

Chapter 11 – The Respiratory System

Complete using BC Biology 12, page 342 - 371

11.1 The Respiratory System

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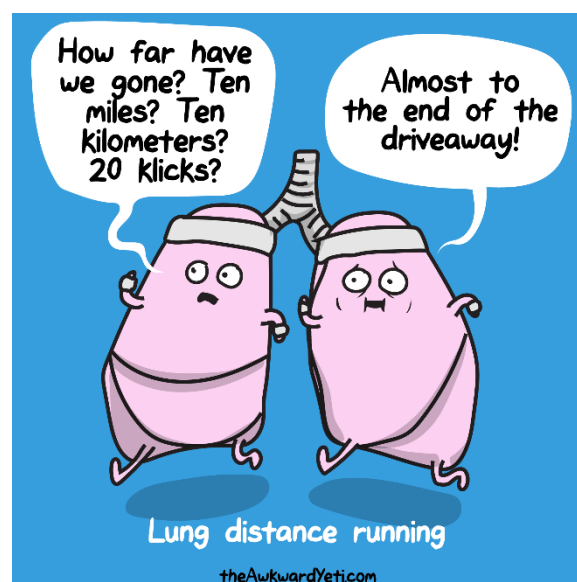
1. Distinguish between...
 - A. ventilation: another term for breathing; combination of both inspiration and expiration; physical process required for air to enter and exit the body
 - B. external respiration: exchange of gases (oxygen and carbon dioxide) between the air in the alveoli and the pulmonary capillaries
 - C. internal respiration: exchange of gases between the systemic capillaries and the tissue fluid
 - D. cellular respiration: production of ATP by the mitochondria (uses up oxygen and gives off carbon dioxide)

2. As air moves in along the airways, it is filtered, warmed, and moistened.
How are each of these accomplished?
 - A. filtered: accomplished by coarse hairs in the nose and the cilia and mucus in the nasal cavities and other airways of the respiratory tract
 - B. warmed: by heat given off by the blood vessels lying close to the surface of the lining of the airways
 - C. moistened: by the wet surfaces of the air passages

3. What happens to air as it moves out during expiration? It cools and loses its moisture; deposits its moisture on the lining of the trachea and the nose.

