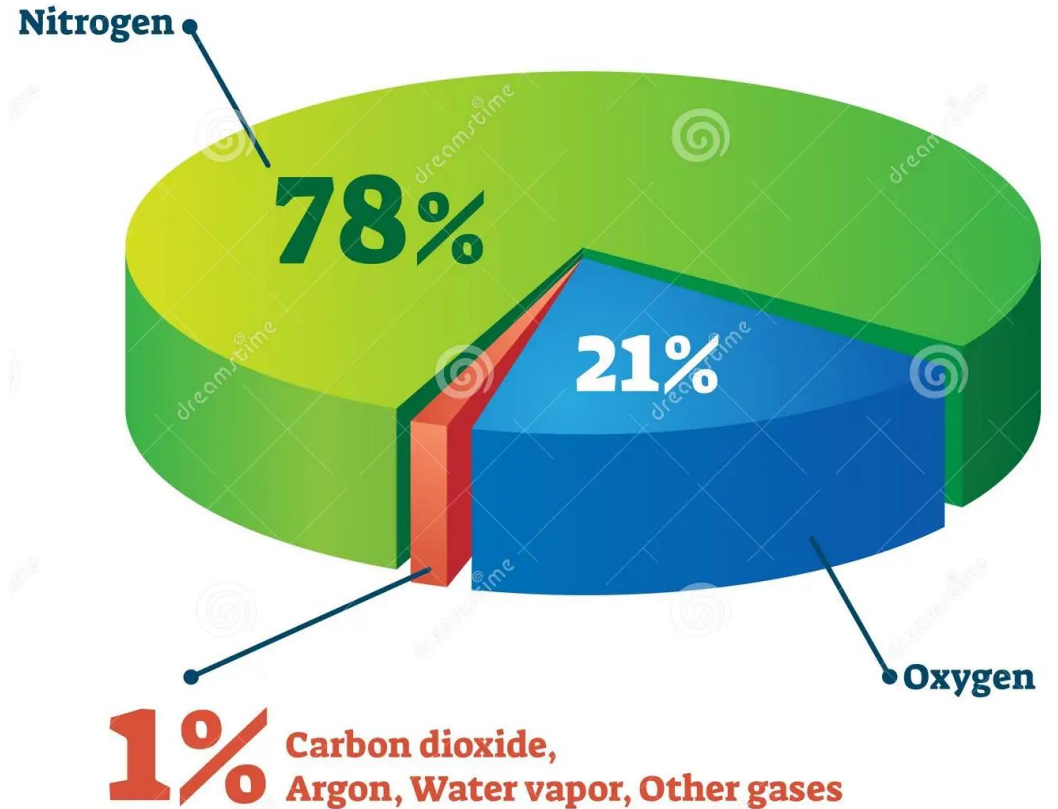


Gaseous Exchange



Composition of air

Air in the atmosphere is composed of **nitrogen**, **oxygen**, and different **trace gases** in addition to particles or aerosols due to various human activities and natural phenomena. The trace gases include carbon dioxide, argon, neon, helium, methane, krypton, and water vapour.



Composition of inhaled and exhaled air

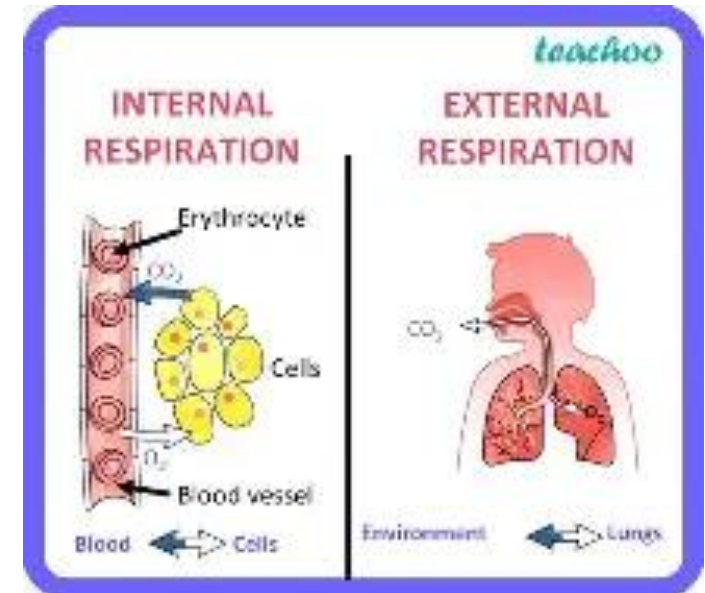
Except for the amount of carbon dioxide and oxygen, the composition of air that is inhaled and exhaled is nearly identical. The following table highlights their percentages:

Substance	Inhaled Air %	Exhaled Air %
Nitrogen	78.0	78.0
Oxygen	21.0	16
Argon	0.9	0.9
Carbon Dioxide	0.0390	4.0
Water Vapour	variable	variable

