

Respiratory and circulatory systems



UNTAMED
EDUCATION

1.2 Anatomy and physiology

Respiratory System

Gaseous Exchange

Heart

Oxyhaemoglobin

Inspiration

The structure and functions of the cardio-vascular system

Spirometer

Expiration

Stroke Volume

Blood Vessels

Cardiac Output



Respiratory and circulatory systems

1. Respiratory system

Mouth/Nose - has three functions.

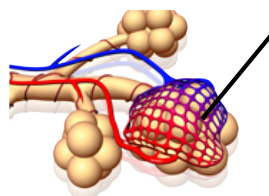
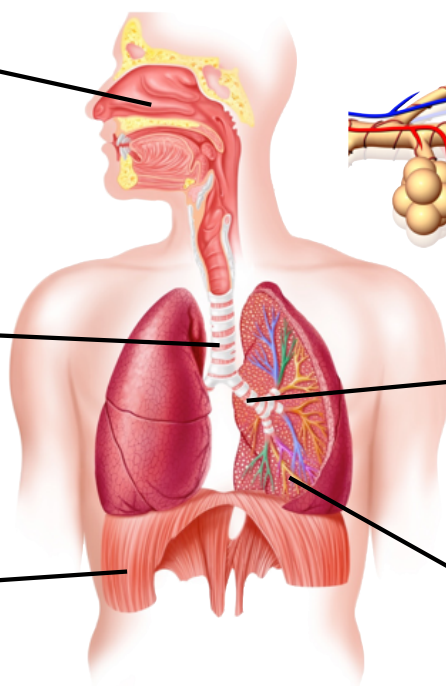
- **Warms** the air to internal temperatures.
- **Cilia** hairs filter the air and remove small particles.
- **Moistens** the air so it can be absorbed more easily.

Trachea

- **Cartilage rings** keeps the windpipe open.

Diaphragm

- A sheet of **muscle** below the lungs.
- **Flattens** to move air into the lungs.
- **Relaxes** into a dome shape to expire air.



Bronchi

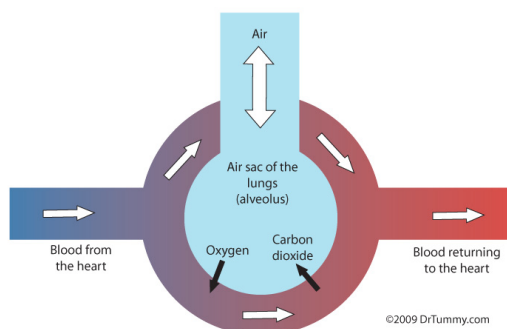
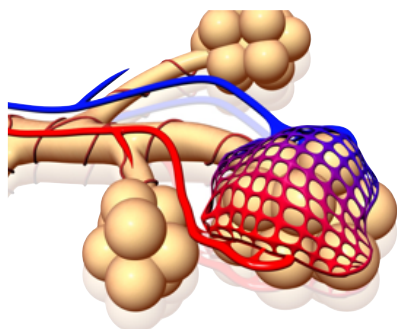
- Two tubes branch from the trachea into the left and right lung.

Bronchioles

- Sub-divisions of the bronchi.

2. Gaseous exchange

1. **Oxygen** breathed in travels **to the alveoli** which are surrounded by **capillaries**. Gases pass through the **capillary walls**.
2. Oxygen combines with haemoglobin to form **oxyhaemoglobin** and is carried around the body.
3. At the same time **carbon dioxide** is **released** by haemoglobin into the alveoli to be breathed out.





