**Cellular Respiration Practice Questions**

1. How are cellular respiration and photosynthesis related to each other?
2. Do bacteria engage in cellular respiration? Explain.
3. Why do unicellular organisms not require cellular respiration to sustain life as multicellular organisms do?
4. Describe the different rates of energy production that occur in ectothermic and endothermic animals. Your answer should describe how body temperature and activity levels of ectotherms and endotherms are affected by external temperature change.
5. State an advantage and disadvantage of being an ectotherm
6. State an advantage and disadvantage of being an endotherm.
7. Why do plants need to engage in cellular respiration?
8. In what ways are plants and animals dependent on each other?
9. When you think of the word “respiration,” you might think about the process of breathing, which is actually called *ventilation*. (The respiratory system consists of the windpipe, lungs, etc.). How is breathing related to cellular respiration? (Hint: Think about both the reactants and the products of cellular respiration.
10. Fill in the blanks on the picture below. Identify the three stages of cellular respiration, the location in the cell of each stage and the input to each stage, and the number of ATPs.



1. Complete the concept map below.
2. Read the excerpt below and answer the following questions.

**Increased Cellular Respiration Builds Maximum Athletic Performance**

Most athletes are aware of the term ‘cellular respiration’ without really understanding what it is and how important it is to their performance levels. So what exactly does this term mean, and what relevance does it have to a runner’s fitness, stamina and explosive power?

Cellular respiration involves the intake and use of oxygen by your body’s cells in order to generate energy called Adenosine Triphosphate (ATP).  To understand the process, consider a very common energy source – fire.  What are the three components needed for fire? They are:

* Fuel
* Oxygen
* Ignition Source

The same is true for the energy your cells generate, Adenosine triphosphate is a biological battery:  a source of energy that changes to ADP, the diphosphate, when it has completely discharged. The ADP then undergoes cellular respiration to change back to the ATP that enables you to attain maximum athletic performance.

The three essential components needed to enable cellular respiration to take place are:

**Fuel:** The fuel is [glucose](http://elitesportsandfitness.com/2010/03/12/glucose-your-bodys-energy-source/), which primarily comes from your carbohydrate intake, whether in the form of simple sugars or complex fats.  Ultimately the [carbohydrates](http://elitesportsandfitness.com/2010/02/24/part-i-carbohydrates-the-body%E2%80%99s-core-fuel-for-energy/) you consume are converted to glucose. That is the raw material for cellular respiration – any unused glucose can be used to top up your [glycogen](http://elitesportsandfitness.com/2010/04/02/build-glycogen-stores/) stores, and any after that forms fatty tissue.

**Oxygen:** Oxygen is taken in by the lungs and attached to the red blood cells, so is available to the body cells when needed to generate energy.

**Ignition Source:** Cellular respiration differs from normal ignition in that it is a series of chemical reactions, and is basically what is known as a redox reaction. There is no single ignition source as such, though ATP kicks it off by breaking open the chemical bonds of the fuel source, glucose.

The whole reaction sequence comprises three basic stages, known as:

* ***Glycolysis***: Glucose is broken down to pyruvate.
* ***Krebs Cycle***:  Also known as the Citric Acid Cycle, pyruvate is used to form the high energy ATP molecules.
* ***Electron Transport System***:  This is an oxidation-reduction process wherein electrons are transferred from a high energy donor molecule to a low energy acceptor molecule with the release of energy and the generation of more ATP.

***What Does All This Mean To You As An Athlete?***

The stronger your [electron transport system](http://living-well.net/2009/11/23/what-is-electron-loss-over-time-and-what-does-it-mean-for-your-health/), then the more [ATP energy](http://elitesportsandfitness.com/2010/06/24/atp-energy/) you can generate. Not only that, but electrons are also essential for the generation of electric current, and guess what? Your nervous system is an electrical system.

Your nerves are the wires that carry electrons from your brain, to the cells that react to contract your muscles. The faster and stronger that these muscle cells contract then the quicker and more powerful your reactions, the more powerfully they can contract, the more strength you have. Your athletic performance is a combination of strong cellular respiration (generating energy for more power when you need it) and a high membrane potential (the electrical charge within your body cells), which are needed to generate the explosive power, sustained speed and stamina needed by runners over all distances.

**Free Radicals and Inflammation**

However, any chemical reactions involving oxygen are liable to produce by-products known as [free-radicals](http://elitesportsandfitness.com/2010/04/04/free-radical-damage/). These are destructive oxygenated molecules that destroy your cells and their means of producing energy – leaving you with less overall energy available.