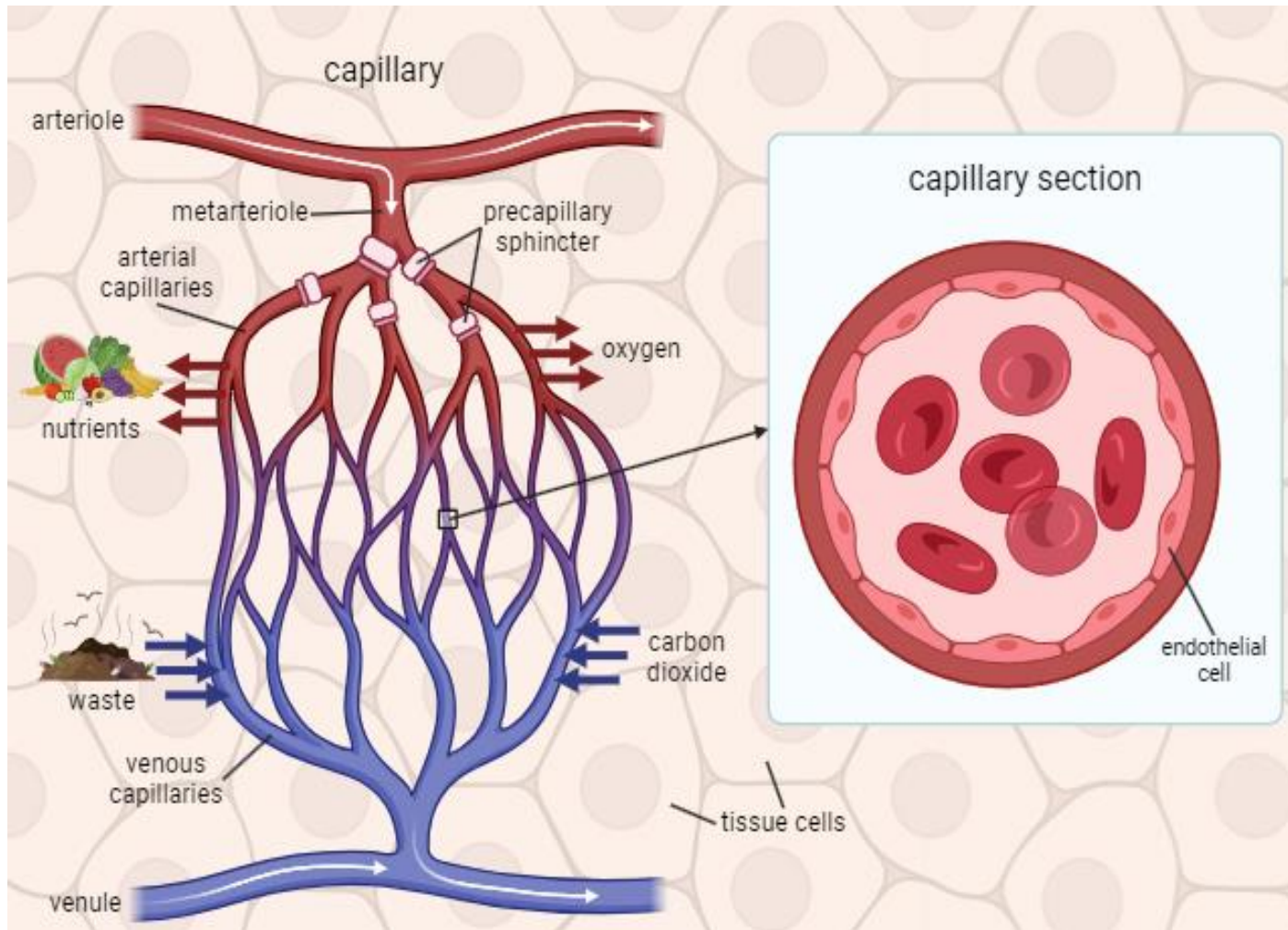
Internal and External Gaseous Exchange

In order to understand the mechanisms of gas exchange in the lung, it is important to understand the underlying principles of gases and their behavior.

Internal and **external** gas exchange are crucial processes in respiration, involving the transfer of oxygen and carbon dioxide between the body and the environment, as well as within the body's tissues.



