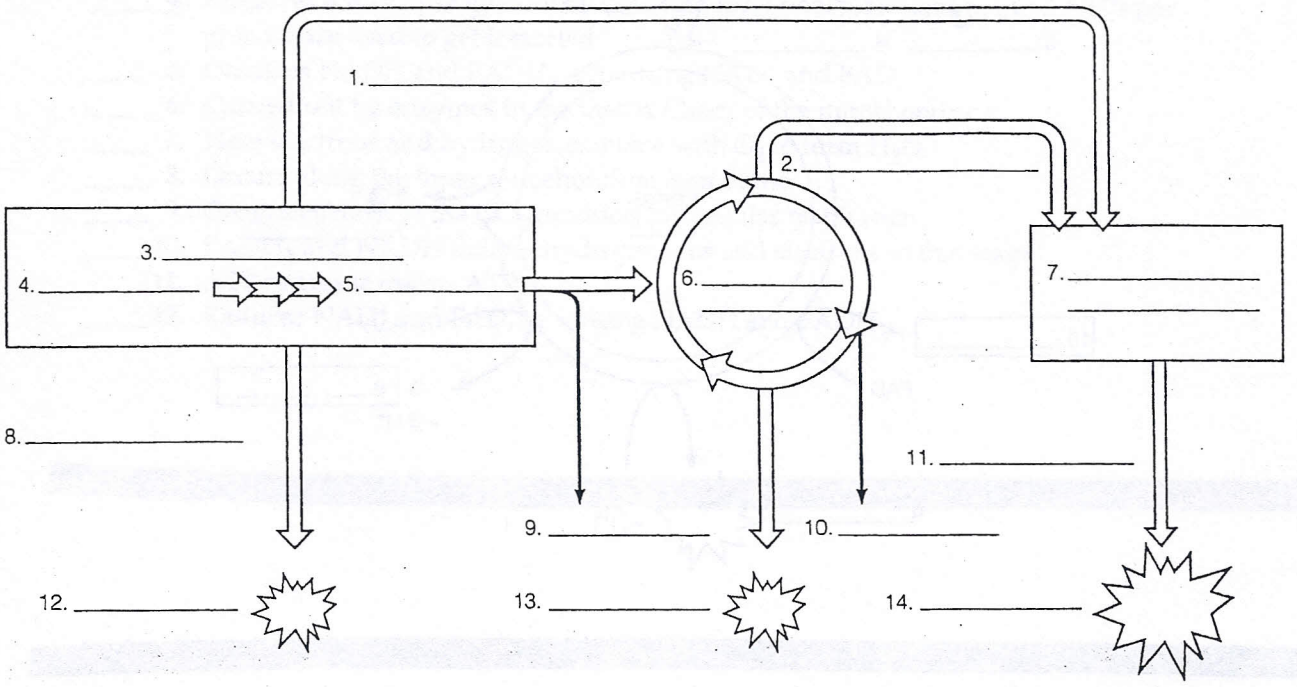
AP Biology / Bratcher **Period** ____ **Name** _____
Ch 9 Cellular Respiration

The illustration . introduces the three stages of cellular respiration. After studying it, see if you can label the diagram below without referring to the text. Include electron transport chain and chemiosmosis, pyruvic acid, mitochondrion, CO_2, high-energy electrons carried by NADH, Krebs cycle, glycolysis, cytoplasmic fluid, ATP, glucose, and NADH and $FADH_2$.

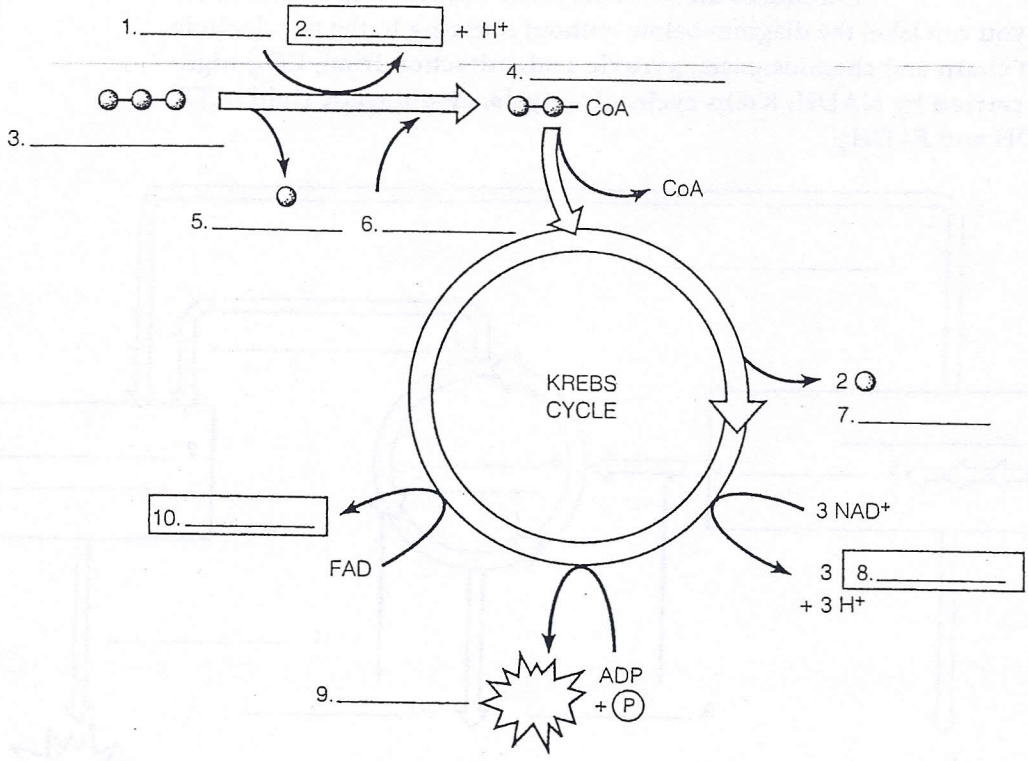


Glycolysis is the first of three steps in cellular respiration. Review glycolysis by matching each phrase on the right with a term on the left. Some terms are used twice.