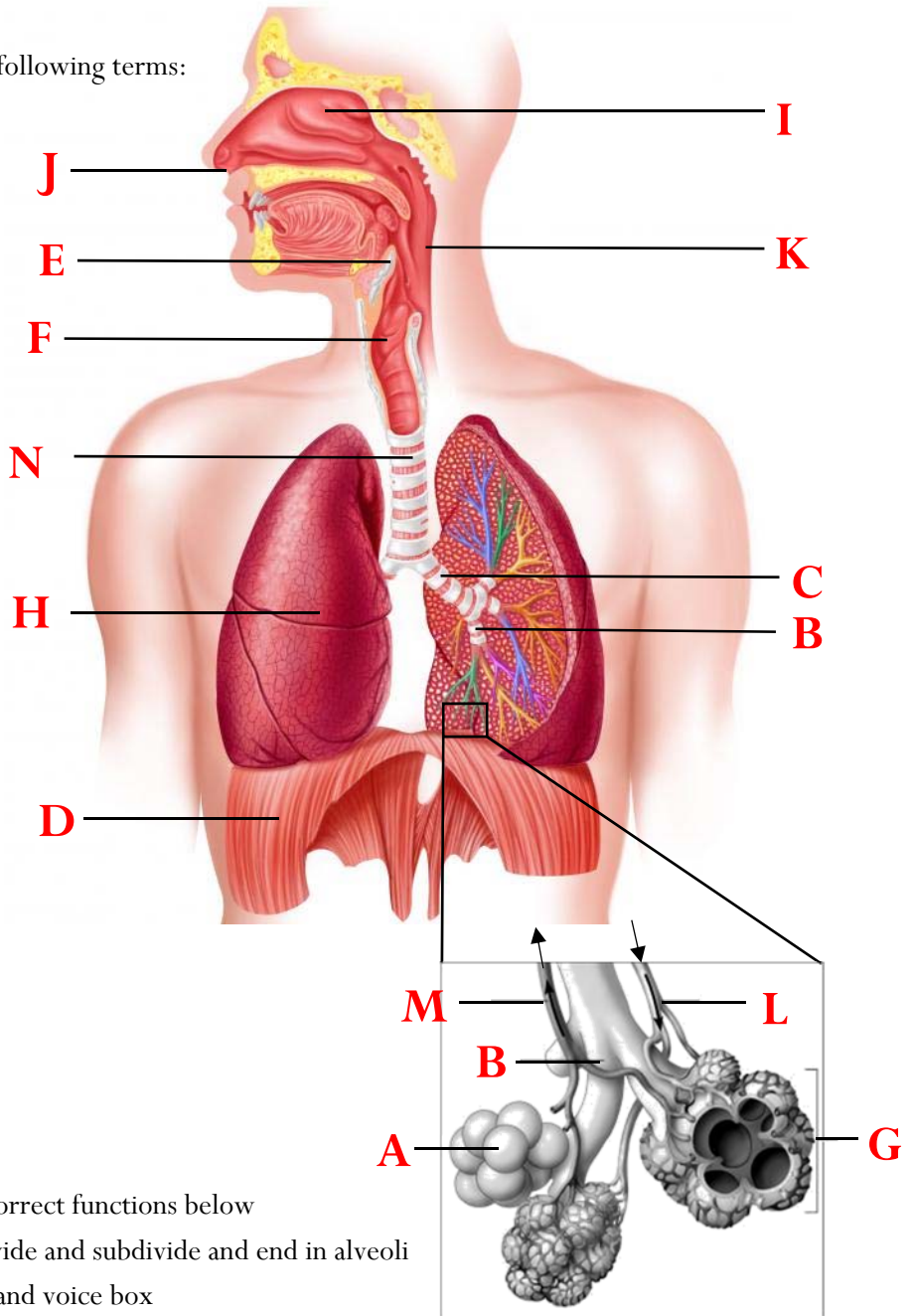
4. What is the **glottis**? the slit between the vocal cords

5. Why are the cartilage rings that hold the trachea open C-shaped? allows the esophagus to expand when swallowing



6. Complete the diagram with the following terms:

- A. alveolus
- B. bronchiole (x2)
- C. bronchus
- D. diaphragm
- E. epiglottis
- F. larynx
- G. lobule
- H. lung
- I. nasal cavity
- J. nostril
- K. pharynx
- L. pulmonary arteriole
- M. pulmonary venule
- N. trachea



7. Match the above parts to their correct functions below

- B _____ smaller airways that divide and subdivide and end in alveoli
- F _____ houses the vocal cords and voice box
- J _____ entrance to the respiratory system
- D _____ dome shaped muscle that separates the thoracic cavity and abdominal cavity
- L _____ carry deoxygenated blood to the alveoli
- A _____ thin walled microscopic air sacs; site of gas exchange between air and blood
- H _____ main organs of the respiratory system
- M _____ carry oxygenated blood away from alveoli
- C _____ two main airways that branch off the trachea and head to each lung
- K _____ chamber for passage of air and food; contains lymphocytes to protect against inhaled antigens
- G _____ grouping of alveoli
- N _____ commonly called the windpipe; held open by C-shaped cartilaginous rings
- E _____ flap of tissue that prevents food from passing into the larynx
- I _____ composed of two canals separated by a septum; also contains chemoreceptors