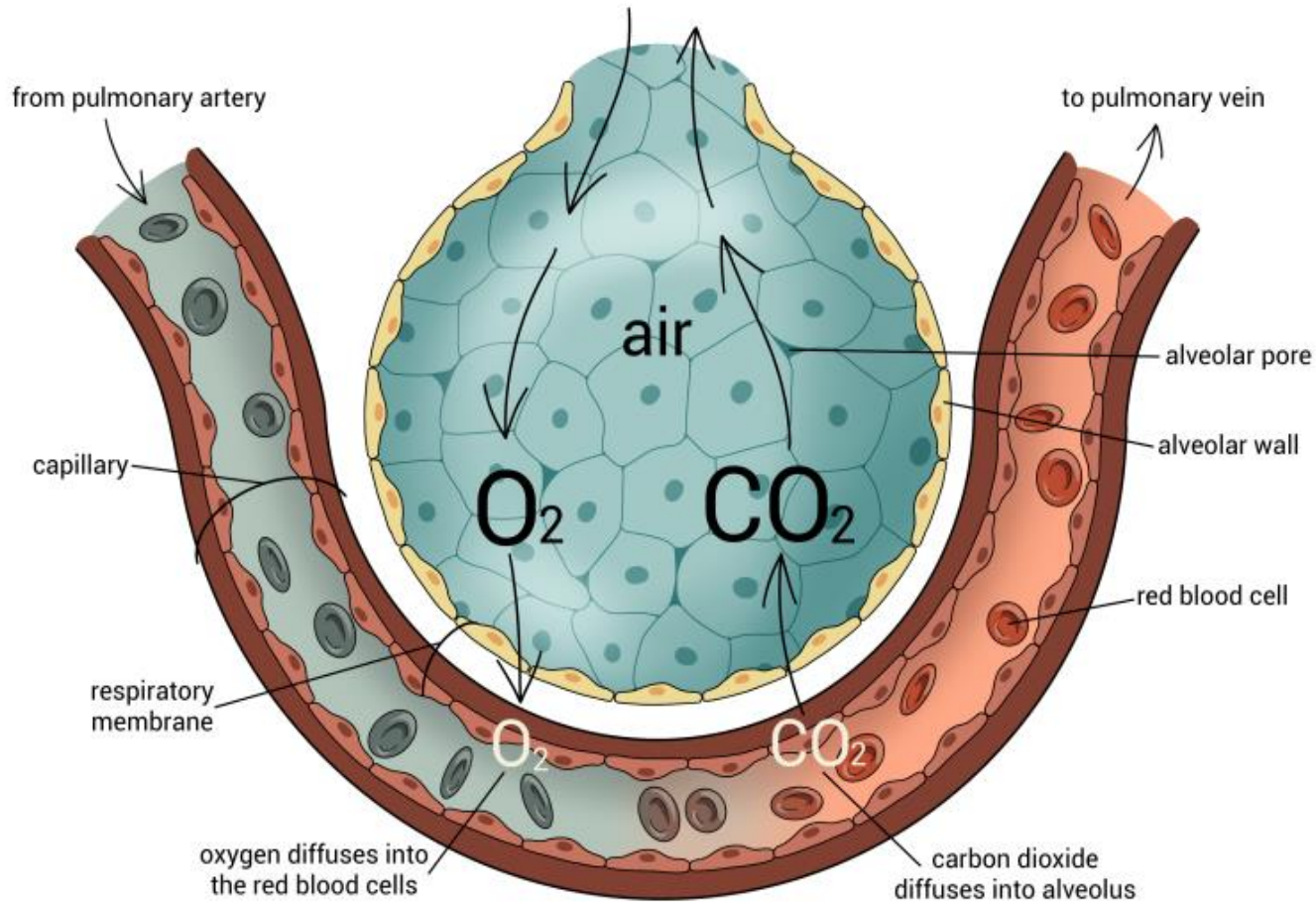
Internal Gaseous Exchange



Definition: Internal gas exchange, also known as cellular respiration, occurs at the level of tissues throughout the body. It involves the exchange of gases between the blood and the cells of the body.

Mechanism: In the tissues, oxygen diffuses from the blood into the cells, where it is used for energy production through cellular respiration. Simultaneously, carbon dioxide produced as a byproduct of metabolism diffuses from the cells into the blood to be transported back to the lungs.

External Gaseous Exchange



Definition: External gas exchange refers to the process of gas exchange that occurs in the lungs, specifically in the **alveoli**, where oxygen is taken in from the atmosphere and carbon dioxide is expelled from the bloodstream.

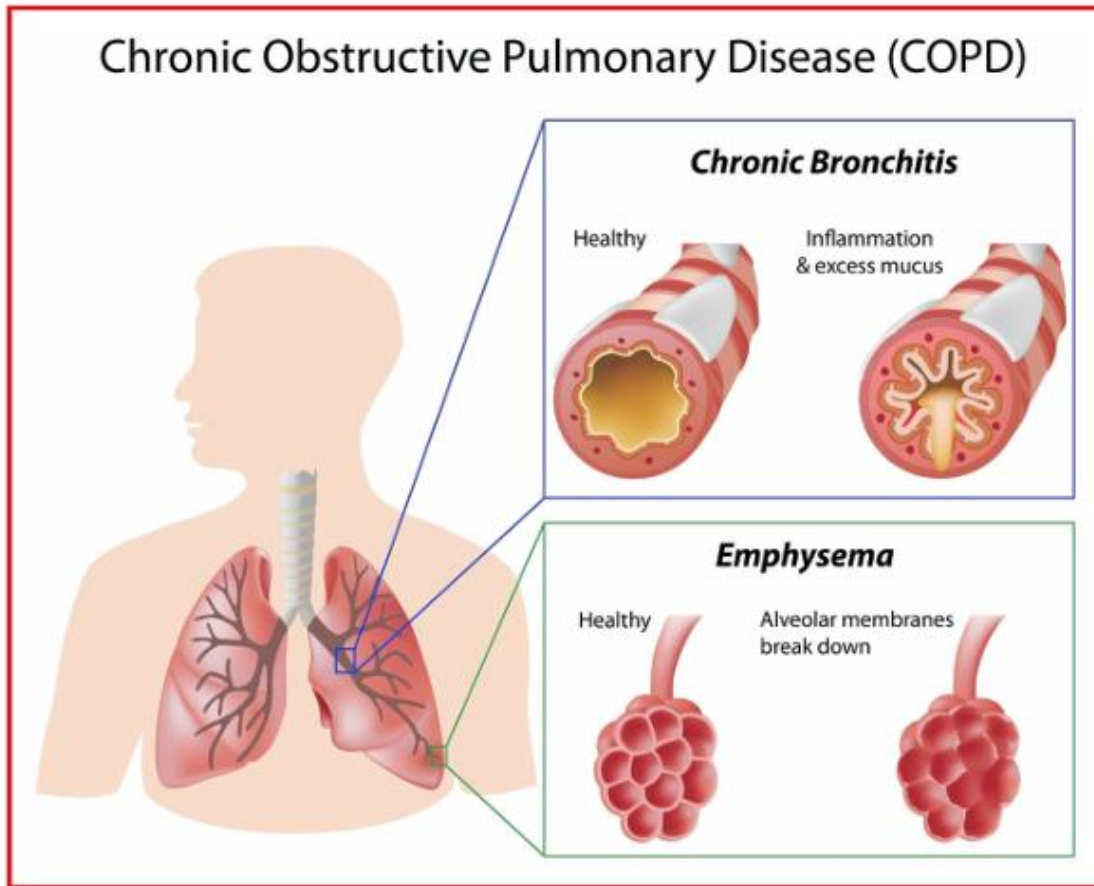
Mechanism: During inhalation, air enters the lungs and reaches the alveoli, where oxygen diffuses across the alveolar-capillary membrane into the blood, while carbon dioxide diffuses from the blood into the alveoli to be exhaled.

