

# 1

## How the normal lungs work

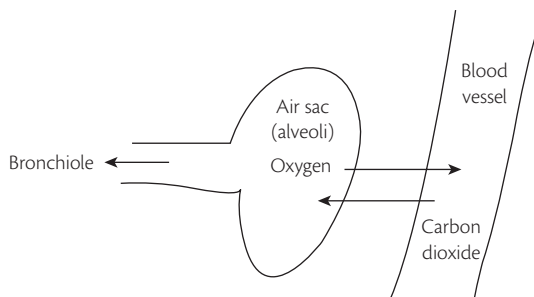
### ➔ Key points

- ◆ Air containing oxygen passes through the mouth and nose into the windpipe (trachea). The windpipe then divides repeatedly into smaller branches of increasingly narrow size (bronchi and bronchioles) within the lungs.
- ◆ The smallest air passages (bronchioles) end as tiny air sacs (alveoli) where gas exchange takes place; oxygen passes from the air sacs into the blood and carbon dioxide passes from the blood into the air sacs.
- ◆ The left lung consists of two lobes and the right lung consists of three lobes.
- ◆ Oxygen is transported throughout the body in red blood cells.
- ◆ The whole process of transportation of oxygen to the body by way of the heart, arteries, capillaries, veins, and lungs is called the circulation.
- ◆ The act of breathing is under automatic control by the brain and consists of inspiration and expiration.

### Air passages

At rest, most healthy people breathe through the nose, although this may change to the mouth when the nose is blocked (e.g. when you have a 'cold') and when exercising. Atmospheric air (containing 21% oxygen) is inhaled through either the mouth or the nose, and passes into a long tube-like structure called the windpipe (trachea). The windpipe is made up of 'C'-shaped rings of cartilage (which is like soft bone), which you can feel in the midline of

the neck; these rings prevent the windpipe from collapsing. It then divides behind the breast bone (sternum) within the chest into two smaller air passages (bronchi), on the left and right sides, which lead into the lungs. These two main bronchi then subdivide even further into smaller branches (called lobar bronchi). These subdivide repeatedly into increasingly smaller branches (called segmental bronchi and bronchioles) and ultimately end in millions of small air sacs (alveoli). It is in these air sacs that a process called gas exchange occurs. This means that oxygen passes from the air sacs into the bloodstream and is then transported around the body. The waste gas carbon dioxide passes from the bloodstream into the air sacs and is eventually exhaled by breathing out through the nose or mouth.

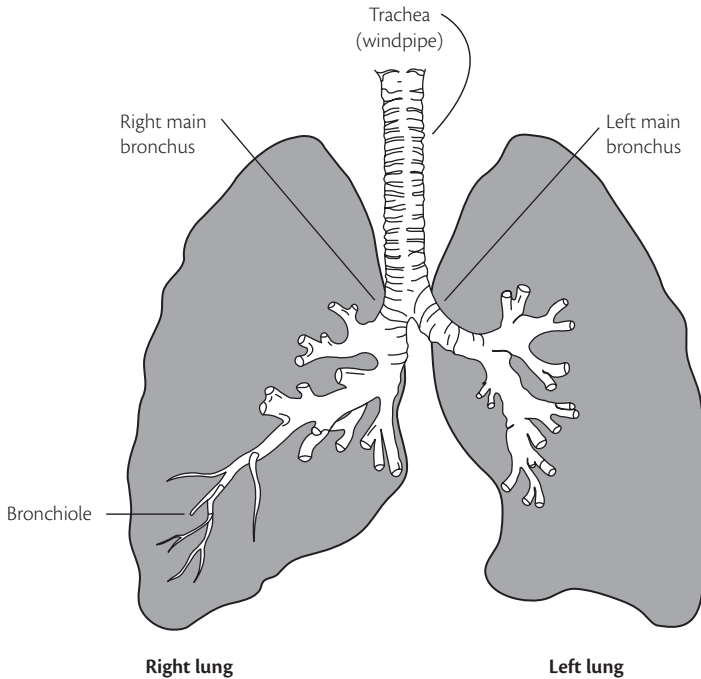


**Fig. 1.1** Diagrammatic representation of air sacs (alveoli) and the process of gas exchange.

## Lungs

The lungs are two cone-shaped structures lying within the chest cavity. They extend from the neck above to the diaphragm (a thin layer of muscle separating the chest cavity from the abdominal cavity) below. Between each lung is found a variety of important structures such as:

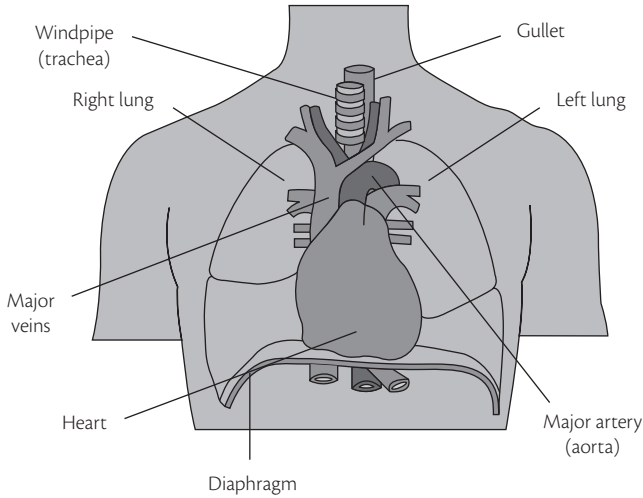
- ◆ the heart;
- ◆ major blood vessels (a mixture of large arteries and veins);
- ◆ lymph glands and lymph vessels;
- ◆ the windpipe (trachea);
- ◆ the gullet.



