Breathing & Respiration

- RESPIRATION
- TYPES OF RESPIRATION: AEROBIC & ANAEROBIC
- STRUCTURE & FUNCTIONS OF THE RESPIRATORY SYSTEM
- BREATHING: INHALATION AND EXHALATION
- GAS EXCHANGE IN THE LUNGS

What is Respiration?

- **Respiration** is a chemical reaction that happens in all living cells, including plant cells and animal cells. It is the way that energy is released from glucose so that all the other chemical processes needed for life can happen.

- **Aerobic respiration:** Glucose and oxygen react together in cells to produce carbon dioxide and water and releases energy. The reaction is called **aerobic respiration** because oxygen from the air is needed.
- **glucose + oxygen → carbon dioxide + water**
- Energy is released in the reaction.
  The **mitochondria**, found in the cell cytoplasm, are where most respiration happens.

- **Anaerobic respiration:** During hard exercise, not enough oxygen can reach your muscle cells. So, aerobic respiration is replaced with **anaerobic respiration**. This does not need oxygen for it to happen.

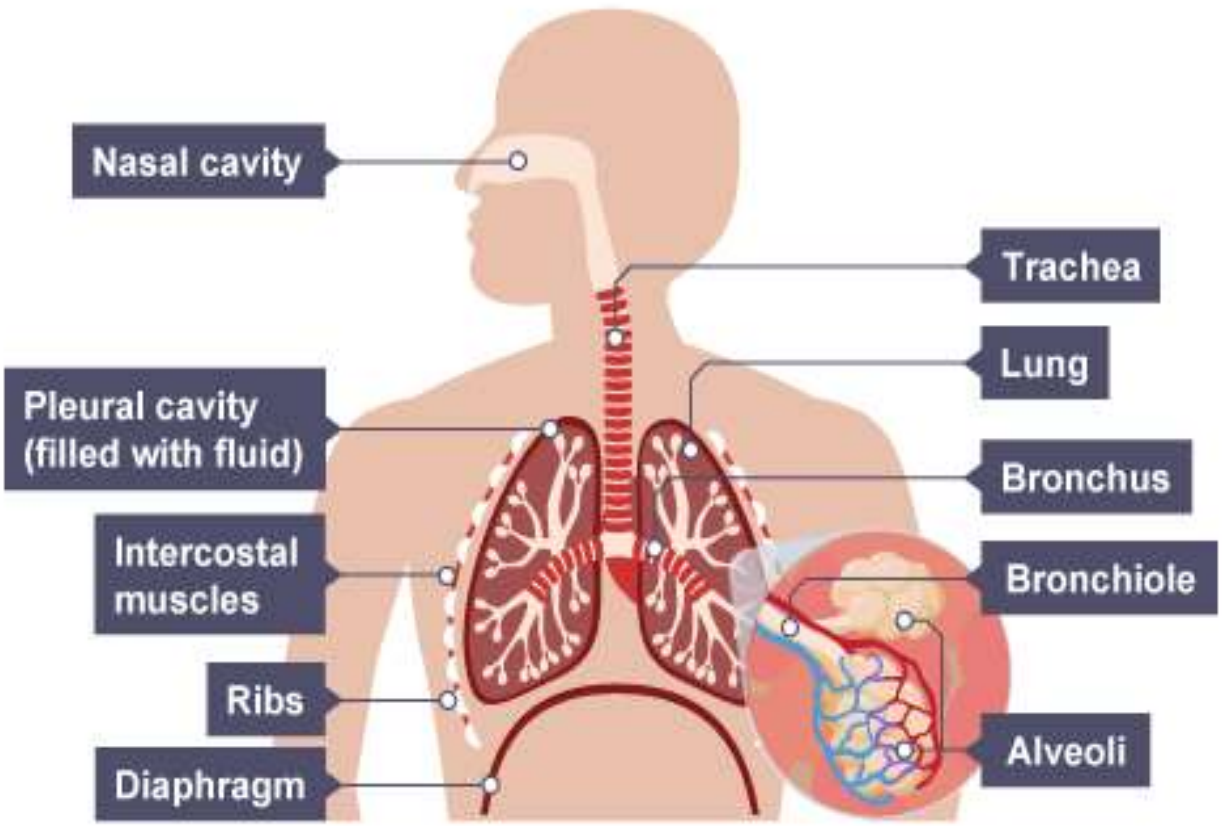
- **Anaerobic respiration in muscles:** Anaerobic respiration produces much less energy than aerobic respiration. The waste product, lactic acid, builds up in the muscles causing pain and tiredness . This leads to cramp. Lactic acid is only broken down when you start aerobic respiration again
- **glucose → lactic acid**

