

## 6.4 Gas Exchange

### Ventilation

*Distinguish between ventilation, gas exchange and cell respiration*

Ventilation: The exchange of air between atmosphere and lungs - achieved by the physical act of breathing

Gas Exchange: The exchange of oxygen and carbon dioxide between alveoli and bloodstream (via diffusion)

Cell Respiration: The release of energy (ATP) from organic molecules

It is enhanced by the presence of oxygen (aerobic respiration)

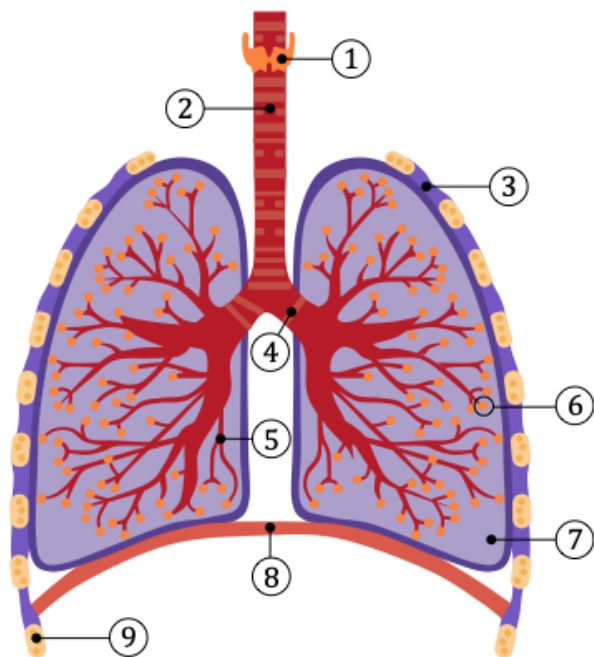
*Explain why a ventilation system is needed to maintain a concentration gradient within the alveoli*

Because gas exchange is a passive process, a ventilation system is needed to maintain a concentration gradient

The lungs continually cycling fresh air into the alveoli from the atmosphere

The lungs also have a very large surface area, so as to increase the overall rate of gas exchange

*Label a diagram of the human lung*



1. Larynx

2. Trachea

3. Intercostal muscles

4. Bronchus

5. Bronchiole

6. Alveolus

7. Lung

8. Diaphragm

9. Rib

*State the purpose of the alveoli*

Alveoli are the small air-filled sacs within lungs that greatly increase surface area and are responsible for

GAS EXCHANGE

Compare type I and type II pneumocytes

Type I Pneumocyte	Type II Pneumocyte
Mediate gas exchange with capillaries	Secrete pulmonary surfactant
Are long and thin (↓ diffusion distance)	Reduces surface tension within alveoli
Comprise most of the alveolar surface	(easier to inflate alveoli, prevents collapsing)

Outline the function of pulmonary surfactant

Type II pneumocytes secrete pulmonary surfactant which reduces the surface tension in alveoli

As alveoli expand with gas intake, the surfactant becomes more spread out across the moist alveolar lining

This increases surface tension and slows the rate of expansion, ensuring all alveoli inflate at the same rate

Explain how Boyle's Law relates to the mechanism of breathing

Boyle's Law: Pressure is inversely proportional to volume (i.e. more volume = less pressure)

Breathing utilises antagonistic sets of respiratory muscles in order to facilitate the passage of air

The muscles change lung volume in order to create a negative pressure vacuum

When pressure in the lung is less than atmospheric pressure, air flows in to equalise (and vice versa)

Explain, with the aid of the diagram, the actions of respiratory muscles in the mechanism of breathing

**INHALATION:** Diaphragm & external intercostal

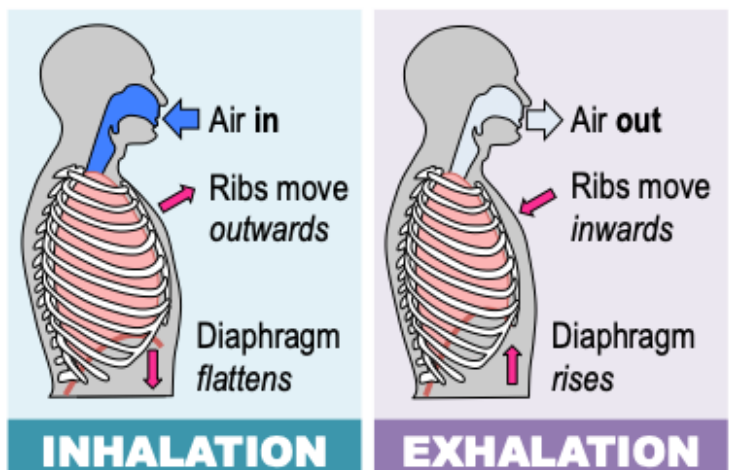
muscles contract, increasing volume of thorax

Pressure in the lungs is decreased, so air flows in

**EXHALATION:** Diaphragm relaxes and internal

intercostals contract, decreasing thoracic volume

Pressure in the lungs is increased, so air flows out



## Lung Activity

*Explain how ventilation rates change with exercise*

Cellular respiration produces carbon dioxide as a waste product

Rising levels of carbon dioxide in the bloodstream alters the blood pH (↓)

This triggers an increase in ventilation rate

*Define spirometry*

Spirometry measures the speed (flow) or amount (volume) of inhalation or exhalation

This data can be recorded with a spirometer

*Outline the causes and consequences of lung cancer*

Causes:

Cancer is the uncontrolled proliferation of cells, leading to abnormal growth (tumors)

Factors that can contribute to the development of lung cancer include genetics, age, some diseases, smoking, asbestos, radiation

Consequences:

Lungs are vital to normal body function and thus the abrogation of their function is detrimental to health

Abnormal growth can impact normal tissue function, with symptoms varying according to size and location

Lungs possess a rich blood supply, increasing the likelihood of the cancer spreading (metastasis)

*Outline the causes and consequences of emphysema*

Causes:

Emphysema is the abnormal enlargement of alveoli (forms huge air spaces - 'bullae')

Emphysema is often caused by smoking, as chemicals in cigarettes damage alveoli

The recruited phagocytes release elastase and the elastase destroys fibres in alveolar walls

Consequences:

Common symptoms of emphysema include shortness of breath, phlegm production, expansion of the ribcage, cyanosis and an increased susceptibility to chest infections