

# CHAPTER 13

## The Respiratory System

As you sit reviewing this system, your body needs 16 quarts of air per minute. Walking requires 24 quarts of air per minute, and running requires 50 quarts per minute. The respiratory system provides the air necessary for you to perform your daily activities and eliminates the waste gases from the air that you breathe. Take a deep breath, and think of the air entering some 250 million tiny air sacs that are similar in appearance to clusters of grapes. These microscopic air sacs expand to let air in and contract to force it out. These tiny sacs, alveoli, are the functioning units of the respiratory system. They provide the necessary volume of oxygen and eliminate carbon dioxide 24 hours a day.

Air enters either through the mouth or the nasal cavity. It next passes through the pharynx and past the epiglottis, then through the glottis and the rest of the larynx. It continues down the trachea, into the bronchi to the bronchioles, and finally through the alveoli. The reverse occurs for expelled air.

The exchange of gases between air in the lungs and in the blood is known as external respiration. The exchange of gases that occurs between the blood and the cells of the body is known as internal respiration. By constantly supplying adequate oxygen and by removing carbon dioxide as it forms, the respiratory system helps to maintain an environment conducive to maximum cell efficiency.

Your review of this system is necessary to provide you with an understanding of this essential homeostatic mechanism.

### TOPICS FOR REVIEW

Before progressing to Chapter 14, you should have an understanding of the structure and function of the organs of the respiratory system. Your review should include knowledge of the mechanisms responsible for both internal and external respiration. Your study should conclude with a knowledge of the volumes of air exchanged in pulmonary ventilation and an understanding of how respiration is regulated.

# STRUCTURAL PLAN

## RESPIRATORY TRACTS

### RESPIRATORY MUCOSA

Match the term with the definition.

- A. Diffusion
- B. Respiratory membrane
- C. Alveoli
- D. URI
- E. Respiration

- F. Respiratory mucosa
- G. Upper respiratory tract
- H. Lower respiratory tract
- I. Cilia
- J. Air distributor

- \_\_\_\_\_ 1. Function of respiratory system
- \_\_\_\_\_ 2. Pharynx
- \_\_\_\_\_ 3. Passive transport process responsible for actual exchange of gases
- \_\_\_\_\_ 4. Assists with the movement of mucus toward the pharynx
- \_\_\_\_\_ 5. Barrier between the blood in the capillaries and the air in the alveolus
- \_\_\_\_\_ 6. Lines the tubes of the respiratory tree
- \_\_\_\_\_ 7. Terminal air sacs
- \_\_\_\_\_ 8. Trachea
- \_\_\_\_\_ 9. Head cold
- \_\_\_\_\_ 10. Homeostatic mechanism

Fill in the blanks.

The organs of the respiratory system are designed to perform two basic functions. They serve as an: (11) \_\_\_\_\_ and as a (12) \_\_\_\_\_. In addition to the above, the respiratory system (13) \_\_\_\_\_, (14) \_\_\_\_\_, and (15) \_\_\_\_\_ the air we breathe. Respiratory organs include the (16) \_\_\_\_\_, (17) \_\_\_\_\_, (18) \_\_\_\_\_, (19) \_\_\_\_\_, (20) \_\_\_\_\_, and the (21) \_\_\_\_\_. The respiratory system ends in millions of tiny, thin-walled sacs called (22) \_\_\_\_\_. (23) \_\_\_\_\_ of gases takes place in these sacs. Two aspects of the structure of these sacs assist them in the exchange of gases. First, an extremely thin membrane, the (24) \_\_\_\_\_, allows for easy exchange, and second, the large number of air sacs makes an enormous (25) \_\_\_\_\_ area.



If you have had difficulty with this section, review pages 331-335.

## NOSE

## PHARYNX

## LARYNX

Circle the one that does not belong.