- **Anaerobic respiration in microorganisms:** Anaerobic respiration happens in microorganisms such as bacteria because they need to release energy from glucose too. Yeast, which are unicellular fungi, can carry out an anaerobic process called fermentation. Here is the word equation for fermentation:
- **glucose → ethanol + carbon dioxide**

Complete the table

	Aerobic Respiration	Anaerobic Respiration
Needs oxygen?		
Is glucose required?		
Product(s) formed		

Structure and Functions of the Respiratory System



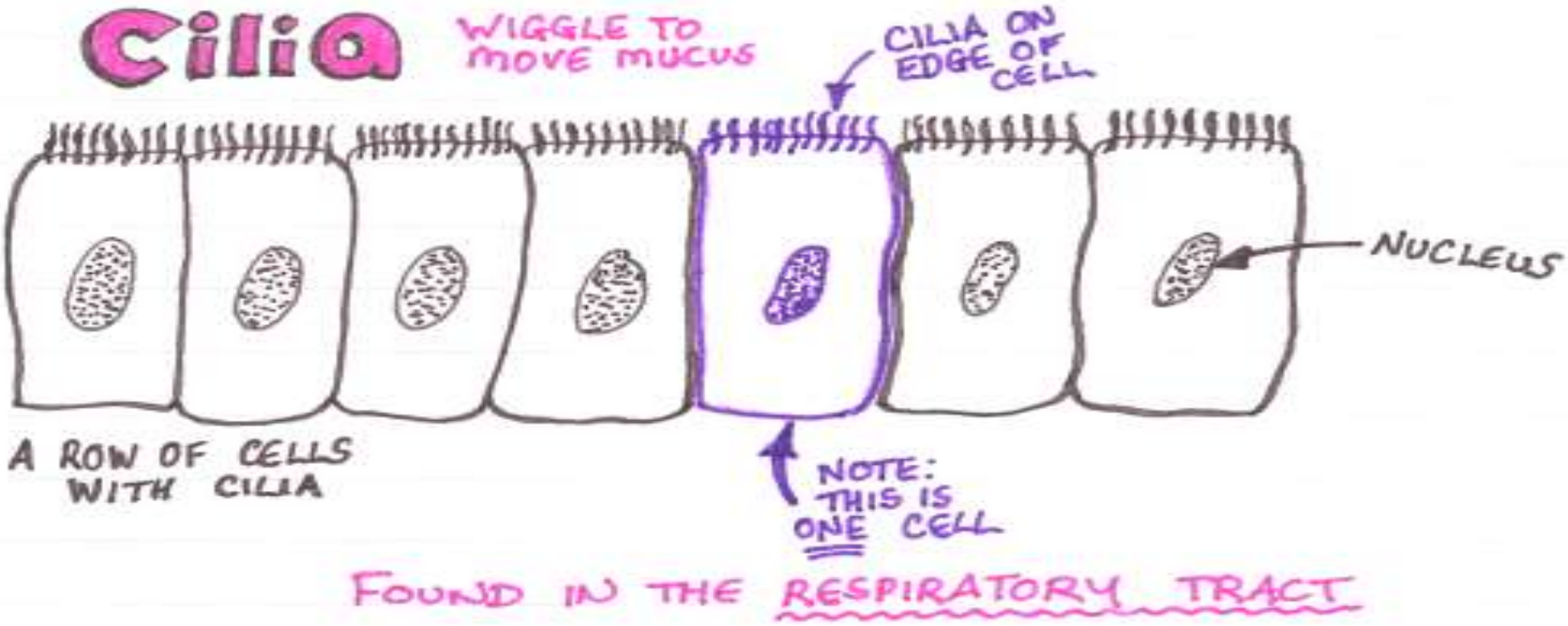
Structure and Functions of the Respiratory System

- Nose & Mouth: Air can enter the body through either nose or mouth.
- It is better to breathe through the nose because the structure allows the air to become warm, moist and filtered before it gets to the lungs.

