Unit 5:
CELLULAR RESPIRATION PACKET

This packet is designed to help you understand several concepts about Cellular Respiration.

As you practice the exercises on each handout, you will be able to:

***CELLULAR RESPIRATION 1*: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of sugar molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.**

- Explain that all living systems use energy from the sun either directly or indirectly through photosynthesis or cellular respiration. (***HS10-LS1-7.1***)
- Describe the general process of cellular respiration including: location (mitochondria) and total ATP produced from 1 glucose molecule. (***HS10-LS1-7.2***)
- Describe the anaerobic processes of cellular respiration: glycolysis, fermentation (alcoholic & lactic acid). (***HS10-LS1-7.3***)
- Describe the aerobic processes of cellular respiration: oxidation of pyruvate, Krebs Cycle, Electron Transport Chain. (***HS10-LS1-7.4***)
- Write a simple chemical equation for the process of cellular respiration. (***HS10-LS1-7.5***)
- Explain the relationship between the equation for photosynthesis and cellular respiration. (***HS10-LS1-7.8***)

***CELLULAR RESPIRATION 2*: Construct an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions, and revise as needed.**

- Describe the flow of energy between both anaerobic and aerobic processes of cellular respiration: NAD^+, FAD^+, NADH, $FADH_2$, ATP, ADP + P_i. (***HS10-LS2-3.1***).
- Describe practical application of aerobic and anaerobic processes of cellular respiration (ex. decomposition, yogurt production, energy for cellular processes) ***(HS-LS2-3.2)***

Record this packet in the Table of Contents for Unit 5.
This will be the first "HANDOUT."

Contained in this Packet:

1. Anaerobic Respiration
2. Glycolysis & Fermentation
3. Aerobic Respiration
4. Oxidation of Pyruvate
5. Krebs Cycle & Electron Transport Chain
6. Mitochondria Handout

UNIT 5: Cellular Respiration
Anaerobic Respiration HANDOUT

The purpose of this handout is to provide information so that students can:

- Describe the flow of energy between both anaerobic and aerobic processes of cellular respiration: NAD^+, FAD^+, NADH, $FADH_2$, ATP, ADP + P_i. (***HS10-LS2-3.1)***
- Describe the anaerobic processes of cellular respiration: glycolysis, fermentation (alcoholic & lactic acid). (***HS10-LS1-7.3)***

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1. What are 2 main differences between anaerobic and aerobic respiration?

