CAIE Biology A-level

Topic 9: Gas Exchange and Smoking

Flashcards

How are mammals adapted for gas exchange?

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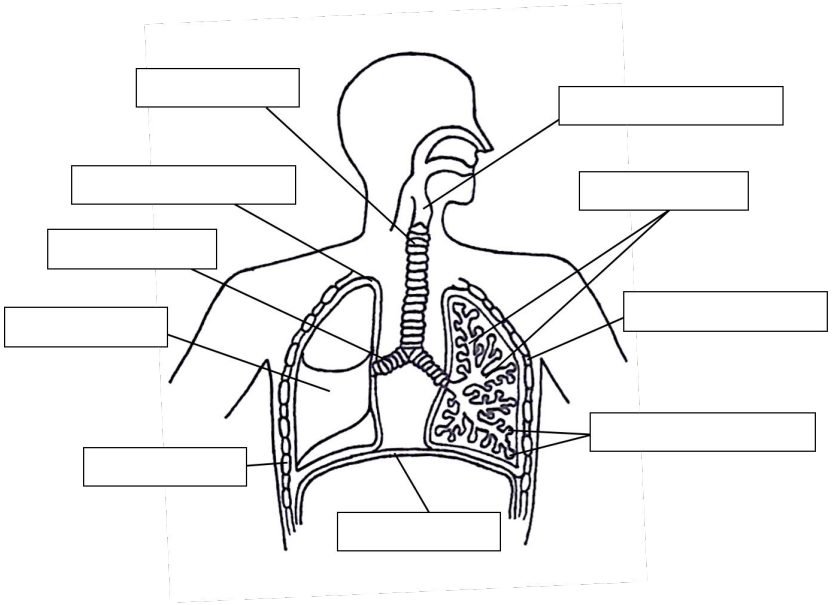
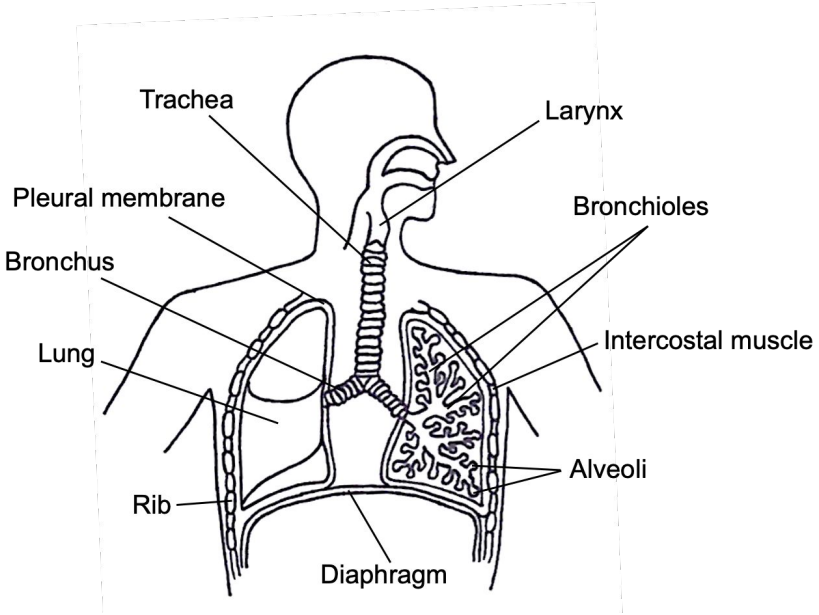
Alveoli provide a **large surface area** and **thin diffusion pathway**, maximising the volume of oxygen absorbed from one breath.

They also have a **good blood supply**, maintaining a **steep concentration gradient**.

Fill in the missing labels in the diagram of the human respiratory system below.



Fill in the missing labels in the diagram of the human respiratory system below.



Describe the structure of the trachea and its function in the mammalian gaseous exchange system.

Describe the structure of the trachea and its function in the mammalian gaseous exchange system.

