

# CELLULAR RESPIRATION

KEY

MULTIPLE CHOICE. Circle ALL that are TRUE. There may be MORE THAN one correct answer.

\_\_\_\_\_ is the first step in cellular respiration that begins releasing energy stored in glucose.

- A. Alcoholic fermentation
- B. Lactic acid fermentation
- C. Glycolysis
- D. Electron transport chain

The carriers for energy and high energy electrons during GLYCOLYSIS are \_\_\_\_\_.

- A. ATP
- B. NADH
- C. FADH<sub>2</sub>
- D. NADPH

If oxygen is NOT present, glycolysis is followed by \_\_\_\_\_

- A. Krebs cycle
- B. electron transport chain
- C. fermentation

Name the 3 carbon molecule produced when glucose is broken in half during glycolysis.

- A. pyruvic acid
- B. lactic acid
- C. Acetyl-CoA
- D. citric acid

Really, it's G3P which is then oxidized & phosphorylated to form pyruvic acid.  
or triose phosphate

Since fermentation does not require oxygen it is said to be \_\_\_\_\_.

- A. aerobic
- B. anaerobic

Which high energy electron carrier is regenerated during fermentation that allows cells to continue to make ATP using glycolysis?

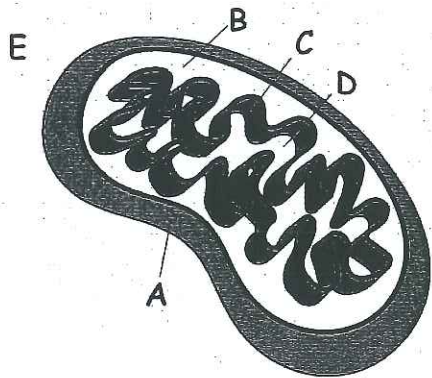
- A. NAD<sup>+</sup>
- B. NADPH
- C. ATP
- D. ADP

How many ATP molecules are added to get glycolysis started? 2

Since glycolysis produces 4 ATP molecules, this results in a NET GAIN of 2 ATP's

MATCH THE LETTER IN THE DIAGRAM WITH THE LABEL:

(You can use them MORE THAN ONCE)



- D MATRIX
- B INTERMEMBRANE SPACE
- E CYTOPLASM
- A OUTER MEMBRANE
- C INNER MEMBRANE (CRISTAE)
- E Place GLYCOLYSIS happens

\* \* \* \* \*

Write the complete overall chemical equation for cellular respiration using chemical symbols instead of words:



Compare this reaction to the one you learned about last chapter for PHOTOSYNTHESIS  
( $6 H_2O + 6 CO_2 + \text{light energy} \rightarrow C_6H_{12}O_6 + 6 O_2$ ) How are these equations related?

the products of one reaction are the reactants to the other

Write in words the equations for the two kind of fermentation:

Alcoholic fermentation



Lactic acid fermentation



\* \* \* \* \*

Tell the kind of fermentation used in each example:

Yeast use this to make bread dough rise alcoholic

Your muscle cells use this during rapid exercise when oxygen is low lactic acid

Bacteria and yeast use this to make beer and wine alcoholic

Bacteria use this to make cheese, yogurt, and sour cream lactic acid (lactate)

If alcoholic fermentation is used to make bread dough rise, how come you don't become intoxicated when you eat the bread?

the alcohol is evaporated by the heat in the oven when baking.

## The Krebs Cycle and Electron Transport Chain

### MULTIPLE CHOICE:

Circle the answer or answers that best complete the statement or answer the question.

(THERE MAY BE MORE THAN ONE RIGHT ANSWER.)

Which of the following shows the correct sequence during cellular respiration?

- A. Electron transport chain → glycolysis → Krebs cycle
- B. Glycolysis → Electron transport chain → Krebs cycle
- C. Krebs cycle → Electron transport chain → glycolysis
- D. Glycolysis → Krebs cycle → Electron transport chain

Where do the carbon atoms in pyruvic acid end up following the Krebs cycle?