8. Describe the function of the mucus and cilia in the trachea. Debris is caught in the mucus (produced by the goblet cells) and the cilia work in unison to sweep the materials into the pharynx where they can be spat out or swallowed.
-
9. Trace the path of air from the human nose to the alveoli. nose – nasal canal – pharynx – larynx – trachea – bronchi – bronchioles - alveoli
-
10. The right lung has 3 lobes and the left lung has 2 lobes, allowing room for the heart whose apex points left. A lobe is further divided into lobules, and each one has a bronchiole serving many alveoli. The apex of the lung is narrow, while the base is broad and curves to fit the dome-shaped diaphragm, the muscle that separates the thoracic cavity from the abdominal cavity.
11. Describe the *pleura*, including both structure and function. Very thin serous membrane covers each lung and another covers the internal chest wall and diaphragm. Membranes produce a lubricating serous fluid that helps the membranes slide freely against each other during ventilation. Surface tension holds the two layers together when the lungs recoil during expiration.
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12. Why do alveoli not collapse, even during exhalation? Have a layer of pulmonary surfactant (lipoprotein) that holds the alveoli with surface tension
- a. What is *infant respiratory distress syndrome*? Some newborn babies (especially premature infants) lack this film when born
-

11.2 Mechanisms of Breathing

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13. To understand ventilation, the following facts should be remembered:
- Normally, there is a continuous column of air from the pharynx to the alveoli in the lungs.
 - The lungs lie within the sealed off thoracic cavity. The rib cage, consisting of ribs joined to the vertebral column posteriorly and to the sternum anteriorly, forms the top and sides of the cavity. The diaphragm and connective tissue form the floor.
 - The lungs adhere to the thoracic wall by way of the pleura. Normally, any space between the two layers is minimal due to the surface tension of the fluid between them.
14. Complete the table

	Inspiration	Expiration
Rib cage	Moves up and out	Moves down and in
Diaphragm	Contracts and lowers	Relaxes and returns to original shape
Pressure difference	Lower pressure in the lungs than atmosphere (air flows in)	Higher pressure in the lungs than atmosphere (air flows out)

15. Explain why inspiration is considered the active phase of ventilation, and expiration the passive phase.

Inspiration requires the contraction of muscles (diaphragm and intercostal) and therefore requires energy to do so... making it the ACTIVE phase.

Expiration simply requires muscles to relax and abdominal organs naturally push on diaphragm so no energy is required... making it the PASSIVE phase.

16. The volume of air exchanged normal and deep breathing can be recorded using a spirometer and the results can be recorded as a graph like the one in the next question.

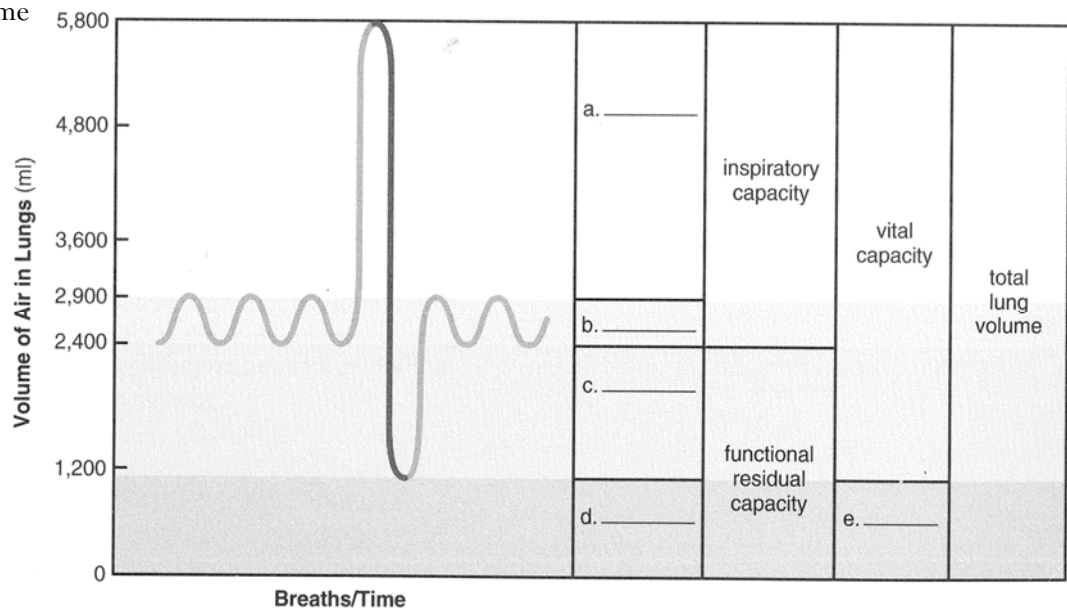
17. Label this diagram, using the following list of terms.