Respiratory and circulatory systems

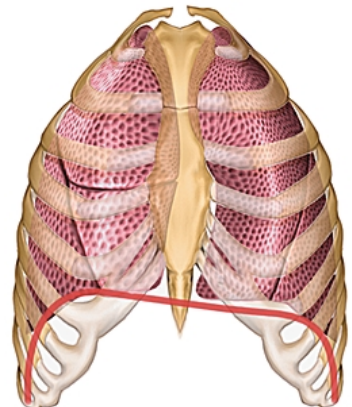
Gaseous exchange (diffusion) occurs efficiently for the following reasons:

- ▶ **Large surface area** of alveoli and lots of capillaries allows for a large amount of oxygen and carbon dioxide to diffuse between the lungs and the blood vessels.
- ▶ The alveoli have **thin walls** that are one cell thick. This reduces the distance of diffusion.
- ▶ The alveoli provide **moisture** as gases must first dissolve in liquid before they can diffuse.
- ▶ The circulatory system provides a **large blood supply**. This maintains a **concentration gradient** as gases need to move from a high concentration to a low concentration.

3. Inspiration and expiration

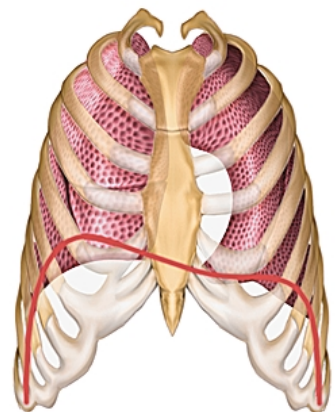
Inspiration (breathing in)

- ▶ The **diaphragm contracts** and **flattens**.
- ▶ The **intercostal muscles contract**.
- ▶ The **ribs** move **upwards** and **outwards**.
- ▶ Air **pressure inside** the lung cavity **decreases**.
- ▶ **Air** from the atmosphere **moves into** the **lungs**.



Expiration (breathing out)

- ▶ The **diaphragm relaxes** into a dome shape.
- ▶ The **intercostal muscles relax**.
- ▶ The **ribs** move **downwards** and **inwards**.
- ▶ Air **pressure inside** the lung cavity **increases**.
- ▶ Air **moves** from inside the lungs **to** the **atmosphere**.

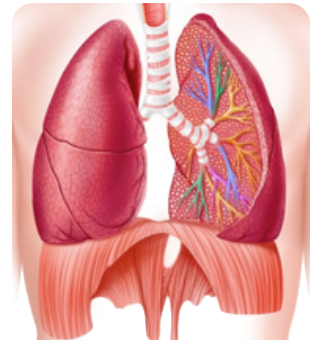




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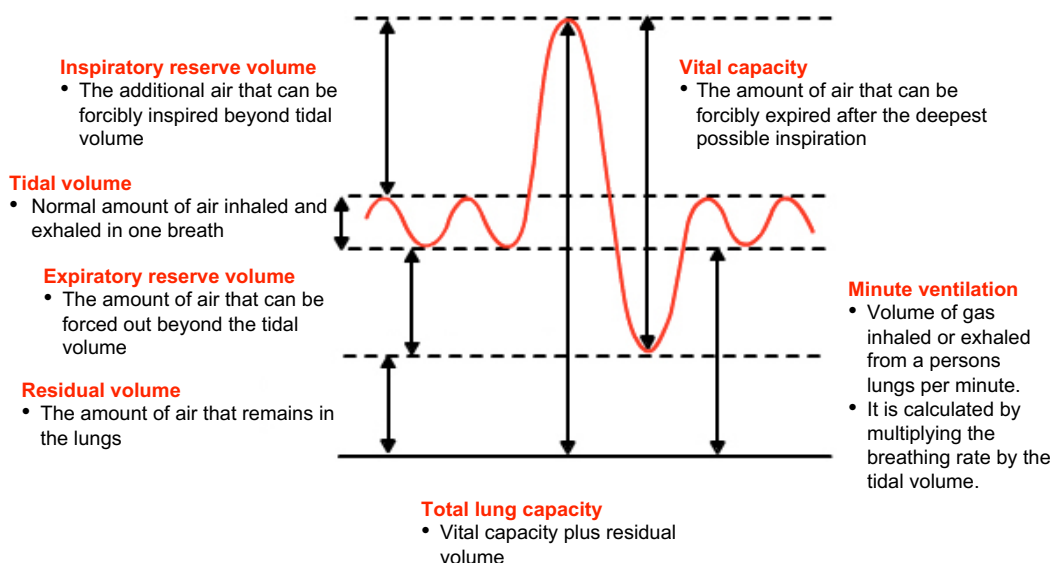
4. Respiratory changes

- ▶ Breathing rate increases.
- ▶ Depth of breathing increases due to the use of pectorals and sternocleidomastoid.
- ▶ When expiring the abdominals are used to force the air out more quickly.
- ▶ Increased gaseous exchange of oxygen and carbon dioxide at the lungs.