Diseases of Respiratory System

Respiratory diseases are disorders that affect the lungs, airways, and other structures involved in breathing, ranging from mild infections to life-threatening conditions.



Chronic obstructive pulmonary disease (COPD)



Chronic obstructive pulmonary disease (COPD) is a persistent lung disease that includes bronchitis, emphysema, or both. COPD occurs when there is persistent airflow obstruction through the bronchial tubes and lungs.

Pneumonia

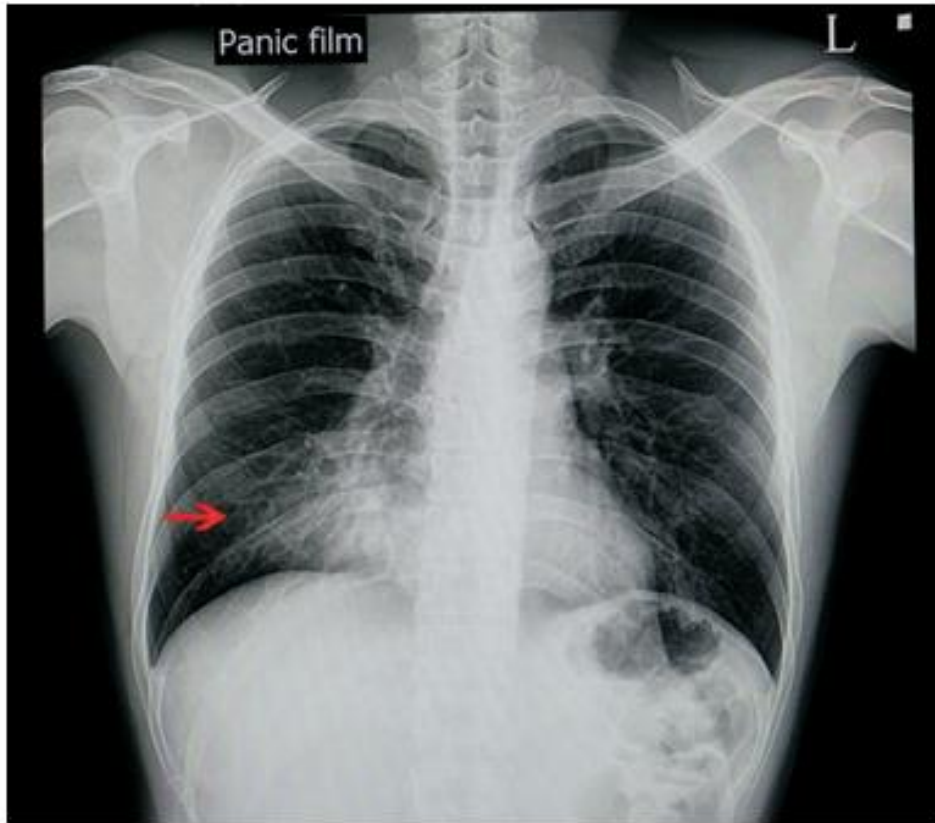


FIGURE 3. This chest x-ray belongs to a patient who has pneumonia on the right side. The location is marked with a red arrow. The pneumonia is in the right lower lobe of the lung.

Pneumonia is an acute infection or inflammation of the alveoli in one or both lungs caused by viruses or bacteria. The alveoli fill with pus or fluid and become solid and may collapse. The collapse is called atelectasis: commonly called a collapsed lung.

