

Circulatory and Respiratory Systems Concept Questions

- What causes a pulse? (When the ventricles contract, blood pressure increases and blood rushes into the arteries, causing them to expand. We feel the expansion as the pulse.)
 - Why can the pulse rate be used to measure the heart rate? (The pulse is caused by the heart pumping blood so the pulse will correspond to the heart rate.)
- Using examples, explain the purpose served by vasoconstriction and vasodilation. (For cooling, vasodilation of surface arterioles can direct more blood to the skin shedding heat. This causes flushing of the skin. For conserving heat, vasoconstriction of surface arterioles can direct blood away from the skin to reduce heat loss to the environment. The skin appears pale.)
- How are the pulmonary arteries and veins different from all other arteries and veins? (Pulmonary arteries carry deoxygenated blood and the pulmonary veins carry oxygenated blood. This is the reverse of all other arteries and veins.)
 - Explain why blood has a higher O₂ concentration in the pulmonary veins than in the venae cavae, which are also veins. (The pulmonary veins carry blood that has just passed through capillary beds in the lungs, where it accumulated O₂. The venae cavae carry blood that has just passed through capillary beds in the rest of the body, where it gave up O₂ to the tissues.)
- What function do capillaries serve? (Capillaries are tiny blood vessels. All the exchange between the blood and body cells happens across the membranes of the cells of the capillaries.)
- Children in famine-stricken African countries are often shown with large, bloated abdomens. Explain how chronic starvation can lead to edema. (Plasma proteins are digested which decreases the osmotic pressure of the blood. More fluid stays in the tissues, causing swelling.)
- You bump into Joe on the Street at McDonalds and he says he doesn't understand what causes a head rush and complains that he hates getting one. You excitedly say that you have the explanation and the solution. What do you say? (Blood pressure in veins is insufficient to return blood to the heart. When standing quickly, the heart is unable to overcome gravity so the brain is deprived of oxygen briefly. By flexing arms and legs, the veins, with their one-way valves, are squeezed by skeletal muscles, contributing to circulation and avoiding orthostatic hypotension.)
 - Joe then asks if arteries have those nifty valves also. (No. The heart provides enough pressure to circulate blood through arteries.)
- It is not unheard of for soldiers to faint while standing at attention for a long period of time. Explain. (Without skeletal muscle movement, blood would pool in the legs. Without sufficient blood supply to the brain a person would pass out.)
- The heart of a normally developing human fetus has a hole between the left and right atria. In some cases, this hole does not close completely before birth. If the hole weren't surgically corrected, how would it affect the O₂ content of the blood entering the systemic circuit? (There would be mixing of oxygenated blood in the left atrium with deoxygenated blood in the right atrium. The resulting decrease in oxygen delivery to the body would cause lethargy.)
- Why are the atrioventricular valves and the semilunar valves so important? (The AV valves prevent the flow of blood back into the atria when the ventricles contract. The semilunar valves prevent the flow of blood from the aorta back into the ventricles when they relax. Without them, blood flow from the heart would be reduced.)

10. Why is it important that the AV node delay the electrical impulse moving from the SA node and the atria to the ventricles? (The delay allows the atria to empty completely, filling ventricles fully before they contract.)
11. The artificial pacemaker is a small battery-powered device that can send small electric impulses to the heart. What is its function and why would one be necessary? (It generates electrical impulses to coordinate the contraction of heart muscle cells. This is required in patients whose heart beat might be irregular or whose natural pacemaker has been damaged by heart attack.)
12. You visit the doctor and have your blood pressure measured. It is 150/110.
 - a) Is this high? (This is considered a high blood pressure.)
 - b) Why might the doctor be more concerned with your diastolic pressure than with your systolic pressure? (The doctor *may* be more concerned with diastolic pressure because a high pressure during ventricular relaxation could be more concerning. The chronic increased pressure may lead to damage to arterial walls and increase the risk of aneurysm.)
13. Imagine that you are a doctor and that you have diagnosed one of your patients as having high blood pressure. You prescribe a low salt diet. Why? (A high salt diet increases the osmotic flow of water into the blood, increasing blood pressure. This puts strain on the heart which can contribute to a heart attack.)
14. What is the adaptive value of the fact that arteries are usually located far below the skin? (Blood in arteries is at a higher pressure so more blood is lost from an artery than from a vein when one is severed. Extra protection results from having the arteries deeper under the skin.)
15. Suppose that after you exercise regularly for several months, your resting heart rate decreases, but your cardiac output at rest is unchanged. Based on these observations, what other change in the function of your heart at rest likely occurred? (The heart, like any other muscle, becomes stronger through regular exercise. You would expect a stronger heart to have a greater stroke volume, which would allow for the decrease in heart rate.)
16.
 - a) Describe the mechanism by which atherosclerosis can cause result in a heart attack. (The narrowing of a coronary artery can reduce the blood supply to cardiac cells, leading to their death.)
 - b) How can atherosclerosis result in high blood pressure? (Narrowing of the arteries increases the pressure. The heart must pump faster and harder to get the same volume of blood through.)
17. While recent research has called into question the danger of saturated fat specifically, what is the connection between a diet high in fat and heart disease? (A high fat, high cholesterol diet can result in deposits of fat on artery walls, decreasing their diameter. This increases blood pressure and can cause heart attack or stroke if a clot gets trapped. Chronic strain on the heart can also result in heart attack.)
18.
 - a) What is an aneurysm? (When the wall of an artery becomes weakened it bulges out.)
 - b) Why are they dangerous? (As the aneurysm increases in size, the risk of rupture increases. A rupture results in severe hemorrhage which can lead to death.)
19. Imagine now that you became bored with the mundane life of a family physician and decided to become an Emergency Medical Technician. At the scene of a car accident, a victim has lost a great deal of blood and is going into shock. The victim's skin appears pale and you observe a weak and rapid pulse, and falling body temperature. Suggest a reason for each of these symptoms. (Loss of blood volume leads to a weakened pulse. The heart tries to compensate by beating faster giving a