- Wide tube supported by C-shaped cartilage to keep the air passage open during pressure changes
- Lined by ciliated epithelial cells which move mucus, (produced by goblet cells) up to the back of the throat to be swallowed, preventing lung infections
- Carries air to the bronchi

Describe the structure of the bronchi and their function in the mammalian gaseous exchange system.

Describe the structure of the bronchi and their function in the mammalian gaseous exchange system.

- Supported by rings of cartilage and lined by ciliated epithelial and goblet cells
- Narrower than the trachea
- Allow passage of air into the bronchioles

Describe the structure of the bronchioles and their function in the mammalian gaseous exchange system.

Describe the structure of the bronchioles and their function in the mammalian gaseous exchange system.

- Narrower than the bronchi
- No cartilage
- Contain elastic fibres and smooth muscle which allows constriction to restrict air flow (protective mechanism)
- Allow passage of air into the alveoli

What is the primary gaseous exchange surface in humans?

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Alveoli

Describe the structure of the alveoli and their function in the mammalian gaseous exchange system.

Describe the structure of the alveoli and their function in the mammalian gaseous exchange system.

- Tiny air sacs, lined with epithelial cells
- Site of gaseous exchange
- Walls one cell thick
- Good blood supply to maintain steep concentration gradient
- 300 million in each lung

Describe the exchange of gases between the alveoli and capillary network.

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Oxygen rich air fills alveoli during inspiration. O_2 concentration greater in alveoli than blood (steep concentration gradient maintained by blood movement). O_2 diffuses across alveolar and capillary wall into blood down its concentration gradient. CO_2 diffuses out of blood into alveoli (CO_2 concentration in alveoli lower than in circulated blood).

What makes smoking harmful?

What makes smoking harmful?

- Contains chemical pollutants
- Tar, nicotine, carbon monoxide exert short-term effects such as irritation/allergic reactions and increase the risk of chronic disease (e.g. lung cancer, COPD)

How do tar, carbon monoxide, nicotine and smoke cause damage to the body?

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- **Tar** - may become deposited on epithelium lining causing inflammation, mucus production and paralysis of the cilia
- **Carbon monoxide** - binds preferentially to haemoglobin, reducing the oxygen-carrying capacity of the blood
- **Nicotine** - causes arterioles to constrict and increases the risk of cardiovascular disease by raising blood pressure
- **Smoke** - damages the cilia, unable to beat, results in a build-up of dirty mucus

How can tobacco smoke cause lung cancer?

How can tobacco smoke cause lung cancer?

- **Carcinogens** present in tobacco smoke, e.g. benzopyrene inactivates p53 gene (tumour suppressor gene)
- Carcinogens present in tar lining the lung surface can enter the nucleus of epithelial cells and affect the genetic material, causing **mutations** and leading to the formation of **cancerous tumours**

Define COPD.

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- **Chronic obstructive pulmonary disease (COPD)**
- Refers to a group of lung conditions which cause breathing difficulties, including emphysema and chronic bronchitis

How can tobacco smoke lead to the development of chronic bronchitis?

How can tobacco smoke lead to the development of chronic bronchitis?

1. Tar deposited in airways:
    - Causes inflammation
    - Stimulates mucus production by goblet cells
    - Paralyses cilia on ciliated epithelial cells
2. Cilia cannot move mucus up the airways
3. Mucus containing dirt and bacteria builds resulting in infections
4. Mucus reduces diameter of bronchi and bronchioles
5. Mucus accumulates in alveoli, increasing diffusion distance for O_2/CO_2

How can tobacco smoke lead to the development of emphysema?

How can tobacco smoke lead to the development of emphysema?

1. WBCs attracted to sites of infection in the alveoli.
2. Produce elastase which digests lung tissue, enabling WBCs to reach site of infections.
3. Elastase breaks down elastin in alveoli walls (A1AT inhibitor which usually prevents this damage is deactivated in smokers).
4. Elastic tissue damaged. Alveoli become enlarged, damaged and burst, reducing SA for gas exchange.
5. Normal elastic recoil of alveoli lost, air hard to remove, stale air remains.