Asthma

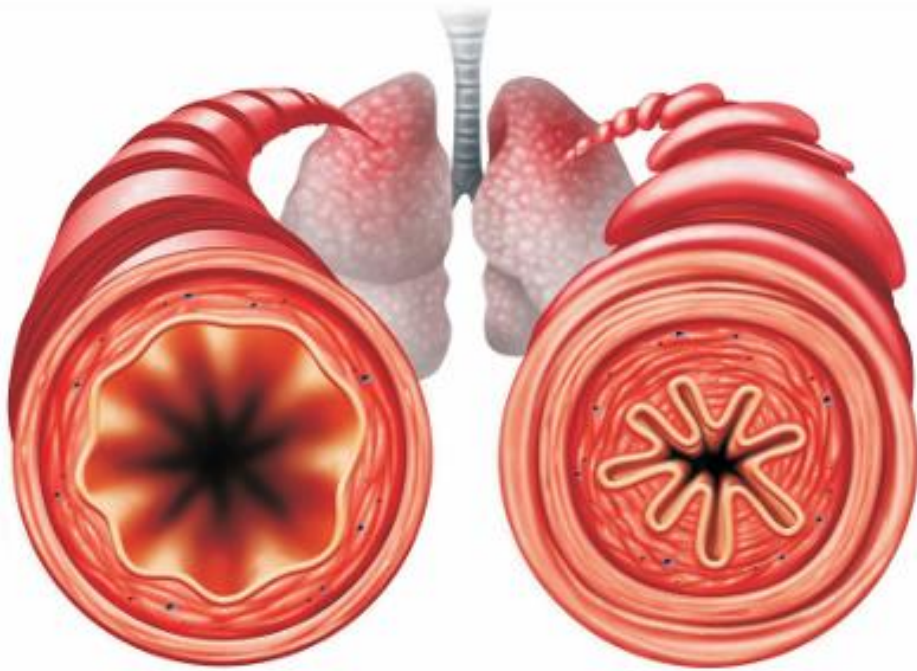


FIGURE 4. You see a healthy bronchial tube on the left and a constricted bronchial tube on the right that represents an asthma flare up.

Asthma is a chronic inflammation disease of the airways leading to the lungs. A person having an asthma attack has difficulty-moving air in and out of the lungs. The disease seems to run in families or be genetic and can begin at any age. With proper treatment, the person can live a healthy life. There is no cure for asthma however it can be treated.

Lung cancer

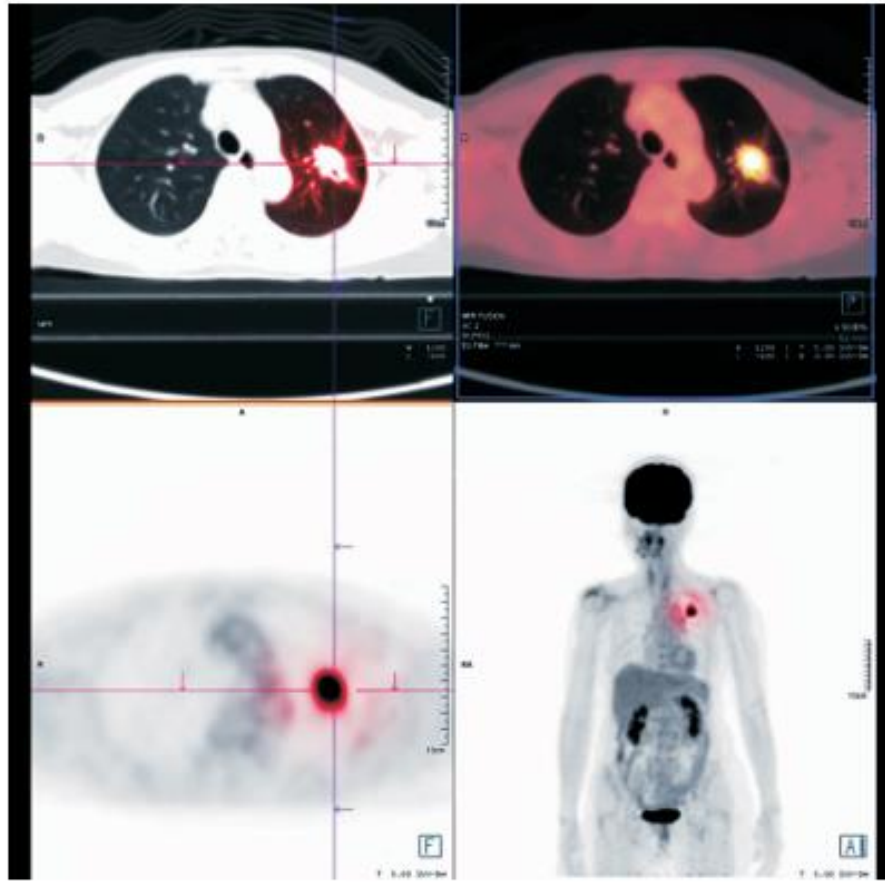


FIGURE 5. Lung cancer is a malignant disease that begins in the lungs. This PET scan film of lung cancer is from different body angles. The cancerous tumor absorbs the radiation and shows up brighter than the surrounding tissue.

Lung cancer is a malignant disease that begins in the lungs. A malignancy is a condition dangerous to health: a term often used interchangeably with the term ‘cancer.’

