

**15. RESPIRATORY SYSTEM: STUDY GUIDE**

The respiratory tract consists of the nose (**nasal cavities**), the nasopharynx, the **pharynx**, the **larynx** (which contains the **vocal cords**), the **trachea**, the **bronchi**, and the **bronchioles**. The **bronchi**, along with the pulmonary arteries and veins, enter the lungs, which consist of the **alveoli**, air sacs surrounded by a capillary network.

**Inspiration** begins when the **respiratory centre** in the medulla oblongata sends excitatory nerve impulses to the **diaphragm** and the muscles of the **rib cage**. As they contract, the diaphragm lowers and the rib cage moves upward and outward; the lungs expand, creating a partial vacuum, which causes air to rush in. The respiratory centre now stops sending impulses to the diaphragm and muscles of the rib cage. As the diaphragm relaxes, it resumes its dome shape, and as the rib cage retracts, air is pushed out of the lungs during **expiration**.

**External respiration** occurs when CO<sub>2</sub> leaves blood and O<sub>2</sub> enters blood at the alveoli. Oxygen is transported to the tissues in combination with **hemoglobin** as **oxyhemoglobin** (HbO<sub>2</sub>). **Internal respiration** occurs when O<sub>2</sub> leaves blood and CO<sub>2</sub> enters blood at the tissues. Carbon dioxide is mainly carried to the lungs within the plasma as the bicarbonate ion (HCO<sub>3</sub><sup>-</sup>). Hemoglobin combines with hydrogen ions and becomes **reduced** (HHb).

A number of illnesses are associated with the respiratory tract. In addition to colds and flu, the lungs may be infected by the more serious **pneumonia** and **tuberculosis**. Two illnesses that have been attributed to breathing polluted air are **emphysema** and **lung cancer**.

**STUDY QUESTIONS**

Study the text section by section. Answer the study questions so that you can fulfill the learning objectives for each section.

**15.1 The Respiratory System (pp.282 – 285)**

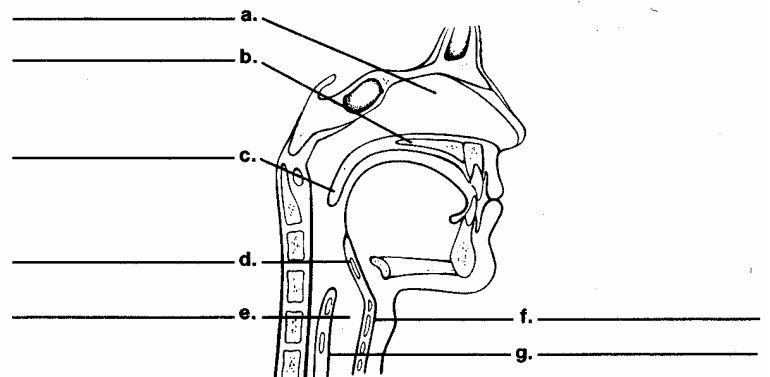
The learning objective for this section is:

- Describe the pathway air takes in and out of the lungs and the structures involved that are designed to filter, warm, and moisten air.
1. Complete this table. Refer to Table 15.1 in the textbook as needed.

Structure	Function
A.	Filter, warm, and moisten air
glottis	B.
C.	Sound production
trachea	D.
E.	Passage of air to each lung
bronchioles	F.
G.	Gas exchange

2. Label this diagram, using the following alphabetized list of terms.

- epiglottis
- glottis
- hard palate
- larynx
- nasal cavity
- soft palate
- trachea



In question 3, fill in the blanks.

3. The nasal cavities contain A. \_\_\_\_\_ and each, as well as the trachea, is lined with B. \_\_\_\_\_ to screen the incoming air. Mucus, dust, and other material are moved into the C. \_\_\_\_\_ for swallowing or excretion. During swallowing, the D. \_\_\_\_\_ folds down over the glottis to keep food from entering the trachea. The lungs of premature infants often lack a film called E. \_\_\_\_\_ that keeps their lung tissues from sticking together.