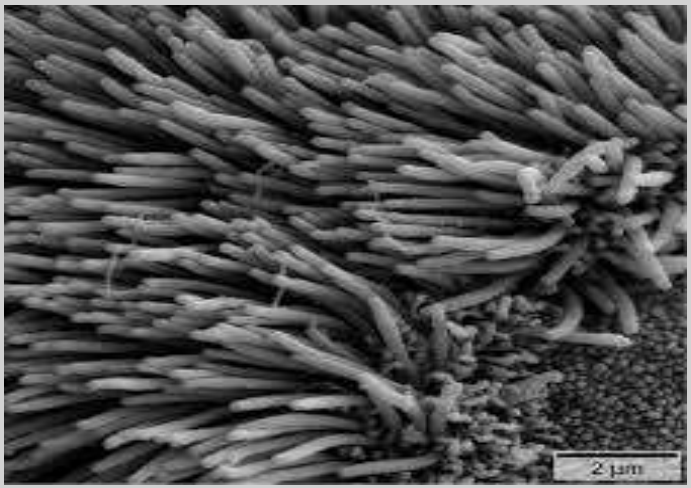
- The respiratory tract is lined with a thin layer of cells. Some of theses cells, called goblet cells, produce mucus. It also has cells which have tiny hair-like projections called cilia. The cilia moves back and forth to trap dust and bacteria. The dust and bacteria gets trapped in the cilia and mucus, and is pushed towards the throat so that it can be swallowed.

Cilia

WIGGLE TO MOVE MUCUS

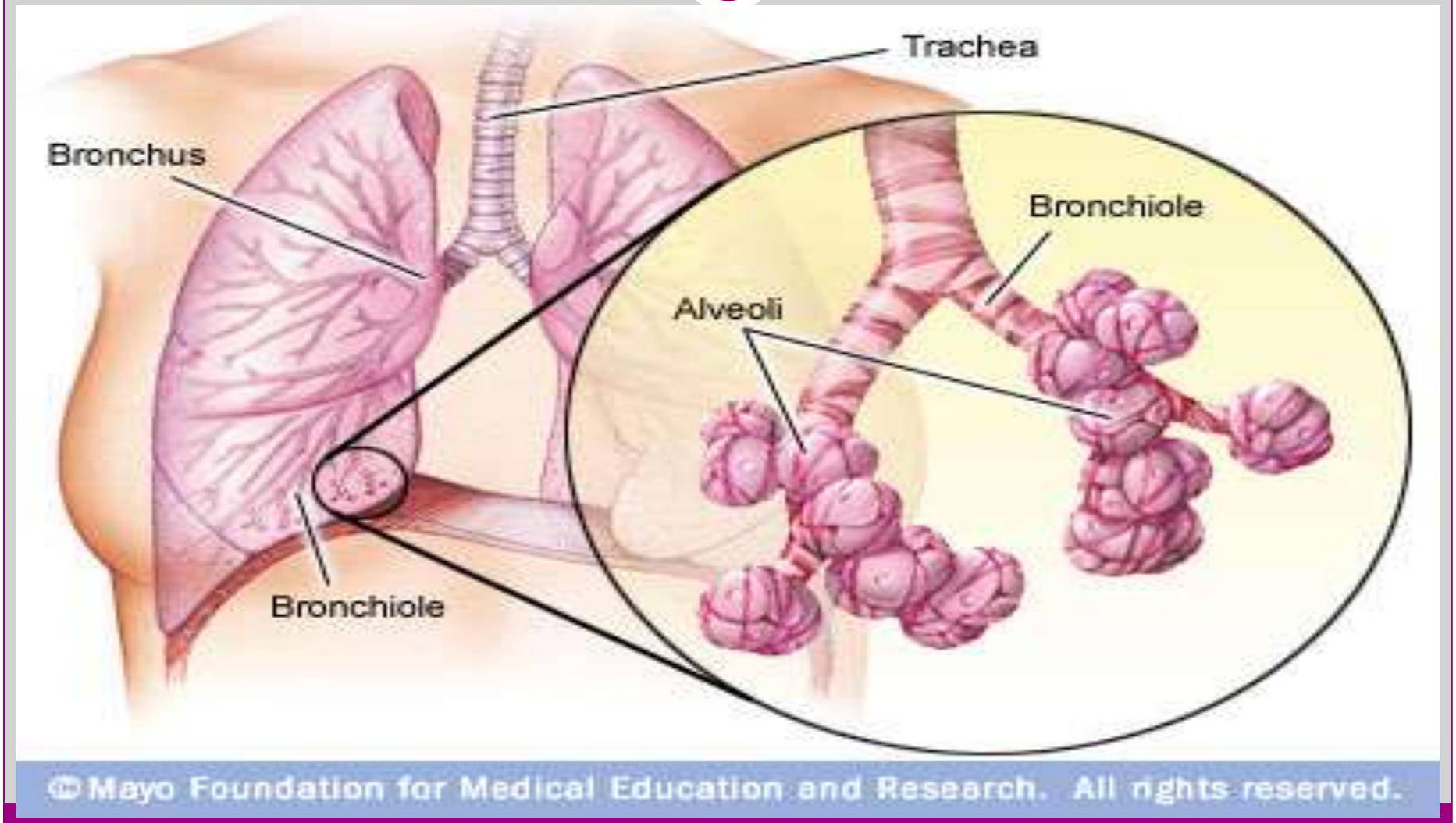


FOUND IN THE RESPIRATORY TRACT



- Trachea: From the nose or mouth, the air passes into the windpipe.
- The trachea is reinforced by rings of C- shaped cartilage and conveys air to and from the lungs.
- The trachea branches into two **bronchi** (one to each lungs).
- The **bronchi** splits into smaller and smaller tubes called **bronchioles**.
- At the end of each bronchiole, there are many air sacs or alveoli. This is where gas exchange takes place.

- PLEURAL MEMBRANE: Allow the lungs to move easily during ventilation.
- RIBCAGE: Provide a moveable cage to enclose and protect the lungs.
- INTERCOSTAL MUSCLES: Allow the ribcage to change in volume for ventilation to happen.
- DIAPHRAGM: Works with the intercostal muscles to allow ventillation to happen. It also separates the lungs from the abdominal cavity.