- |             |         |            |            |
|-------------|---------|------------|------------|
| 26. Nares   | Septum  | Oropharynx | Conchae    |
| 27. Conchae | Frontal | Maxillary  | Sphenoidal |

28. Oropharynx	Throat	5 inches	Epiglottis
29. Pharyngeal	Adenoids	Uvula	Nasopharynx
30. Middle ear	Tubes	Nasopharynx	Larynx
31. Voice box	Thyroid cartilage	Tonsils	Vocal cords
32. Palatine	Eustachian tube	Tonsils	Oropharynx
33. Pharynx	Epiglottis	Adam's apple	Voice box

Select the correct term from the options given and write the letter in the answer blank.

- \_\_\_\_\_ A. Nose                      B. Pharynx                      C. Larynx
- \_\_\_\_\_ 34. Warms and humidifies air
- \_\_\_\_\_ 35. Air and food pass through here
- \_\_\_\_\_ 36. Sinuses
- \_\_\_\_\_ 37. Conchae
- \_\_\_\_\_ 38. Septum
- \_\_\_\_\_ 39. Tonsils
- \_\_\_\_\_ 40. Middle ear infections
- \_\_\_\_\_ 41. Epiglottis



If you have had difficulty with this section, review pages 335-338.

## TRACHEA BRONCHI, BRONCHIOLES, AND ALVEOLI LUNGS AND PLEURA

Fill in the blanks.

42. The windpipe is more properly referred to as the \_\_\_\_\_.
43. \_\_\_\_\_ keeps the framework of the trachea almost noncollapsible.
44. A lifesaving technique designed to free the trachea of ingested food or foreign objects is the \_\_\_\_\_.
45. The first branch or division of the trachea leading to the lungs is the \_\_\_\_\_.
46. Each alveolar duct ends in several \_\_\_\_\_.
47. The narrow part of each lung, up under the collarbone, is its \_\_\_\_\_.
48. The \_\_\_\_\_ covers the outer surface of the lungs and lines the inner surface of the rib cage.
49. Inflammation of the lining of the thoracic cavity is \_\_\_\_\_.
50. The presence of air in the pleural space on one side of the chest is a \_\_\_\_\_.



If you have had difficulty with this section, review pages 338-344.

# RESPIRATION

If the statement is true, write "T" in the answer blank. If the statement is false, correct the statement by circling the incorrect term and writing the correct term in the answer blank.

- \_\_\_\_\_ 51. Diffusion is the process that moves air into and out of the lungs.
- \_\_\_\_\_ 52. For inspiration to take place, the diaphragm and other respiratory muscles relax.
- \_\_\_\_\_ 53. Diffusion is a passive process that results in movement up a concentration gradient.
- \_\_\_\_\_ 54. The exchange of gases that occurs between blood in tissue capillaries and the body cells is external respiration.
- \_\_\_\_\_ 55. Many pulmonary volumes can be measured as a person breathes into a spirometer.
- \_\_\_\_\_ 56. Ordinarily we take about 2 pints of air into our lungs.
- \_\_\_\_\_ 57. The amount of air normally breathed in and out with each breath is called tidal volume.
- \_\_\_\_\_ 58. The largest amount of air that one can breathe out in one expiration is called residual volume.
- \_\_\_\_\_ 59. The inspiratory reserve volume is the amount of air that can be forcibly inhaled after a normal inspiration.



If you have had difficulty with this section, review pages 346-349.

**Circle the best answer.**

60. The term that means the same thing as breathing is:
- A. Gas exchange
  - B. Respiration
  - C. Inspiration
  - D. Expiration
  - E. Pulmonary ventilation
61. Carbaminohemoglobin is formed when \_\_\_\_\_ binds to hemoglobin.
- A. Oxygen
  - B. Amino acids
  - C. Carbon dioxide
  - D. Nitrogen
  - E. None of the above
62. Most of the oxygen transported by the blood is:
- A. Dissolved in white blood cells
  - B. Bound to white blood cells
  - C. Bound to hemoglobin
  - D. Bound to carbaminohemoglobin
  - E. None of the above