- A. They enter the electron transport chain and make ATP
- B. They become part of a carbon dioxide molecule and end up in the atmosphere
- C. They join with citric acid to make Acetyl-CoA
- D. They build up in the intermembrane space

Because cellular respiration requires oxygen it is said to be \_\_\_\_\_

- A. aerobic
- B. anaerobic

How many total ATP molecules are produced by 1 molecule of glucose completing cellular respiration ?

2                      6                      24                       36

WHICH OF THE FOLLOWING ARE PRODUCED DURING THE KREBS CYCLE?

- A. ATP
- B. NADH
- C. FADH<sub>2</sub>
- D. CO<sub>2</sub>

What molecule is the final electron acceptor at the end of the Electron transport chain?

- A. oxygen
- B. carbon dioxide
- C. glucose
- D. NADH

The movement of which ion across the membrane from the intermembrane space to the matrix causes ATP synthase to spin and make ATP

- A. Na<sup>+</sup> ions
- B. oxygen
- C. H<sup>+</sup> ions
- D. water



Which stage of cellular respiration produces the most ATP?

- A. glycolysis
- B. Krebs cycle
- C. Electron transport**
- D. Acetyl-CoA charging

Which of the following happens as electrons pass down the Electron Transport chain?

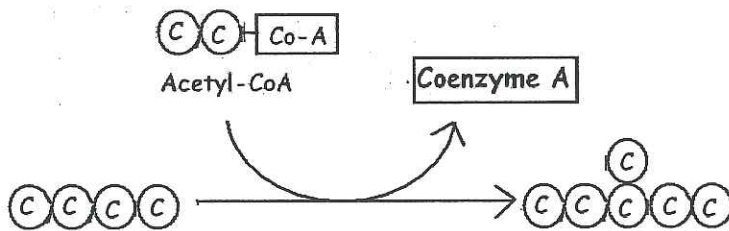
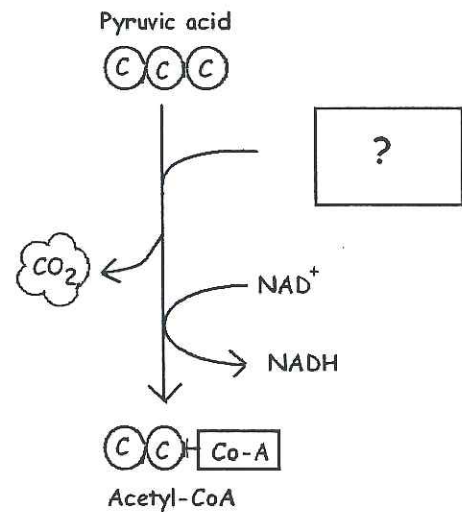
- A. Energy from the moving electrons transports  $H^+$  ions into the intermembrane space**
- B. Carbon dioxide is released
- C. Energy from  $H^+$  ions crossing back into the matrix causes ATP synthase to make ATP.**
- D. Water is produced**

Name the ? molecule that joins in this reaction to make Acetyl-CoA.

- A. ATP
- B.  $NADP^+$
- C. Coenzyme A**
- D. citric acid

If oxygen is present, what will happen to the NADH produced in this reaction?

- A. Its electrons will enter the Electron transport chain**
- B. It will donate its  $H^+$  ions to make glucose
- C. It will join with ATP to make citric acid
- D. It will join with oxygen to make  $CO_2$

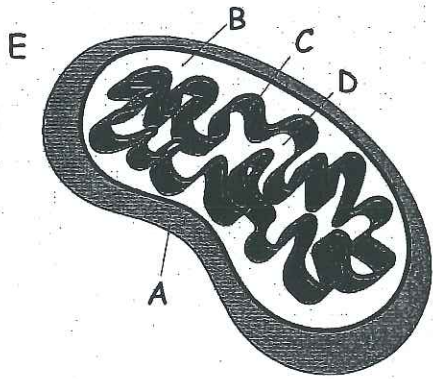


Name the 6 carbon molecule that forms when Acetyl-CoA joins its 2 carbons to a 4 carbon molecule during the Krebs cycle.