5. Spirometer

A spirometer measures air capacity of the lungs



6. Effects of exercise

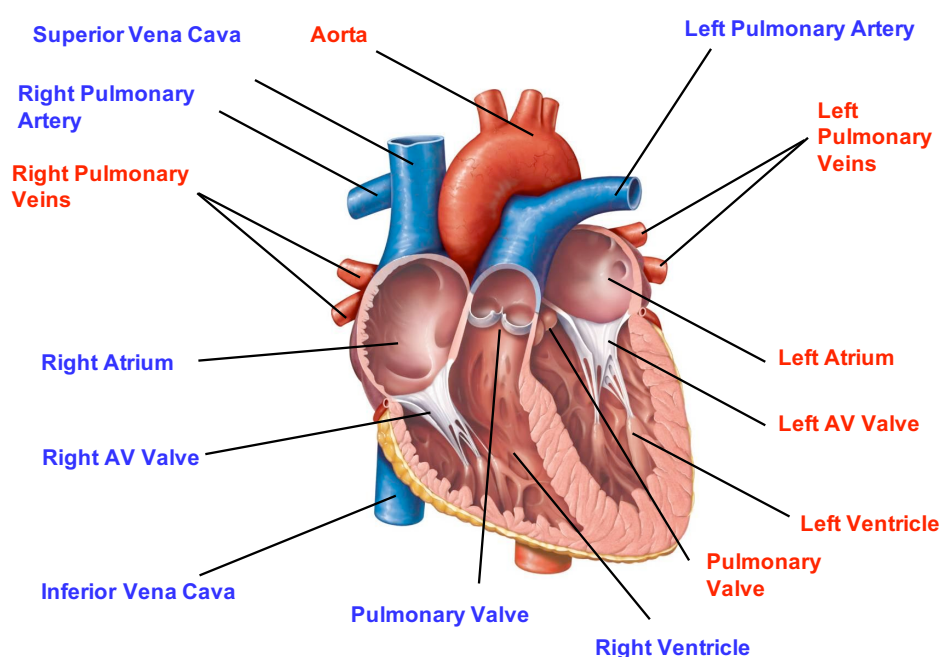
- ▶ Breathing rate **increases**.
- ▶ Tidal volume **increases**.
- ▶ Minute volume **increases**.
- ▶ Expiratory reserve volume **decreases**.
- ▶ Inspiratory reserve volume **decreases**.



Respiratory and circulatory systems

- ▶ **Residual volume does not change.**
- ▶ **Vital capacity does not change.**
- ▶ **Total lung volume does not change.**
- ▶ **Long term** effects include an increased **vital capacity and minute ventilation.**

7. The heart



3. LEFT AND RIGHT PULMONARY ARTERY

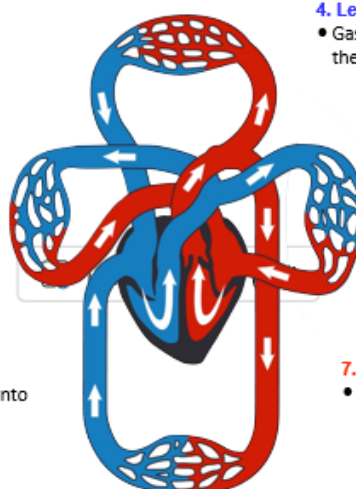
- These arteries transport deoxygenated blood to the lungs.

2. Right ventricle

- Blood is pumped into the right ventricle.
- Right ventricle contracts and pumps the blood to the lungs.

1. Right atrium

- Deoxygenated blood flows into the RA through the **VENA CAVA.**



4. Left and right lungs

- Gaseous exchange occurs at the left and right lungs.