2. What processes are involved in anaerobic respiration?

3. Where in the cell does glycolysis occur?

4. Where in the cell does fermentation occur?

5. What are the two types of fermentation?

6. What is the difference between the 2 types of fermentation in question #5?

7. What is the purpose of NAD^+?

8. What is the purpose of NADH?

9. What is the name of the 3-carbon compound produced at the end of glycolysis?

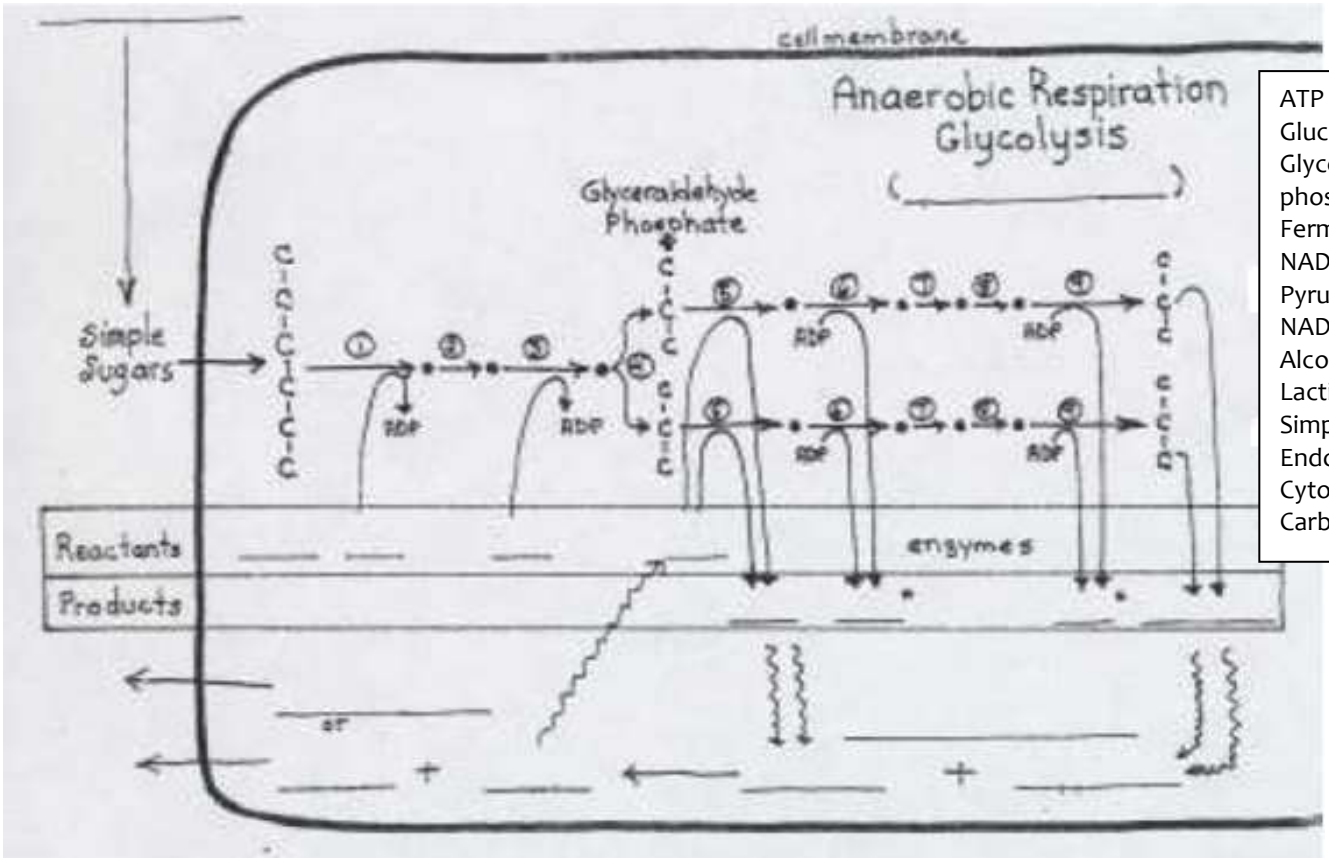
10. What is the purpose of glycolysis?

11. How are glycolysis and fermentation connected?

UNIT 5: Cellular Respiration
GLYCOLYSIS & FERMENTATION

The purpose of this handout is to provide information so that students can:

- Describe the anaerobic processes of cellular respiration: glycolysis, fermentation (alcoholic & lactic acid). (***HS10-LS1-7.3***)Explain the relationship between the equation for photosynthesis and cellular respiration. (***HS10-LS1-7.8***)
- Describe practical application of aerobic and anaerobic processes of cellular respiration (ex. decomposition, yogurt production, energy for cellular processes) ***(HS-LS2-3.2)***
- Describe the flow of energy between both anaerobic and aerobic processes of cellular respiration: NAD^+, FAD^+, NADH, $FADH_2$, ATP, ADP + P_i. (***HS10-LS2-3.1)***



ATP
Glucose
Glyceraldehyde phosphate
Fermentation
NAD^+
Pyruvate
NADH
Alcohol
Lactic acid
Simple carbohydrates
Endocytosis
Cytoplasm
Carbon dioxide