63. Which of the following would *not* assist inspiration?
- Elevation of the ribs
  - Elevation of the diaphragm
  - Contraction of the diaphragm
  - Chest cavity becomes longer from top to bottom
64. A young adult male would have a vital capacity of about \_\_\_\_\_ mL.
- 500
  - 1200
  - 3300
  - 4800
  - 6200
65. The amount of air that can be forcibly exhaled after expiring the tidal volume is known as the:
- Total lung capacity
  - Vital capacity
  - Inspiratory reserve volume
  - Expiratory reserve volume
  - None of the above
66. Which one of the following is correct?
- $VC = TV - IRV + ERV$
  - $VC = TV + IRV - ERV$
  - $VC = TV + IRV \times ERV$
  - $VC = TV + IRV + ERV$
  - None of the above



*If you have had difficulty with this section, review pages 346-349.*

## REGULATION OF RESPIRATION

### RECEPTORS INFLUENCING RESPIRATION

### TYPES OF BREATHING

*Match the term on the left with the proper selection on the right.*

- |                                       |  |
|---------------------------------------|--|
| _____ 67. Inspiratory center          | A. Difficult breathing                                     |
| _____ 68. Chemoreceptors              | B. Located in carotid bodies                               |
| _____ 69. Pulmonary stretch receptors | C. Slow and shallow respirations                           |
| _____ 70. Dyspnea                     | D. Normal respiratory rate                                 |
| _____ 71. Respiratory arrest          | E. Located in the medulla                                  |
| _____ 72. Eupnea                      | F. Failure to resume breathing following a period of apnea |
| _____ 73. Hypoventilation             | G. Located throughout pulmonary airways and in the alveoli |



*If you have had difficulty with this section, review page 351.*



80. Kim was 5 years old and was a mouth breather. She had repeated episodes of tonsillitis, and her pediatrician suggested removal of her tonsils and adenoids. He further suggested that the surgery would probably cure her mouth-breathing problem. Why is this a possibility?

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81. WORD FIND

Can you find 14 terms from this chapter? Words may be spelled top to bottom, bottom to top, right to left, left to right, or diagonally.

N K S A Q B I L V A D T I X D  
 O X O O B F I F G I M N R G Y  
 I G N X W D E E F L B A U T S  
 T B K Y N H E F O I U T I R P  
 A T M H E O U T R C C C P V N  
 L L A E P S I R I Z A A N F E  
 I P T M I H G T I P R F P C A  
 T U B O G Q E V A Q O R V N W  
 N L N G L R J C C R T U P D C  
 E M U L O V L A U D I S E R E  
 V O V O T A N G J E D P Z U U  
 O N K B T C N U U E B O S J S  
 P A L I I K E U C N O Z K N A  
 Y R V N S D I O N E D A M F I  
 H Y O M L O A Z D T Y M N L K

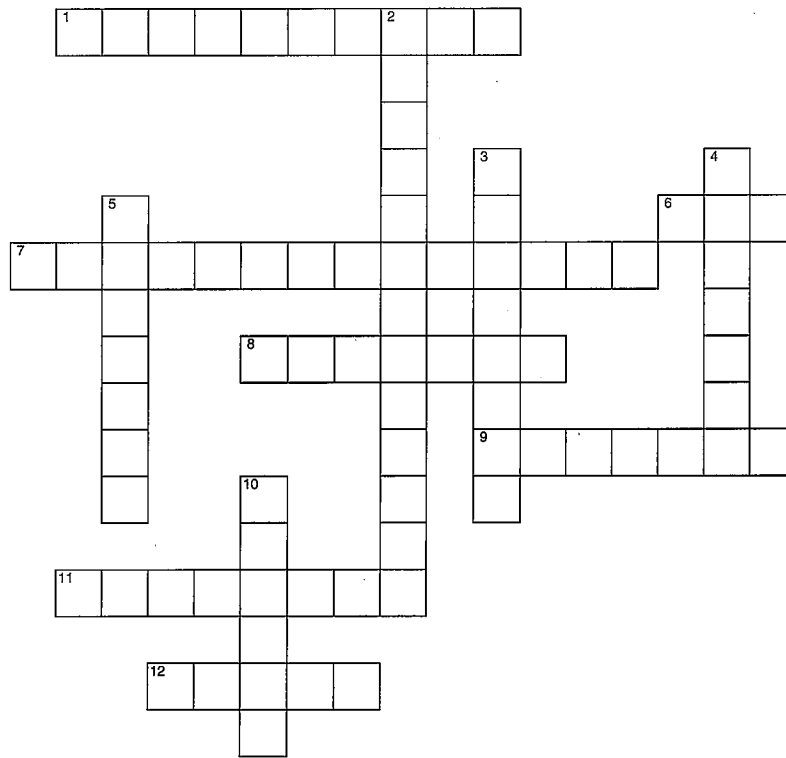
Adenoids	Epiglottis	Residual volume
Carotid body	Hypoventilation	Surfactant
Cilia	Inspiration	URI
Diffusion	Oxyhemoglobin	Vital capacity
Dyspnea	Pulmonary	

