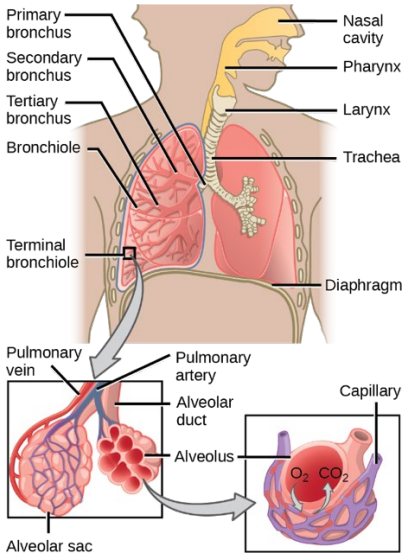
Biology 2e
Unit 7: Animal Structure and Function
Chapter 39: The Respiratory System

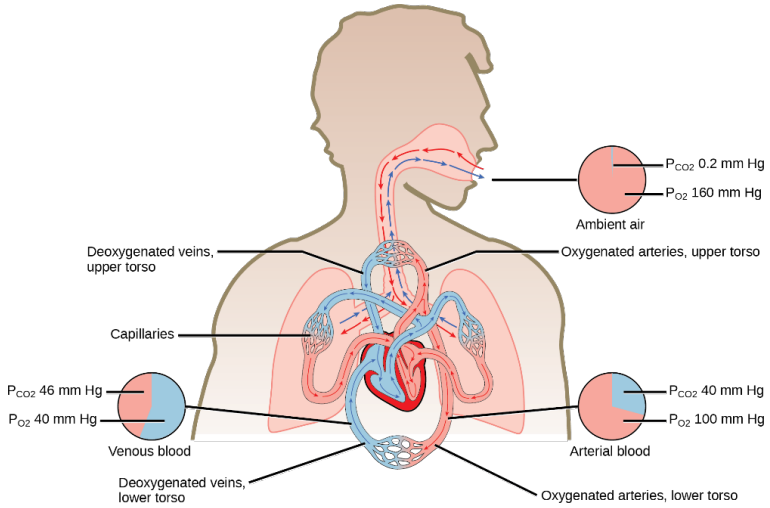
Visual Connection Questions

1. Which of the following statements about the mammalian respiratory system is false?



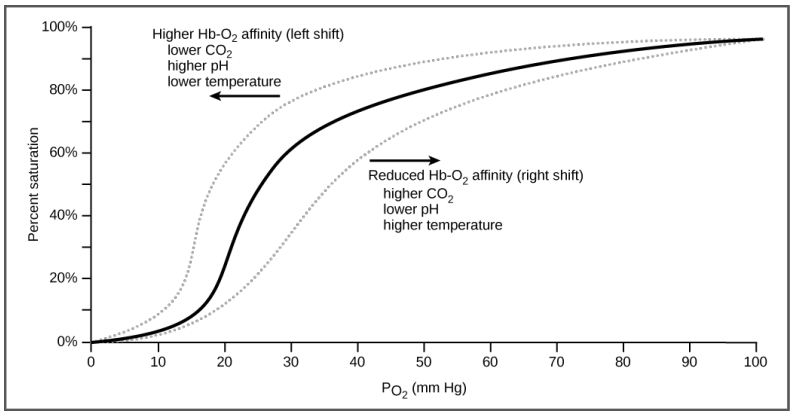
b. The bronchioles branch into bronchi.

2. Which of the following statements is false?



c. Blood travels from the lungs to the heart to body tissues, then back to the lungs, then the heart.

3. The kidneys are responsible for removing excess H+ ions from the blood. If the kidneys fail, what would happen to blood pH and to hemoglobin affinity for oxygen?



The blood pH will drop and hemoglobin affinity for oxygen will decrease.

Review Questions

4. The respiratory system _____.

a. provides body tissues with oxygen

5. Air is warmed and humidified in the nasal passages. This helps to _____.

c. prevent damage to the lungs

6. Which is the order of airflow during inhalation?

b. nasal cavity, larynx, trachea, bronchi, bronchioles, alveoli

7. The inspiratory reserve volume measures the _____.

d. amount of air that can be further inhaled after a normal breath

8. Of the following, which does not explain why the partial pressure of oxygen is lower in the lung than in the external air?

d. Lungs exert a pressure on the air to reduce the oxygen pressure.