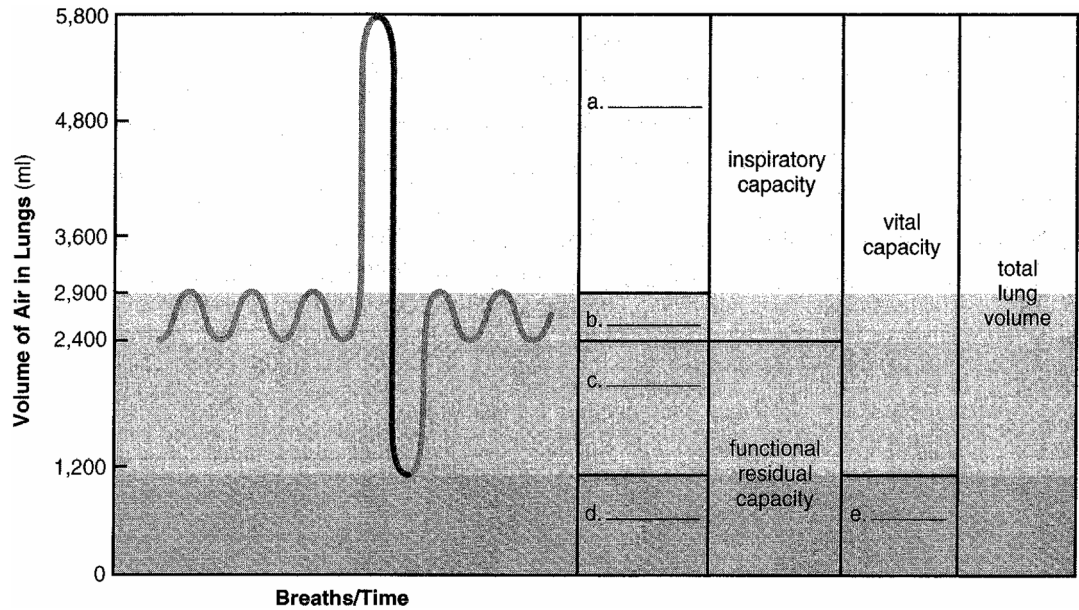
## 15.2 Mechanism of Breathing (pp.286 – 289)

The learning objectives for this section are:

- Relate the respiratory volumes to a diagram showing the amount of air that is moved in and out of the lungs when breathing occurs.
- Describe the mechanism by which breathing occurs, including respiration and expiration.

4. Label this diagram, using the following alphabetized list of terms.

expiratory reserve volume  
 inspiratory reserve volume  
 residual volume (used twice)  
 tidal volume



5. In the preceding diagram, the sum of the volumes labelled *a*, *b*, and *c* is termed the \_\_\_\_\_.

6. Place the appropriate letter next to each phrase.

I – inspiration

E – expiration

A. \_\_\_\_\_ lungs expanded

D. \_\_\_\_\_ chest enlarged

B. \_\_\_\_\_ muscles (diaphragm and ribs) relaxed

E. \_\_\_\_\_ less air pressure in lungs than in the environment

C. \_\_\_\_\_ diaphragm dome-shaped

7. What is the proper sequence for these statements? (Indicate by letters.) \_\_\_\_\_

- Respiratory centre stops sending nerve impulse to diaphragm and rib cage.
- Respiratory centre sends nerve impulse to diaphragm and rib cage.
- Diaphragm relaxes and becomes dome-shaped, and rib cage moves down and inward.
- Lungs expand as diaphragm lowers and rib cage moves upward and outward.
- Air goes rushing out as lungs recoil.
- Air comes rushing in as lungs expand.

## 15.3 Gas Exchange in the Body (pp.290 – 292)

The learning objectives for this section are:

- Describe the events that occur during external and internal respiration.
- Show that haemoglobin is well suited to its role as a respiratory pigment.

8. Match the statements to these terms:

internal respiration

cellular respiration

inspiration and expiration

external respiration

A. \_\_\_\_\_ entrance and exit of air into and out of lungs

B. \_\_\_\_\_ exchange of gases between blood and tissue fluid

C. \_\_\_\_\_ production of ATP in cells

D. \_\_\_\_\_ exchange of gases between lungs and blood

E. Next, place the terms in the proper sequence.

First \_\_\_\_\_

Second \_\_\_\_\_

Third \_\_\_\_\_

Last \_\_\_\_\_

9. Give the equation that describes how oxygen is transported in the blood. Label one arrow *lungs* and the reverse arrow *tissues*.

10. A. 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*.

In questions 10B–D, fill in the blanks.