A. NADH
B. Pyruvic acid
C. ATP
D. NAD^+
E. Glucose
F. Glycolysis
G. ADP and P
H. Oxygen
I. Intermediate

____ 1. Compound formed between glucose and pyruvic acid
____ 2. Not involved in glycolysis
____ 3. Fuel molecule broken down in glycolysis
____ 4. Produced by substrate-level phosphorylation
____ 5. Invested to energize glucose molecule at start of process
____ 6. Reduced as glucose is oxidized
____ 7. Glucose converted to two molecules of this
____ 8. Assembled to make ATP
____ 9. "Splitting of sugar"
____ 10. Carries hydrogen and electrons from oxidation of glucose

Pyruvic acid from glycolysis is chemically altered and then enters the Krebs cycle, a series of steps that completes the oxidation of glucose. The energy of pyruvic acid is stored in NADH and $FADH_2$. To review these processes, fill in the blanks in the diagram below. (Try to do as many as you can without referring to the text.) Include the following: NAD^+, pyruvic acid, CO_2, $FADH_2$, NADH, coenzyme A, ATP, and acetyl CoA.



Circle the correct words or phrases in parentheses to complete each sentence.

The [1] *(final, second)* stage of cellular respiration is the electron transport chain and synthesis of [2] *(glucose, ATP)* by [3] *(chemiosmosis, active transport)*. The electron transport chain is a sequence of [4] *(electron, proton)* carriers built into the [5] *(outer, inner)* membrane of the mitochondrion. Molecules of [6] *(ADP, NADH)* bring hydrogens and electrons to the chain from glycolysis and [7] *(the Krebs cycle, chemiosmosis)*. The electrons move along the chain from carrier to carrier in a series of redox reactions, finally joining with [8] *(H_2O, CO_2, O_2)* and H^+ from the surrounding solution to form [9] *(H_2O, CO_2, O_2)*. Energy released by the electrons is used to move protons—[10] *(H^+ ions, ADP molecules)*—by [11] *(active transport, passive transport)* into the space between the inner and outer mitochondrial membranes.

The buildup of protons in the intermembrane space—a proton gradient—constitutes [12] *(kinetic, potential)* energy that the cell can tap to make [13] *(ATP, glucose)*. The concentration of protons tends to drive them back through the membrane into the [14] *(inner compartment of the mitochondrion, cytoplasm of the cell)*, but protons can cross the membrane only by passing through special protein complexes, called [15] *(coenzyme A's, ATP synthases)*. As these complexes allow protons back through the membrane, their enzymes harness the energy of the moving protons to phosphorylate [16] *(NAD, ADP)* and make [17] *(NADH, ATP)*. Thus, electron transport and chemiosmosis transform [18] *(most, some, a small portion)* of the energy extracted from glucose into the phosphate bonds of ATP.

Check your overall understanding of cellular respiration by matching each of the phrases below with one of the three stages of the process. Use G for glycolysis, K for Krebs cycle, and E for electron transport and chemiosmosis.

_____ 1. Generates most of the ATP formed by cellular respiration
_____ 2. Begins the oxidation of glucose
_____ 3. Occurs outside the mitochondrion
_____ 4. Produces 4 ATPs per glucose by substrate-level phosphorylation, but 2 ATPs per glucose are used to get it started
_____ 5. Oxidizes NADH and $FADH_2$, producing NAD^+ and FAD
_____ 6. Carried out by enzymes in the matrix (fluid) of the mitochondrion
_____ 7. Here electrons and hydrogen combine with O_2 to form H_2O
_____ 8. Occurs along the inner mitochondrial membrane
_____ 9. Generates most of the CO_2 produced by cellular respiration
_____10. $FADH_2$ and NADH deliver hydrogen ions and electrons to this stage
_____11. ATP synthase makes ATP
_____12. Reduces NAD^+ and FAD, producing NADH and $FADH_2$

Review fermentation by filling in the blanks below.

1. _____ anaerobes can make their ATP by fermentation or aerobic respiration.
2. _____ is an organism that normally uses aerobic respiration to produce ATP, but it can generate ATP without oxygen, via alcoholic fermentation.
3. Fermenters replenish their supply of NAD^+ by using NADH to oxidize _____ acid.
4. When oxygen is scarce, human _____ cells can make ATP by lactic acid fermentation.
5. Fermentation enables cells to make ATP in the absence of _____ .
6. For every molecule of glucose consumed, glycolysis produces two molecules of pyruvic acid, two molecules of ATP, and two molecules of _____ .
7. The waste products of alcoholic fermentation are _____ and carbon dioxide.
8. _____ acid fermentation is used to make cheese and yogurt.
9. Fermentation generates two _____ molecules for every molecule of glucose consumed.
10. A cell can use _____ to generate a small amount of ATP, but it must somehow recycle its supply of NAD^+.
11. Like aerobic respiration, alcoholic fermentation produces _____ gas as a waste product.
12. Strict _____ require anaerobic conditions and are poisoned by oxygen.