Trachea
Bronchus
Bronchiole
Alveoli
Bronchiole
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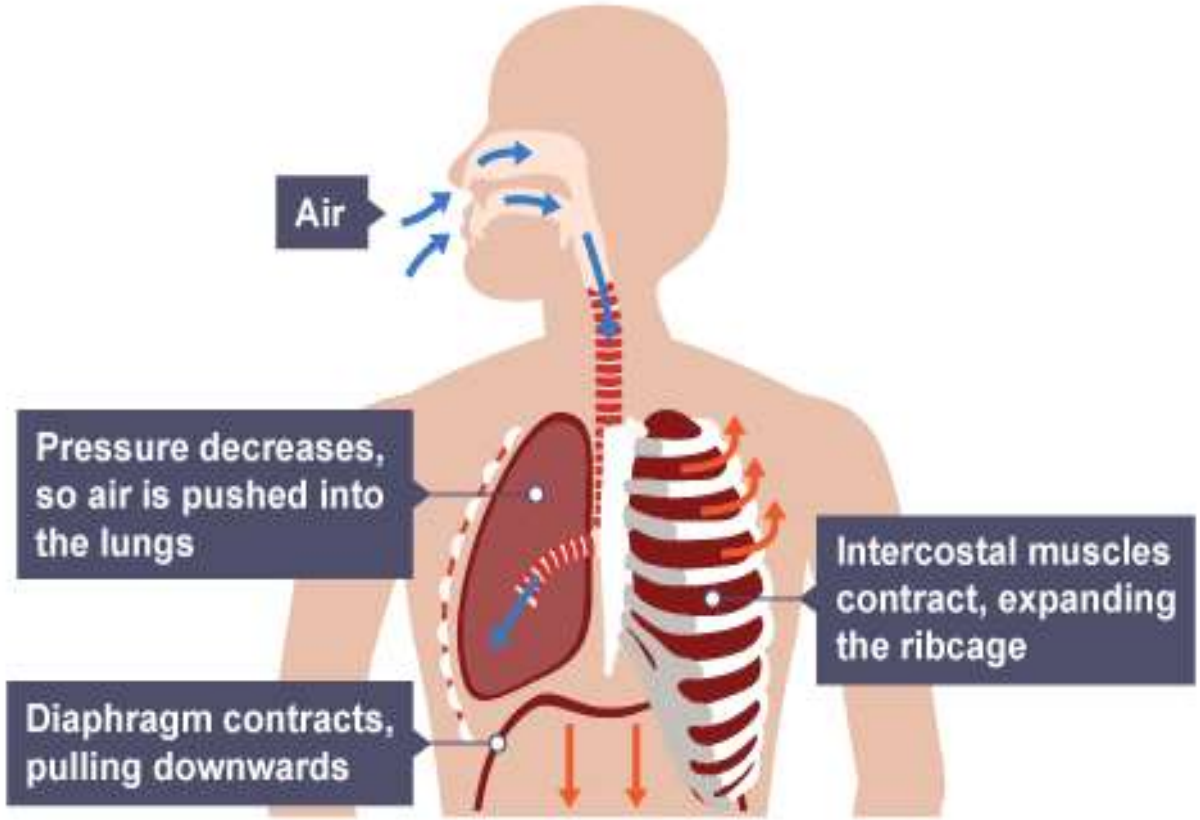
Ventilation: The movement of air between the environment and the lungs via *inhalation* and *exhalation*

- Air is warmed, moistened and filtered as it travels through the **mouth** and **nasal passages**.
- It then passes through the trachea and one of the two *bronchi* into one of the lungs.
- After passing into the many **bronchioles**, it finally arrives into some of the millions of tiny sacs called **alveoli**.
- This is where gas exchange takes place - **oxygen** passes out of the air into the blood, and **carbon dioxide** passes out of the blood into the air in the alveoli.

Breathing in: Inhalation

- The ***internal intercostal muscles*** relax and the external intercostal muscles contract, pulling the ribcage upwards and outwards
- The **diaphragm** contracts, pulling downwards
- Lung volume increases and the air pressure inside decreases
- Air is pushed into the lungs

