

Chapter 31 - Human Breathing

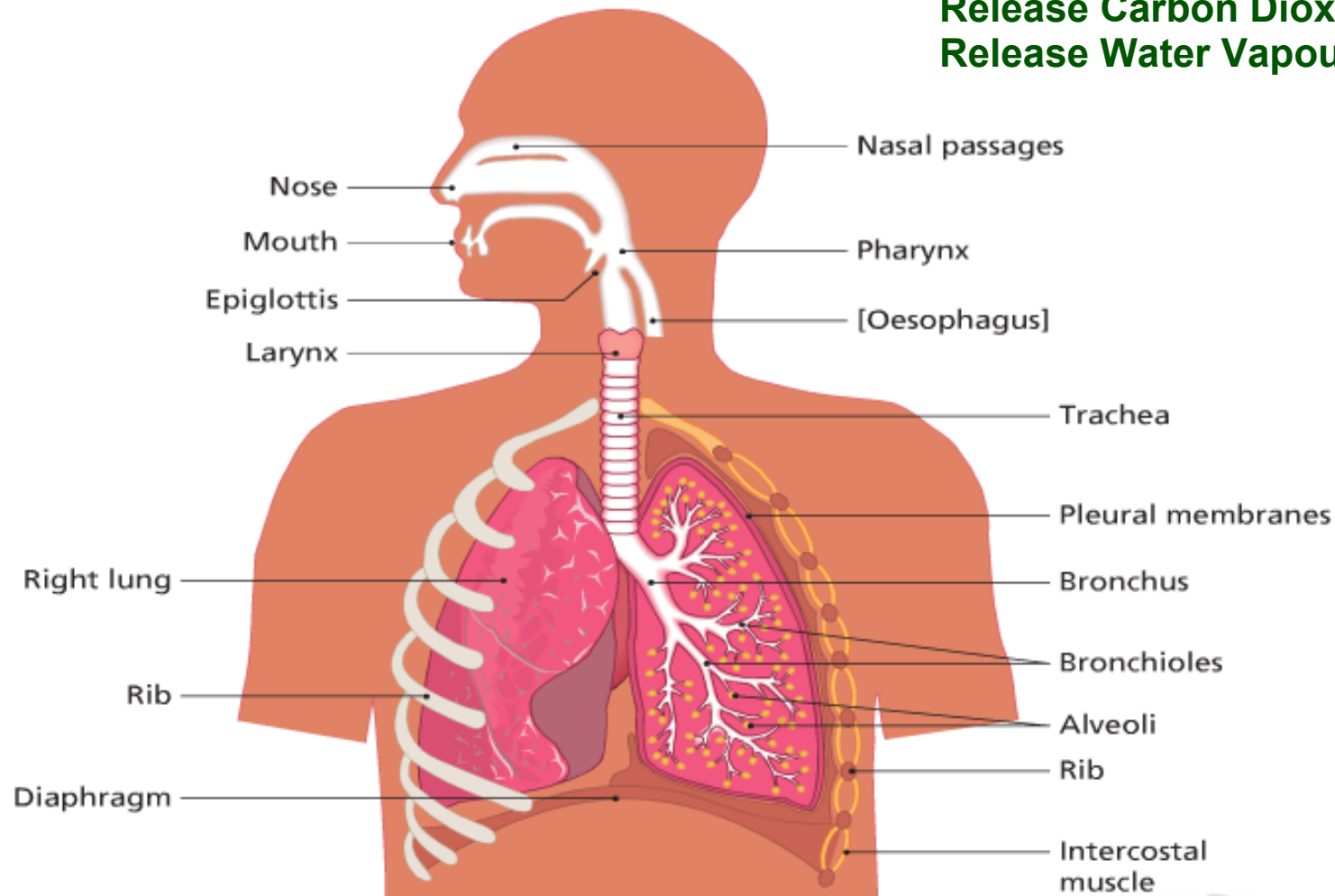
Learning objectives

- To describe the structure and function of the breathing system in humans
- To describe the essential features of the alveoli and capillaries as surfaces for gas exchange
- To describe the mechanism of the human breathing system in gas exchange
- To describe asthma or bronchitis in terms of one possible cause, prevention and treatment
- HIGHER** ● To explain how carbon dioxide is a controlling factor in the human breathing system
- To investigate the effect of exercise on breathing rate.

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Parts of the respiratory system

Functions of the system,
Take in Oxygen.
Release Carbon Dioxide.
Release Water Vapour.