- A. ATP
- B. pyruvic acid
- C. glucose
- D. citric acid**

MATCH THE LETTER IN THE DIAGRAM WITH THE LABEL:

(You can use them MORE THAN ONCE or NOT AT ALL)



E Place where glycolysis happens

C Place where enzymes for the Electron Transport Chain are located

B Place that fills with  $H^+$  ions as electrons move down the Electron transport chain

D Place where ADP and P join to make ATP

D (near C) Place where oxygen acts as the final electron acceptor to make water

\* \* \* \* \*

Explain why  $FADH_2$  produces fewer ATP molecules than NADH when it passes its electrons down the Electron transport chain.

*skip - see question 7 on next page.*

Explain where the enzymes for Electron Transport are located in bacteria (prokaryotes) if they don't have internal membranes.

*within the cytoplasm*

\* \* \* \* \*

CELLULAR RESPIRATION VOCABULARY REVIEW

1. citric acid is a 6 carbon molecule that is produced first when acetyl-CoA joins with a 4 carbon molecule to enter the Krebs cycle.
2. Glycolysis is the process of splitting a glucose molecule into 2 pyruvic acid molecules.
3. The molecule used by cells to store and transfer energy is ATP.
4. Glycolysis happens outside the mitochondria in the cytoplasm of the cell.

- (cellular)  
5. aerobic respiration happens when oxygen is present and includes glycolysis, Krebs cycle, and Electron transport.
6. This describes a process that requires oxygen = aerobic
7. This high energy electron carrier produces fewer ATP's than NADH as its electrons pass through the Electron Transport Chain because it enters farther down the chain  
a. = FADH<sub>2</sub>
8. This atmospheric gas is required for aerobic respiration = oxygen
9. This describes a process that does NOT require oxygen; it means "without air"  
a. = anaerobic
10. Type of fermentation used by human muscles in low oxygen conditions and microorganisms to make yogurt, cheese, pickles, sauerkraut and kimchi. = lactic acid
11. As electrons pass down the electron transport chain, H<sup>+</sup> ions build up in the  
a. intermembrane space.
12. The Krebs cycle breaks down pyruvic acid into carbon dioxide and produces NADH, FADH<sub>2</sub>, and ATP.
13. The NADH and FADH<sub>2</sub> produced during the Krebs cycle pass their electrons down the  
14. electron transport chain to produce ATP.
15. The passage of H<sup>+</sup> ions through ATP synthase causes it to spin and produce ATP.
16. This 3 carbon molecule is produced during glycolysis when glucose splits in half  
a. = pyruvic acid
17. Cell organelle which acts as the cell's power plant to burn glucose and store energy as ATP  
a. = mitochondria
18. If oxygen is NOT present, glycolysis is followed by fermentation
19. Type of fermentation used to make bread dough rise and produce beer and wine.  
a. = alcoholic
20. This molecule has the formula C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> and is split in half during glycolysis = glucose
21. The carbon atoms in pyruvic acid end up as CO<sub>2</sub> in the atmosphere following the Krebs cycle.
22. 9. The folded inner membranes inside a mitochondrion are called cristae.
23. This molecule reacts with pyruvic acid to release CO<sub>2</sub>, produce NADH, and acetyl-CoA.  
a. = coenzyme A



24. Acetyl CoA forms when Coenzyme A attaches to two carbons from pyruvic acid.
25. Glycogen is the storage form of glucose used by animal cells which can be broken down for energy when glucose is used up.
26. The area inside the cristae where the Krebs cycle happens is the matrix.

LABEL &/OR EXPLAIN EACH OF THE FOLLOWING DIAGRAMS:

