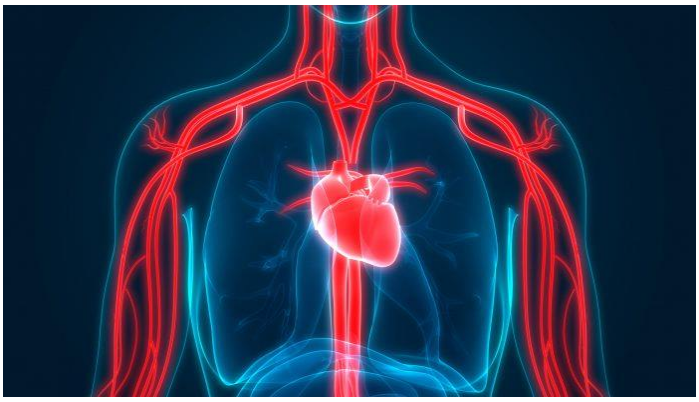
Unit 3 Maintaining Homeostasis Part 2: Circulatory/Immune/Respiratory Systems and Homeostasis

Mr. Gillam

Holy Heart

Name: _____

The Human Circulatory System and Homeostasis



_____ in animals, the system of vessels that transports blood, cells and substances dissolved in blood throughout the body.

Main Functions of the Circulatory System

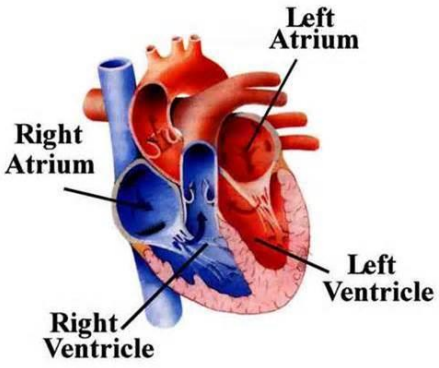
The circulatory system has three main functions, all of which help maintain homeostasis in the body:

1. The circulatory system transports gases (from the respiratory system), nutrient molecules (from the digestive system), and waste materials (from the excretory system).

2. The circulatory system regulates internal temperature and transports hormones. Much of the body's heat is generated by the muscular system. Hormones are reaction-triggering chemicals that are produced by the endocrine system. Gastrin, secretin, and CCK are involved in regulating digestion.

3. The circulatory system protects against blood loss from injury and against disease-causing microbes or toxic substances introduced into the body

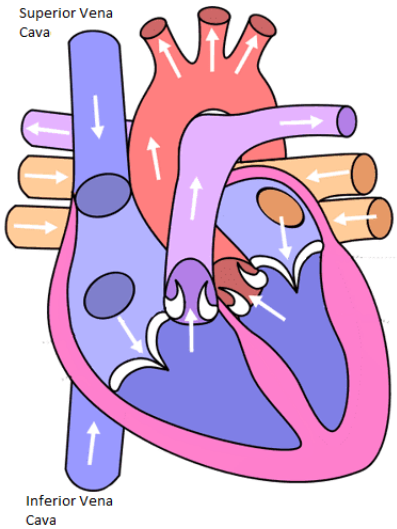
Structures of the Circulatory System



_____

Located slightly to the left of the middle of the chest, the heart has several important functions. These functions include pumping blood through the body, keeping oxygen-rich blood separate from oxygen-poor blood, and ensuring that blood flows only in one direction through the body. The walls of the heart are made up of a special type of muscle tissue, called cardiac muscle, that is found nowhere else in the body. It is about the size of your fist as a child and the size of two fists as an adult.

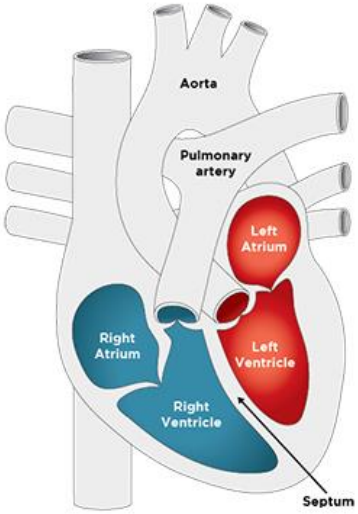
The human heart, like the hearts of all mammals and birds, has four chambers: one top chamber and one bottom chamber on both the right and left sides.



The Heart

_____ one of two large vessels, the superior and inferior vena cava, that open into the right atrium of the heart.

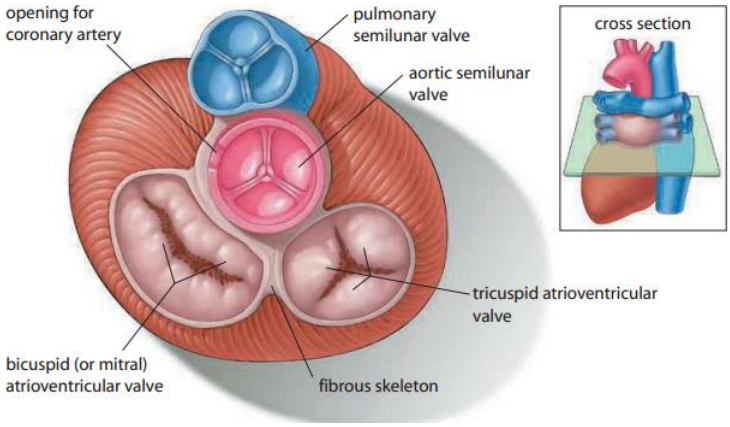
The superior vena cava collects oxygen-poor blood coming from the tissues in the head, chest, and arms. The inferior vena cava collects oxygen-poor blood coming from the tissues elsewhere in the body.



_____ one of two upper chambers of the heart that collects blood lowing into the heart.

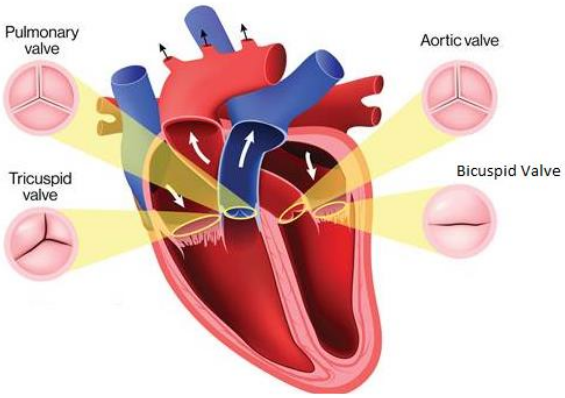
_____ one of the two lower chambers of the heart; each ventricle receives blood from one of the atria and pumps it into systemic or pulmonary circulation

_____ in the heart, the muscular wall that separates the two ventricles and the two atria. It stops oxygenated and deoxygenated blood from mixing.

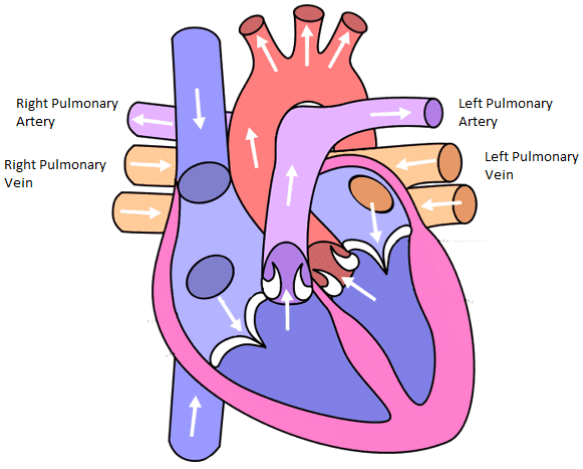


_____membranous extension of a vessel or the heart wall that opens and closes, ensuring one-way fluid flow. The heart has four valves inside it.

The atria and ventricles are separated from each other by two valves called the _____.



The atrioventricular valve on the right side is called the _____ because it is made up of three flaps. The atrioventricular valve on the left side is called the _____ _____ because it has only two flaps. The other two valves are called _____ _____ because of their half-moon shape.

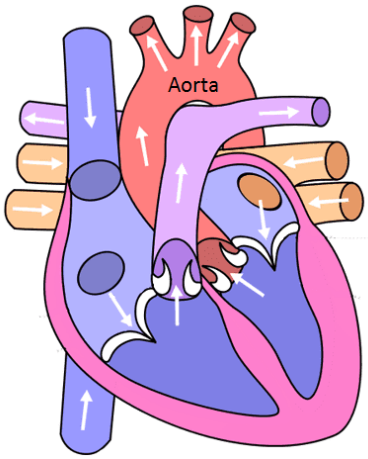


_____

blood vessel that carries blood from the heart to the lungs. These are the only arteries in the circulatory system that contain oxygen-poor blood.

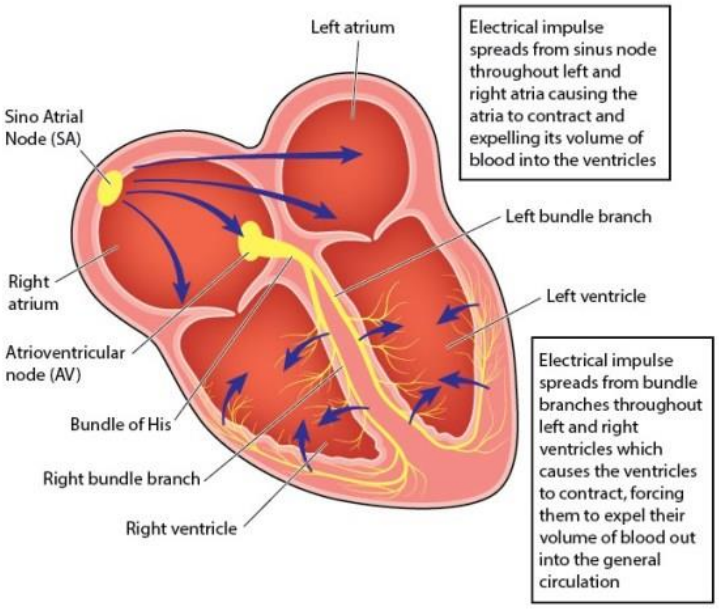
_____

blood vessel that carries blood from the lungs to the heart. These are the only veins in the circulatory system that contain oxygenated blood.



aorta major artery that carries oxygenated blood away from the heart to all regions of the body except the lungs.

the largest blood vessel in the body.



_____

_____

bundle of specialized muscle tissue located in the wall of the right atrium of the mammalian heart; generates an electrical impulse that stimulates cardiac muscle fibres to contract and relax rhythmically, producing a regular Heartbeat

The SA node is also referred to as the pacemaker, because it sets the pace for cardiac activity.

_____ bundle of specialized muscle tissue located in the wall of the right atrium; receives electrical stimulus from the sinoatrial node and transmits this impulse over the walls of the ventricles to start their contraction

<u>Pumping of the Heart</u>

1) The SA node generates an electrical signal that spreads over the two atria and makes them contract simultaneously.

2) As the atria contract, the signal reaches another node called the atrioventricular (AV) node.

3) The AV node transmits the electrical signal through a bundle of specialized fibres called the **bundle of His.**

4) The Bundle of His relays the signal through two bundle branches that divide into fast-conducting **Purkinje fibres,** which initiate the almost simultaneous contraction of all cells of the right and left ventricles.

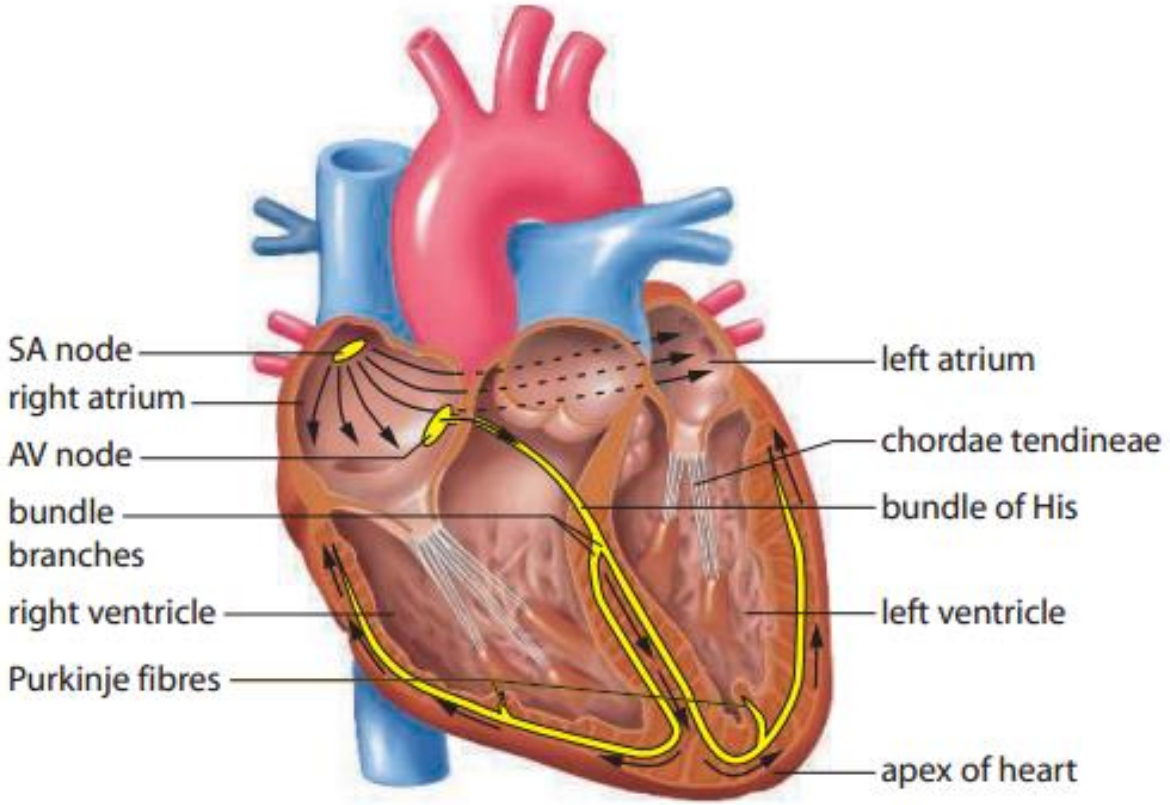
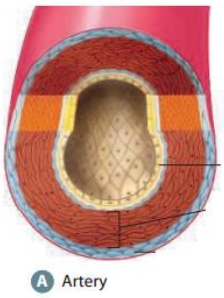


Figure 7.7 The SA node sends out an electrical stimulus that causes the atria to contract. When this stimulus reaches the AV node, it is passed through the bundle of His and the Purkinje fibres. The stimulus causes the ventricles to contract, starting from the apex and then upward, which forces blood toward the pulmonary artery and aorta. The chordae tendineae are strong, fibrous strings that prevent the valves in the heart from inverting when the heart contracts.

Launch Lab: Listen to your Heart

Investigation 7A Identifying Structures of the Circulatory System

<u>Structures of the Circulatory System</u>


A Artery

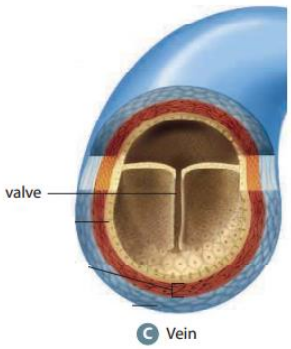
_____ blood vessel that carries oxygen-rich blood away from the heart

An artery has highly elastic walls. This elasticity allows the artery to expand as a wave of blood surges through it during the contraction of the ventricles, and then to snap back again during the relaxation of the ventricles.

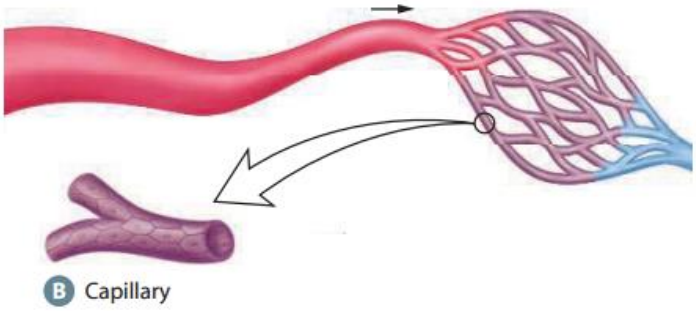
The action of the artery keeps the blood flowing in the right direction and provides an additional pumping motion to help force the blood through the blood vessels.

When you measure your pulse, what you feel is the rhythmic expansion and contraction of an artery as blood moves through it.

_____blood vessel that carries oxygen-poor blood to the heart



Veins have thinner walls than arteries and a larger inner circumference. Veins are not as elastic, and they cannot contract to help move the blood back to the heart. Instead, the contraction of muscles keeps the blood flowing toward the heart. Veins also have one-way valves that prevent the blood from flowing backward. These one-way valves are especially important in your legs because they ensure that the blood flows upward to your heart, against the downward pull of gravity.



_____ the smallest blood vessel; gases and other substances are exchanged between the circulatory system and body tissues across the capillary wall, which is only a single cell thick

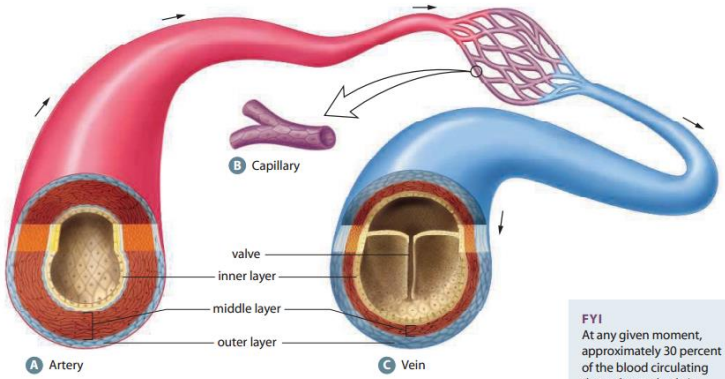


Figure 7.4 Arteries **(A)** and veins **(C)** have three layers. The outer layer is a covering of connective tissue mixed with elastic tissue. The middle layer consists of alternating, circular bands of elastic tissue and smooth muscle tissue. The inner layer is only one cell thick and consists of flat, smooth cells. The shape and texture of these cells serve to reduce friction as blood moves through them. Capillaries **(B)** consist of a single layer that is one cell thick.

FYI
At any given moment, approximately 30 percent of the blood circulating through your body is found in the arteries, 5 percent is found in the capillaries, and 65 percent is found in the veins.

Circulation and the Action of capillaries

The cells of the body are constantly bathed in a liquid called **interstitial fluid (extracellular fluid or tissue fluid).** Any material exchanged between the capillaries and the cells must pass through the interstitial fluid.

Capillaries have an **arterial end, a mid-section, and a venous end.**

When blood enters a capillary at the arterial end, it appears to be bright red because the hemoglobin in the red blood cells is rich in oxygen.

The diffusion of materials, including the **oxygen** attached to the hemoglobin in red blood cells and the **nutrients** suspended in the blood's plasma, takes place along the **mid-section of a capillary.**

The direction of diffusion is determined by a material's concentration gradient. For example,

_____
_____
_____
_____.

_____
_____
_____
_____

<u>Circulation</u>

_____ the circulatory pathway that supplies oxygen-rich blood to and carries deoxygenated blood from the muscle tissue of the heart

_____ the circulatory pathway that carries oxygen-poor blood from the heart to the lungs and oxygen-rich blood from the lungs to the heart

_____ the circulatory pathway that carries oxygen-rich blood from the heart to the body tissues, and oxygen-poor blood from the tissues back to the heart

Circulation Pathway

1) The superior/inferior vena cava collect oxygen-poor blood coming from the tissues and dumps it into the right atrium.

2) The blood then flows from the right atrium into the right ventricle through the tricuspid valve.

3) Next, it leaves the right ventricle through the **pulmonary semi lunar valve** into the pulmonary arteries.

4) From there, it continues to the left and right lungs for gas exchange.

5) oxygen-rich blood from the lungs flows back to the heart through the pulmonary veins to the left atrium.

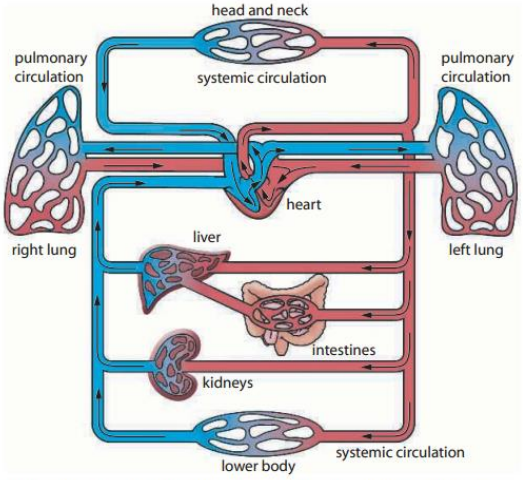


Figure 7.9 Trace the flow of blood through the pulmonary and systemic pathways. Arteries carry blood away from the heart; veins carry blood toward it. Note that in the systemic pathway, arteries carry oxygen-rich blood (red) and veins carry oxygen-poor blood (blue). The reverse is true in the pulmonary pathway: arteries carry oxygen-poor blood and veins carry oxygen-rich blood.

6) The left atrium pumps blood through the bicuspid valve into the left ventricle,

7) The left ventricle pumps blood through the **aortic semilunar valve** into the aorta

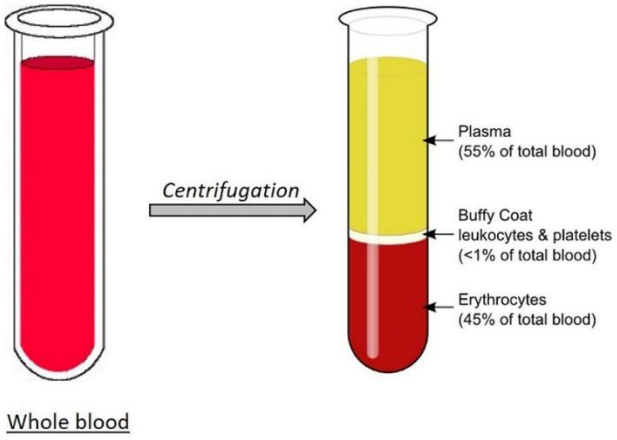
8) Blood is then dispersed from the aorta to all arteries.

9) It then passes from arteries in to capillaries and then veins before returning to the superior/inferior vena cava.

Components of Blood

_____ fluid portion of the blood, made up of water, dissolved gases, proteins, sugars, vitamins, minerals, hormones, and waste products

Plasma makes up about 55 percent of the blood volume.



Whole blood

Table 7.3 The Composition of Plasma

Constituent	Percentage
Water	~ 92%
Blood proteins fibrinogen serum albumin serum globulin	~ 7%
Other organic substances non-protein nitrogen (urea) organic nutrients	~ 0.1%
Inorganic ions calcium, chlorine, magnesium, potassium, sodium, bicarbonates, carbonates, phosphates	~ 0.9%

_____ (_____)
blood cell that contains the respiratory protein **hemoglobin** and is specialized for _____

make up approximately 44 percent of the total volume of blood.

A mature red mammalian blood cell has **no nucleus.**

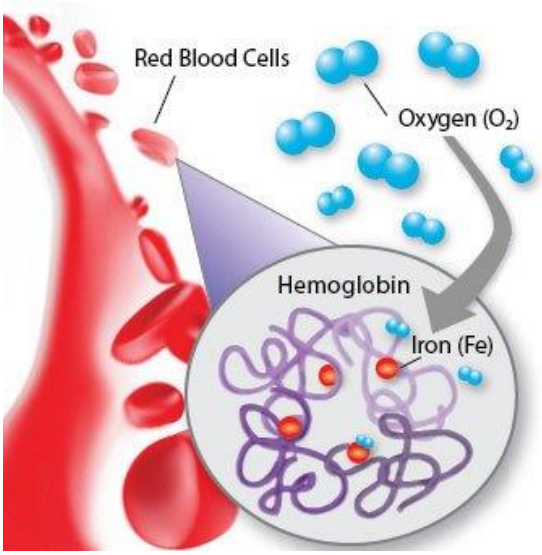
each **disk-shaped** red blood cell is packed with about 280 million iron-containing molecules of the respiratory pigment **hemoglobin.**

hemoglobin iron-containing respiratory pigment found in red blood cells that transports oxygen from the lungs to body tissues

After carbon dioxide diffuses into the blood, it enters the red blood cells, where a small amount is taken up by hemoglobin.

Magnification: 4175 ×

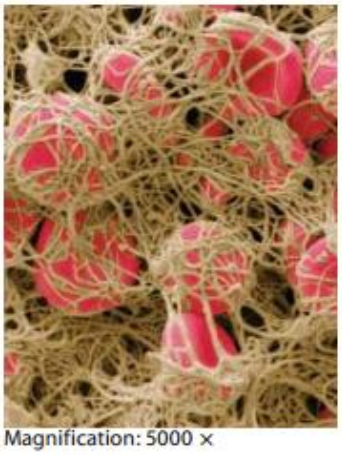
Figure 7.16 A mammalian red blood cell, also known as an erythrocyte, is a biconcave disk. Because the respiratory pigment hemoglobin reflects red wavelengths of light, oxygenated red blood cells appear to be a bright red colour. As oxygen is released, the colour that is reflected is a darker blue-red.



_____ component of the formed portion of the blood, consisting of fragments of cells that are created when larger cells in the bone marrow break apart; contains no nucleus and _____

_____

_____



Magnification: 5000 ×

Blood Clotting Process and positive feedback

Injury to a blood vessel starts a cascade of cellular events.

1) Substances released by the broken blood vessel attract platelets to the site. _____
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_____
_____

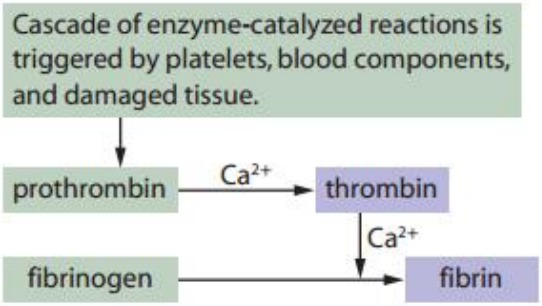


Figure 7.18 Fibrin threads wind around the platelet plug in the damaged area of a blood vessel, providing the framework for a clot.

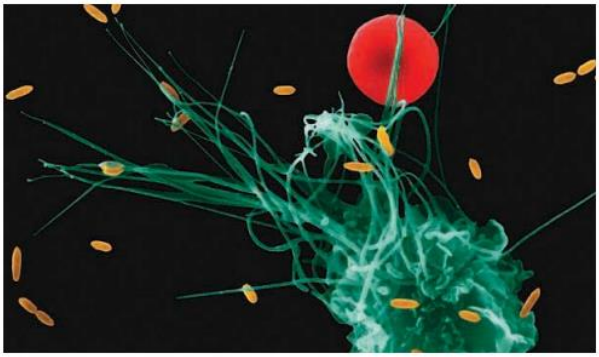
2) The collecting platelets rupture and release chemicals that combine with other blood components to produce an enzyme called thromboplastin.

3) As long as there are calcium ions (Ca2+) present, thromboplastin will react with prothrombin (a plasma protein produced by the liver) to produce thrombin.

4) Thrombin is an enzyme that reacts with fibrinogen (another plasma protein) to produce fibrin.

5) Fibrin is an insoluble material that forms a mesh of strands around the injured area. This mesh traps escaping blood cells and forms the clot.

Figure 7.17 A leucocyte, or white blood cell, attacking *Escherichia coli (E. coli)* bacteria. A single red blood cell is also visible.



_____

colourless blood cell that protects the body from infection by way of the immune response; also known as a leucocyte

Leucocytes make up about 1 percent of your total blood volume but may increase to more than double normal levels when your body is fighting an infection. All white blood cells have nuclei and appear to be colourless.

Blood and Homeostasis

Another important function of blood is to maintain homeostasis within the body, especially in relation to _____.

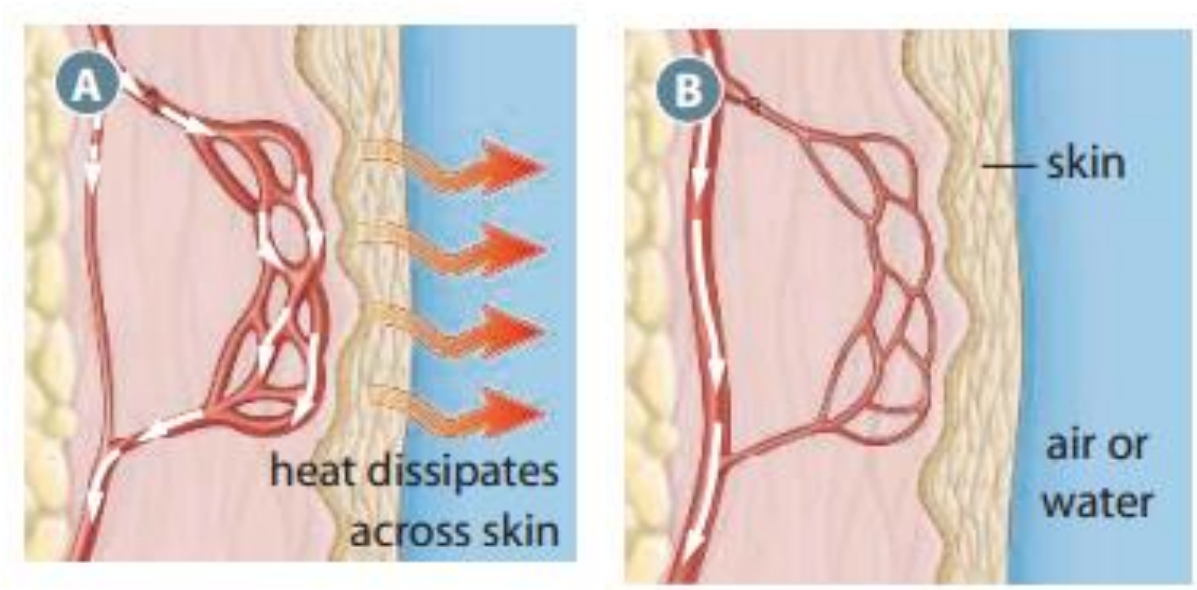
Temperature regulation involves balancing heat production with heat loss.

Shivering, increase the production of heat by cellular metabolism. The heat that is produced is spread through the body by the blood.

_____ decrease in the diameter of blood vessels; vasoconstriction near the skin conserves body heat

_____ expansion in the diameter of blood vessels; vasodilation near the skin brings more blood to the surface to help reduce body temperature

Figure 7.19 Vasodilation (A) and vasoconstriction (B)



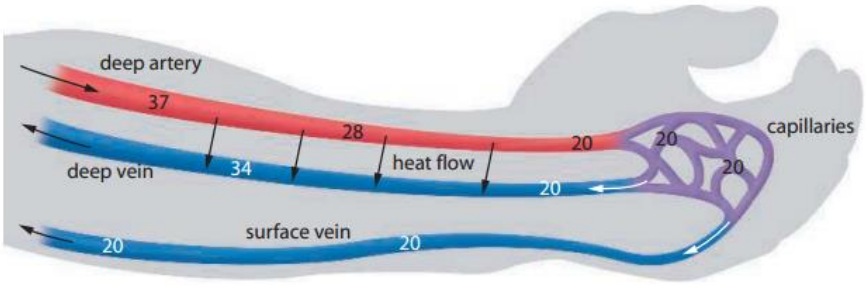


Figure 7.20 The counter-current heat exchange mechanism between the blood vessels in the human arm: The deep vein and artery are adjacent to one another, so heat is exchanged from one to the other. As a result, arterial blood is cooled as it nears the hand, and venous blood is warmed as it leaves the hand and returns to the body core. When heat conservation is important, more blood returns to the heart through the deep vein. In higher-temperature conditions, when heat conservation is not a concern, more blood returns through the surface vein. Numerals indicate the temperature of the blood in degrees Celsius.

Cardiovascular Fitness

Table 7.1 Relationship among Stroke Volume, Heart Rate, and Cardiac Output

Individual	Resting Heart Rate (beats/min)	Stroke Volume (mL/beat)	Cardiac Output (mL/min)
A	70	70	4900
B	98	50	4900
C	35	140	4900

According to this table, individual C's heart is exceptionally fit, having a very high stroke volume.

C can maintain the same level of cardiac output (and oxygen delivery) at a much lower heart rate than the less fit heart of B or the average heart of A.

This means that C's heart is working more efficiently than A's and B's.

_____
_____
_____

Maximum heart rate is the highest heart rate attained during an all-out physical effort. This rate diminishes with age.

Maximum heart rate does not appear to be related to cardiovascular fitness, however. _____

_____
_____
_____
_____

Recovery time diminishes as the heart becomes more fit.

Investigation 7.b Factors Affecting Heart Rate and Blood Pressure

The Human Immune System and Homeostasis

The lymphatic System

The _____ is a network of tissues and organs that help rid the body of toxins, waste and other unwanted materials.

The primary function of the lymphatic system is to transport lymph, a fluid containing infection-fighting white blood cells, throughout the body

Lymph is either **colourless or pale yellow and, in composition, is much like the plasma of blood.**

_____, also called _____ are part of the body's response to infection.

Leucocytes can be divided into three groups: granulocytes, monocytes, and _____.

Granulocytes consist of neutrophils, basophils, and eosinophils

_____ are white blood cells that are also one of the body's main types of immune cells. They are made in the bone marrow and found in the blood and lymph tissue.

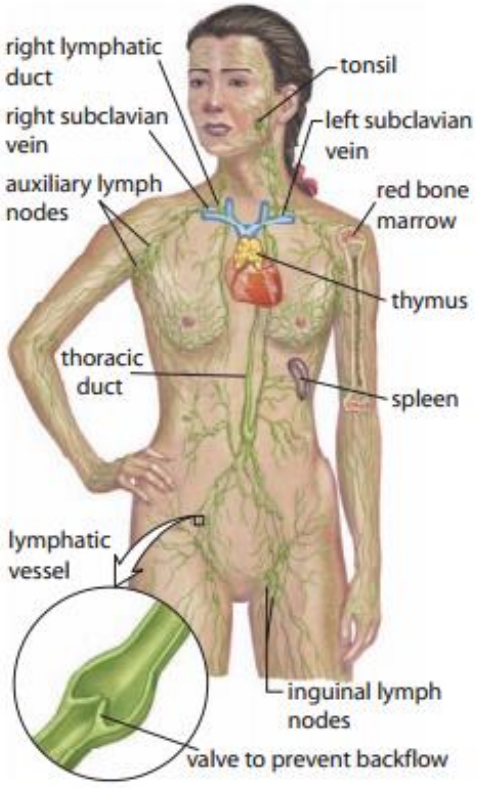


Figure 8.25 The human lymphatic system is spread throughout the body. Its largest vessels are in the region of the abdomen and thoracic cavity.

_____ (_____) are one of the major components of the adaptive immune system.

_____
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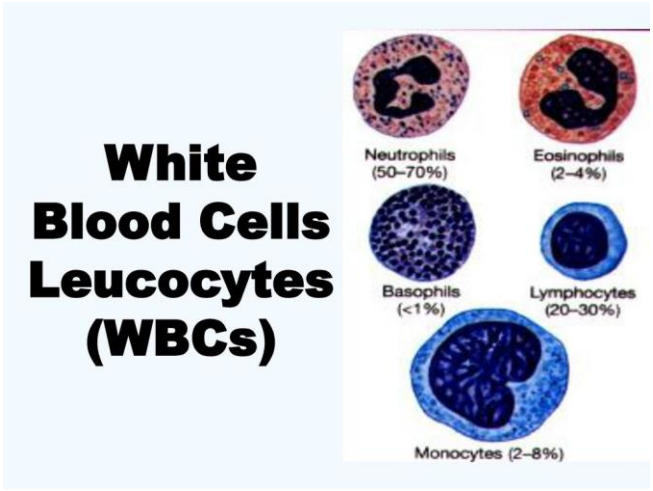
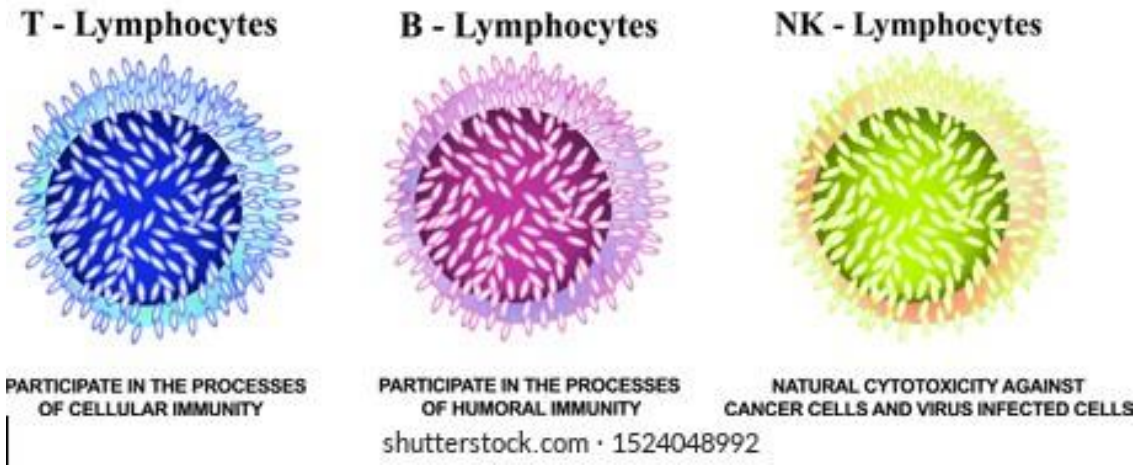


Types of Lymphocytes

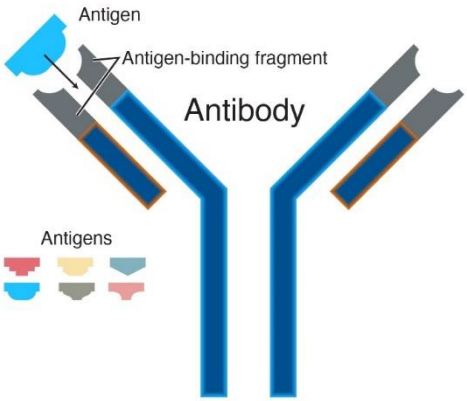


Lymphocytes

_____ are a type of white blood cell of the lymphocyte subtype. They function in the humoral immunity component of the adaptive immune system by secreting antibodies.

_____ are NK cells are classified as group I Innate Lymphocytes (ILCs) _____
_____

_____ are specialized, Y-shaped proteins that bind like a lock-and-key to the body's foreign invaders — whether they are viruses, bacteria, fungi or parasites. When these proteins bind to the body's foreign invaders they signal the immune system to get to work.



_____ are molecules that are found on the surface of the cells and on pathogens.

_____ is a type of phagocyte, which is a cell responsible for detecting, engulfing and destroying pathogens and apoptotic cells.

Macrophages are produced through the differentiation of monocytes, which turn into macrophages when they leave the blood.

The bacterium is taken into the macrophage in a vacuole, which then fuses with a lysosome.

The lysosome contents break down the macromolecules in the bacterium, killing it.

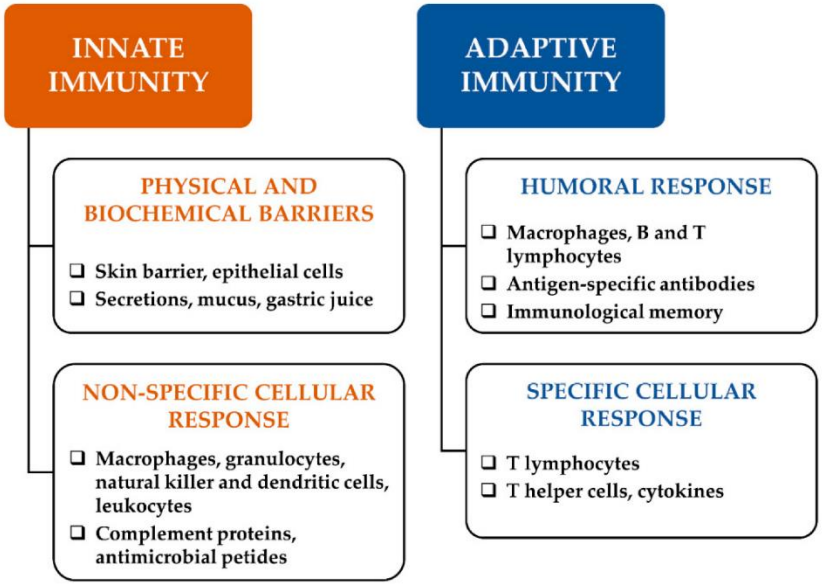
The Defense System

These defences can be divided into three groups:

1) barriers (innate)to keep pathogens out

2) non-specific (innate) defences against a wide variety of pathogens

3) specific defences (adaptive) against particular pathogens



_____ (_____)

The _____ are all of the _____
_____
_____
_____

The largest barrier is the skin. It is a hostile environment for the survival of many micro-organisms.

The outer layer of the skin is dry and contains large amounts of tough, relatively indigestible keratin.

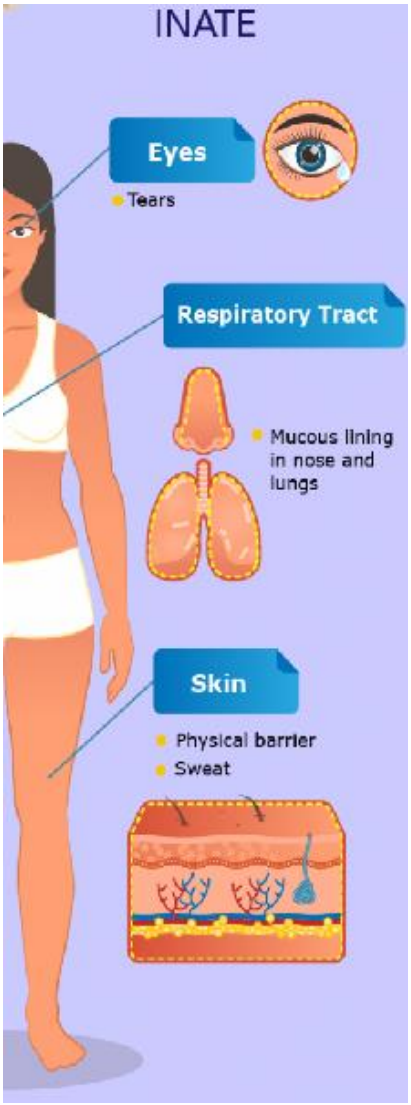
The skin's oil contains bactericides, and perspiration forms an acidic layer that is inhospitable for microbial growth.

_____ (_____)

The _____ is the non-specific defences, which include three types of white blood cells—**macrophages,** neutrophils, and monocytes—and so is called cell-mediated immunity.

Neutrophils and monocytes are white blood cells that kill bacteria using phagocytosis, a process in which they ingest the bacteria.

Macrophages, which develop from monocytes, also use phagocytosis. They are found in the liver, spleen, brain, and lungs, and **circulate in the blood** and interstitial fluid.



_____ **natural killer cells, which target body cells that have become cancerous or infected by viruses.**

_____ (_____)

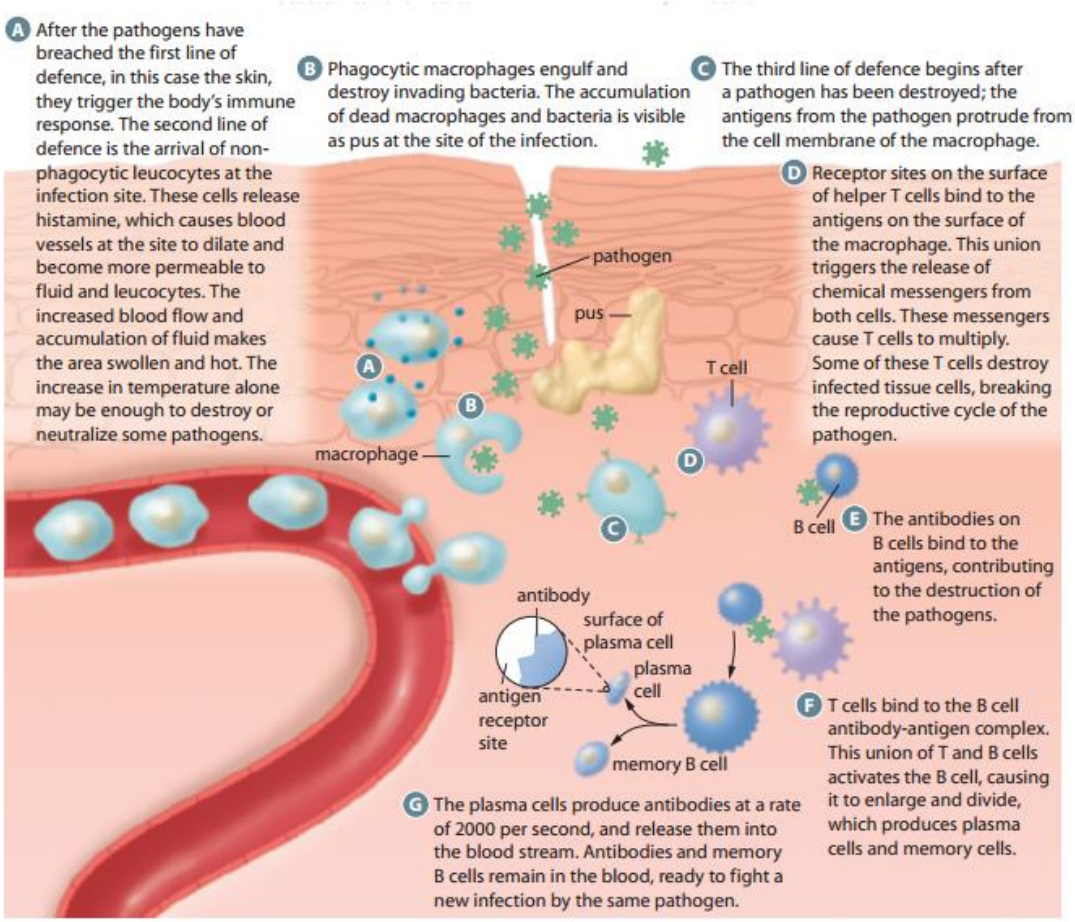
The _____.

Immunity is developed by the actions of the specific defences, using antibodies, and so is called antibody-mediated immunity.

Antibodies are proteins that recognize foreign substances and act to neutralize or destroy them. Because of exposure to foreign substances over time, as well as variations in genetic make-up, each person develops an immune system that is unique in its ability to deal with a wide variety of possible infections.

We are not all exposed to the same diseases, and some diseases require a stronger response than others because they are more virulent than others.

The specific immune system is primarily a function of the lymphocytes in the circulatory system. The lymphocytes are divided into two specialized groups, depending on where they mature. **B lymphocytes, or B cells,** mature in the bone marrow. **T lymphocytes, or T cells,** mature in the thymus gland, which is located near the heart.



Antibiotics/Vaccinations and a Healthy Society

_____ are medicines that fight bacterial infections in people and animals. They work by killing the bacteria or by making it hard for the bacteria to grow and multiply.

_____ a substance used to stimulate the production of antibodies and provide immunity against one or several diseases, prepared from the causative agent of a disease, its products, or a synthetic substitute, treated to act as an antigen without inducing the disease.

Antibiotics History

Antibiotics have been used for millennia to treat infections, although until the last century or so people did not know the infections were caused by bacteria.

the ancient Egyptians, for example, applied mouldy bread to infected wounds.

_____ – that are caused by bacteria, were the number one cause of human death in the developed world.

In 1909, Paul Ehrlich discovered that a chemical called _____ was an effective treatment for _____. This became the first modern antibiotic, although Ehrlich himself referred to his discovery as 'chemotherapy‘.

The word 'antibiotics' was first used over 30 years later by the Ukrainian-American inventor and microbiologist Selman Waksman, who in his lifetime discovered over 20 antibiotics.

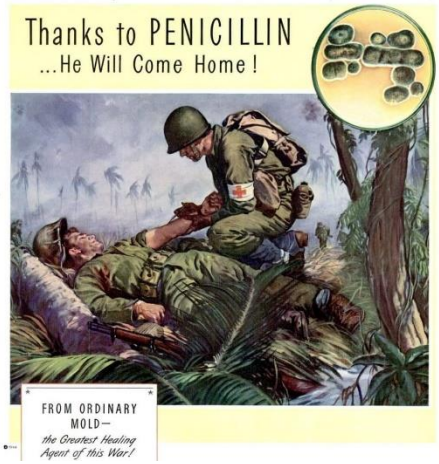
Alexander Fleming was, it seems, a bit disorderly in his work and accidentally discovered penicillin. Upon returning from a holiday in Suffolk in 1928, he noticed that a fungus, _____ _____ , had contaminated a culture plate of Staphylococcus bacteria he had accidentally left uncovered.

_____

wherever it grew on the plate. Fleming isolated and grew the mould in pure culture. He found that P. notatum proved extremely effective even at very low concentrations, preventing Staphylococcus growth even when diluted 800 times, and was less toxic than the disinfectants used at the time.

By D-Day in 1944, penicillin was being widely used to treat troops for infections both in the field and in hospitals throughout Europe. By the end of World War II, penicillin was nicknamed 'the wonder drug' and had saved many lives.

Scientists in Oxford were instrumental in developing the mass production process, and Howard Florey and Ernst Chain shared the 1945 Nobel Prize in Medicine with Alexander Fleming for their role in creating the first mass-produced antibiotic.



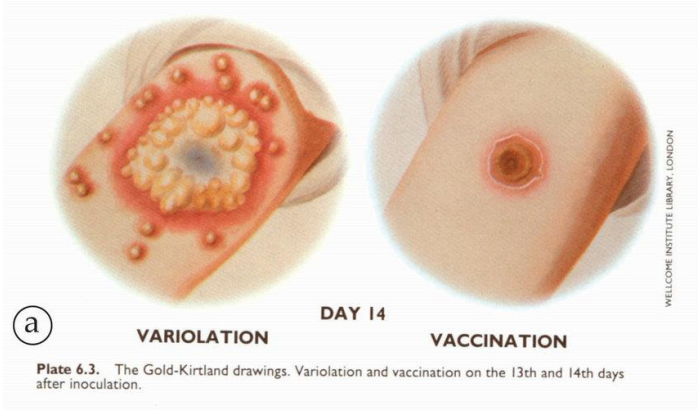
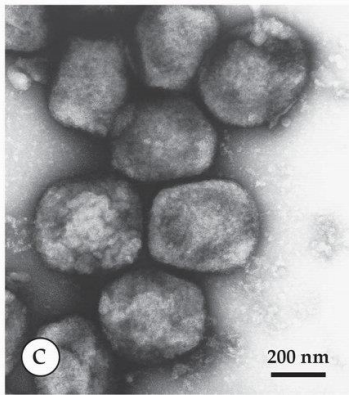


Plate 6.3. The Gold-Kirtland drawings. Variolation and vaccination on the 13th and 14th days after inoculation.



Vaccine History

The practice of immunisation dates back hundreds of years. **Buddhist monks drank snake venom to confer immunity to snake bite and variolation (smearing of a skin tear with cowpox to confer immunity to smallpox) was practiced in 17th century China.**

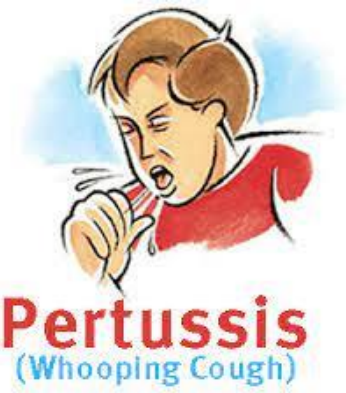
Edward Jenner is considered the founder of vaccinology in the West in **1796, after he inoculated a 13 year-old-boy with vaccinia virus (cowpox), and demonstrated immunity to smallpox.** In 1798, the first smallpox vaccine was developed. Over the 18th and 19th centuries, systematic implementation of mass smallpox immunisation culminated in its global eradication in 1979.

_____ experiments spearheaded the development of live attenuated cholera vaccine and inactivated anthrax vaccine in humans (1897 and 1904, respectively).

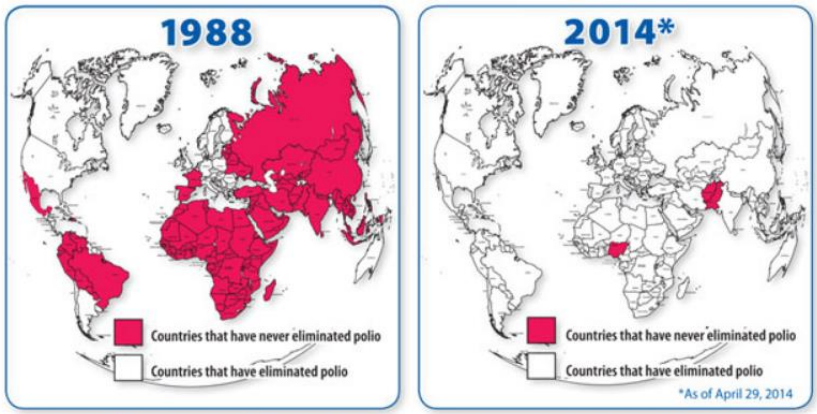
_____vaccine was also invented in the late 19th Century. Between 1890 and 1950, bacterial vaccine development proliferated, including the **Bacillis-Calmette-Guerin (BCG) vaccination, which is still in use today.**

In 1923, **Alexander Glenny** perfected a method to **inactivate tetanus toxin with formaldehyde.** The same method was used to develop a vaccine against **diphtheria in 1926.**

_____(_____)
vaccine development took considerably longer, with a whole cell vaccine first licensed for use in the US in 1948.



Viral tissue culture methods developed from 1950-1985, and led to the advent of the Salk (inactivated) _____ and the Sabin (live attenuated oral) polio vaccine. Mass polio immunization has now eradicated the disease from many regions around the world



Progess of polio elimination 1988 and 2014
Image:CDC

Molecular Genetics (Bio 3201)

The past two decades have seen the application of molecular genetics and its increased insights into immunology, microbiology and genomics applied to vaccinology. Current successes include the development of _____, the less reactogenic acellular pertussis vaccine, and new techniques for seasonal influenza vaccine manufacture.

Molecular genetics sets the scene for a bright future for vaccinology, including the development of new vaccine delivery systems (e.g. DNA vaccines, viral vectors, plant vaccines and topical formulations), new adjuvants, the development of more effective tuberculosis vaccines, and vaccines against **cytomegalovirus (CMV), herpes simplex virus (HSV), respiratory syncytial virus (RSV), staphylococcal disease, streptococcal disease, pandemic influenza, shigella, HIV and schistosomiasis among others. Therapeutic vaccines may also soon be available for allergies, autoimmune diseases and addictions.**

https://www.historyofvaccines.org/timeline/all

How the Immune System Maintains Homeostasis

The _____ contributes to _____
_____
_____
_____

During infection, the immune system will cause the body to develop a _____.

The immune system also causes _____
to bring oxygen and other immune cells to sites of infection.

In addition, the immune system helps in _____, that proper barriers in organs can be reformed such that those organs can correctly participate in homeostasis.

Fever

When a body is infected by bacteria or viruses, the body must invest a lot of energy to fight off the invaders.

There is no point in maintaining homeostasis of hydration levels and the many other systems the body regulates if the whole organism is going to die from infection.

Pyrogens are released by infected cells or infectious agents.

Their presence alerts the brain to increase body temperature, which it does by ordering the body to retain heat.

This results in a fever. _____
_____
_____
_____
_____

Increase in Blood Flow

The site of an injury or infection will turn red, swell, and feel tender and warm.

These are the symptoms of what is called inflammation.

Immune cells rush to the site and release chemicals that cause these symptoms.

Mast cells are immune cells which release chemicals that enlarge, or dilate, the blood vessels at the site of a bruise or a cut.

_____
_____
_____

Increased blood flow means faster repair. Faster repair means the body can get back to normal faster.

Wound Healing

_____

_____

At the site of damage, dead or broken cells are eaten by immune cells called macrophages.

In **damaged skeletal muscle**, macrophages accumulate at the site of injury and **release a protein that causes muscle cells to regrow.**

In **damaged skin,** macrophages fill up the wound and release chemicals that cause **new blood vessels to form.**

These **blood vessels will be necessary to bring nutrients to and remove wastes** from the new skin cells that will form.

Until the wound is repaired, the body is at higher risk of infection and homeostasis cannot be fully attained.

Memory Cells

Immune cells called T or B lymphocytes become activated for battle after they encounter foreign proteins that were captured from invading organisms. After finding a protein molecule from a particular type of foreign invader, T and B cells train themselves to fight against this invader. T and B cells can undergo what is called clonal selection, which is the process in which they divide to make **two different types of copies of themselves. One type of copied cell is called the effector cells, which go right into battle fighting invaders. The other type of copied cell is called memory cells,** which stay inactive in the body for a long time, waiting to encounter the same invader in the future so that they can mount a faster attack the second time around**. Memory cells make the body better prepared for future invasions, which makes it easier to maintain homeostasis in the future.**

Circulatory/Immune System Poster Assignment

The Respiratory System and Homeostasis

_____ system responsible for gas exchange (bringing oxygen into the body and removing carbon dioxide from the body)

Respiration and Homeostasis

There are three main requirements for respiration.

1) The respiratory surface must be large enough for the exchange of oxygen and carbon dioxide to occur at fast enough rates to meet the body's needs.

2) The respiratory surface must be moist: respiration must take place in a moist environment so that the oxygen and carbon dioxide are dissolved in water.

3) The respiratory surface must be thin enough to allow oxygen and carbon dioxide to diffuse across it.

Stages of Respiration

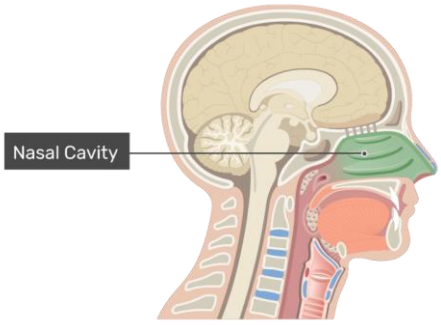
1) _____ involves two basic processes: _____ (breathing in, or inhaling) and expiration (breathing out, or exhaling). Inspiration moves air from the external environment to the lungs inside the body. _____ moves air from the lungs back to the external environment.

2) _____ is the exchange of oxygen and carbon dioxide between the air and the blood.

3) _____ is the series of energy-releasing chemical reactions that take place inside cells. Cellular respiration is the final stage in respiration; it is the only means of providing energy for all cellular activities, and it helps the body maintain homeostasis.

Structures of the Respiratory System the Upper Respiratory Tract

_____ passage from the nostrils to the back of the throat through which air enters the body



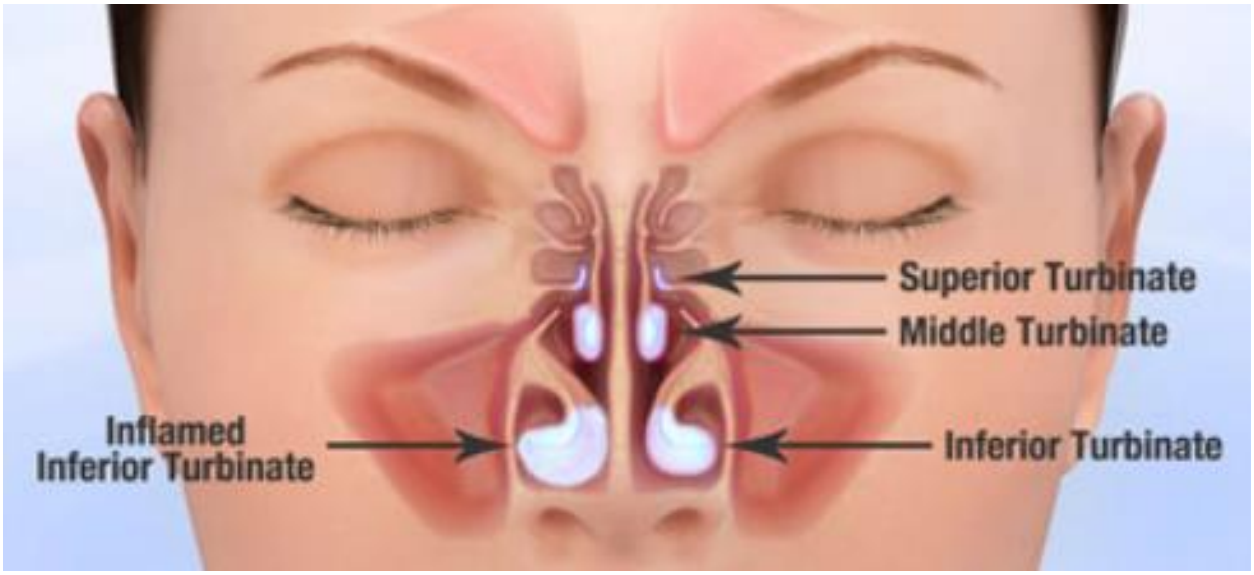
It is lined with ciliated cells, like those shown in Figure 6.3. Other cells secrete mucus, which cleans the air by trapping foreign particles, such as dust and bacteria.

The action of the ciliated cells moves the foreign particles back up into the nose and throat.

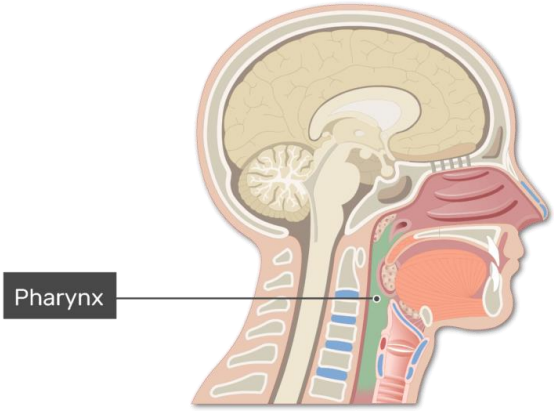
The foreign particles can then be expelled by coughing or sneezing.

Very thin bones, called turbinate bones, project into the nasal cavity. These bones serve an important function by increasing the surface area of the nasal cavity. They are covered in cilia, which catch and remove particles in the air. The turbinate bones, and the rest of the lining of the nasal cavity, are covered with a thin membrane that secretes mucus and is well-supplied with blood vessels. The heat

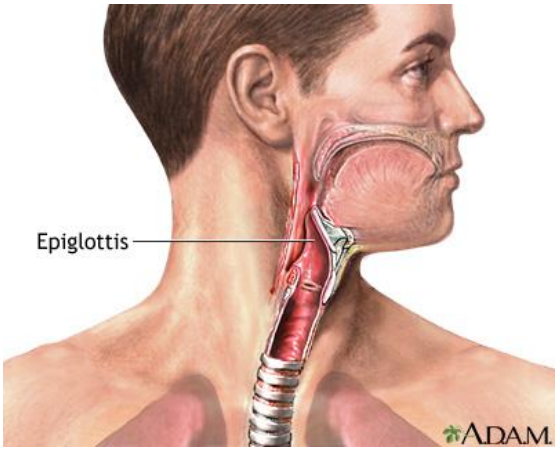
from the blood warms the air as it passes through, and the mucus moistens the air. Both the warming and the moistening of the air are necessary to protect the delicate structures that are found in the lower respiratory tract.



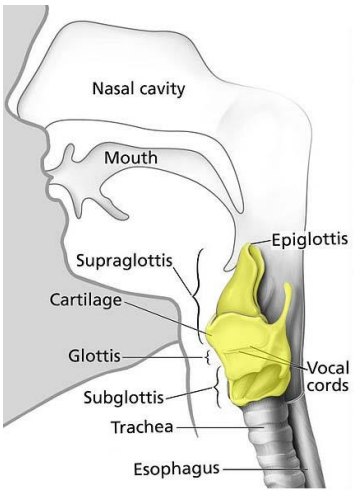
_____ passage way that connects back of mouth and nasal cavity to larynx and esophagus



_____ flap of cartilage over entrance of trachea



This prevents food and drink from entering the trachea and passing into the bronchi of the lungs. When the epiglottis is at rest, it is upright and allows air to pass unobstructed into the lower respiratory tract.



larynx structure that contains the vocal cords

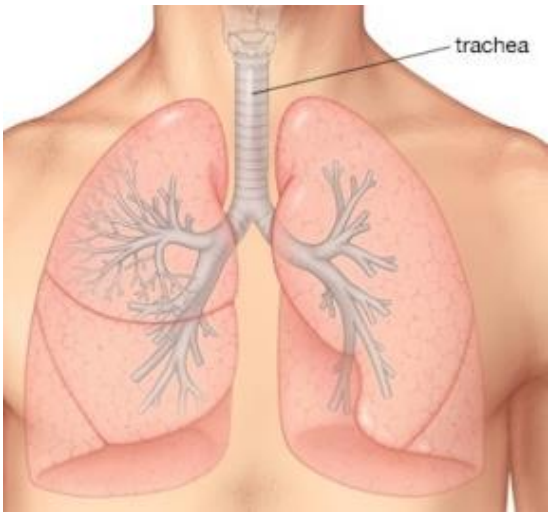
Also known as the voice box.

Made from cartilage - a tough and firm connective tissue

- Not curriculum

_____ flexible tube through which air moves from the mouth to the bronchi

Also known as the windpipe.

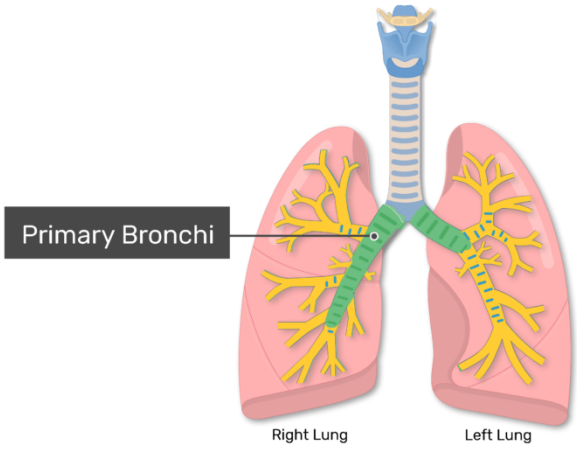


_____
_____
_____
_____
_____ The open part of the semicircle faces the esophagus and allows the esophagus to expand when food is being swallowed.

<u>The Lower Respiratory Tract</u>

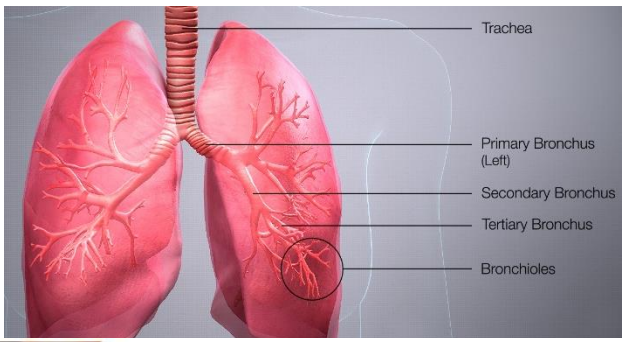
_____ passageways that branch from trachea into lungs (singular: bronchus)

The bronchi contain C-shaped cartilaginous rings that surround and are part of the bronchus wall. They are stacked one on the next, running the length of the bronchus and providing support.



bronchioles passageways that branch from bronchi into lobes of lungs

Bronchioles do not have C rings.

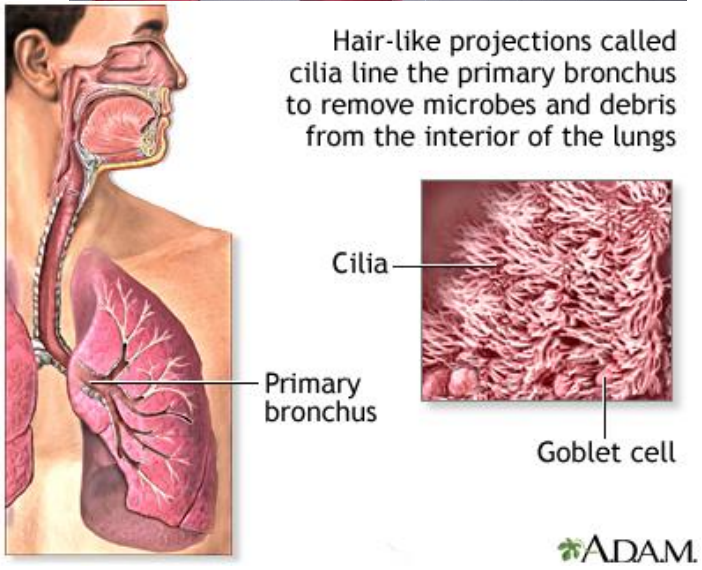


Both the bronchi and bronchioles are lined with cilia and mucus-producing cells, just as in the upper respiratory tract.

The mucus captures foreign particles, such as microscopic pollutants and pathogens.

The cilia move the foreign particles up into the upper respiratory tract.

From there, the foreign particles can be ejected from the body by coughing or sneezing, or they can be swallowed.



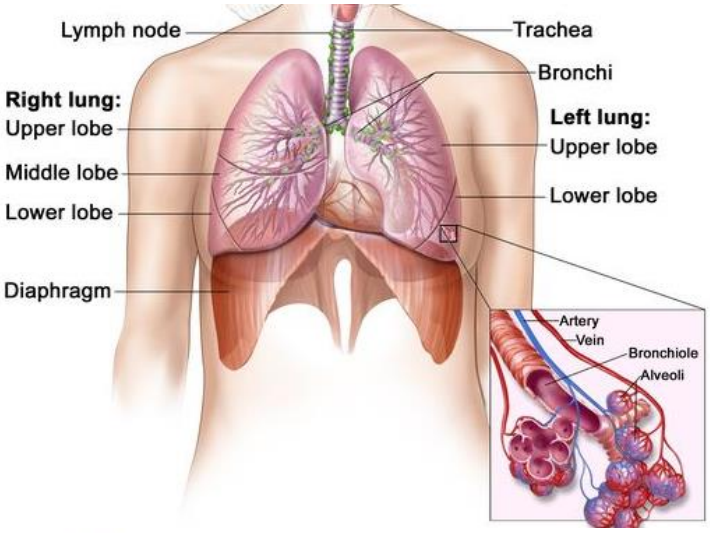
_____ are the principal organs of respiration. Site of gas exchange in the human body.

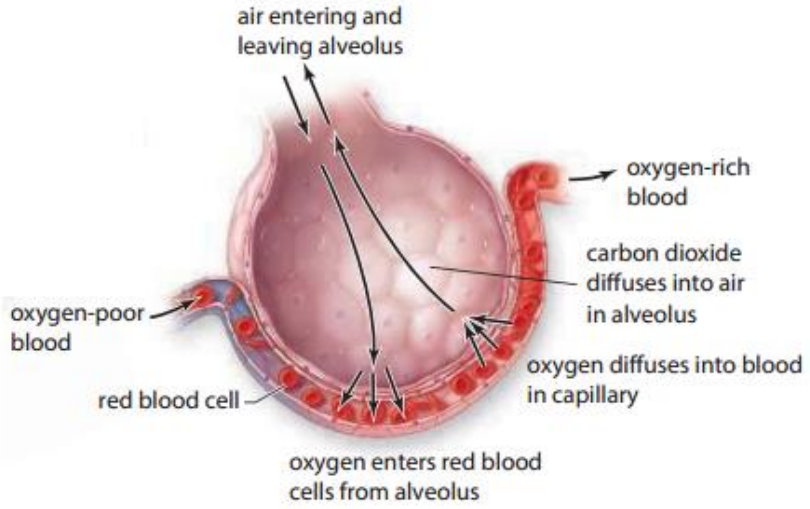
_____ gas exchange structures within the lungs (singular: alveolus)

The alveolar wall is one cell thick and is surrounded by a network of tiny capillaries

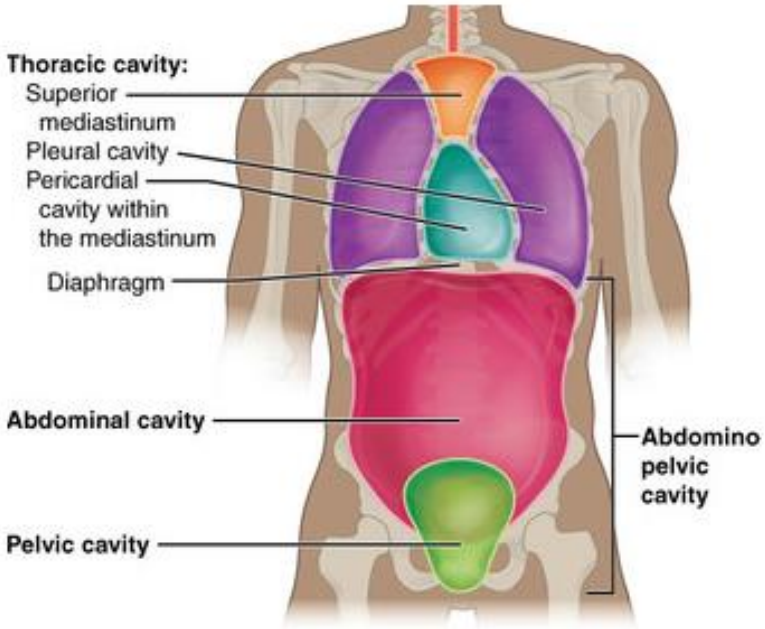
Capillaries are tiny blood vessels—their walls are also one cell thick—that link the arteries with the veins. (Arteries carry oxygen-rich blood from the heart to the body tissues. Veins carry oxygen-poor blood from the body tissues back to the heart.) **Where capillaries surround the alveoli, carbon dioxide dissolved in the blood is exchanged for oxygen.**

The alveoli are lined with a fluid that permits the diffusion of gases and that helps to keep them from collapsing and prevents their sides from sticking together and closing.





_____ sheet of muscle separating thoracic and abdominal cavities



The Mechanics of Breathing

_____ movement of air into lungs

the external rib muscles and the diaphragm contract.

This action expands the rib cage _____, and the floor of the chest cavity downward. Since the thoracic cavity is airtight, its volume increases. The increase in volume means that the same amount of air is contained in a larger space. When the molecules of a gas are farther apart, as they are when the volume of the thoracic cavity increases, they exert less outward pressure. _____
_____

_____ movement of air out of lungs

_____,
reducing the volume of the thoracic cavity.

As a result, the volume of the lungs decreases, _____
_____, and air moves from the lungs to the lower-pressure environment outside the body.

In other words, a change in air pressure causes air to move from an area of high pressure (the lungs) to an area of lower pressure (the external environment).