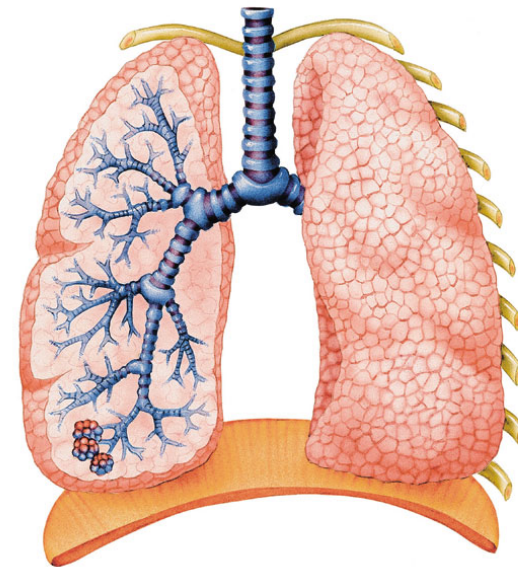
Lungs

Lungs

The lungs are large, pink, spongy structures in which gas exchange takes place. Each lung is enclosed by a pair of pleural membranes (the pleura):

- The outer pleura lines the chest wall and the diaphragm
- The inner pleura lines the lungs.

The pleural cavity is the gap between the two pleura. It contains a liquid which lubricates the membranes and reduces friction during breathing.

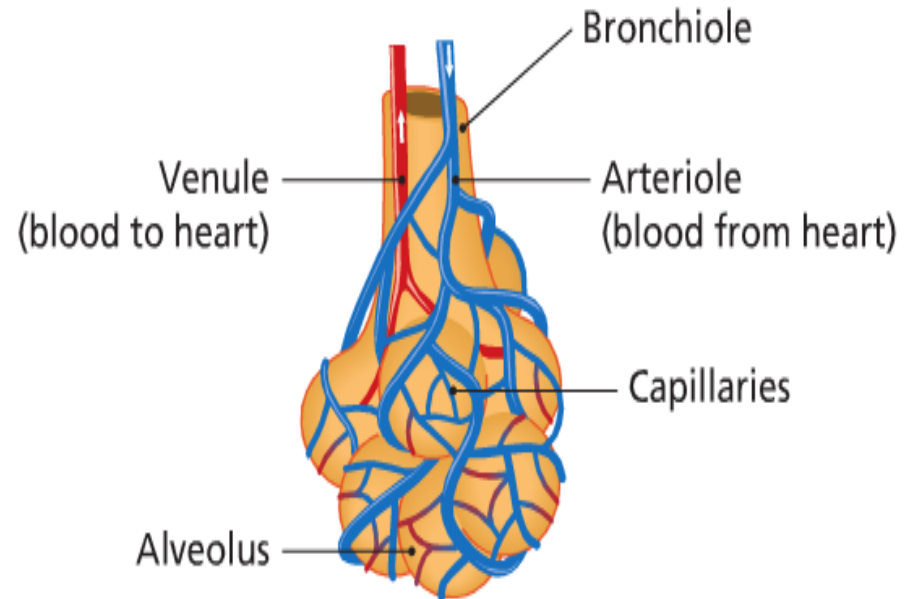


Alveoli

Each bronchus subdivides into about 1 million bronchioles. These end in tiny, hollow, balloon-like air sacs called alveoli.

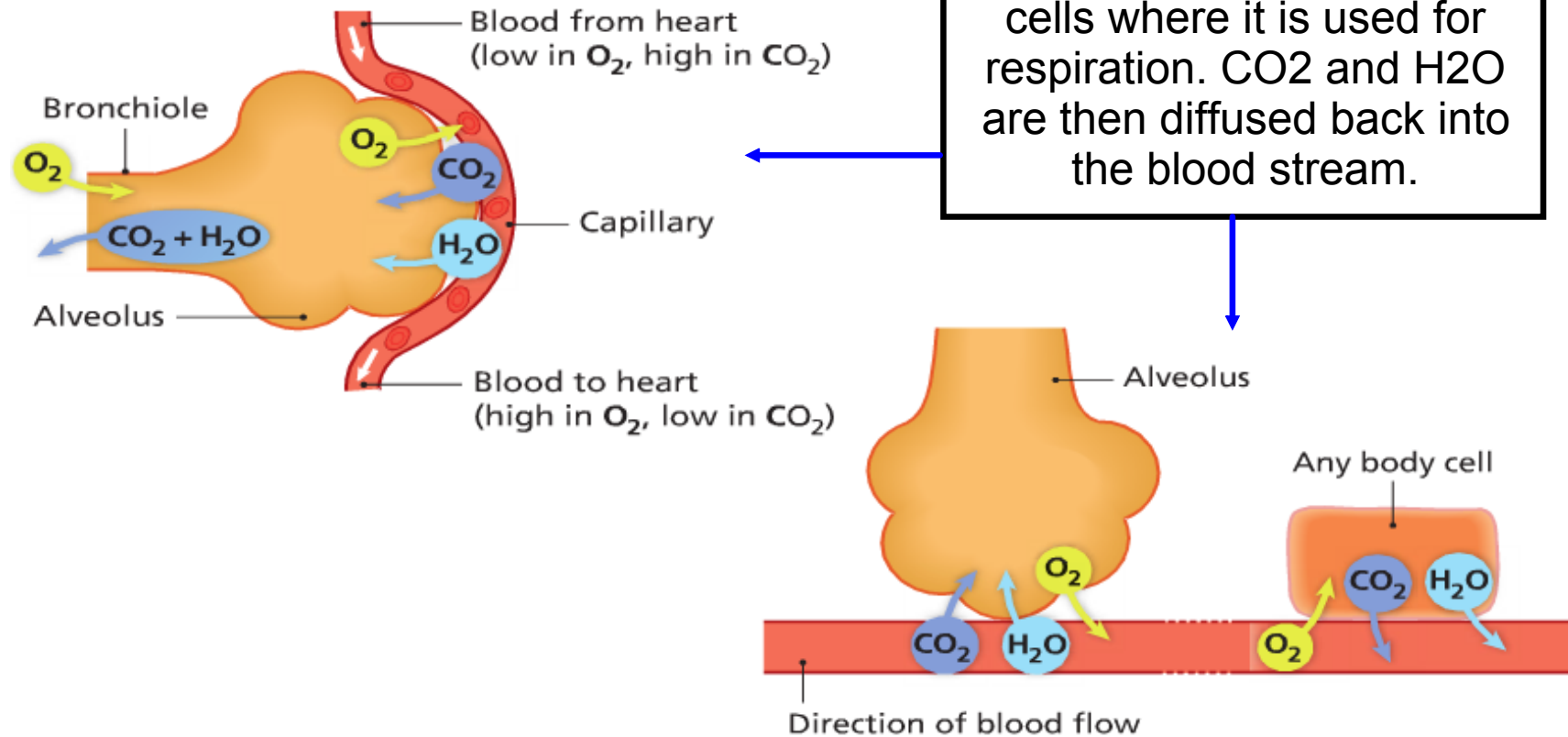
The function of the alveoli is gas exchange. They are adapted for this function because:

- The huge number of alveoli (over 700 million between the two lungs) provide a huge surface area for gas exchange
- They are thin walled (only one cell thick)
- They have moist surfaces
- They are enclosed in a network of blood capillaries.



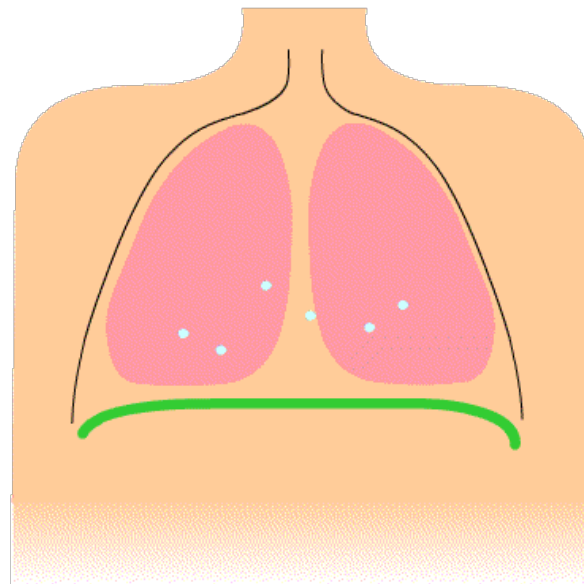
Transport of gases

- Oxygen is mainly transported by combining with the red pigment haemoglobin, to form oxyhaemoglobin. Only about 3% of oxygen is carried dissolved in plasma.
- Carbon dioxide and water are both carried in blood plasma.