**DID YOU KNOW?**

If the alveoli in our lungs were flattened out, they would cover a half of a tennis court.

# RESPIRATORY SYSTEM

Fill in the crossword puzzle.



## Across

1. Device used to measure the amount of air exchanged in breathing
6. Expiratory reserve volume (abbreviation)
7. Sphenoidal (two words)
8. Terminal air sacs
9. Shelf-like structures that protrude into the nasal cavity
11. Inflammation of pleura
12. Respirations stop

## Down

2. Surgical procedure to remove tonsils
3. Doctor who developed lifesaving technique
4. Windpipe
5. Trachea branches into right and left structures
10. Voice box

# CHECK YOUR KNOWLEDGE

## Multiple Choice

Circle the correct answer.

1. Chemoreceptors in the carotid and aortic bodies are characterized by which of the following?
  - A. Sensitive to increases in blood carbon dioxide level
  - B. Found in the brain
  - C. Sensitive to increases in blood oxygen level
  - D. Send impulses to the heart
2. What is the lowest segment of the pharynx called?
  - A. Oropharynx
  - B. Laryngopharynx
  - C. Nasopharynx
  - D. Hypopharynx
3. What is the narrow upper portion of a lung called?
  - A. Base
  - B. Notch
  - C. Costal surface
  - D. Apex
4. What is the largest amount of air that we can breathe in and out in one inspiration and expiration called?
  - A. Tidal volume
  - B. Vital capacity
  - C. Residual volume
  - D. Inspiratory reserve volume
5. Which of the following statements, if any, does *not* describe a characteristic of human lungs?
  - A. Both right and left lungs are composed of three lobes.
  - B. Bronchi subdivide to form bronchioles.
  - C. Capillary supply is abundant to facilitate gas exchange.
  - D. All of the above statements are characteristic of human lungs
6. Which body function is made possible by the existence of fibrous bands stretched across the larynx?
  - A. Swallowing
  - B. Breathing
  - C. Diffusion
  - D. Speech
7. The trachea is made almost noncollapsible by the presence of which of the following?
  - A. Rings of cartilage
  - B. Thyroid cartilage
  - C. Epiglottis
  - D. Vocal cords