c expiratory reserve volume

a inspiratory reserve volume

d,e residual volume (used twice)

b tidal volume



18. Use the graph above to name the parts of respiration

a. tidal volume amount of air exchanged while at rest (~500mL)

b. inspiratory capacity maximum inhalation (~3400mL)

c. expiratory reserve capacity maximum exhalation (~1200mL)

d. residual capacity air that remains after maximum expiration (~1200mL)

19. Control of Breathing

a. Resting breathing rate of 12 - 20 ventilations per minute

b. Rhythm controlled by respiratory centre located in the medulla oblongata

i. Sends impulses to diaphragm by way of phrenic nerve and to the intercostal muscles (between ribs) by way of the intercostal nerves

ii. Following forced inhalation, stretch receptors in the alveoli send inhibitory nerve impulses via the vagus nerve

c. Chemical input: respiratory center is sensitive to levels of CO₂ and H⁺. If either rises, breathing rate and depth is increased. Oxygen levels are monitored by the carotid and aortic bodies.

20. Place the appropriate letter next to each phrase: I for inspiration or E for expiration

- I _____ lungs expanded
- E _____ muscles (diaphragm and ribs) relaxed
- E _____ diaphragm dome-shaped
- I _____ chest enlarged
- I _____ less air pressure in lungs than in the environment

21. What is the proper sequence for these statements? Put them in order from 1 – 6.

- 4 _____ Respiratory center stops sending nerve impulse to diaphragm and rib cage
- 1 _____ Respiratory center sends nerve impulse to diaphragm and rib cage
- 5 _____ Diaphragm relaxes and becomes dome-shaped, and rib cage moves down and inward
- 2 _____ Lungs expand as diaphragm lowers and rib cage moves upward and outward
- 6 _____ Air goes rushing out as lungs recoil
- 3 _____ Air comes rushing in as lungs expand

11.3 Gas Exchanges in the Body

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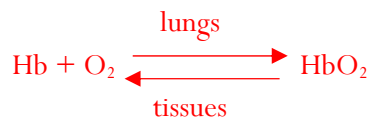
22. Match the statements to these terms:

ventilation

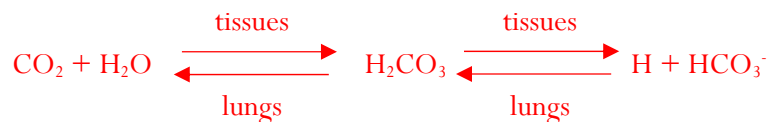
internal respiration cellular respiration inspiration & expiration external respiration

- inspiration & expiration _____ entrance and exit of air into and out of lungs
- internal respiration _____ exchange of gases between blood and tissue fluid
- cellular respiration _____ production of ATP in cells
- external respiration _____ exchange of gases between lungs and blood
- Next, place the terms in the proper sequence
 - First inspiration & expiration (ventilation) _____
 - Second external respiration _____
 - Third internal respiration _____
 - Last cellular respiration _____

23. Give the equation that describes how oxygen is transported in the blood. Label one arrow *lungs* and the reverse arrow *tissues*. (Hint: look at the 2nd and 3rd boxes)



24. Give the equation that describes how most of the carbon dioxide is transported in the blood. Label one arrow *lungs* and the reverse arrow *tissues*. (Hint: look at the 1st and 4th boxes)