Inhalation

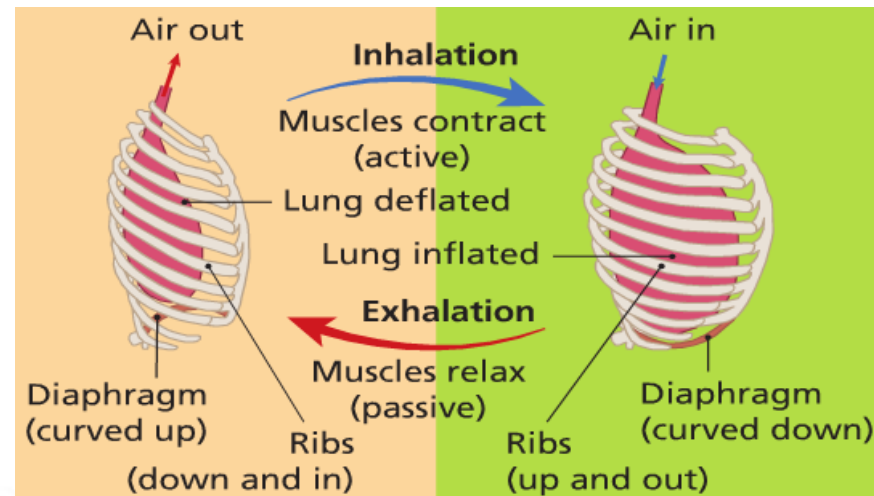
1. The brain controls the rate of breathing.
2. Normally a message is sent from the brain to the intercostal muscles (located between the ribs) and the diaphragm.
3. These muscles use energy (in the form of ATP) to contract. For this reason inhalation is said to be an **active** process.
4. The ribs are pulled up and out and the diaphragm curves down.
5. The volume or size of the chest cavity (or thorax) increases.
6. The pressure in the chest cavity decreases.
7. The external air pressure is now higher than the air pressure in the chest. As a result air is forced into the lungs. This is called inhalation or inspiration.



Exhalation

To exhale, the process is reversed as outlined below in points 1 to 5. Note that nervous control is not necessary for exhalation.

1. The intercostal muscles and diaphragm relax.
As a result exhalation is a **passive** process.
2. The ribs move down and in and the diaphragm curves up.
3. The volume or size of the chest cavity (or thorax) decreases.
4. The pressure in the chest cavity increases.
5. Air is forced out of the lungs.



Breathing Disorder - Asthma

Symptoms

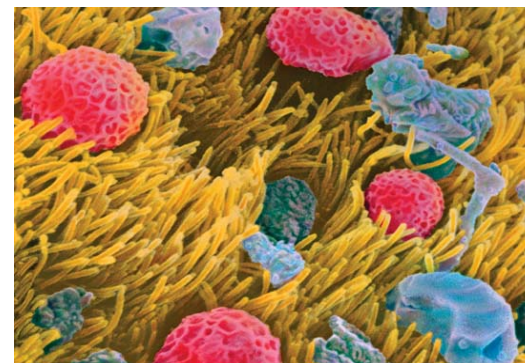
Signs of asthma include noisy, wheezy breathing and breathlessness

Causes - External

Attacks may be triggered by **Allergens**, which can be pollen, dust, animal hair, etc.

Causes - Internal

During an attack the bronchioles become narrow. 10% of children have asthma and it is increasing in developed countries.



Prevention

Avoid the allergens that cause the reaction and use an inhaler.

Treatment

Bronchodilators - are inhalers that widen the bronchioles. Steroids or injections may also be given for more serious conditions.



Control of Human Breathing - Higher Level

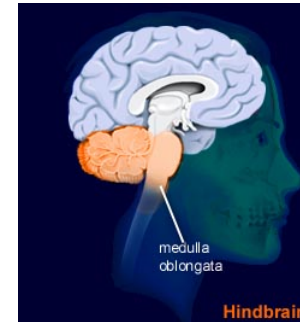
Human breathing is controlled by the **Medulla Oblongata**.

Carbon Dioxide builds up in the blood from Respiration.

Carbon dioxide is **acidic** and causes the blood **pH** to **drop**.

This drop is sensed by the brain and causes the **lungs** to **inhale**.

So, our Oxygen intake is controlled by CO₂ levels (as in plants).



Activity 19b To investigate the effect of exercise on breathing rate

1. Work in pairs, one person recording the results.
2. Sit down on a chair and rest for a few minutes.
3. Breathing in and breathing out is considered to be one breath.
4. Count the number of inhalations or exhalations per minute while at rest.
5. Repeat this two more times.
6. Calculate your average breathing rate per minute (measured in breaths per minute, or bpm) at rest by adding the three values and dividing the total by three. This is called the resting breathing rate and is used as a control.
7. Walk slowly for 5 minutes.
8. Count your breathing rate per minute immediately after walking.
9. Walk briskly for 5 minutes.
10. Count your breathing rate per minute immediately after walking.
11. Exercise strenuously for 5 minutes (e.g. step up and down on a chair every 3 seconds or run).
12. Count your breathing rate per minute immediately after exercising.
13. Compare your resting rate with the rate immediately after each type of exercise.
14. Present your results in tables such as those shown below.

Syllabus You have a choice to carry out either this activity or Activity 19a on page 311.

Breathing rates before exercise					
Before exercise	Trial 1	Trial 2	Trial 3	Total	Average
Resting breathing rate (bpm)					

Breathing rates after different types of exercise			
Activity	Slow walk	Brisk walk	Strenuous exercise
Breathing rate (bpm)			

15. After exercise the rate of breathing often falls below the resting rate. This is due to deeper breathing.

Exercise and Breathing