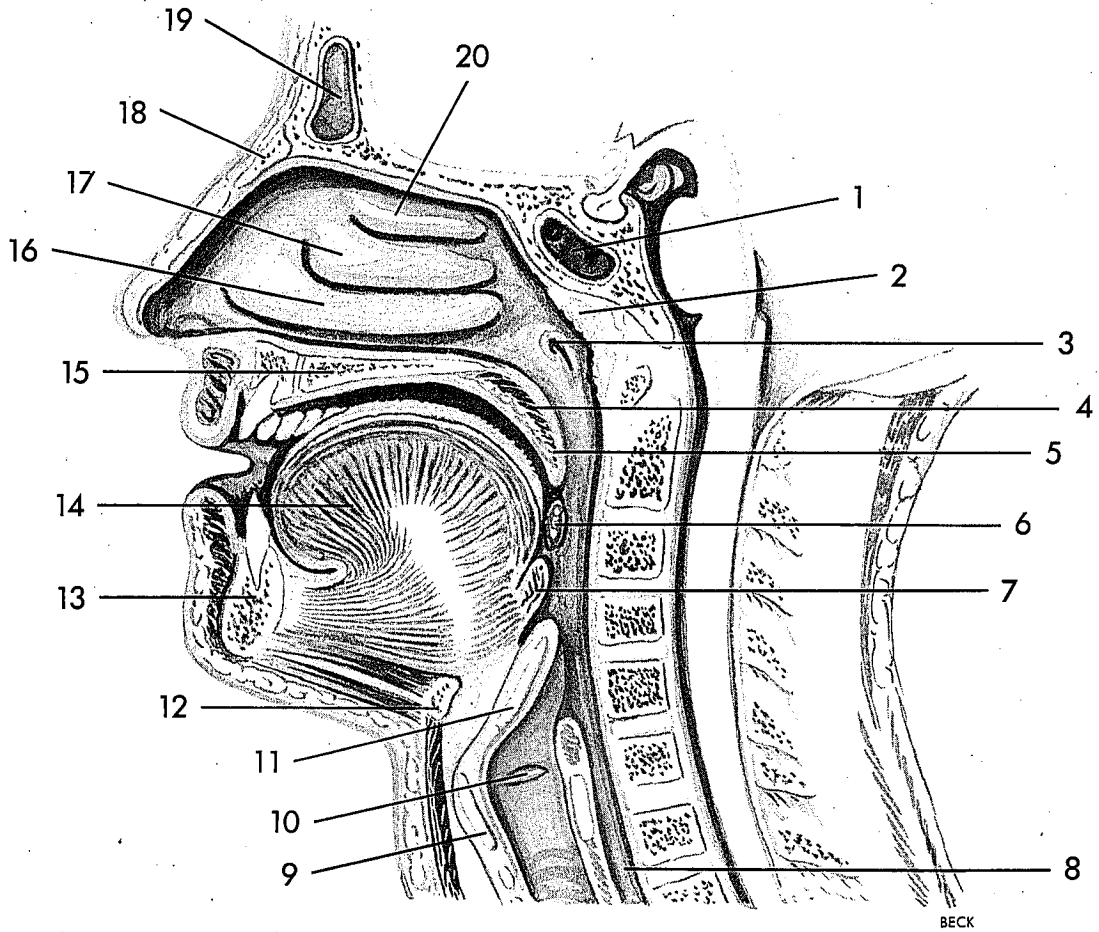
8. Which of the following is *true* of the exchange of respiratory gases between the lungs and the blood?
  - A. It takes place by diffusion.
  - B. It is called external respiration.
  - C. Both A and B are true
  - D. None of the above is true
9. When the diaphragm contracts, which phase of ventilation is taking place?
  - A. External respiration
  - B. Expiration
  - C. Internal respiration
  - D. Inspiration
10. Which of the following is *not* characteristic of the nasal cavities?
  - A. They contain many blood vessels that warm incoming air.
  - B. They contain the adenoids.
  - C. They are lined with mucous membranes.
  - D. They are separated by a partition called the nasal septum.