Not only that, but exercise can damage body tissue and initiate the inflammatory response of your immune system. Neither of these side-effects is desirable in athletes, and can severely affect you fitness and performance.

1. What is the fuel for cellular respiration?
2. What process needs to be improved so that an athlete can run faster or longer?
3. What are the negative repercussions of cellular respiration?
4. If no oxygen is present, pyruvic acid breaks down to form lactic acid. You can feel the effects of lactic acid if you exercise very hard. One way to produce lactic acid is to do a “wall sit,” supporting yourself against a wall in a sitting position. Try doing this for a few minutes. What do you feel in your thigh muscles?
5. Complete the illustration by adding labels for the three main stages of cellular respiration.



1. Would a baseball player running to first base and a cross-country skier use the same or different pathways to release energy? Explain your answer.
2. Where does the heat that warms your body come from? Explain your answer.
3. Compare glycolysis, fermentation, and cellular respiration by filling in the missing information in the compare/contrast table below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Glycolysis** | **Fermentation** | **Cellular Respiration** |
| **Function** | 1.  | 5.  | 8. |
| **Reactants** | 2.  | 6. | Oxygen, glucose |
| **Products** | 3.  | NAD+, alcohol, CO2, lactic acid | 9. |
| **Advantages** | Can produce thousands of ATP molecules in milliseconds | 7. | 10. |
| **Disadvantages** | 4. | Produces ATP for only 20 or 30 seconds, lactic acid causes painful side effects | 11. |

1. Read the following excerpt and answer the following questions.

Understanding Baking: *How Yeast Works*

Did you ever wonder why flour tastes like sawdust but a French or Italian bread made with that same flour and little else has a pleasant, sweet taste?

Bread wouldn't be bread without yeast and yeast can't work without sugars.  Yeast is alive—living organisms—and living organisms need food for fuel, in this case, simple sugars.  But flour is mostly starch and table sugar (sucrose) is too complex for the yeast before fermentation.  Amylase and invertase, enzymes present in the flour or created by the yeast, break down the starch molecules into sugars.  Some of these simple sugar molecules become food for the yeast; others create the sweet flavor we find in a fine bread—even a French bread where there is no sugar added.

As the yeast feeds on the sugar, it creates two digestive byproducts—alcohol (ethanol) and carbon dioxide.  The carbon dioxide is what leavens the bread—carbon dioxide gases filter through the dough creating loft.  The alcohol is evaporated in baking.

The biological and chemical actions taking place as the bread ages and rises are called fermentation.  Generally, a long, slow fermentation makes for better flavor, texture, and moisture retention.  Many fine breads call for "retarding" or slowing down the growth of the yeast with refrigeration.  If dough is refrigerated, the yeast grows more slowly.  Fermentation still takes place as the amylase enzymes work within the dough and sugar is released albeit at a slower rate.  When the dough is warmed and the growth of the yeast takes off, there is plenty of sugar present for the yeast and an excess of sugar to sweeten the bread.

When yeast grows more slowly, we find the richer, fuller flavor of breads made with retarded dough.  In the production of focaccia, refrigeration is used to slow down the growth of the yeast and create the desired crumb and flavor.  Is it a good bread without retarding?  Yes, but retarding does give it desirable flavor overtones and a more open crumb.

1. Explain why yeast cannot digest starch or sucrose without the help of amylase and invertase.
2. What causes the bread dough to raise?
3. Why is it necessary to refrigerate the yeast to produce a better bread?
4. Examine the graph below and answer the following questions.

1. Based on your knowledge and the graph above concerning corn cellular respiration, what is the relationship between cellular respiration and corn’s germination?
2. Based on your knowledge and the graph above concerning corn cellular respiration, what relationship is there between respiration (mL of O2 consumed) and temperature?
3. Explain why a germinating corn consumes more oxygen than a non-germinating corn.
4. What is the optimum temperature for cellular respiration in corn? Explain your answer.
5. Examine the graph below and answer the following questions.



1. Which sugar source provides the most energy for the growth of yeast? Explain.
2. Explain why sucrose and lactose had lower respiration rates than glucose.
3. How was respiration rates measured in this experiment?
4. Examine the picture below and answer the following questions.
	1. What substances is being used by the rabbit’s mitochondria?
	2. What products are made by the mitochondria?
	3. If no sunlight existed, how would that affect the stages represented in this diagram?