5. PULMONARY VEIN

- Transports oxygenated blood to the left atrium.

6. Left atrium

- Receives oxygenated blood and pumps it into the left ventricle.

7. Left ventricle

- The heart contracts and the left ventricle pumps oxygenated blood to the body's organs and tissues via the **AORTA.**

8. Organs and tissues

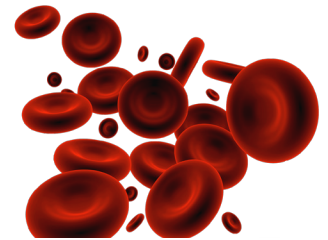
- Gaseous exchange occurs at the organs and tissues.



8. Components of blood

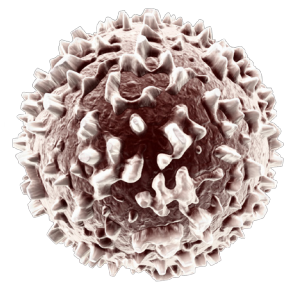
a. Red Blood Cells (RBC)

- ▶ RBC's main function is to **carry oxygen** to the working muscles.
- ▶ **Haemoglobin**, found in RBCs, is the **oxygen carrying protein**.
- ▶ **Altitude training** can **increase** the number of **RBCs**.
- ▶ The **more RBCs** the **more oxygen** can be **delivered** to the working **muscles**.
- ▶ The more RBCs the **longer the performer can participate**.



b. White Blood Cells (WBC)

- ▶ WBCs are our **defence** against **infection and disease**.
- ▶ They **fight infections** and reduce illness.
- ▶ This **aids recovery** and allows the participant to **continue training and performing**.



c. Platelets

- ▶ The role of platelets is to **clot our blood** when it comes into contact with air.
- ▶ If we sustain a cut, platelets will clot the blood to form a **scab**.
- ▶ Cuts and grazes can happen frequently in contact sport so platelets **prevent heavy blood loss** and **aid recovery**.



d. Plasma

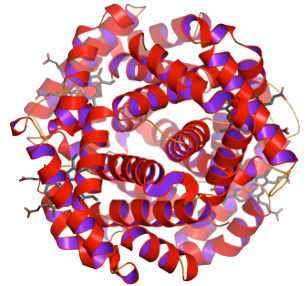
- ▶ Plasma is the **blood transport system**.
- ▶ It carries vital nutrients (**glucose**, **vitamins**, **minerals**, etc.) and hormones such as **adrenalin**, which is important in readying a performer to participate.
- ▶ It **removes waste products** such as **carbon dioxide** and **lactic acid**.
- ▶ Plasma **regulates the body's temperature** by balancing our water content.
- ▶ It also maintains the **correct chemical balance**.





Respiratory and circulatory systems

- e. **Haemoglobin** is a protein found in red blood cells.
- ▶ It has a number of functions:
 - ▶ Carries **oxygen** to muscle cells.
 - ▶ **Transports carbon dioxide** from cells to lungs.
 - ▶ Regulates **blood pressure** by combining with nitric oxide.
 - ▶ Helps **regulate** blood flow.
 - ▶ Regulates **iron** levels.



9. Blood vessels

Arteries

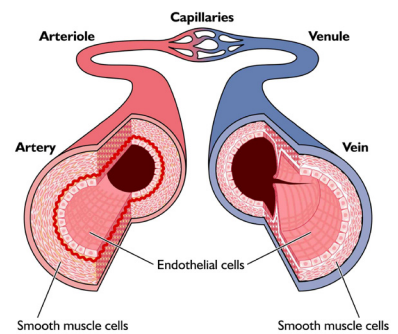
- ▶ Carry oxygenated blood **away** from the **heart**.
- ▶ Thick walls withstand **high blood pressure**.

Capillaries

- ▶ These are the **smallest blood vessels** with walls that are only one cell thick.
- ▶ They are very **efficient at gaseous exchange** at the lungs and muscles.

Veins

- ▶ Carry deoxygenated blood **to** the **heart**.
- ▶ They have a **larger diameter**.
- ▶ They work under **low pressure** so have **valves** to prevent the back flow of blood.