25. What is the name of the enzyme that speeds up this reaction? carbonic anhydrase
26. Carbon dioxide transport produces hydrogen ions. Why does the blood not become acidic? picked up by hemoglobin to form reduced hemoglobin
27. By what process does carbon dioxide move from the blood to the alveoli? diffusion
28. After studying Figure 11.10, fill in the blanks
- Where does oxygen enter the blood? alveoli in lungs
 - Where does oxygen exit the blood? at tissues
 - Where does carbon dioxide enter the blood? at tissues
 - Where does carbon dioxide exit the blood? alveoli in lungs
 - Which vessels are rich in oxygen? pulmonary veins and systemic arteries
 - Which vessels are rich in carbon dioxide? pulmonary arteries and systemic veins
29. Hemoglobin is remarkably suited to the transport of oxygen. Why? Has a high affinity for oxygen, the iron "heme" portion readily binds to oxygen in the lungs and gives it away at the tissues
30. Why does a person rapidly die from carbon monoxide poisoning? Hemoglobin has a higher affinity for CO than O₂ and will readily bind with CO and make hemoglobin unavailable for oxygen transport.
31. How does hemoglobin help with the transport of carbon dioxide? able to bind with excess CO₂ and forms HbCO₂ (carbaminohemoglobin)

11.4 Disorders of the Respiratory System

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32. Complete the table. Your knowledge of the disorders will not be tested but rather is provided for interest.

Disorder	Description
Upper Respiratory Tract	
Common cold	Characterized by sneezing, a runny nose, and perhaps a mild fever. What is the most common group of viruses that cause colds? <u>Rhinoviruses</u>
Pharyngitis	Inflammation of the throat. Commonly called <u>strep throat</u> and is caused by a <u>bacterium (Streptococcus pyogenes)</u>
Tonsillitis	Inflammation of the tonsils. Can be removed if breathing is impaired. Why are fewer tonsillectomies performed today than in the past? <u>Discovered that tonsils help initiate immune responses to many of the pathogens that enter the pharynx</u>
Laryngitis	Inflammation of the larynx with accompanying hoarseness. Overused vocal cords may develop benign growths, or <u>polyps</u> , on their vocal cords.
Sinusitis	Inflammation of the cranial sinuses. Multiple possible causes.
Otitis media	Inflammation of the middle ear. Why is this disorder considered in the respiratory section of the book? <u>Can be caused by nasal infection that spreads to ear</u> What is a common treatment for children with chronic ear infections? <u>Tubes surgically placed in the eardrum to prevent pressure buildup</u>

Lower Respiratory Tract	
Choking	Obstructed trachea. The <u>Heimlick</u> maneuver can be performed to dislodge object. If unsuccessful, trained medical personnel may cut the trachea and insert a breathing tube during an operation called a <u>tracheotomy</u> .
Acute bronchitis	Inflammation of primary and secondary bronchi.
Chronic bronchitis	Airways are inflamed and filled with mucus. What is the most frequent cause? <u>Smoking</u>
Asthma	Disease of bronchi and bronchioles that is marked by wheezing, breathlessness, and sometimes a cough. Smooth muscle of bronchioles undergoes spasms and restrict breathing pathways. Give the name of the drug that can help control the inflammation and prevent an asthma attack. <u>Beta-antagonists (dilate the bronchioles) & corticosteroids</u>
Diseases of the Lungs	
Pneumonia	Infection of the lungs. Bronchi or alveoli fill with thick fluid.
Pulmonary tuberculosis	Caused by a bacterium that invades the lung tissue and a “tubercle” is formed to encapsulate the bacteria.
Emphysema	Chronic and incurable disorder often preceded by chronic bronchitis. Alveoli burst and fuse into enlarged air spaces, reducing surface area available for gas exchange.
Cystic fibrosis (CF)	Genetic disease. 1 in 25 Canadians carries the defective gene, but 2 copies must be inherited to have the disease.
Lung cancer	Leading cause of cancer death. More prevalent in men than women. <u>85</u> % associated with cigarette smoking. Name and describe the only treatment that offers a <i>possibility</i> of a cure. <u>Pneumonectomy – removal of a lobe or the whole lung is removed before metastasis occurs</u>