Upper respiratory infection (URI)

An **upper respiratory infection (URI)** is a disease of the nose, sinuses, larynx, or throat: the structures of the upper respiratory system. A URI is commonly called a cold. The common cold is a contagious viral infection of the upper respiratory tract transmitted by airborne droplets or by direct contact with infected secretions.

- **Rhinitis** is drainage through the nose (a runny nose). The drainage is normally clear and thin. A physician should be contacted if the drainage becomes thick or colored (green or yellow).
- **Sinusitis** is an inflammation of the facial sinuses. The symptoms may include fullness in the face and pain or tenderness below the eyes. A person could also experience increased nasal drainage and fever.
- **Laryngitis** is inflammation of the larynx that results in hoarseness or loss of voice and a sore throat.

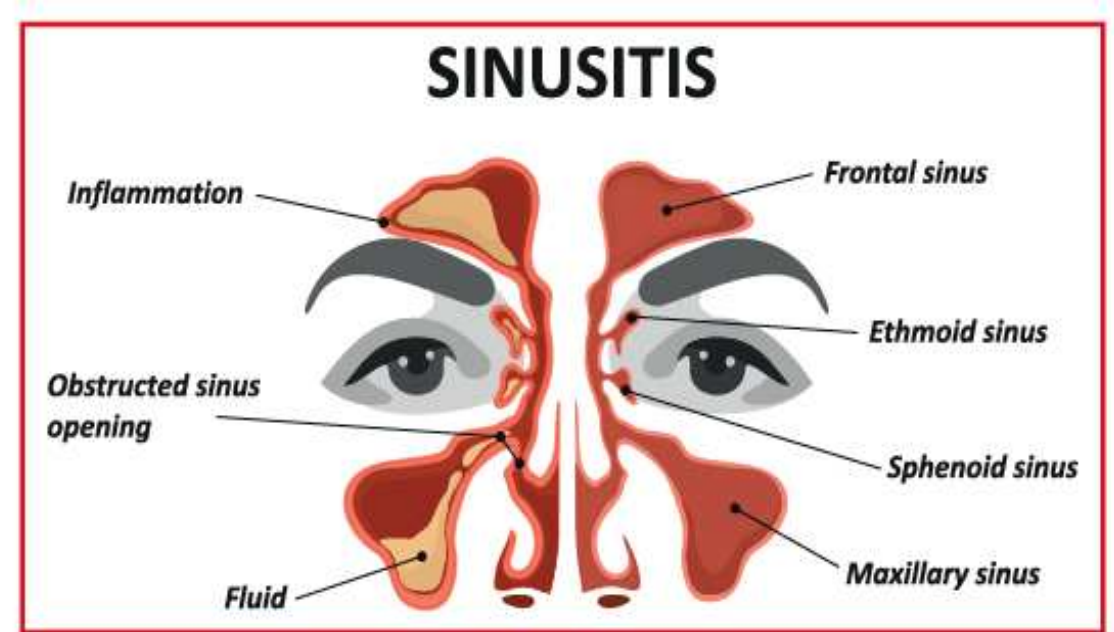
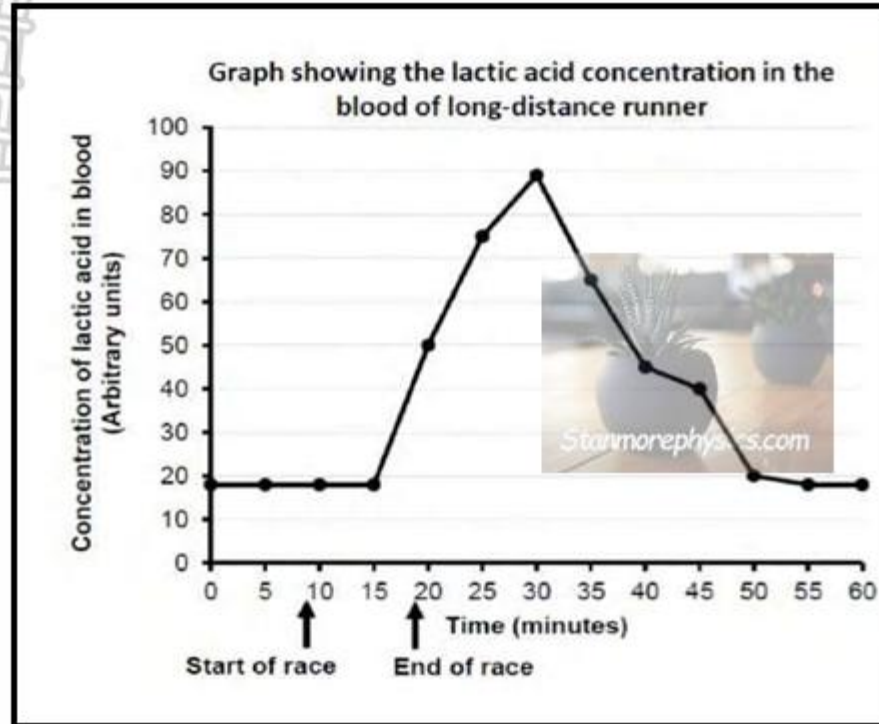


FIGURE 6. This image depicts healthy and inflamed sinuses.