rapid pulse. The loss of blood contributes to the lower temperature.)

20. a) Why might a person with anemia or a low RBC count feel tired all the time? (Iron is needed for hemoglobin to carry oxygen. With a lack of iron, hemoglobin carries less oxygen so less energy can be produced from food.)
b) In both Canada and the US, rates of anemia are higher in women and girls than in men and boys. Suggest a reason for this difference. (Menstrual blood loss likely contributes to anemia in women and girls.)
21. What would happen if a blood clot formed in a major artery? (The part of the body supplied by that artery would be deprived of oxygen.)
22. Aspirin reduces the ability of blood to form clots. Why do you think doctors prescribe aspirin to patients who have had a heart attack or stroke? (It reduces the chance of a clot forming again and causing another heart attack or stroke.)
23. a) Why would someone with hemophilia have to be careful not to cut himself or herself? (They have an absent or defective clotting factor so they could lose lots of blood even from minor bleeding.)
b) Clots in arteries can cause heart attacks and strokes. Why, then, does it make sense to treat people with hemophilia by introducing clotting factors into their blood? (Clotting factors do not initiate clotting. The introduction of these factors provides the missing clotting factors and help reduce the risk of the disease.)
24. Explain why a physician might order a white cell count for a patient with symptoms of an infection. (An increase in the number of white blood cells (leukocytes) may indicate that the person is combating an infection.)
25. a) Why is a large surface area important for a respiratory surface? (A large surface area increases the gas exchange.)
b) How does the human respiratory system achieve a large surface area? (Bronchioles branch into smaller and smaller tubes and terminate in tiny sacs called alveoli.)
26. Joe on the street stops you and says “Hey, buddy. How do we breathe anyway?” What do you say? (As the diaphragm drops, the chest cavity expands, and pressure decreases. The decreased pressure allows air to enter the lungs. The reverse happens when during exhalation.)
27. a) When you are exercising, your respiratory rate increases. Explain how this happens. (Sensors in the aorta and carotid arteries detect carbon dioxide in the blood. An increase in carbon dioxide means oxygen is being used so respiratory rate increases.)
b) A decrease in blood pH also causes an increase in heart rate. What is the function of this control mechanism? (Increased heart rate increases the rate at which CO₂-rich blood is delivered to the lungs, where CO₂ is removed.)
28. The breathing control center responds to the level of carbon dioxide in the blood - not the level of oxygen. What consequence would this have for people at high altitude where there is less oxygen? (At high altitude, the level of carbon dioxide in the blood is normal so the breathing control center does not increase the rate of breathing. The result is a feeling of shortness of breath caused by a lack of oxygen. For mountain climbers, this can be fatal.)
29. When CO₂ dissolves in blood, it decreases the blood pH (*i.e.*, increases the acidity). The drop in pH is detected by the medulla and the sensors in the carotid and aorta and trigger an increase in the

breathing rate. A drop in blood pH also causes an increase in heart rate. Explain the functions of these two responses. (The increase in breathing rate increases the amount of oxygen getting to the lungs. The increased heart rate increases the amount of blood reaching the lungs so that the CO₂ can diffuse out.)

30. Metabolic acidosis is a condition that occurs when the pH of the blood is too low (*i.e.*, it is too acidic) and can occur when there is too much CO₂ in your blood. One symptom is a very rapid breathing rate. One treatment is to administer bicarbonate (which increases pH). Explain the effectiveness of this treatment. (The bicarbonate should increase the blood pH so the breathing control slows the breathing rate.)
31. A friend of yours is a smoker. Use your knowledge of the respiratory system to try to convince them to quit. (Smoking causes increased mucus production and damage to cilia. The mucus can be difficult for cilia to clear so it becomes polluted with bacteria or other pathogens and contaminants. Smoking can also lead to emphysema and dramatically increases your risk of lung cancer.)