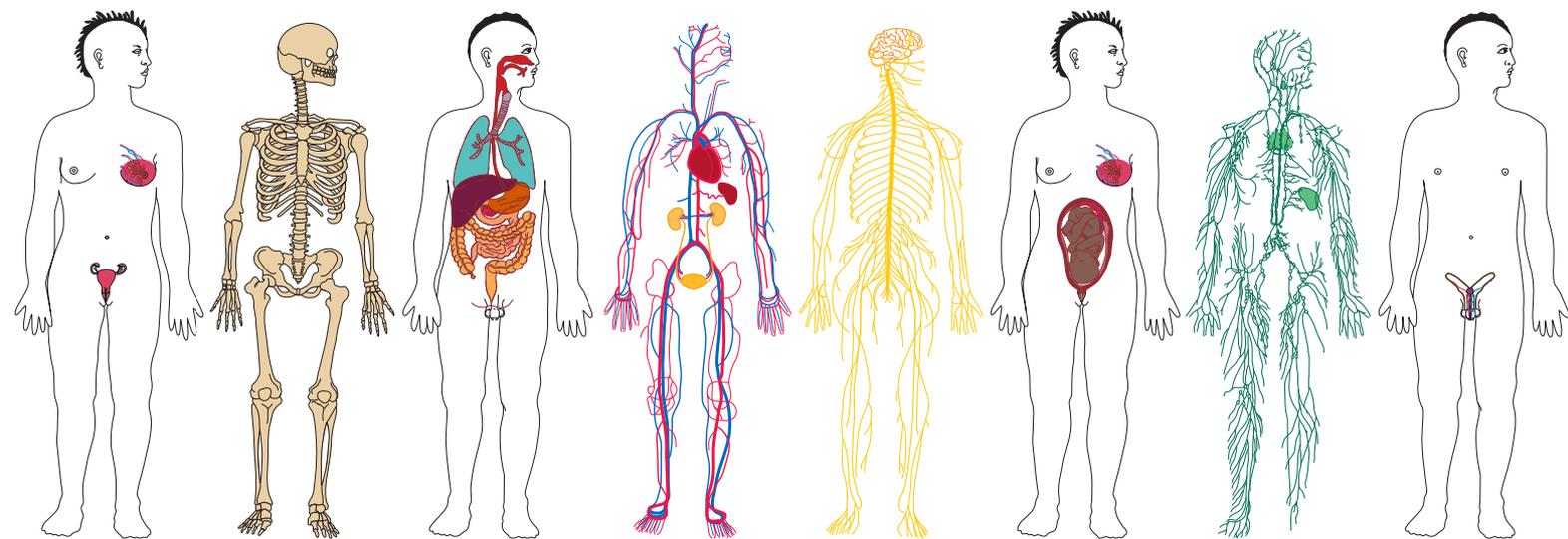


Mapping our Lives

Visual Body Map Resource Guide



For Educators



University of Cape Town

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Resource Guide

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The Visual Body Map

Introduction

This visual material and resource guide aims to support participatory learning in the classroom and other peer-education settings. The visual body map reveals the hidden parts of the body in a simple and accessible way. It consists of nine different PVC sheets that represent nine of the body's systems. This allows each system to be studied independently or in relation to one or more of the other systems. It is suitable for primary and high school learners as well as adults. It is a valuable resource for HIV/AIDS education, anti-retroviral treatment literacy and general classroom biology.

Research and Development

This anatomical body visual came about while testing the You, Me and HIV teacher's hand-book. It emerged that educators needed a visual resource in order to demonstrate how the complex systems of the human body work and interact. Peer-educators experienced similar problems when teaching about HIV/AIDS and the human body.

The AIDS and Society Research Unit (ASRU) at the University of Cape Town supported the idea of developing a series of body visuals and a resource guide that would be anatomically correct, but not too complex to understand. This would contribute to ASRU's peer-education and psychosocial support for people living with HIV/AIDS.

An assessment of the available materials found that none met the needs of the educators nor the learners for a unified representation and explanation of the body and its systems. The research and development of the body visual involved showing different types of illustrations, drawings and photographs of the human body to HIV-positive adult support groups, educators and learners in Grade 6 and 7. Both adults and youth preferred large, bold and coloured representations of the body's systems. Accordingly, this Resource Guide was developed to provide basic, accurate and relevant information to support the illustrations.

What does the Visual Body Map consist of?

The body visual consists of seven sheets of transparent PVC plastic, two white sheets of PVC plastic and two hanging stands. The nine PVC sheets (2 x white, 7 x clear) show representations of:

- 1 Male Body and Reproductive System**
- 2 Female Body and Reproductive System**
- 3 Skeletal System**
- 4 Nervous System**
- 5 Circulatory System**
- 6 Lymphatic System**
- 7 Respiratory System and Digestive System**
- 8 Front Rib-cage**
- 9 Full-term (38 week) baby**

The Human Body

Cells

Life begins when the mother's egg is fertilized by the father's sperm. At this point the egg and the sperm join together to form a single cell. The cell is the basis (or building block) of all living things, including humans. At the beginning, this one cell divides into 2 then 4, then 8 and so on to create a new human being.