1. Examine the picture below and answer the following questions.
	1. What is the starting molecule for the Krebs cycle?
	2. What is missing at each stage of this diagram?
	3. What would happen to the production of malate if the temperate increased by 40C?
	4. The production of which substance would be directly negatively affected by the decrease in citrate?
	5. In the chemical reaction involving the enzyme that operates on succinate, identify the substrate, and product(s) of the reaction.



1. Examine the graph below and answer the following questions.
	1. What is the effect of sugar on the production of ATP?
	2. Explain why the production of ATP increases with an increased concentration of sugar.



1. Examine the picture below and answer the following questions.
	1. Which letter indicates a test tube containing an organism that is capable of engaging in both cellular respiration and fermentation?
	2. Which letter indicates a test tube containing an organism that requires oxygen for cellular respiration and cannot live without oxygen?
	3. Which letter indicates a test tube containing an organism that would die if exposed to oxygenated environments?
	4. Which letter indicates a test tube containing an organism that grows best in aerobic conditions?



1. Examine the picture below and answer the following questions.
	1. What other product is produced simultaneously with CO2 during step 2?
	2. What is the effect of adding a competitive inhibitor to the chemical reaction involving the 4 carbon compound?



1. Examine the picture below and answer the following questions.
	1. What enzyme produces D-fructose- 1.6- biphosphate F8P?
	2. What are the effects of altering the active site for hexokinase glucokinase?



1. The diagram shows a graph of the relative rates of respiration (red line) and photosynthesis in two different types of plant (green and blue lines).
	1. Which letter shows the point at which there is no net change in carbon dioxide concentration for **plant B** (blue line)?
	2. Explain how light intensity affected plant A and plant B.
	3. Which plant produced the most amount of starch at a light intensity of 2,000 fc?
	4. Which letter presents the point at which carbon dioxide production is equal to its consumption in plant B? Plant A?
	5. Which letter presents the point at which more oxygen is consumed than being produced in plant B? Plant A?



1. Read the excerpt below and answer the following questions.

**How Carbon Monoxide Kills**

One function of the blood is to carry oxygen from your lungs to your body’s cells. However, only about 1.5 percent of the oxygen in your blood is dissolved in the liquid portion of blood, called plasma. The remaining 98.5 percent of oxygen travels with red blood cells, bound to molecules of hemoglobin.

Carbon Monoxide

Carbon monoxide, CO, is an odorless, colorless gas produced when a fuel, such as gasoline or wood, is burned without enough oxygen. If carbon monoxide is inhaled, it competes with oxygen for binding sites on hemoglobin. In fact, hemoglobin binds to carbon monoxide more than 200 times more strongly than it binds to oxygen. Thus, even at very low concentrations, carbon monoxide can displace oxygen from hemoglobin, severely reducing the amount of oxygen the blood can carry. A condition known as carbon monoxide poisoning results. Each year, nearly 5,000 people in the United States are treated for carbon monoxide poisoning, and about 300 people die from the condition. Carbon monoxide poisoning is the leading cause of death from fire.

Symptoms of Carbon Monoxide Poisoning

People with low levels of carbon monoxide in their blood typically experience headaches, nausea, drowsiness, and vomiting. Higher levels of carbon monoxide may cause disorientation, unconsciousness, and even death. Most symptoms of carbon monoxide poisoning result from depriving the brain of oxygen; oxygen deprivation may cause cells in the brain to die.

Effect on Cellular Respiration

Without oxygen to accept electrons from the mitochondrial electron transport chains, aerobic respiration cannot occur. As a result, brain cells must rely on glycolysis alone to produce ATP. Glycolysis is much less efficient than aerobic respiration, and the cells cannot make enough ATP to meet their needs.

1. Carbon monoxide’s competition for the binding sites on hemoglobin is an example of which principle that we have previously discussed?
2. Explain why CO’s binding to hemoglobin results in drowsiness, vomiting, and headaches.
3. Explain why CO poisoning can result in death.
4. Usain Bolt, a Jamaican sprinter, is regarded as the fastest man ever in human history. He is the first man to hold both the 10 meters and 200 meters world records since fully automatic time measurements became mandatory in 1977. Additionally, Shelly-Ann Fraser-Pryce, another Jamaican sprinter, is ranked the fourth fastest 100m female sprinters of all time, winning gold at the 2012 Olympics and 2 consecutive World Championships. Jamaica also heralds the fastest 4 men and women in the 100m and 200m relays. Aside from bragging, explain 4 ways that you could measure the rate of cellular respiration in these athletes and explain how the results would differ from the average athlete.