AS Biology Unit 1

Lungs & Lung Disease
Structure and functions of the human lung

Label the diagram using the following labels and use the following space to write a short description of the functions of each structure you have labeled.

Trachea
Incomplete rings of cartilage
Rib
Internal intercostal muscle
Pleural fluid
Diaphragm
Bronchus
Bronchiole
External intercostal muscle
Pleural membranes
Position of the heart
The structure and function of alveoli

O₂ dissolves in surface film of water

O₂, CO₂

ciliated epithelial cells lining bronchioles

section of lung capillary

red blood cell

Diffusion follows concentration gradient

Diffusion distance = approx 2.5μm
Describe the functions of the following structures

- Goblet cells
- Ciliated cells
- Macrophages
- Squamous cells
- Hemoglobin in red blood cells
- Lining layer of moisture

**Microscopic view of bronchiole and alveoli**

*Identify and label: ciliated epithelium, alveoli, elastic tissue, smooth muscle*
Breathing movements - ventilation

Breathing movements (inspiration and expiration) ventilate the gas exchange surface, maintaining the highest possible diffusion gradient.

Look at the diagram on the next page and outline the sequence of events as you complete one breath using the following words:

Inspiration, Diaphragm, External intercostal muscles, Volume of thoracic cavity, Pressure in thoracic cavity, Lung volume, Elastic recoil,Expiration

Forced expiration =
Smoking and health

Tobacco smoke contains TAR * CARBON MONOXIDE * NICOTINE

TAR

Physiological effects of tar

- Increases diffusion distance
  At alveolar surface

- Causes smooth muscle in
  artery walls to contract
  narrowing lumen

- Paralyses / destroys ciliated
  Epithelium lining airways

- Enlarges goblet cells.
  Overproduction of mucus,
  blocking airways

- Contains carcinogens which
  Mutate DNA and stimulate
  Uncontrolled mitosis.

Lung diseases caused by tar

With the increased risk of pathogen entry, phagocytic cells are attracted to sites of infection. They release enzymes in order to break through the endothelial lining cells and attack the pathogen. One of these enzymes is elastase. This destroys elasticity of alveoli preventing elastic recoil and causing breakage and scar tissue formation.

First signs of this are chronic bronchitis, inflammation of lining of airways with frequent following infections.

Pulmonary fibrosis follows as scar tissue forms and oxygen diffusion is impaired

Loss of elasticity leads to emphysema. Burst alveoli, accumulations of fatty tissue make for very restricted breathing. Generally fatal.
Chronic Obstructive Pulmonary Disease (COPD) is a combination of the above with asthma

**Asthma**

Localized allergic reaction caused by an allergen e.g pollen, fur. Histamine is released and the epithelial cells become inflamed. A lot of mucus is produced. Fluid leaves the capillaries and enters the airways. The smooth muscle contacts and constricts the airway.

**NICOTINE**

Nicotine is the reason for smoking – it is the addictive active drug in tobacco. *Tobacco plants produce this alkaloid drug in order to protect themselves from insects!*

<table>
<thead>
<tr>
<th>Physiological effects of Nicotine</th>
<th>Health effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>It mimics a transmitter substance</td>
<td></td>
</tr>
<tr>
<td>Increasing rate of nervous</td>
<td></td>
</tr>
<tr>
<td>Conduction. It is a stimulant.</td>
<td></td>
</tr>
<tr>
<td>Release of adrenaline. This</td>
<td></td>
</tr>
<tr>
<td>Stimulates increase of heart</td>
<td></td>
</tr>
<tr>
<td>Rate and blood pressure.</td>
<td></td>
</tr>
<tr>
<td>Constriction of arterioles</td>
<td></td>
</tr>
<tr>
<td>Supplying body extremities</td>
<td></td>
</tr>
<tr>
<td>Makes platelets more sticky</td>
<td></td>
</tr>
<tr>
<td>Decreasing clotting time.</td>
<td></td>
</tr>
</tbody>
</table>

**CARBON MONOXIDE (CO)**

<table>
<thead>
<tr>
<th>Physiological effects of CO</th>
<th>Health effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO combines more readily than O2</td>
<td></td>
</tr>
<tr>
<td>With hemoglobin to form</td>
<td></td>
</tr>
<tr>
<td><em>Carboxyhemoglobin</em></td>
<td></td>
</tr>
<tr>
<td>Damage to endothelial lining of</td>
<td></td>
</tr>
<tr>
<td>Arteries</td>
<td></td>
</tr>
</tbody>
</table>
Evidence linking smoking to disease.

