the energy
- the H⁺ ions move along the mitochondria membrane
- The end result of the ETC is
 - This creates 32 ATP
 - water = Some of the oxygen unite with H⁺ to create water which is released by the body as (sweat)

- Trivia fact: the body uses about 1 million ATP molecules per cell per second

THUS at the end of AEROBIC respiration:

How many ATP molecules have been made from 1 glucose molecule?

Glycolysis produced 2 ATP

Krebs Cycle produced 2 ATP

Electron transport chain produced 32 ATP

Total amount of ATP produced from 1 glucose molecule = 36 ATP

WHY DOES THIS MAKE SENSE?

① We need energy

② 36 ATP - this gives the body plenty of energy to use

Prokaryotic Aerobic Cellular Respiration

- No mitochondria
- Thus it uses the cell membrane instead
- Results in 38 ATP being produced

So what happens when oxygen is not available?

- The cell must go through anaerobic respiration
- Start with Glycolysis then go through fermentation
- This occurs in the Cytoplasm of cells
- There are 2 types of Anaerobic Respiration
 - Alcoholic Fermentation
 - Lactic Acid Fermentation

ALCOHOLIC FERMENTATION

- Yeast and some other microorganisms can go through this process
- Produces: CO₂ and ethyl Alcohol
- CO₂ is released (bubbles)
- Used to make beverages or bread
- Chemical formula:
pyruvic acid + NADH → Alcohol + CO₂ + NAD⁺

LACTIC ACID FERMENTATION

- Converts pyruvic acid into lactic acid
- Chemical formula:
Pyruvic acid + NADH → lactic acid + NAD⁺
- Bacteria that produce lactic acid are important because they help to create certain foods and beverages like: cheese, yogurt, buttermilk, sour cream, pickles, sauerkraut
- Humans are lactic acid fermenters
 - When the body is exhausted from strenuous/vigorous exercise it runs out of oxygen
 - muscle cells can go through this
 - The muscle has left the lactic acid making you sore
 - Once the oxygen can be replenished then the soreness will go away

THUS at the end of ANEROBIC RESPIRATION:

How many ATP molecules have been made?

Glycolysis produced 2
Lactic Acid Fermentation produced 0
Total amount = 2

Glycolysis produced 2
Alcoholic Ferm. produced 0
Total amount = 2

WHY DOES THIS MAKE SENSE?

- not energy efficient but still allows some energy creation

Energy and Exercise (Think about running a race)

Humans have 3 main sources of ATP

- 1) ATP already in muscles
- 2) ATP made by Lactic acid fermentation
- 3) ATP made by Cellular respiration

Quick Energy Need

- For short, quick burst of energy, the body uses ATP already in muscles as well as ATP made by lactic acid fermentation
- It will get replenished with oxygen Thus the deep breathing after running

Long-term Energy Need

- For exercise longer than about 90seconds, Cellular respiration is the only way to continue generating a supply of ATP
- This is where practice and Conditioning are very important for athletes
- The body stores enough carbohydrate in muscles to last about 15-20 minutes
glycogen

CUT THIS OUT AND PASTE INTO JOURNAL BOOKS

~Diagram of the Flow of Cellular Respiration~ YOU MUST KNOW THIS!!!!!!!