9. The total lung capacity is calculated using which of the following formulas?

d. residual volume + expiratory reserve volume + tidal volume + inspiratory reserve volume

10. How would paralysis of the diaphragm alter inspiration?

b. It would prevent inhalation because the intrapleural pressure would not change.

11. Restrictive airway diseases _____.

b. decrease the compliance of the lung

12. Alveolar ventilation remains constant when _____.
d. both a and c (the respiratory rate and the volume of air per breath are increased and the respiratory rate is decreased while increasing the volume per breath)

13. Which of the following will NOT facilitate the transfer of oxygen to tissues?
a. decreased body temperature

14. The majority of carbon dioxide in the blood is transported by _____.
c. conversion to bicarbonate

15. The majority of oxygen in the blood is transported by _____.
d. binding to hemoglobin

Critical Thinking Questions

16. Describe the function of these terms and describe where they are located: main bronchus, trachea, alveoli, and acinus.
The main bronchus is the conduit in the lung that funnels air to the airways where gas exchange occurs. The main bronchus attaches the lungs to the very end of the trachea where it bifurcates. The trachea is the cartilaginous structure that extends from the pharynx to the primary bronchi. It serves to funnel air to the lungs. The alveoli are the sites of gas exchange; they are located at the terminal regions of the lung and are attached to the respiratory bronchioles. The acinus is the structure in the lung where gas exchange occurs.

17. How does the structure of alveoli maximize gas exchange?
The sac-like structure of the alveoli increases their surface area. In addition, the alveoli are made of thin-walled parenchymal cells. These features allow gases to easily diffuse across the cells.

18. What does FEV1/FVC measure? What factors may affect FEV1/FVC?
FEV1/FVC measures the forced expiratory volume in one second in relation to the total forced vital capacity (the total amount of air that is exhaled from the lung from a maximal inhalation). This ratio changes with alterations in lung function that arise from diseases such as fibrosis, asthma, and COPD.

19. What is the reason for having residual volume in the lung?
If all the air in the lung were exhaled, then opening the alveoli for the next inspiration would be very difficult. This is because the tissues would stick together.

20. How can a decrease in the percent of oxygen in the air affect the movement of oxygen in the body?
Oxygen moves from the lung to the bloodstream to the tissues according to the pressure gradient. This is measured as the partial pressure of oxygen. If the amount of oxygen drops in the inspired air, there would be reduced partial pressure. This would decrease the driving force that moves the oxygen into the blood and into the tissues. P_{O2} is also reduced at high

elevations: P_{O2} at high elevations is lower than at sea level because the total atmospheric pressure is less than atmospheric pressure at sea level.

21. If a patient has increased resistance in his or her lungs, how can this detected by a doctor? What does this mean?

A doctor can detect a restrictive disease using spirometry. By detecting the rate at which air can be expelled from the lung, a diagnosis of fibrosis or another restrictive disease can be made.

22. How would increased airway resistance affect intrapleural pressure during inhalation?

Increased airway resistance increases the volume and pressure in the lung; therefore, the intrapleural pressure would be less negative and breathing would be more difficult.

23. Explain how a puncture to the thoracic cavity (from a knife wound, for instance) could alter the ability to inhale.

A puncture to the thoracic cavity would equalize the pressure inside the thoracic cavity to the outside environment. For the lung to function properly, the intrapleural pressure must be negative. This is caused by the contraction of the diaphragm pulling the lungs down and drawing air into the lungs.

24. When someone is standing, gravity stretches the bottom of the lung down toward the floor to a greater extent than the top of the lung. What implication could this have on the flow of air in the lungs? Where does gas exchange occur in the lungs?

The lung is particularly susceptible to changes in the magnitude and direction of gravitational forces. When someone is standing or sitting upright, the pleural pressure gradient leads to increased ventilation further down in the lung.

25. What would happen if no carbonic anhydrase were present in red blood cells?

Without carbonic anhydrase, carbon dioxide would not be hydrolyzed into carbonic acid or bicarbonate. Therefore, very little carbon dioxide (only 15 percent) would be transported in the blood away from the tissues.

26. How does the administration of 100 percent oxygen save a patient from carbon monoxide poisoning? Why wouldn't giving carbon dioxide work?

Carbon monoxide has a higher affinity for hemoglobin than oxygen. This means that carbon monoxide will preferentially bind to hemoglobin over oxygen. Administration of 100 percent oxygen is an effective therapy because at that concentration, oxygen will displace the carbon monoxide from the hemoglobin.