10. Cardio-vascular measurements

Heart Rate

- ▶ This is the amount of times your heart **beats per minute**.
- ▶ A **low resting heart rate** indicates an **efficient heart** and circulatory system. Delivering more oxygen per minute.



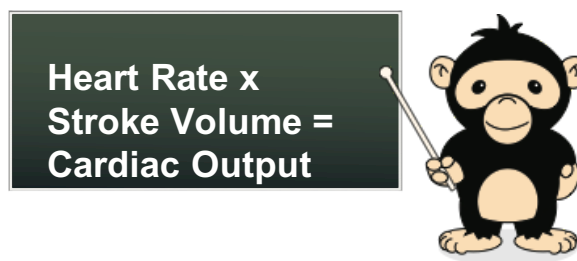
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Stroke Volume

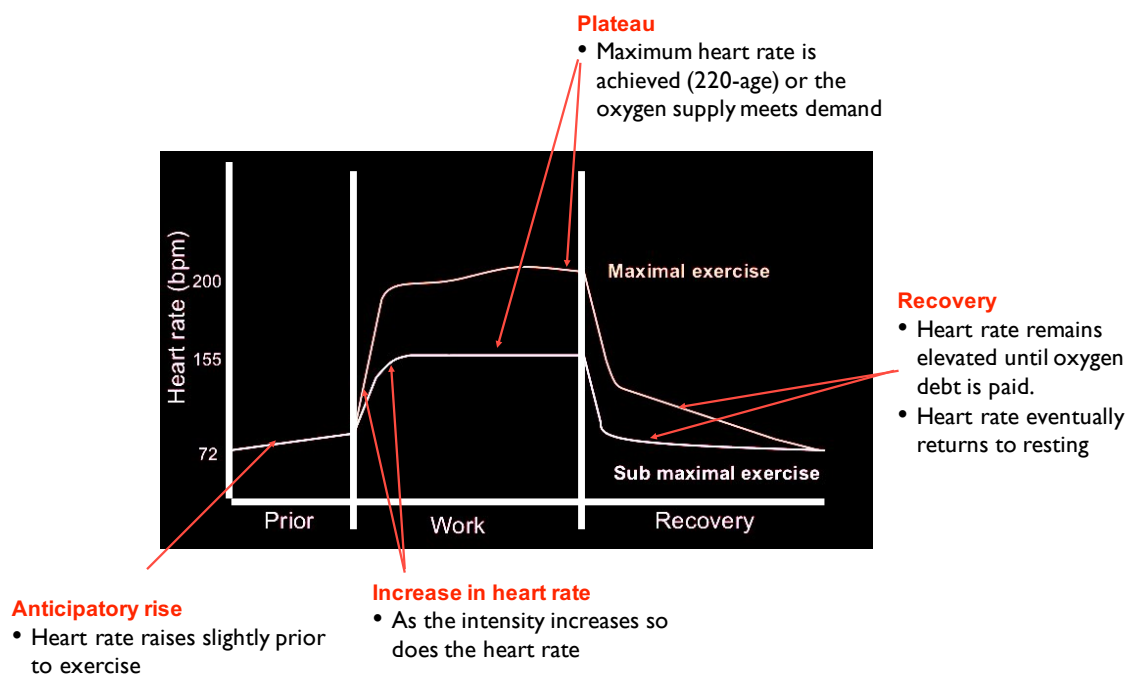
- ▶ This is the **volume of blood** the **left ventricle of your heart pumps** in **one beat**.
- ▶ An **improved stroke volume** increases gaseous exchange, delivering **more oxygen** and **removing more waste products**.

Cardiac Output (Q)

- ▶ This is the **volume of blood pumped** from the left ventricle **in 1 minute**.



11. Heart rate graph





12. Long-term effects of exercise on the heart

- ▶ The heart grows larger and more muscular so it can hold more blood. This is called **hypertrophy**.
- ▶ Resting **heart rate decreases**.
- ▶ **Stroke volume increases**.
- ▶ **Cardiac output increases**.
- ▶ **Decreased recovery time**.