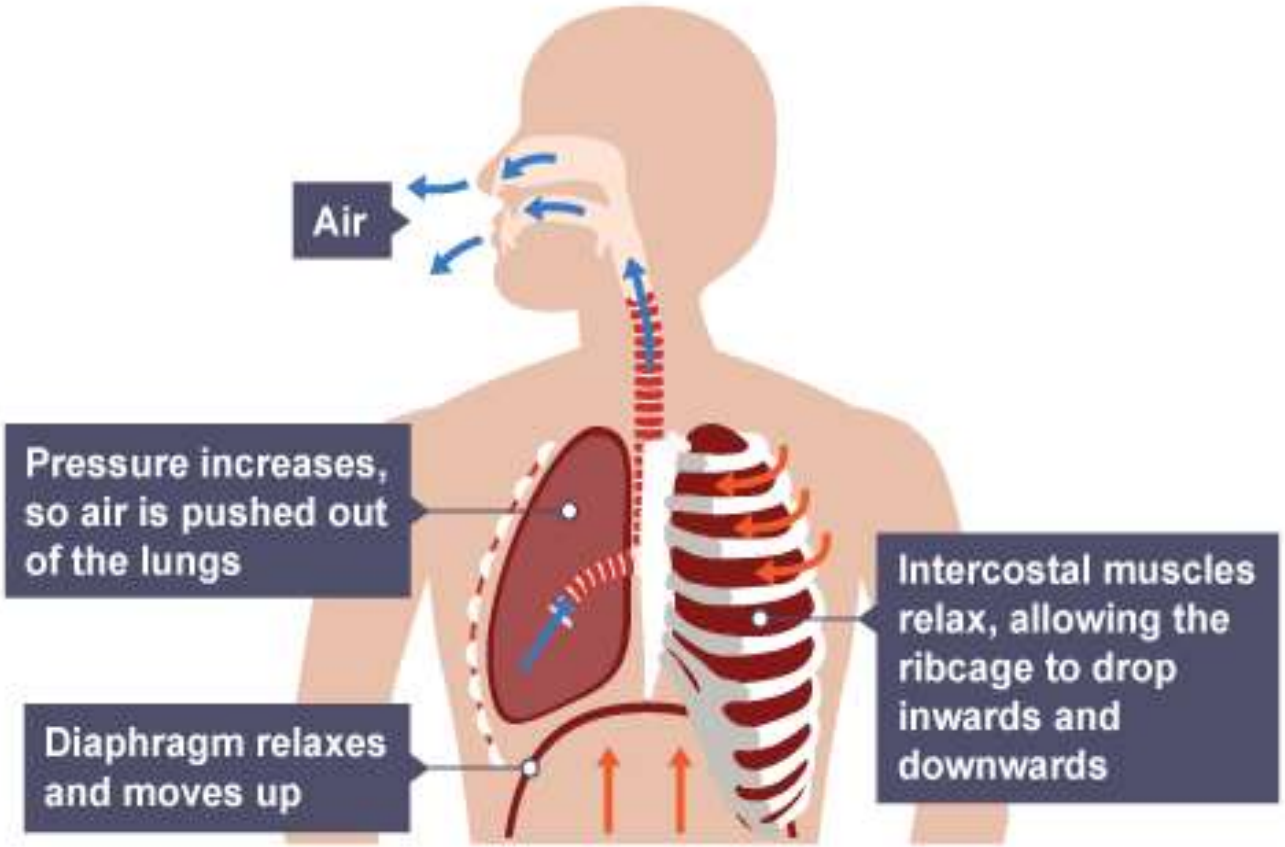
Breathing in: Inhalation



Breathing out: Exhalation

- The external intercostal muscles relax and the internal intercostal muscles contract, pulling the ribcage downwards and inwards
- The diaphragm relaxes, moving back upwards
- Lung volume decreases and the air pressure inside increases
- Air is pushed out of the lungs