1. Glycolysis is a process that occurs in what kind of "critters?" ***aerobic / anaerobic / both aerobic & anaerobic*** .
2. _____ is the name of the "ultimate" monomer produced during glycolysis when the chemical bond is broken between carbon #3 & #4 in glucose.
3. Glycolysis occurs in the ***cytoplasm / mitochondrion*** of the cell.
4. The purpose of Glycolysis is to break apart one molecule of _____ to produce ____ ATP and ____ NADH.
5. _____ is the "*sponge*" that picks up the acidic _____and _____ to become _____ .
6. After one cycle of Glycolysis, all the NAD^+ has become _____.
7. How does fermentation take care of the problem mentioned in question #6 & keep glycolysis running?

8. When there is no oxygen or not enough oxygen to perform aerobic respiration, the cell will perform glycolysis first and then _____ to survive.
9. ***lactic acid / alcoholic*** fermentation is important for making bread because of the production of carbon dioxide
10. ***lactic acid / alcoholic*** fermentation is responsible for making muscles sore because of the production of lactic acid

11. ***glycolysis / fermentation*** produces a net gain of 2ATP, 2NADH & 2 pyruvate

12. ***glycolysis / fermentation*** regenerates NAD^+ in aerobic respirators when not enough oxygen is present

13. ***glycolysis / cellular respiration*** almost the opposite process of photosynthesis

14. Photosynthesis ***builds / breaks down*** molecules of glucose in order to ***STORE / RELEASE*** energy.
    Cellular respiration ***builds / breaks down*** molecules of _____ to ***STORE / RELEASE*** energy in the form of _____.

UNIT 5: Cellular Respiration
Aerobic Respiration:
GLYCOLYSIS, OXIDATION OF PYRUVATE, KREBS CYCLE, ELECTRON TRANSPORT CHAIN

The purpose of this handout is to provide information so that students can:

- Describe the general process of cellular respiration including: location (mitochondria) and total ATP produced from 1 glucose molecule. (***HS10-LS1-7.2***)
- Describe the aerobic processes of cellular respiration: oxidation of pyruvate, Krebs Cycle, Electron Transport Chain. (***HS10-LS1-7.4***)
- Write a simple chemical equation for the process of cellular respiration. (***HS10-LS1-7.5***)
- Describe the flow of energy between both anaerobic and aerobic processes of cellular respiration: NAD^+, FAD^+, NADH, $FADH_2$, ATP, ADP + P_i. (***HS10-LS2-3.1***)

PART 1: GENERAL CELL RESPIRATION & GLYCOLYSIS

1. What are 2 main differences between anaerobic and aerobic respiration?

2. Where is glycolysis located in the cell? (be specific)

PART 2: OXIDATION OF PYRUVATE

3. Where does the oxidation of pyruvate occur in the cell? (be specific)

4. What is the purpose of Coenzyme A?

5. What happens to Coenzyme A after it has done its "job"?

6. What is the purpose of the oxidation of pyruvate?

PART 3: KREBS CYCLE

7. Where does the Krebs Cycle occur in the cell? (be specific)

8. What is the purpose of the Krebs Cycle?

9. What is the purpose of FAD^+?

10. What is the purpose of NADH and $FADH_2$?

PART 4: ELECTRON TRANSPORT CHAIN

11. Name the donor molecule(s).

12. What do the donor molecule(s) donate?

13. What is the purpose of Electron Transport?

14. What is the purpose of Chemiosmosis?

15. Name the acceptor molecule.

16. What does the acceptor molecule accept?

17. What is produced from the acceptor molecule?

18. What happens to the NAD^+ and FAD^+?

19. Overall, what is the purpose of Cellular Respiration? Make sure to be <u>specific</u> and include:
    - the total amount of ATP produced
    - the chemical equation

Unit 5: Cellular Respiration

OXIDATION OF PYRUVATE WORKSHEET

The purpose of this handout is to provide practice so that students can:

- Describe the aerobic processes of cellular respiration: oxidation of pyruvate, Krebs Cycle, Electron Transport Chain. (***HS10-LS1-7.4***)

