Name _____ Date _____

Cellular Respiration Step by Step: Glycolysis, the Krebs Cycle and the Electron Transport Chain

Directions: Match each set of steps to its order first. The remaining questions cover what each stage does, and one group uses a table of pea respiration data.

1. Put these stages of aerobic respiration in order, following one glucose molecule from its first breakdown to the formation of water. Label each stage First, Second, Third or Fourth.

Write the letter of the matching answer on each line.

1. _____ The citric acid cycle breaks down the acetyl groups, releasing carbon dioxide and loading electron carriers.
2. _____ Oxygen accepts electrons at the end of the electron transport chain, forming water.
3. _____ Glycolysis splits glucose into two molecules of pyruvate.
4. _____ Each pyruvate loses one carbon as carbon dioxide and becomes acetyl CoA.

A. Fourth
B. First
C. Third
D. Second

2. Follow the energy carried by one NADH molecule until it is used to make ATP, and label each event First, Second or Third.

Write the letter of the matching answer on each line.

1. _____ Hydrogen ions flow back across the membrane through ATP synthase, which makes ATP.
2. _____ NADH hands a pair of electrons to the first protein of the electron transport chain.
3. _____ As the electrons pass along the chain, the energy they release pumps hydrogen ions across the membrane.

A. Third
B. Second
C. First

3. Use the word bank to complete these sentences about where each stage of cellular respiration happens in a eukaryotic cell.

Word bank

stroma • inner membrane • outer membrane • nucleus • cytoplasm • matrix

Glycolysis takes place in the _____, outside the mitochondria. The citric acid cycle takes place in the mitochondrial _____, and the electron transport chain is built into the _____ of the mitochondrion.

4. Which statement correctly describes how mitochondria supply a cell with usable energy?

A. They make new energy from nothing and store it in the cell.
B. They build glucose from carbon dioxide and water using light.
C. They turn the atoms of glucose directly into ATP molecules.
D. They release energy stored in food molecules and capture much of it in ATP.

5. In aerobic respiration, one glucose molecule yields about 30 to 32 ATP. Which stage makes most of them?

A. Fermentation
B. Glycolysis
C. The citric acid cycle
D. The electron transport chain, with ATP synthase

6. Bread dough rises because yeast cells in the dough break down sugar by alcohol fermentation. Which gas makes the dough rise?

A. Carbon dioxide, released as the yeast make ethanol
B. Hydrogen, released as the yeast split water
C. Nitrogen, released as the yeast break down proteins
D. Oxygen, released as the yeast break down sugar

7. A cell gets far less ATP from each glucose molecule by fermentation than by aerobic respiration. What explains the difference?

A. Fermentation makes ATP only through glycolysis, so much of the energy stays in lactate or ethanol.

B. Fermentation destroys the ATP that glycolysis makes.

C. Fermentation uses oxygen less efficiently than the electron transport chain.

D. Fermentation takes place in the mitochondria, which work slowly without oxygen.

8. During fermentation, pyruvate is turned into lactate or ethanol. What does this step do for the cell?

A. It breaks pyruvate down completely to carbon dioxide and water.

B. It produces the oxygen that the electron transport chain needs.

C. It turns NADH back into NAD^+, so glycolysis can keep making ATP.

D. It stores the pyruvate as glucose for the cell to use later.

Oxygen Use by Peas

In an investigation, respirometers held germinating peas, dry peas or glass beads only, and glass beads were added to the dry pea tubes so every tube held the same total volume. Each tube also held a chemical that absorbs carbon dioxide, so in the pea tubes a drop in gas volume showed oxygen being used. All tubes sat in a 25 °C water bath, and readings were taken every 5 minutes.

Mean readings from 3 respirometers of each kind at 25 °C. The peas' oxygen use was estimated after correcting for the gas-volume change in the glass-bead tubes.

Time (minutes)	Germinating peas: estimated oxygen used (mL)	Dry peas: estimated oxygen used (mL)	Glass beads only: decrease in gas volume (mL)
0	0.00	0.00	0.00
5	0.26	0.02	0.00
10	0.51	0.05	0.01
15	0.77	0.07	0.00
20	1.03	0.09	0.01

9. Which conclusion about the germinating and dry peas fits these results?

A. Glass beads carry out cellular respiration slowly, like dry peas.

B. All seeds use about 1 mL of oxygen every 20 minutes.

C. Dry peas are not alive, since they used no oxygen at all.

D. In this test, germinating peas used oxygen much faster than dry peas.

10. Why did the investigation include respirometers holding only glass beads?

A. To keep the peas at 25 °C during the test

B. To show any change in gas volume not caused by living things, such as from small temperature shifts

C. To absorb the carbon dioxide that the peas gave off

D. To give the peas extra oxygen to use