B. What is the name of the enzyme that speeds up this reaction? \_\_\_\_\_

C. Carbon dioxide transport produces hydrogen ions. Why does the blood not become acidic? \_\_\_\_\_

D. By what process does carbon dioxide move from the blood to the alveoli? \_\_\_\_\_

11. After studying Figure 15.8 in the text, fill in the blanks.

A. Where does oxygen enter the blood? \_\_\_\_\_

B. Where does oxygen exit the blood? \_\_\_\_\_

C. Where does carbon dioxide enter the blood? \_\_\_\_\_

D. Where does carbon dioxide exit the blood? \_\_\_\_\_

E. In Figure 15.8, what two types of vessels are high in oxygen? \_\_\_\_\_

F. In the figure, what two types of vessels are high in carbon dioxide? \_\_\_\_\_

12. A. Hemoglobin is remarkably suited to the transport of oxygen. Why? \_\_\_\_\_

B. Why does a person die from carbon monoxide poisoning? \_\_\_\_\_

C. How does hemoglobin help with the transport of carbon dioxide? \_\_\_\_\_

### 15.4 Respiration and Health (pp.293 – 296)

The learning objectives for this section are:

- List the names, symptoms, and causes of various diseases of the respiratory tract.
- Explain why women now have an increase of lung cancer equal to that of men.

13. Match the descriptions to these terms:

emphysema      lung cancer      pneumonia      pulmonary fibrosis      tonsillitis      tuberculosis

A. \_\_\_\_\_ Cells build a protective capsule around the bacteria. X-rays can detect the presence of these capsules.

B. \_\_\_\_\_ Fibrous connective tissue builds up in the lungs of a person who has inhaled particles.

C. \_\_\_\_\_ A first line of defense against an invasion of the body.

D. \_\_\_\_\_ This most often begins in a bronchus and is caused by smoking cigarettes.

E. \_\_\_\_\_ Lungs balloon because air is trapped in the alveoli.

F. \_\_\_\_\_ Lobules of the lungs fill with fluid, caused by a pathogen.

14. Why do women now suffer from lung cancer rates equivalent to those of men when in past they did not?

**KEY**

- 1 *A. nasal cavities* *E. bronchi*  
*B. passage of air into larynx* *F. passage of air between bronchi & lungs*  
*C. larynx* *G. lungs*  
*D. passage of air between pharynx & bronchi*
- 2 *A. nasal cavity* *C. soft palate* *E. glottis* *G. trachea*  
*B. hard palate* *D. epiglottis* *F. larynx*
- 3 *A. coarse hairs* *B. cilia* *C. pharynx* *D. epiglottis* *E. surfactant*
- 4 *A. inspiratory reserve volume* *C. expiratory reserve volume* *E. residual volume*  
*B. tidal volume* *D. residual volume*
- 5 *vital capacity*
- 6 *A. I* *B. E* *C. E* *D. I* *E. I*
- 7 *B, D, F, A, C, E*
- 8 *A. inspiration & expiration* *C. cellular respiration* *E. inspiration & expiration, external, internal, cellular*  
*B. internal respiration* *D. external respiration*
9. 
$$\underset{\text{tissues}}{\text{Hb}} + \underset{\text{lungs}}{\text{O}_2} \rightleftharpoons \text{HbO}_2$$
10. 
$$\underset{\text{lungs}}{\text{CO}_2} + \underset{\text{tissues}}{\text{H}_2\text{O}} \rightleftharpoons \underset{\text{lungs}}{\text{H}_2\text{CO}_3} \rightleftharpoons \text{H}^+ + \text{HCO}_3^-$$
  
*B. carbonic anhydrase* *C. Hemoglobin combines with excess hydrogen ions.* *D. diffusion*
11. *A. lungs* *C. tissues* *E. pulmonary vein & aorta (systemic arteries)*  
*B. tissues* *D. lungs* *F. venae cavae (systemic veins) & pulmonary artery*
12. *A. It easily combines with oxygen in the lungs & easily gives it up in the tissues.*  
*B. Hemoglobin combines with carbon monoxide preferentially to oxygen.*  
*C. It combines with carbon dioxide to a degree, called carbaminohemoglobin, & picks up hydrogen ions from the equation of 10A.*
13. *A. tuberculosis* *C. tonsillitis* *E. emphysema*  
*B. pulmonary fibrosis* *D. lung cancer* *F. pneumonia*
14. *Women now smoke cigarettes as frequently as men. In the past, it was less acceptable for women to smoke.*