The human body is made up of millions of cells. Different cells perform different tasks. Cells are tiny. A new born baby's finger contains about 10 billion cells. Throughout life, the body is constantly producing new cells:

- for growth e.g. bone cells
- for repair cells become worn out and die. 3 billion of the body's cells die every minute; most are renewed by the body

All cells need oxygen and nutrients to **function** (carry out their tasks) and to replace old cells.

Fluids

Approximately two thirds of the human body is water, which makes up a large part of the **body fluids**.

Body fluids include:

- **semen**
- **saliva**
- **tears**
- **blood**
- **sweat**
- **urine**
- **vaginal fluid**
- **lymph**
- **breast milk**

There is also body fluid in and around the cells. We will look at the functions of some of these body fluids in greater detail later.

How can we learn about the human body?

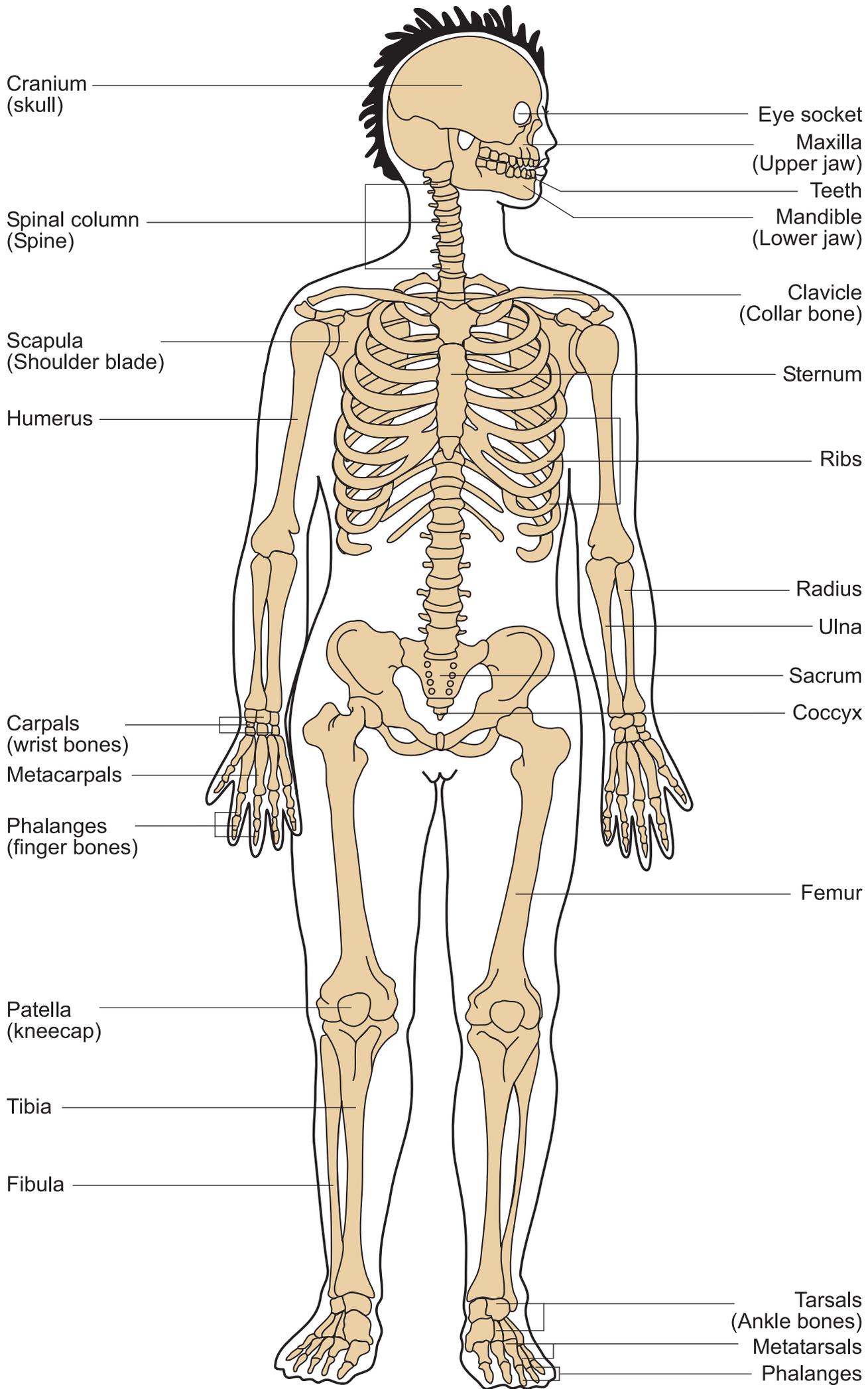
It is useful to look at the human body in sections in order to understand it. The body is usually divided into systems, each system performing a particular function. All the systems are linked, and work together.

Body systems are made up of **organs**, which are a collection of **tissues**, which are a collection of **cells**.



Example:

The circulatory **system** consists of the heart, the blood vessels and blood. The heart is an **organ**, consisting largely of muscle **tissue**. The muscle tissue of the heart is made up of special **cells** that give the heart its ability to act as a pump.



Skeletal System

What does the skeletal system consist of?

The skeletal system consists of 206 bones.

What does the skeletal system do?

- Gives the body shape and support
- Allows movement
- Protects the delicate organs and tissues of the body
- Produces blood cells

How does the skeletal system work?

Protection

The outer shell of bone is hard and rigid. Minerals from blood (such as calcium and phosphorus) help to make bone tissue strong. Bones are specifically shaped e.g. the skull covers the brain like a crash helmet, and the spine forms a tube to encase the spinal cord.

Movement

Muscles are attached to bones by bands of strong tissue called **tendons**. Muscles are made of strands or fibres. It is the contracting (or shortening) of muscle fibres that pulls the bones in different directions. The muscles contract and relax in response to messages from the brain (which we will look at in more detail later).

Joints are where two or more bones meet.

Blood cell production

Bone marrow is found within some bones in the body, such as the femur (thigh bone). Bone marrow produces blood cells.

The Skin

What does the skin do?

Skin is the barrier that protects the body as it interacts with the world around it.

How does the skin work?

The skin is made up of more than one tissue.

Outer layer: the outer layer of the skin is strong, waterproof, pliable and elastic.

Sweat glands: sweat glands produce sweat that rids the body of some of its waste and keep the skin cool.

Nerve endings: nerve endings provide the sense of touch. Feeling pain is one way in which the body avoids injury.

Sebaceous glands: sebaceous glands produce oil which keeps skin supple and prevents it from drying. Fingers and toes do not produce this oil which is why they wrinkle after a long period in water.

Hair follicles: hair follicles produce hair that provides warmth.

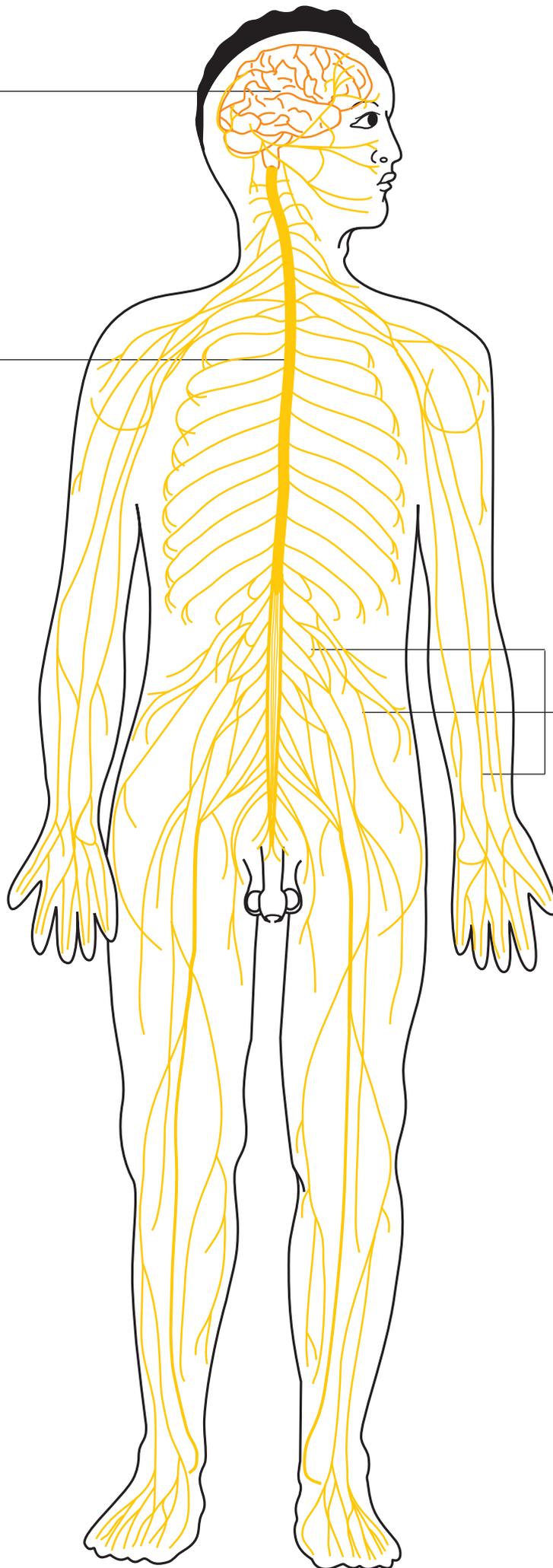
Pigment or colour: special skin cells produce pigment that provides some protection against the sun.

Tears: special cells in the skin around the eyes produce tears. Tears keep the eyes moist and free of germs.

Brain

Spinal Cord

Nerves



Nervous System

The nervous system consists of:

● **Brain**

● **Spinal cord**

● **Network of nerve fibres**

What does the nervous system do?

The nervous system is responsible for control and communication in the human body.

How does the nervous system work?

The nervous system is composed of millions of nerve cells. When we talk about nerves we refer to a collection of **nerve fibres** (made of nerve cells and called **nerves**) which act like bundle of telephone wires. Nerves reach every part of the body and carry messages to and from the brain at speeds of up to 100 metres per second.

Different nerves have different functions:

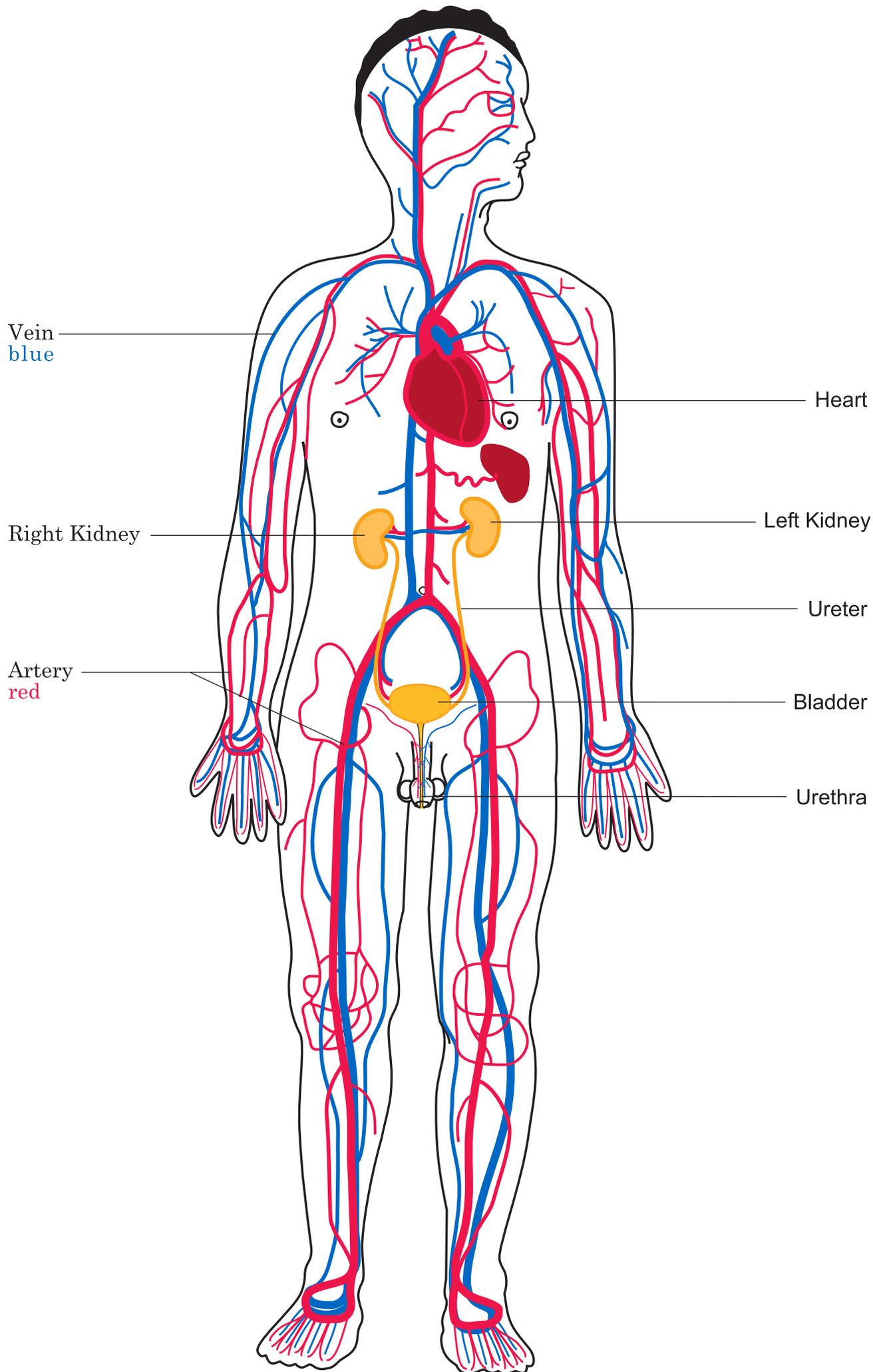
- **Sensory** nerves carry information received via the senses to the brain i.e. sight, hearing, touch, taste and smell.
- **Motor** nerves carry messages from the brain to the skeletal muscles instructing them to contract or relax.
- Other nerves control all the functions in the body which are under our conscious control e.g. the pumping of the heart, breathing and digestion. The brain constantly controls these, even when sleeping.

The Brain

The **brain** is the most complex organ in the body.

Functions of the brain:

- Receives and interprets all the information from the outside world via the senses.
- Controls the skeleton and movement.
- Controls and regulates all the body functions e.g. breathing and digestion.
- Processes and stores information in the memory – sorts and stores.
- Analyses complex information and abstract ideas. The brain enables humans to make decisions and plans of action. It enables communication through language and writing. The ability for complex thinking and creativity separates humans from other animals.



Circulatory System

The circulatory system consists of:

● Heart

● Blood vessels

● Blood

What does the circulatory system do?

The circulatory system supplies oxygen and nutrients to all cells in the body and removes waste products from them.

How does the circulatory system work?

The oxygen received from the lungs and the nutrients in food are dissolved in the **bloodstream**. 'Stream' describes how the blood is constantly flowing.

Blood

Blood is composed of cells, just as the rest of the body is. These cells are contained in fluid called **plasma**.

- **Red blood cells** give blood its colour. Their function is to carry oxygen.
- **White blood cells** defend the body against germs
- **Platelets** help blood to clot.
- **Blood vessels** are the tubes in which the blood is transported (circulated) around the body. They branch into smaller and smaller vessels until they become a network of tiny vessels. The walls of these vessels are thin enough to allow the oxygen and nutrients that are dissolved in the plasma, to pass through and into the body's cells. Arteries carry blood from the heart to the rest of the body. Veins carry blood to the heart.

The **heart** is approximately the size of the person's closed fist. It is mostly made of muscle tissue and it functions as a pump that pumps the blood continually around the body. The heart pumps (beats) approximately 30 million times a year.

Renal System

The renal system consists of:

● Kidneys

● Ureters

● Bladder

● Urethra

What does the renal system do?

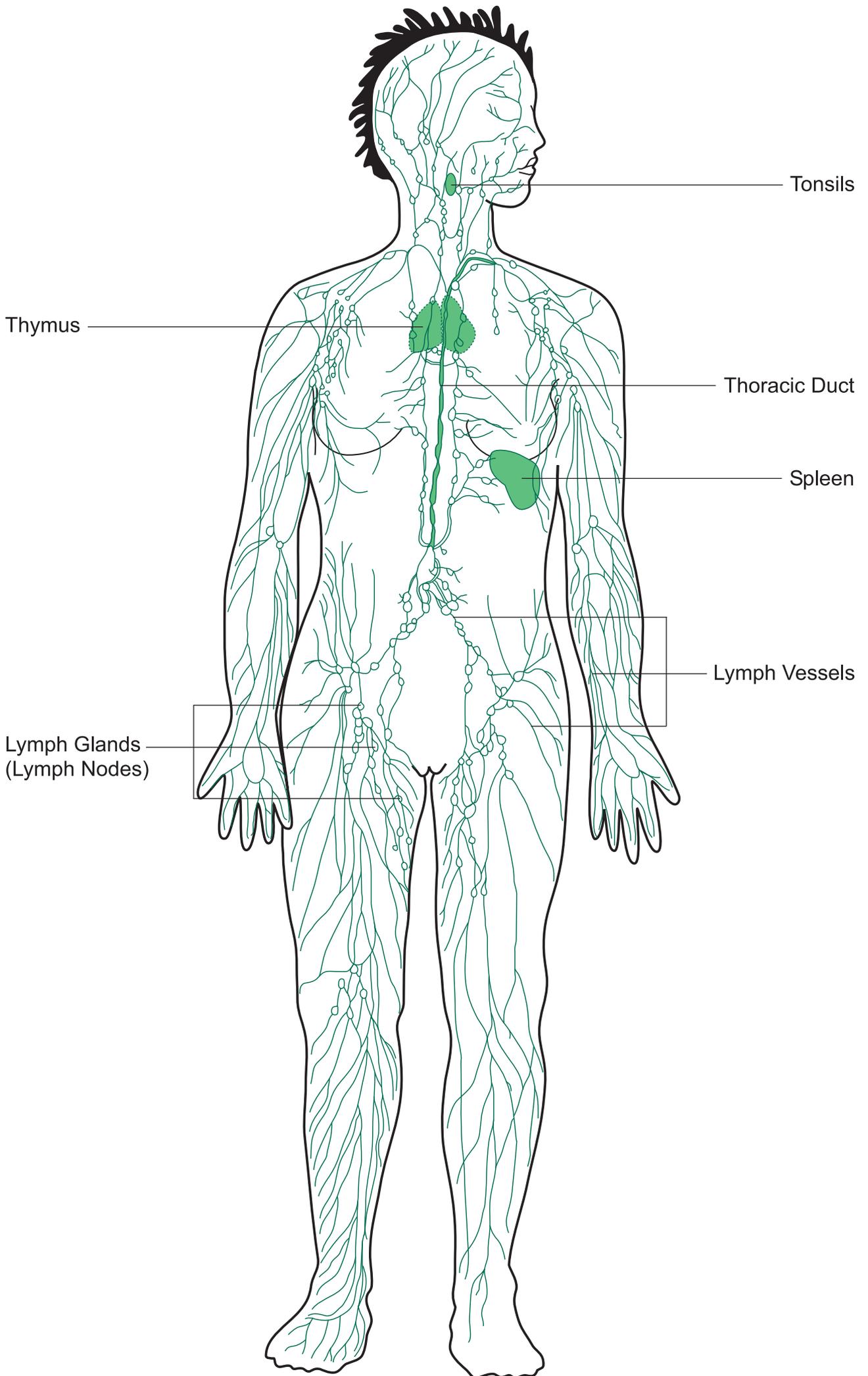
The renal system clears the blood of wastes and disposes of them.

How does the renal system work?

Waste from the cells is transported in the bloodstream to the **kidneys**. The kidneys' function is to remove and process the waste along with excess fluid that the body no longer needs.

The excess fluid and waste are passed down 2 tubes called **ureters**, and into the **bladder**, where it is stored. It is then passed from the bladder through a tube called the **urethra**, and out of the body in the form of **urine**.

The openings for the urethra are; the end of the penis in the male and a small opening just in front of the vaginal opening in the female.



Lymphatic System

The lymphatic system consists of:

- Lymph glands
- Lymph vessels
- Lymph fluid
- Thymus
- Tonsils
- Spleen

What does the lymphatic system do?

- It is responsible for clearing the tissues of the body of **germs** and dead cells.
- It is the site for production and storage of white cells responsible for the body's defence against **germs**.

How does the lymphatic system work?

As we said before, the walls of the tiniest blood vessels are thin enough to allow the passage of fluid in and out of the body's cells. Similarly, waste fluid drains into the smallest **lymph vessels**.

Lymph fluid circulates through the lymph vessels and lymph glands where it is cleared of germs and dead cells. It is eventually returned to the bloodstream via a vessel connecting the lymphatic and circulatory system in the upper part of the chest. This vessel is called the **thoracic duct**.

White cells are produced in the bone marrow (found inside long bones such as the thigh, not shown here) and the **thymus**. Some white cells are stored in the **thymus, spleen, lymph glands** and **tonsils**.

The Immune System

What does the immune system do?

The immune system defends the body against foreign substances and disease. It is an extremely sophisticated of cells that work together to destroy and remove all the harmful substances from the body.

It is made up of different cells that have different functions. When germs enter the body, the immune system uses its white blood cells to fight off and destroy the germs. There are many different types of white cells and special chemicals in the body whose job it is to provide defence against harmful germs. These are grouped together and collectively referred to as the immune system.

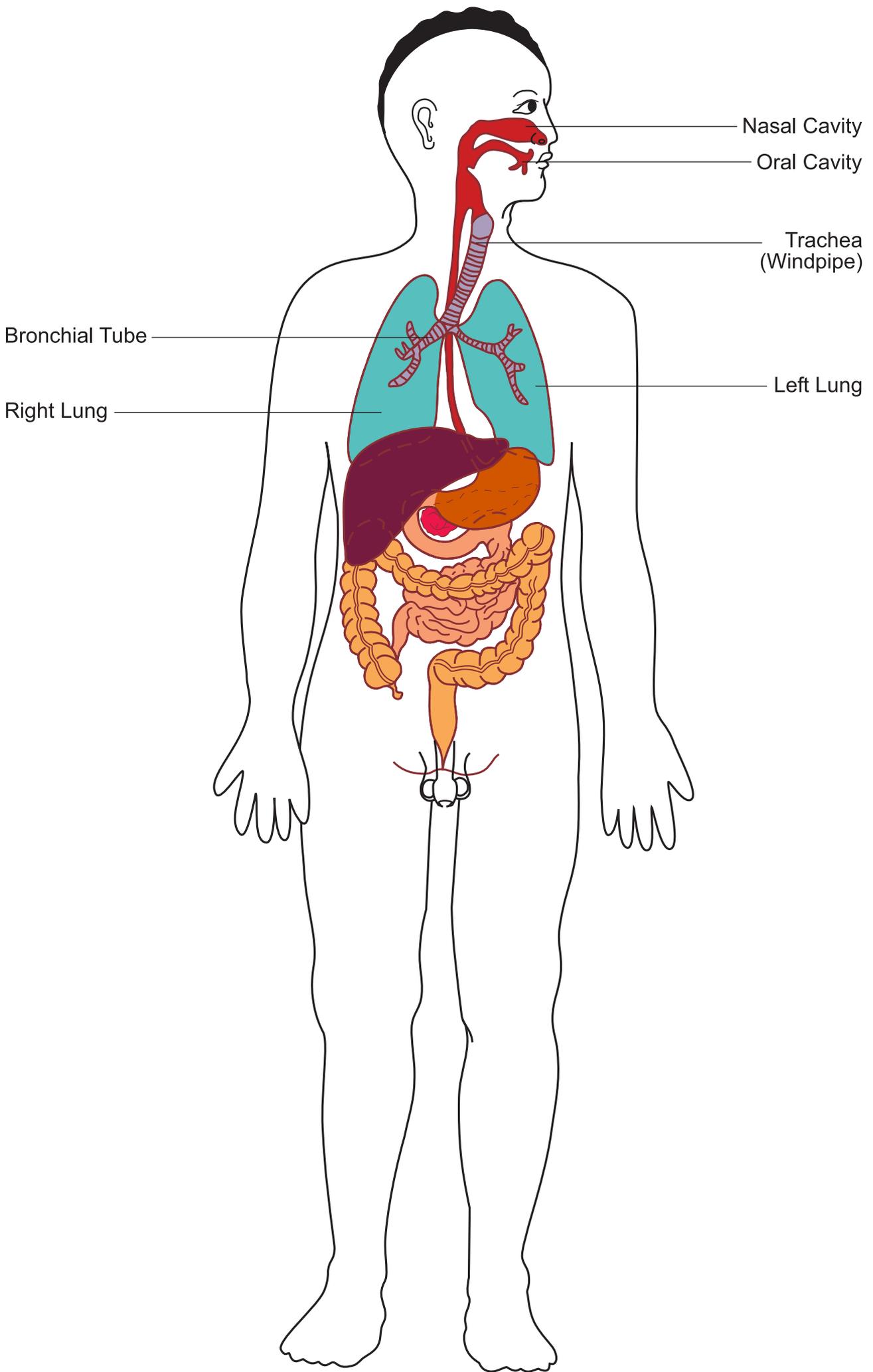
About 10 billion new white cells are made everyday. They are found in the tissues, blood and lymph fluid.

How does the immune system work?

All the different types of white cells have different functions or strategies for identifying and attacking **germs**. Employing a variety of strategies means they have a greater chance of destroying the **germs**.

CD4 and CD8 cells

Some cells produce; chemicals that help destroy foreign invading germs (anti-bodies), and other cells that kill germs directly. These killer cells (**CD8**) are helped by helper cells called **CD4** which are destroyed by HIV leaving the CD8 cells unable to function normally. Eventually, the whole immune system is incapacitated and can no longer fight germs efficiently.



Digestive System

The digestive system consists of:

- Oral cavity (mouth)
- Oesophagus (Gullet)
- Stomach
- Small Intestine
- Pancreas and Liver
- Large intestine (Colon)
- Rectum and Anus

What does the digestive system do?

The digestive system breaks down food into nutrients that provide the body with energy and warmth. This process is known as **digestion**.

How does the digestive system work?

Nutrients

Nutrients are a general term that includes proteins, carbohydrates, fats, vitamins and minerals. The body requires adequate supplies of each nutrient to produce, maintain and repair the body's tissues. Without nutrients, the body cannot grow, develop and function correctly throughout its lifetime. Food must be broken down into smaller, basic components before the nutrients can pass into the bloodstream to be used. We will see how this works as we follow the passage of food.

Mouth

The **mouth** processes food in 2 ways: **mechanical** and **chemical**. Mechanically, food is cut, chewed and mixed in the mouth. Chemically, the salivary glands (groups of special cells on the walls of the mouth) produce saliva which begins breaking down carbohydrates.

Oesophagus (Gullet) and Epiglottis

The food is swallowed and passed down the **oesophagus (gullet)** to the stomach. The oesophagus is a long muscular tube. There is a small flap of skin called the **epiglottis** which lies at the junction of the oesophagus and trachea (windpipe). During swallowing, this flap covers the trachea opening so that food does not go into the lungs.