Respiratory Volume

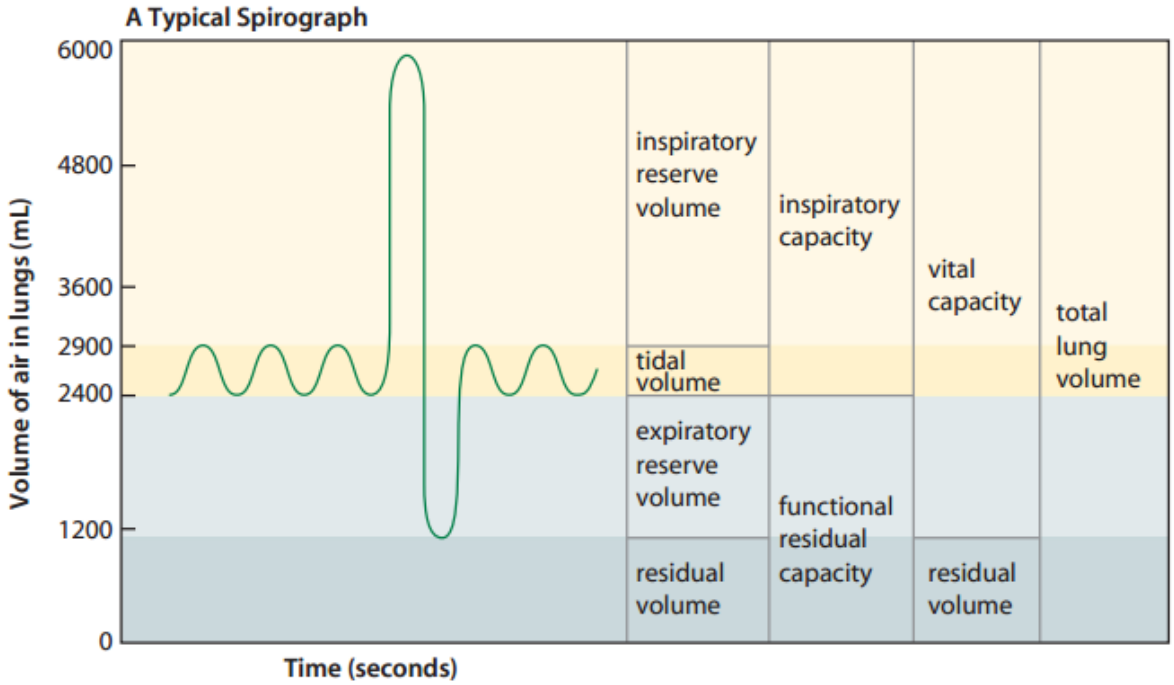
_____ volume of air inspired and expired in normal breathing at rest

_____ the additional volume of air that can be taken into the lungs, beyond a regular inspiration

_____ additional volume of air that can be forced out of the lungs, beyond a regular expiration

_____ total volume of gas that can be moved in or out of lungs

_____ amount of gas left in lungs after a full expiration



Investigation 6.B Measuring Respiratory Volumes

Launch Lab Modeling Your Lungs

Environmental Factors Affecting the Respiratory System

Dangerous chemicals in tobacco smoke

Highly damaging components of tobacco smoke include:

_____ – is the word for the solid particles suspended in tobacco smoke. The particles contain chemicals, including cancer-causing substances (carcinogens). Tar is sticky and brown, and stains teeth, fingernails and lung tissue

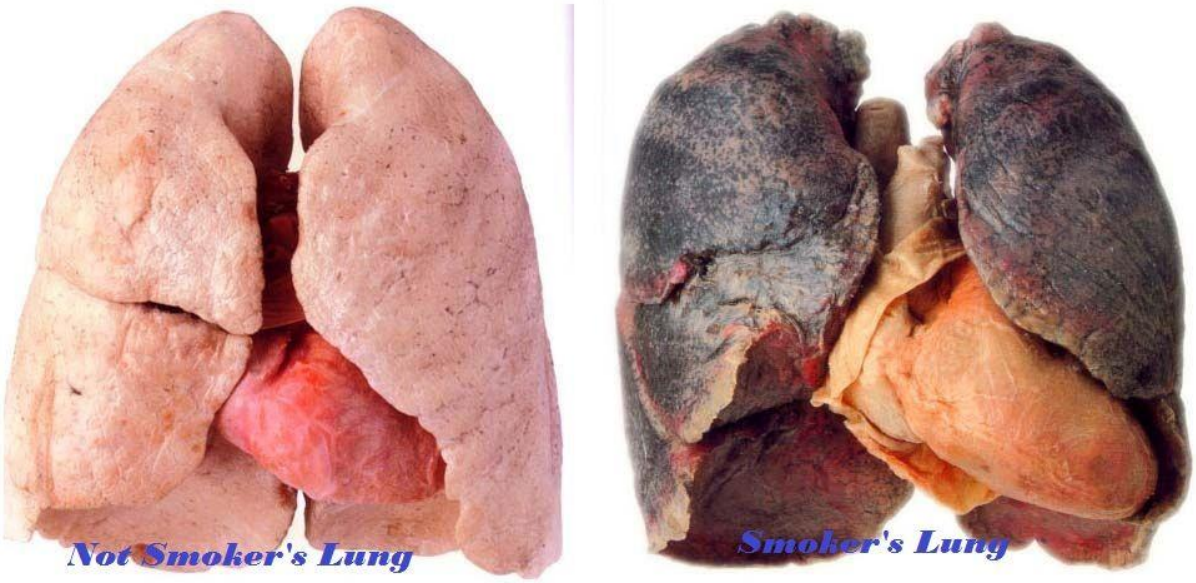
_____ – is a poisonous gas. It is odourless and colourless and, in large doses, quickly causes death because it takes the place of oxygen in the blood. In people

who smoke, the carbon monoxide in their blood makes it harder for oxygen to get to their organs and muscles

_____ – are highly reactive chemicals that can damage the heart muscles and blood vessels of people who smoke. They react with cholesterol, leading to the build-up of fatty material on artery walls. Their actions lead to heart disease, stroke and blood vessel disease

_____ – tobacco smoke contains several metals that cause cancer, including arsenic, beryllium, cadmium, chromium, cobalt, lead and nickel

_____ – tobacco smoke contains radioactive compounds that are known to be carcinogenic.



Cigarette Smoke

The effects of tobacco smoke on the respiratory system include:

1.) Irritation of the trachea (windpipe) and larynx (voice box)
2.) Reduced lung function and breathlessness due to swelling and narrowing of the lung airways and excess mucus in the lung passages
3.) Impairment of the lungs' clearance system, leading to the build-up of poisonous substances, which results in lung irritation and damage
4.) Increased risk of lung infection and symptoms such as coughing and wheezing
5.) Permanent damage to the air sacs of the lungs.

Vaping Fumes

Nicotine dependence: vaping products contain large amounts of nicotine, which is a highly addictive drug. For instance, 1 Juul Pod (Juul is one brand name of a vaping product) has the same amount of nicotine as 20 cigarettes (approximately one pack). This means people may develop dependence quickly and it may even increase your chances of smoking traditional cigarettes.

Short-term symptoms: Individuals should watch for signs of cough, shortness of breath, chest pain, nausea, vomiting and/or diarrhea. These may be signs of lung damage. If you are experiencing these symptoms, seek medical attention.

Lung disease: Vaping can make asthma and other existing lung diseases worse. Breathing in the harmful chemicals from vaping products can cause irreversible (cannot be cured) lung damage, lung disease and, in some cases, death. Some chemicals in vaping products can also cause cardiovascular disease and biological changes that are associated with cancer development.

Allergens – dust and mold

Allergies can cause inflammation in your lungs. This inflammation can result in coughing, wheezing, shortness of breath, and other symptoms.

The symptoms of allergies, such as **nasal congestion and watery eyes**, come from inflammation of your body tissues. Allergies can also cause inflammation in your lungs. This inflammation is the result of your body's misguided attempt to protect itself from the allergens.

Allergies can cause lung problems. Exposure to allergens can cause allergy-induced **asthma,** a condition in which the airways swell and produce extra mucus.

Individuals with allergies are at higher risk of developing **respiratory infections**, such as bronchitis. Exposure to seasonal allergies can **compromise the immune system and increase mucus production,** which can promote the development of **bronchitis and other respiratory infections.**

People can develop hypersensitivity to dust, tiny organisms, and chemicals. This hypersensitivity can cause hypersensitivity **pneumonitis,** a type of allergic reaction that causes i**nflammation of the lung's air sacs.**

The Respiratory Systems Allergic Response

During an asthma attack, the bronchi and bronchioles swell, the bronchial muscles tighten, and mucus production increases. These changes obstruct the airways and make breathing difficult or impossible.

Other airborne chemicals

Many types of gases—such as **chlorine, phosgene, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, and ammonia**—may suddenly be released during industrial accidents and may severely irritate the lungs. Gases have also been used as chemical warfare agents.

Gases such as **chlorine and ammonia easily dissolve and immediately irritate the mouth, nose, and throat.** The parts deep inside the lungs are affected only when the gas is inhaled deeply. A common household exposure occurs when a person mixes household ammonia with cleansers containing bleach. The irritant gas chloramine is released.

Some gases—for instance, **nitrogen dioxide**—do not dissolve easily. Therefore, they do not produce early warning signs of exposure, such as irritation of the nose and eyes, and they are more likely to be inhaled deeply into the lungs. **Such gases can cause inflammation of the small airways (bronchiolitis) or lead to fluid accumulation in the lungs (pulmonary edema).**

Silo filler's disease (which mostly affects farmers) results from inhaling fumes that contain **nitrogen dioxide** given off by moist silage, such as fresh corn or grains**. Fluid may develop in the lungs as late as 12 hours after exposure.** The condition may temporarily resolve and then recur 10 to 14 days later, even without further contact with the gas. A recurrence tends to affect the small airways (bronchioles).

Inhalation of some gases and chemicals may also trigger an allergic response that leads to inflammation and, in some cases, scarring in and around the tiny air sacs (alveoli) and bronchioles of the lung. This condition is called hypersensitivity pneumonitis.

Radioactive gases, which may be released in a nuclear reactor accident, may cause **lung cancer** and other cancers many years after the exposure.

Other inhaled gases may cause a **general body poisoning (including breathing difficulty)** because they are poisonous to the body's cells (such as cyanide) or because they **displace oxygen in the blood** and therefore limit the amount of oxygen reaching the tissues (such as methane or carbon monoxide).

In some people, **inhalation of small amounts of gas or other chemicals over a long period may result in chronic bronchitis (inflammation of the airways).** Also, inhalation of some chemicals, such as **arsenic compounds and hydrocarbons, can cause cancer.** Cancer may develop in the lungs or elsewhere in the body, depending on the substance inhaled.

Respiratory System Disorder Poster
Tonsillitis
Laryngitis
Bronchitis
Bronchitis
Pneumonia
Pleurisy
Emphysema
Cystic Fibrosis
Asthma
Lung Cancer

Investigation 6.A The Alveoli Area Advantage

Investigation 6.C Breathing Rate and Oxygen Demand