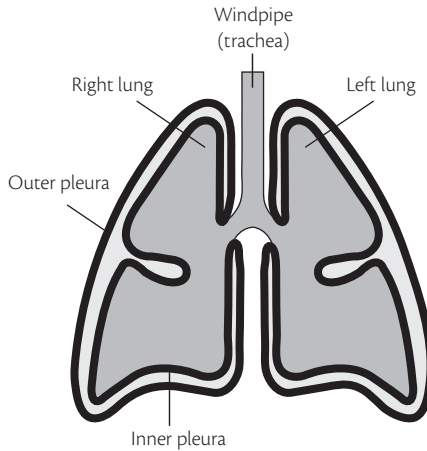
**Fig. 1.2** The airway, its branches, and the lungs.

Since the heart lies mainly on the left side of the chest, the right lung is slightly larger than the left lung. The right lung consists of three lobes and the left lung consists of two lobes. The lobes of the lung are made up mainly of millions of air passages (bronchi and bronchioles), air sacs (alveoli), lymph glands and lymph vessels, blood vessels, and surrounding (or connecting) tissues.

The lungs are surrounded by two thin layers called the pleura. The pleura are separated from one another by a small amount of fluid that acts as a lubricant between them. This allows the pleura to slide easily against each other without any friction when the lungs increase and decrease in size during breathing. This fluid is rather like a thin film of water trapped between two layers of glass; the layers can easily slide over one another but cannot be easily pulled apart. The outer layer of pleura is firmly attached to the inside of the chest wall.



**Fig. 1.3** The relationship between the heart, lungs, and other structures found in the chest.



**Fig. 1.4** Diagrammatic representation of the lungs and inner and outer pleura.

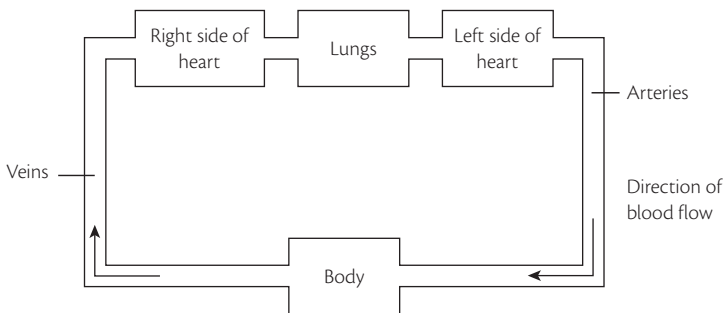
## Breathing

Breathing involves two main actions: inspiration (breathing in) and expiration (breathing out). The action of breathing is largely under the control of the breathing centre of the brain and occurs spontaneously (around 12 breaths

per minute in resting healthy adults). However, we all have some control over how fast or slow we breathe and it may alter in response to a variety of triggers such as fear, anxiety, exercise, illness, or pain. When breathing in, muscles of the chest (mainly the diaphragm and muscles between the ribs (intercostal muscles)) cause the lungs to increase in size—you can consider this to be like a partially filled balloon being blown up further. During periods where deeper breathing is necessary (e.g. during exercise), other muscles of the chest and neck help in this process. When breathing out, the diaphragm and intercostal muscles relax and the inflated lungs partially deflate—like some of the air being let out of a filled balloon.

## Circulation of blood

Red blood cells, which are one of several constituents of blood, carry oxygen around the body. Blood (containing red blood cells) is pumped throughout the body by vessels called arteries. The main artery of the body, which arises from the left side of the heart, is called the aorta; the aorta subdivides into many other smaller arteries, which supply all the organs and tissues of the body. The various organs and tissues of the body extract oxygen from red blood cells via smaller blood vessels called capillaries and release the waste gas, carbon dioxide. Veins then transport blood (without a supply of oxygen but with carbon dioxide) to the right side of the heart. The two main veins that enter the right side of the heart (and ultimately collect blood from all the veins in the body) are called the superior and inferior vena cava. From the right side of the heart, blood containing red blood cells then passes through both lungs and become enriched with oxygen again. Carbon dioxide is transferred from the bloodstream into the lungs. This whole process of transportation of oxygen



**Fig. 1.5** Diagrammatic representation of how blood passes through the heart, arteries, veins, and lungs (the circulation).

to the body, with the help of the heart, arteries, capillaries, veins, and lungs, is called the circulation.

## When things go wrong

As described above, nature has developed a highly efficient system by which to keep us all feeling alive and well. This is largely by making sure that all our organs and tissues are supplied with plenty of oxygen and that waste products are removed. When things start to go wrong with parts of this process, we often know about it mainly due to the appearance of:

- ◆ symptoms—these are things that you feel wrong with you such as breathlessness, cough, reduced exercise tolerance and wheeze.
- ◆ signs—these are physical abnormalities that doctors or nurses find when they examine you.

In chronic obstructive pulmonary disease (COPD), it is the lungs that are predominantly affected and your body will usually react to this by making you aware that there might be something going wrong.