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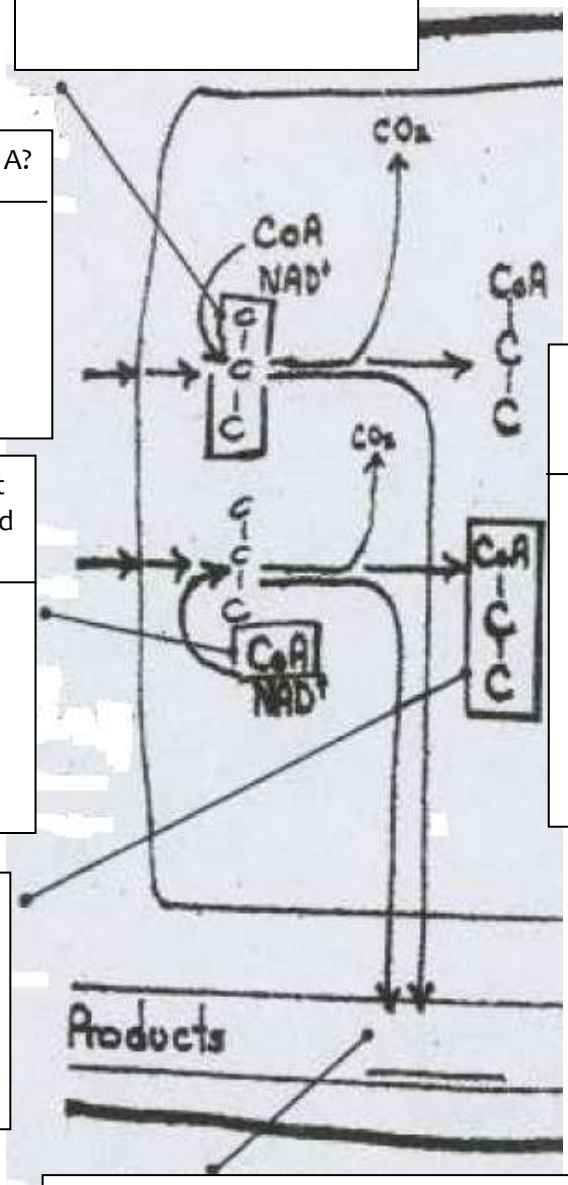
3. What is the name of the larger 6-carbon compound that was broken down to produce this 3-carbon compound?