Breathing out: Exhalation

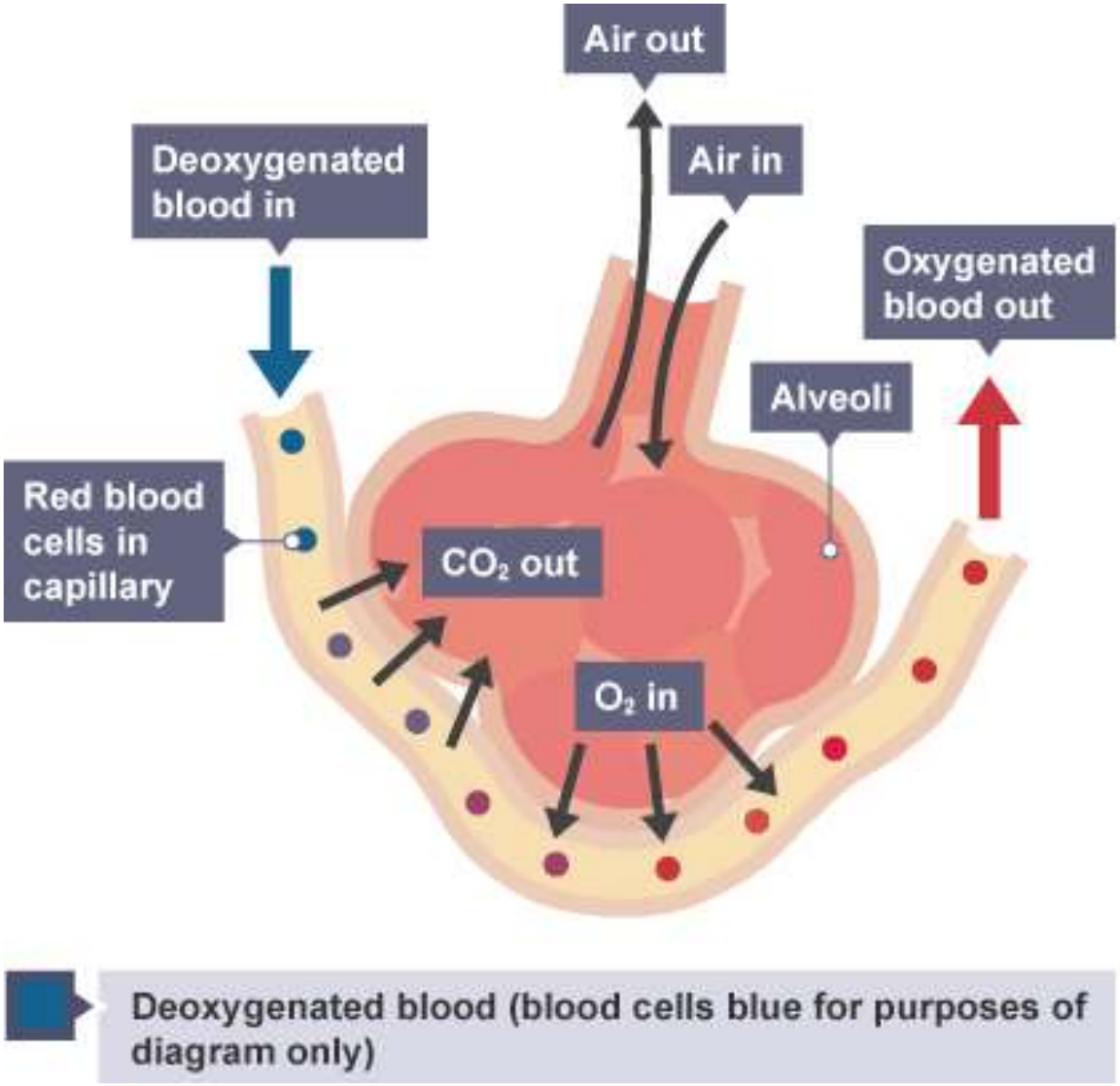


GAS EXCHANGE IN THE LUNGS

Gas exchange in the lungs happens in the **alveoli**.

Some of the features of alveoli include:

- thin walls (just one cell thick)
- large surface area
- moist surface
- many blood capillaries


Air out
Air in
Deoxygenated blood in
Oxygenated blood out
Alveoli
Red blood cells in capillary
CO_2 out
O_2 in
Deoxygenated blood (blood cells blue for purposes of diagram only)

Gas exchange in the alveolus

- The **gases** move by diffusion from where they have a high concentration to where they have a low concentration: Oxygen diffuses from the air in the **alveoli** into the blood. Carbon dioxide diffuses from the blood into the air in the **alveoli**.