## Matching

*Select the most appropriate answer from column B for each item in column A. There is only one correct answer for each item.*

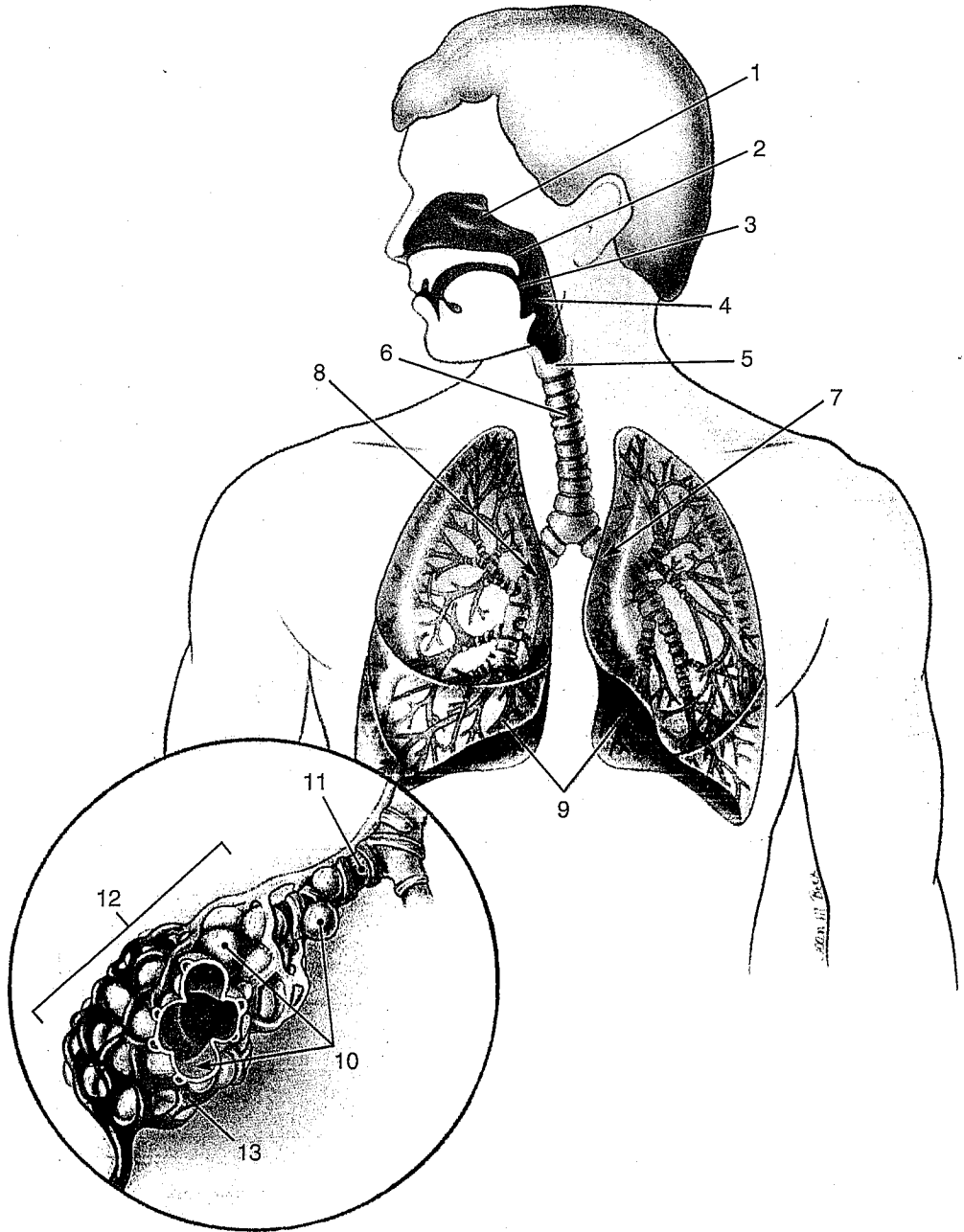
<i>Column A</i>	<i>Column B</i>
_____ 11. Vocal cords	A. Serous membrane
_____ 12. Pulmonary ventilation	B. Pharynx
_____ 13. Pleura	C. Paranasal sinus
_____ 14. Pneumothorax	D. LVRS
_____ 15. Emphysema	E. Larynx
_____ 16. Throat	F. Diffusion
_____ 17. Ethmoidal	G. Collapsed lung
_____ 18. Windpipe	H. Trachea
_____ 19. Alveoli	I. Breathing
_____ 20. Surfactant	J. IRDS