Question

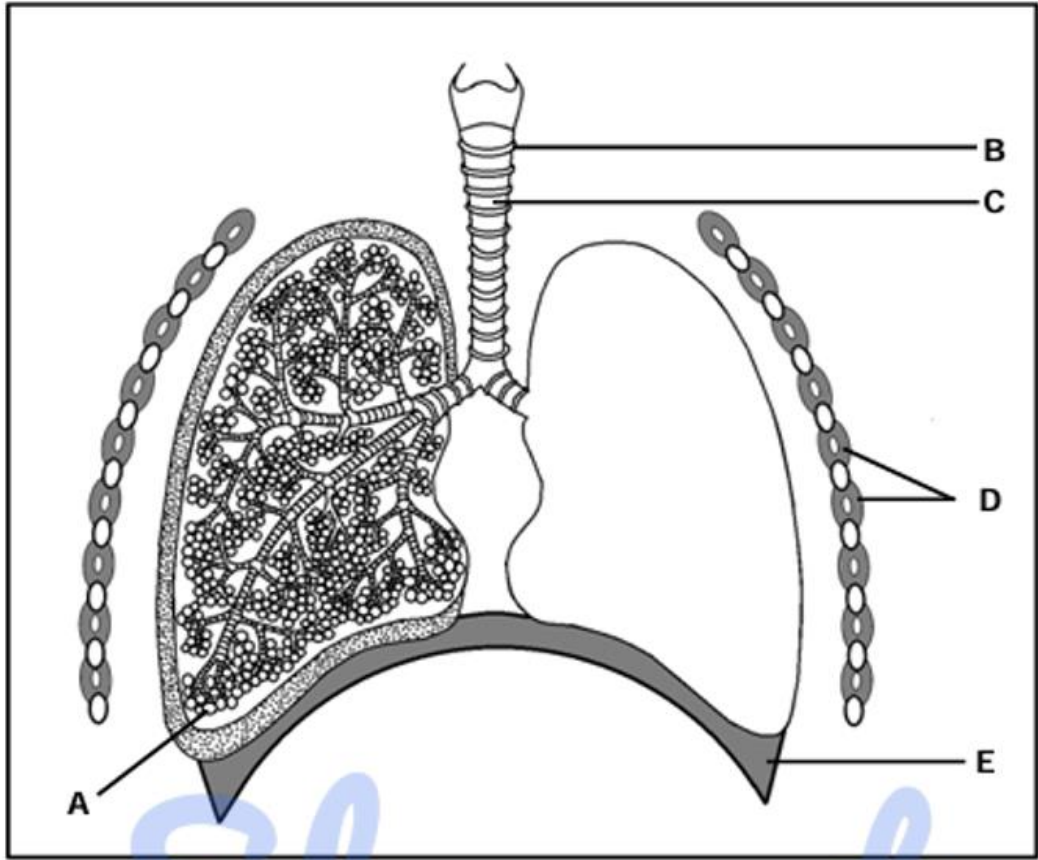
1.1.8 The graph below represents the lactic acid levels in the blood of a long-distance runner.



According to the graph, the acceptable level of lactic acid in the blood in arbitrary unit is ...