1. What is the name if this 3-carbon compound?



4. What is the purpose of coenzyme A?

2. Where in the cell does the oxidation of pyruvate occur (be specific)?

5. What happens to Coenzyme A after it has accomplished its purpose as stated in questions #4?

6. What is the name of this 2-carbon compound attached to CoA?

7. What is produced during the oxidation of pyruvate in this step?

UNIT 5: Cellular Respiration

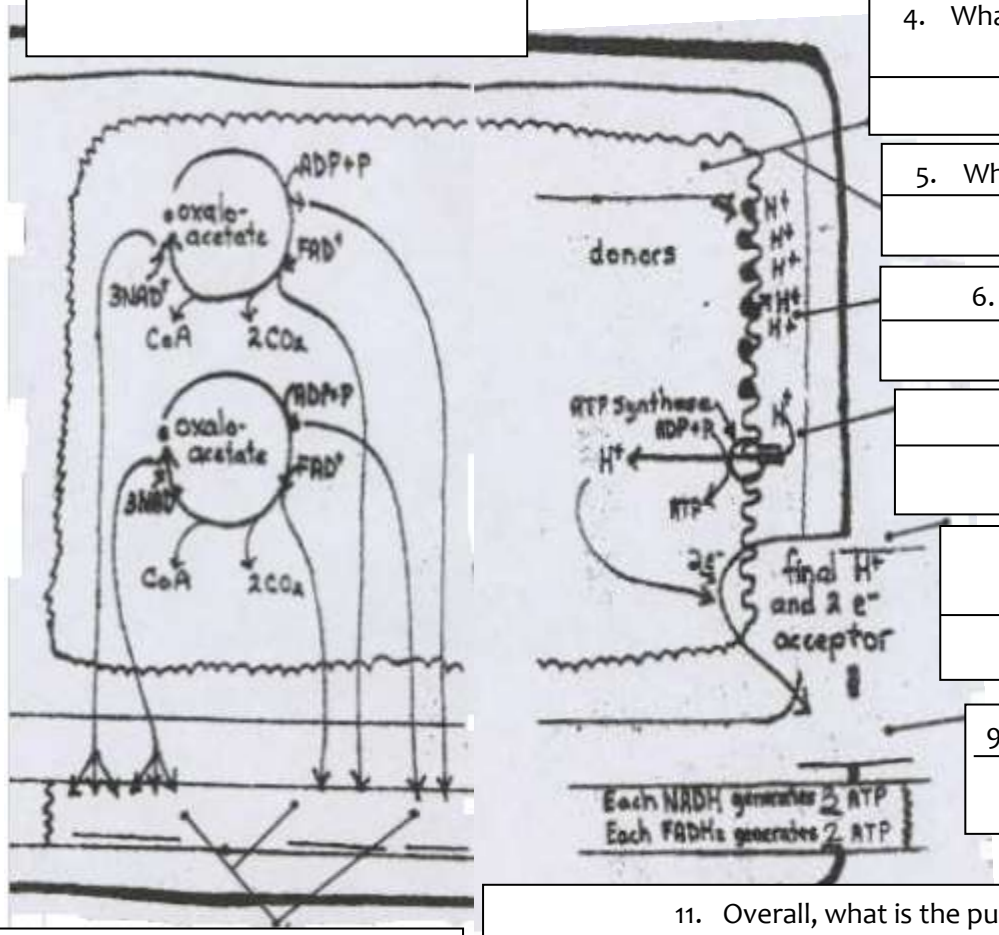
KREBS CYCLE & ELECTRON TRANSPORT & CHEMIOSMOSIS

The purpose of this handout is to provide practice so that students can:

- Describe the general process of cellular respiration including: location (mitochondria) and total ATP produced from 1 glucose molecule. (***HS10-LS1-7.2***)
- Describe the aerobic processes of cellular respiration: oxidation of pyruvate, Krebs Cycle, Electron Transport Chain. (***HS10-LS1-7.4***)