Chapter Questions

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- | | | | |
|--------------|--------------|--------------|--------------|
| 1. <u>D</u> | 12. <u>C</u> | 23. <u>D</u> | 34. <u>D</u> |
| 2. <u>C</u> | 13. <u>C</u> | 24. <u>D</u> | 35. <u>A</u> |
| 3. <u>B</u> | 14. <u>D</u> | 25. <u>C</u> | 36. <u>C</u> |
| 4. <u>A</u> | 15. <u>D</u> | 26. <u>B</u> | 37. <u>A</u> |
| 5. <u>C</u> | 16. <u>A</u> | 27. <u>B</u> | 38. <u>B</u> |
| 6. <u>C</u> | 17. <u>D</u> | 28. <u>B</u> | 39. <u>D</u> |
| 7. <u>C</u> | 18. <u>B</u> | 29. <u>C</u> | 40. <u>B</u> |
| 8. <u>B</u> | 19. <u>C</u> | 30. <u>C</u> | 41. <u>D</u> |
| 9. <u>A</u> | 20. <u>A</u> | 31. <u>C</u> | 42. <u>A</u> |
| 10. <u>D</u> | 21. <u>A</u> | 32. <u>B</u> | 43. <u>D</u> |
| 11. <u>C</u> | 22. <u>D</u> | 33. <u>C</u> | |

44. Label the parts of the respiratory system and the muscles used in ventilation.

- | | |
|-------------------|------------------------|
| 1. <u>pharynx</u> | 4. <u>bronchi</u> |
| 2. <u>trachea</u> | 5. <u>diaphragm</u> |
| 3. <u>lungs</u> | 6. <u>nasal cavity</u> |

46. moves down as it contracts

47. C-shaped rings of cartilage (keeps trachea open), lined with cilia and mucus (keeps trachea clean)

49. Match the descriptions with the corresponding structures.

- | | | | |
|-------------|-------------|-------------|--------------|
| a. <u>1</u> | e. <u>1</u> | i. <u>3</u> | m. <u>10</u> |
| b. <u>2</u> | f. <u>5</u> | j. <u>3</u> | |
| c. <u>7</u> | g. <u>2</u> | k. <u>2</u> | |
| d. <u>8</u> | h. <u>9</u> | l. <u>6</u> | |

50. D

52. Internal respiration: occurs between the tissue fluid and systemic capillaries

External respiration: occurs between the alveoli and the pulmonary capillaries

56. Very thin walled (simple squamous epithelium) and are surrounded by blood capillaries allowing easy diffusion of gases. Their small size, spherical shape, and high numbers make for a large surface area to perform gas exchange.

57. Pleurae prevent the lungs from collapsing when exhaling; held to thoracic cavity wall by surface tension

58. Breathing depends on a sealed off thoracic cavity; puncturing the cavity prevents the lungs from inflating

63. Air is drier in the winter which causes the tissues to dry out more easily, leading to rupturing of the blood vessels

64. Not properly filtered, warmed or moistened

65. Causes you to breathe in carbon dioxide which increases the levels of carbon dioxide in the blood and brings up the pH of the blood

71. Place the following in the correct box on the flowchart.

- | | | |
|-------------|-------------|--------------|
| a. <u>8</u> | d. <u>2</u> | g. <u>10</u> |
| b. <u>6</u> | e. <u>7</u> | h. <u>3</u> |
| c. <u>9</u> | f. <u>4</u> | i. <u>5</u> |

73. a. tidal volume = 500 mL vital capacity = 4500 mL

b. breathing rate = 5 breaths per minute

c. Smoker would be "shallower" and more rapid to get in the same amount of oxygen

74. d. carbon dioxide: respiratory center would trigger the body to breath more rapidly and deeply

78. a. in the tissues b. in the lungs