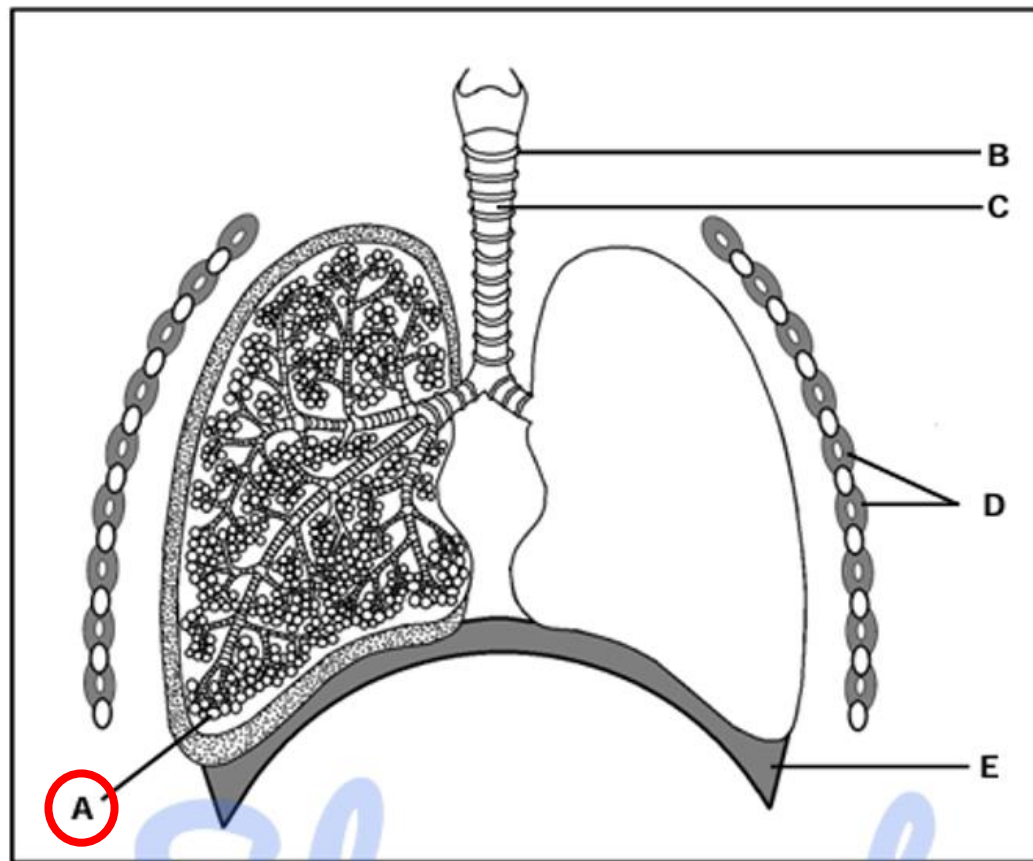
- ☒ A 18
- ☐ B 20
- ☐ C 50
- ☐ D 90

3.2 The diagram below represents the human lungs.



- 3.2.1 Identify parts: (1)
- (a) D **Intercostal muscles** (1)
- (b) E **Diaphragm** (1)
- 3.2.2 Name the epithelial tissue that lines the inside of part C. (1)
- Ciliated epithelial tissue.**
- 3.2.3 State the function of the part labelled B (1)
- Cartilage rings keep trachea open.**
- 3.2.4 Describe the process of inhalation. (5)
- **Diaphragm contracts and becomes flattened.**
 - **The length of the thoracic cavity is increased.**
 - **The external intercostal muscles contract and the rib cage is lifted.**
 - **This causes the thoracic cavity to be enlarged.**
 - **The total volume of the thoracic cavity increases and the pressure on the lungs decreases.**

3.2 The diagram below represents the human lungs.

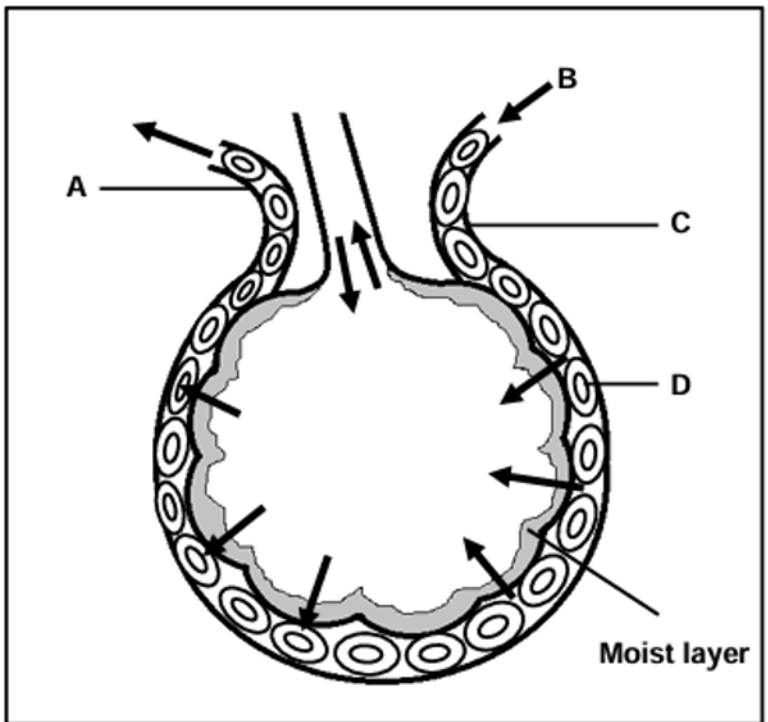


3.2.5 The corona virus, responsible for Covid-19, infects the lower respiratory passages. This causes the accumulation of fluids in the pulmonary tubes and in the parts labelled **A**. Furthermore, the tissues that line part **A** become scarred and thickened. This may lead to the death of a patient.

- (a) Name the part labelled **A** **Alveolus** (1)
- (b) Explain why the infection of lower respiratory pathways leads to possible death. (4)
- **The corona virus infection causes the squamous epithelium to become scarred and thickened.**
 - **This prevents gaseous exchange between the alveolus and surrounding blood capillaries.**
 - **The accumulation of fluids in the pulmonary tube (bronchiole) prevents air flow to the alveolus.**

QUESTION 3

3.1 The diagram below represents an alveolus.



- 3.1.1 Identify the gas which is at high concentration in blood vessel **B**. (1)
Carbon Dioxide
- 3.1.2 State TWO ways in which this gas in **B** is transported in the blood. (2)
Bicarbonate ions and blood plasma
- 3.1.3 Which large blood vessel receives blood from **A**? (1)
Pulmonary vein
- 3.1.4 Give an observable reason for your answer to QUESTION 3.1.3. (1)
The direction of arrow indicates the outward flow of blood
- 3.1.5 Explain TWO ways in which the blood cell labelled **D** is structurally suited for its function. (4)

- The red blood cells/ erythrocytes contain **haemoglobin** for the transportation of oxygen to the tissues and carbon dioxide from the tissues.
- Red blood cells/erythrocytes are **biconcave discs** to increase the surface area for the maximum absorption of oxygen.