# Sagittal View of Face and Neck



- |           |           |
|-----------|-----------|
| 1. _____  | 11. _____ |
| 2. _____  | 12. _____ |
| 3. _____  | 13. _____ |
| 4. _____  | 14. _____ |
| 5. _____  | 15. _____ |
| 6. _____  | 16. _____ |
| 7. _____  | 17. _____ |
| 8. _____  | 18. _____ |
| 9. _____  | 19. _____ |
| 10. _____ | 20. _____ |

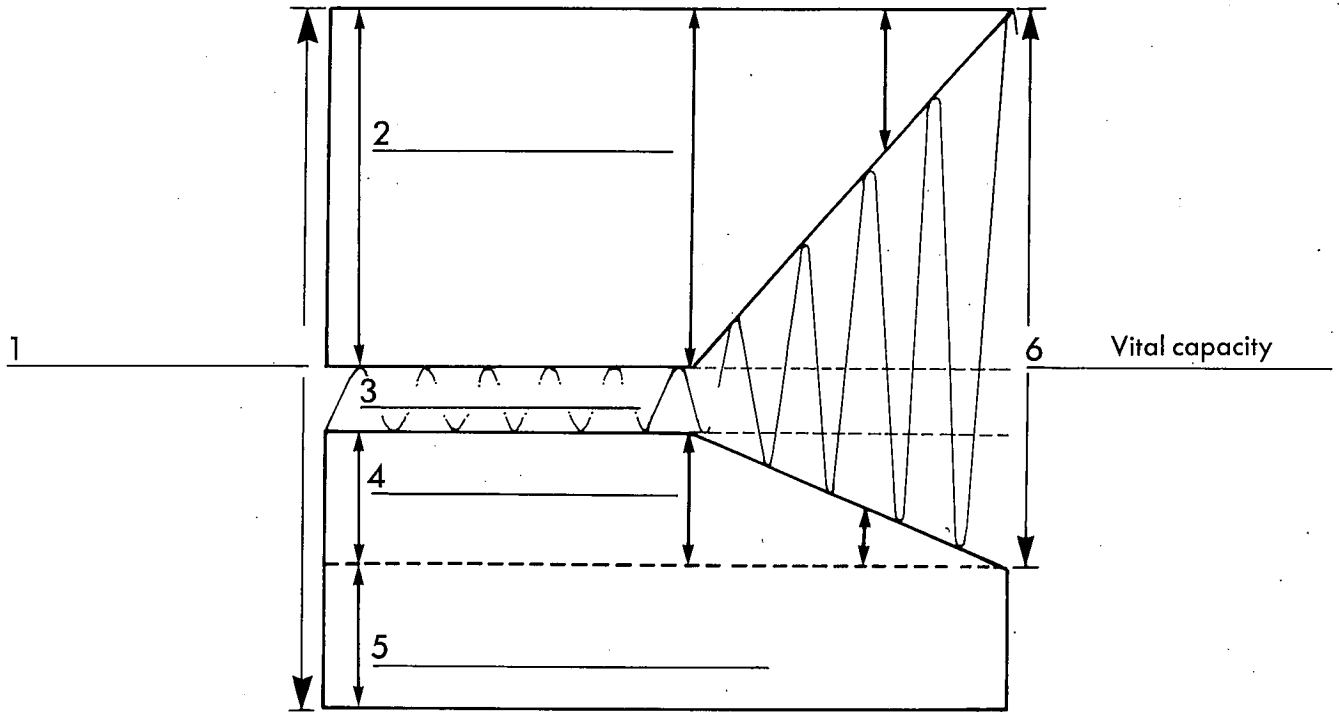
# Respiratory Organs



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_

8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_
13. \_\_\_\_\_

# Pulmonary Ventilation Volumes



1. \_\_\_\_\_

4. \_\_\_\_\_

2. \_\_\_\_\_

5. \_\_\_\_\_

3. \_\_\_\_\_