Constituent	Inhaled Air	Exhaled Air
Oxygen	20.9%	16%
Carbon dioxide	0.03%	4.0%
Water vapour	Variable	Variable but more than in inhaled air
Nitrogen	78.1%	78.1%
Noble gases	0.94%	0.94%

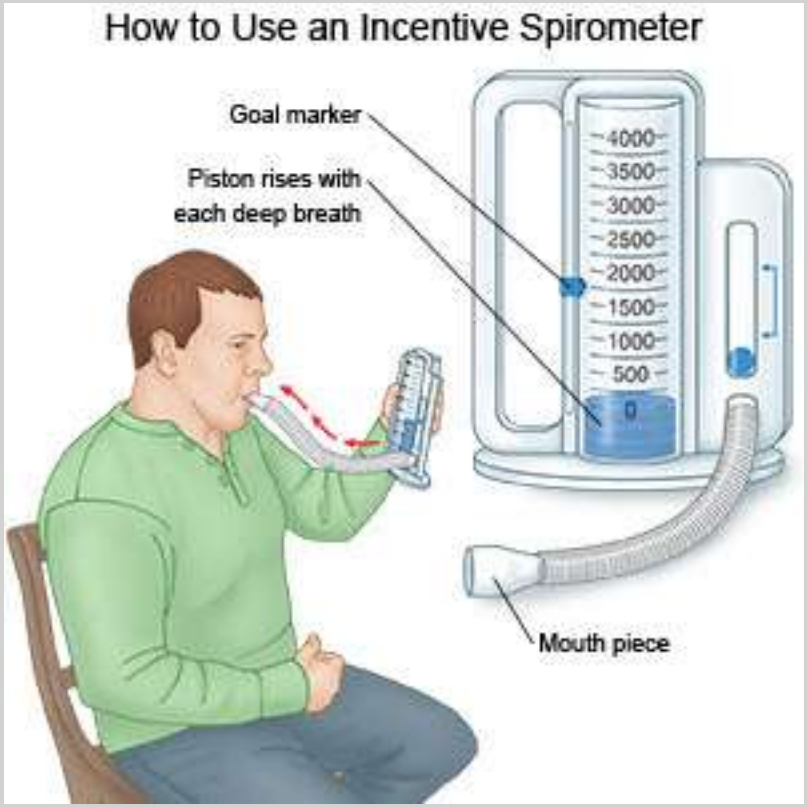
What are the main differences?

Why is there a difference in the percentages?

Effects of exercise on breathing

- During exercise there is an increase in physical activity and muscle cells **respire** more than they do when the body is at rest.
- Exercise increases the rate and depth of breathing
- The heart rate increases during exercise. The rate and depth of breathing increases - this makes sure that more oxygen is absorbed into the blood, and more carbon dioxide is removed from it.

- The rate of breathing can be measured by counting the number of breaths in one minute. The depth of breathing can be measured using a **spirometer** (a device that measures the volume of air inhaled and exhaled).



- Vital capacity: The maximum volume of air that can be expelled from the lungs after taking the deepest possible breath.

- Tidal Volume: The amount of air we breathe out when you are resting.

- Importance of Tidal volume & vital capacity:

To test lung function.

Effects of Smoking

- **Smoking** can cause lung disease, heart disease and certain cancers.
- **Nicotine** is the addictive substance in tobacco. It quickly reaches the brain and creates a dependency so that smokers become addicted.
- **Effects on the air passages**
- Sticky mucus in the lungs traps **pathogens**. The mucus is normally swept out of the lungs by the **cilia** on the lining of the trachea, **bronchi** and **bronchioles**. However, cigarette smoke contains harmful chemicals that damage these cells, leading to a build-up of mucus and a smoker's cough. Smoke irritates the bronchi, causing **bronchitis**.

Effects of Smoking

- **Effects on the alveoli**
- Smoke damages the walls of the **alveoli**. The alveoli walls break down and join together, forming larger air spaces than normal. This reduces the efficiency of gas exchange, so people with the lung disease **emphysema** (a type of COPD or chronic obstructive pulmonary disease) carry less oxygen in their blood and find even mild exercise difficult.
- **Carbon monoxide**
- Carbon monoxide, CO, combines with the **haemoglobin** in red blood cells. This reduces the ability of the blood to carry oxygen, putting strain on the **circulatory system** and increasing the risk of **coronary heart disease** and strokes.
- **Lung cancer**
- Carcinogens are substances that cause cancer. Tobacco smoke contains many carcinogens, including tar. Smoking increases the risk of lung cancer, and cancer of the mouth, throat and oesophagus.