**EPIDEMIOLOGY** = the comparison of data on disease

Epidemiology analyses correlation between a particular disease and factors such as nationality, ethnicity, sex, age, lifestyle, pollution building up a series of interconnected data which can be used to form hypotheses about causative factors.

The epidemiological evidence on smoking

**General**

- Regular smokers are three times more likely to die prematurely than non-smokers.
- 50% of regular smokers are likely to die of a smoking-related disease.
- The more cigarettes smoked, the greater the risk.

**Lung cancer**

- 25% of smokers die from lung cancer.
- Smokers are 18 times more likely to die from lung cancer than non-smokers.
- Heavy smokers (25+ per day) are 25 times more likely to die of lung cancer than non-smokers.

**Lung disease**

- COPD is rare in non-smokers.
- 98% of people with emphysema are smokers.
- 20% of smokers have emphysema.

**CHD**

- There are too many contributory risk factors with CHD (diet, lifestyle, genetics etc. etc. for the effects of smoking to be identified and measured separately but the information makes smoking the single most important contributory factor.
Questions on data and disease

1. Lung cancer, chronic bronchitis and coronary heart disease (CHD) are associated with smoking. Tables 1 and 2 give the total number of deaths from these diseases in the UK in 1974.

### Table 1 Men

<table>
<thead>
<tr>
<th>Age / years</th>
<th>Number of deaths (in thousands)</th>
<th>Lung cancer</th>
<th>Chronic bronchitis</th>
<th>Coronary heart disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-64</td>
<td>11.5</td>
<td>4.2</td>
<td>31.7</td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>12.6</td>
<td>8.5</td>
<td>33.3</td>
<td></td>
</tr>
<tr>
<td>75+</td>
<td>5.8</td>
<td>8.1</td>
<td>29.1</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>29.9</td>
<td>20.8</td>
<td>94.1</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2 Women

<table>
<thead>
<tr>
<th>Age / years</th>
<th>Number of deaths (in thousands)</th>
<th>Lung cancer</th>
<th>Chronic bronchitis</th>
<th>Coronary heart disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-64</td>
<td>3.2</td>
<td>1.3</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>2.6</td>
<td>1.9</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>75+</td>
<td>1.8</td>
<td>3.5</td>
<td>42.3</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>7.6</td>
<td>6.7</td>
<td>68.9</td>
<td></td>
</tr>
</tbody>
</table>

a) (i) Using an example from the tables, explain why it is useful to give data for men and women separately (2 marks)

(ii) Data like these are often given as percentages of people dying from each cause. Explain the advantage of giving these data as percentages. (2 marks)

b) Give two factors, other than smoking, which increase the risk of CHD (2 marks)

c) Comment on two differences between the data for men and women which you consider to be significant suggesting causes and explaining your reasons. (4 marks)
Pulmonary Tuberculosis (TB)

Tuberculosis (TB) is a contagious disease caused by the bacterium *Mycobacterium tuberculosis* (MTB).

Like the common cold, it is spread through the air when infectious people cough, sneeze, talk, or spit.

Infectivity of MTB is high when MTB droplets are propelled into the air. A person only needs to inhale a small number of the bacteria to be infected.

Left untreated, each person with active TB will infect between 10 and 15 people.

Effects:

- Bacteria multiply in the upper regions of the respiratory system where oxygen supplies are good
- The immune response causes inflammation and cold symptoms. This is the primary infection. It occurs in children and is easy to control
- After adult years, the bacteria may re-emerge causing a secondary infection called post-primary TB.
- This is more serious and causes damage and scar tissue
- Without treatment it may spread to other parts of the body.