2. Where does the Krebs Cycle take place in the cell (be specific)?

3. Where does the electron transport chain take place in the cell during cellular respiration (be specific)?



4. What are the names of the 2 "donor" molecules in the electron transport chain of cellular respiration?

5. What do the "donor" molecules donate to the electron transport chain?

6. What is the purpose of electron transport in cellular respiration?

7. What is the purpose of Chemiosmosis in cellular respiration?

8. What is the name of the final H^+ ion and 2 electron acceptor in cellular respiration?

9. What is produced when the acceptor picks up 1 H^+ ion and 2 electrons?

1. What 3 energy storing compounds are produced during the Krebs Cycle?

11. Overall, what is the purpose of cellular respiration?

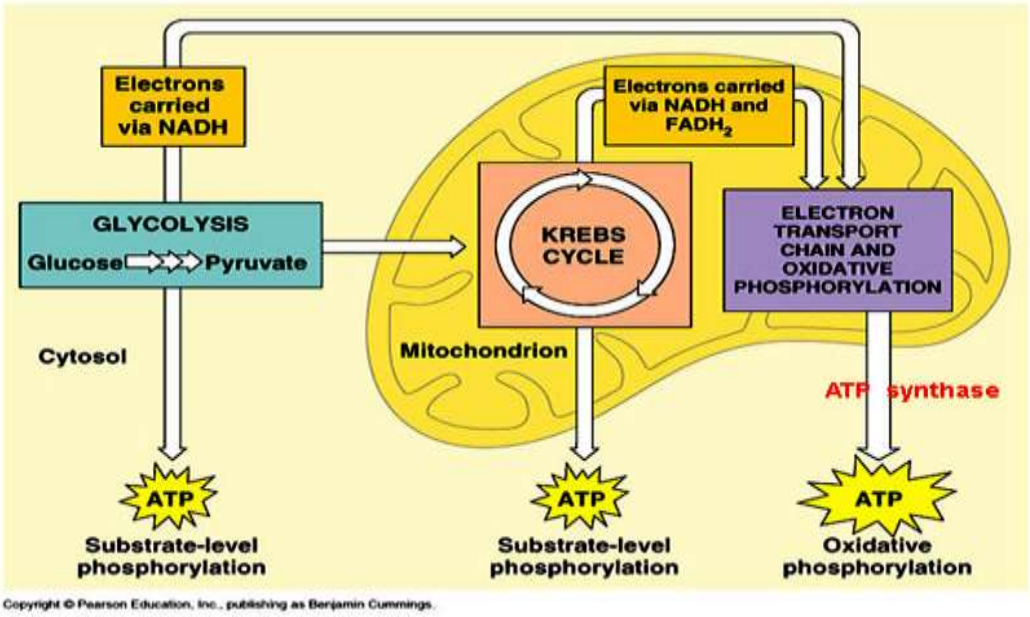
10. How many ATP can be produced from 1 molecule of glucose during aerobic respiration?

UNIT 5: Cellular Respiration
Mitochondria Handout

This handout addresses the following learning targets:

- Describe the flow of energy between both anaerobic and aerobic processes of cellular respiration: NAD^+, FAD^+, NADH, $FADH_2$, ATP, ADP + P_i. (***HS10-LS2-3.1***).
- Describe practical application of aerobic and anaerobic processes of cellular respiration (ex. decomposition, yogurt production, energy for cellular processes) ***(HS-LS2-3.2)***
- Describe the anaerobic processes of cellular respiration: glycolysis, fermentation (alcoholic & lactic acid). (***HS10-LS1-7.3***)
- Describe the aerobic processes of respiration: oxidation of pyruvate, Krebs Cycle, Electron Transport Chain. (***HS10-LS1-7.4***)

Cellular Respiration is a complicated process that involves two main pathways: ANAEROBIC and AEROBIC. The **anaerobic** pathway does not require oxygen and includes glycolysis and fermentation (lactic acid & alcoholic), occurs in the cytoplasm, and produces very little ATP. The **aerobic** pathway requires oxygen and includes glycolysis, oxidation of pyruvate, Krebs Cycle and the Electron Transport Chain. Part of the aerobic pathway occurs in the cytoplasm, while the rest in the mitochondria and has the ability to produce large amounts of ATP. The diagram below is a representation of the **AEROBIC** pathway of respiration.



1. Is this diagram an example of aerobic respiration or anaerobic respiration (circle one)? What evidence does the DIAGRAM provide that supports your choice? (be specific)
2. What is the different between aerobic respiration and anaerobic respiration?
3. Name all 4 processes involved in aerobic respiration (3 are in the diagram).
4. In the diagram above, NAME and IDENTIFY the location of the "missing process" mentioned in question #3.
5. Where does glycolysis occur?
6. Name 3 products produced during glycolysis.
7. Where does the Krebs Cycle occur (be specific)?
8. Name 3 energy storing compounds produced during the Krebs Cycle.
9. Where does the Electron Transport Chain occur (be specific)?
10. How are glycolysis and the Krebs Cycle connected to the Electron Transport Chain?
11. There is a missing link between the Electron Transport Chain and the Krebs Cycle. In the diagram above, DRAW in that missing link that completely shows how the Krebs Cycle and the Electron Transport Chain are connected.