Stomach and Small intestine

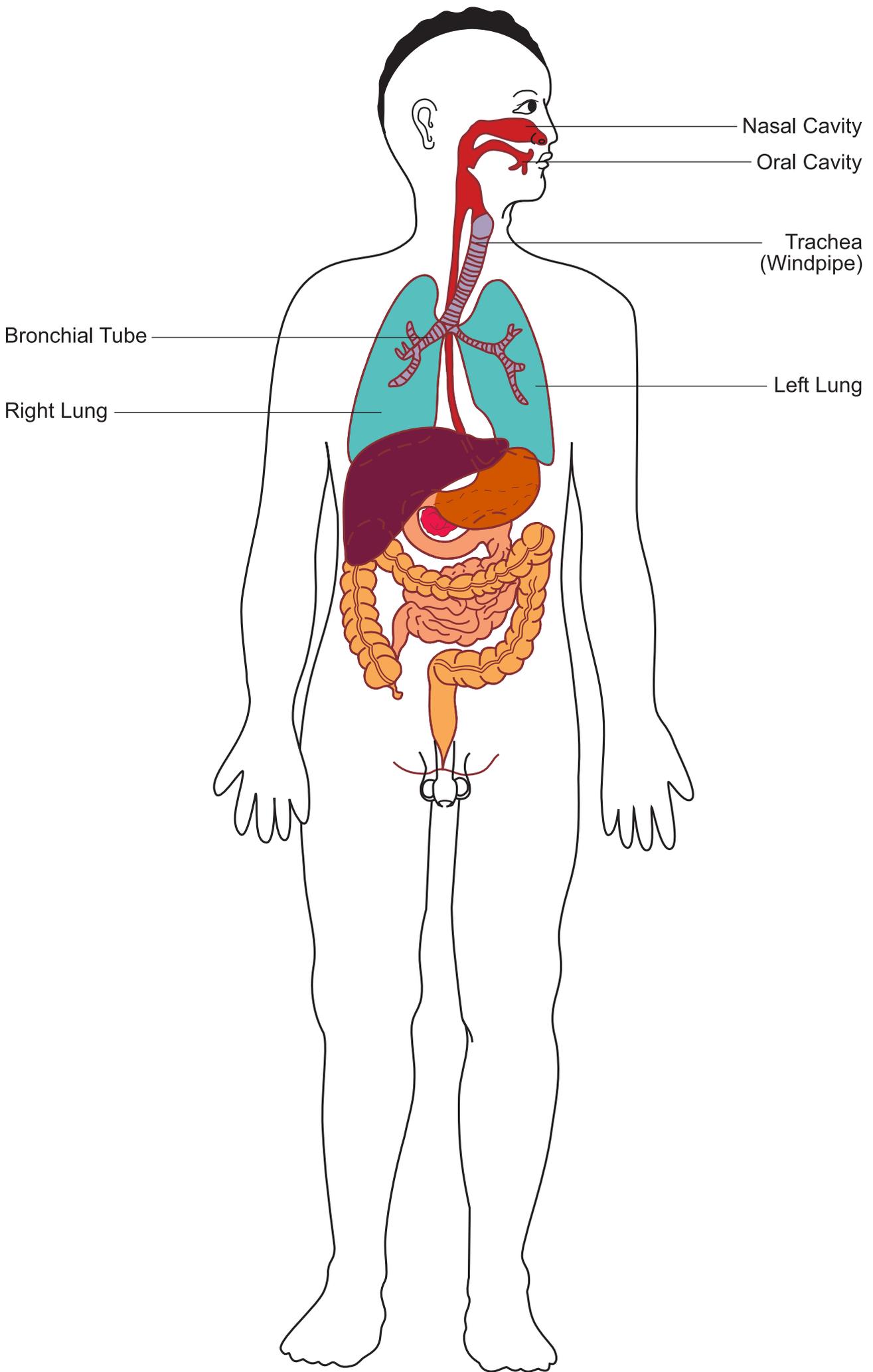
Similarly to the mouth, the **stomach** also uses mechanical and chemical processes to break down food. The muscular wall of the stomach churns the food. The stomach produces a fluid containing acid and chemicals which break down food. The acid also helps to kill germs. Food spends up to six hours in the stomach. The food is now the consistency of soup and passes into the **small intestine**, a coiled tube almost 3 meters in length. This provides a large surface area for nutrients and water to pass through the inner wall of the intestine and into the bloodstream.

Liver and Pancreas

The **liver** and **pancreas** produce chemicals that break down different nutrients. The chemicals from the liver pass into the **gall-bladder** (not shown) and from there into the small intestine. Chemicals from the pancreas pass directly into the small intestine.

Large Intestine, Rectum and Anus

At this point, most of the nutrients have passed into the blood stream. The remaining food continues into the **large intestine (colon)**. Any remaining water and nutrients that the body requires can pass through the walls of the colon, leaving waste products called faeces or stools. These are stored in the **rectum** and passed out through the **anus**.



Respiratory System

The respiratory system consists of:

- **Nasal Cavity (Nose)**
- **Oral Cavity (Mouth)**
- **Trachea (Windpipe)**
- **Bronchial tubes**
- **Lungs**

What does the respiratory system do?

As we have mentioned earlier, all cells require oxygen to produce and carry out their functions. The respiratory system provides the body with oxygen. This process is known as respiration.

How does the respiratory system work?

Inhalation - breathing in

The lungs are attached to a large muscle that lies below them (the **diaphragm**), and to the ribs. During inhalation, the brain sends messages, via the nerves, to the diaphragm and rib muscles to contract. This expands the rib-cage and air rushes into the lungs.

Exhalation - breathing out

When the muscles relax, the rib-cage returns to its original position and the air is forced out.

How does oxygen enter the bloodstream?

The lungs are a network of tubes which end in tiny air sacs (over 300 million). It is here that oxygen (one of the gases in the inhaled air) passes through the thin walls of the air sacs directly into the blood stream. When the cells use the oxygen, they produce a waste product (a gas called carbon dioxide), which is passed from the blood to the sacs to be breathed out.

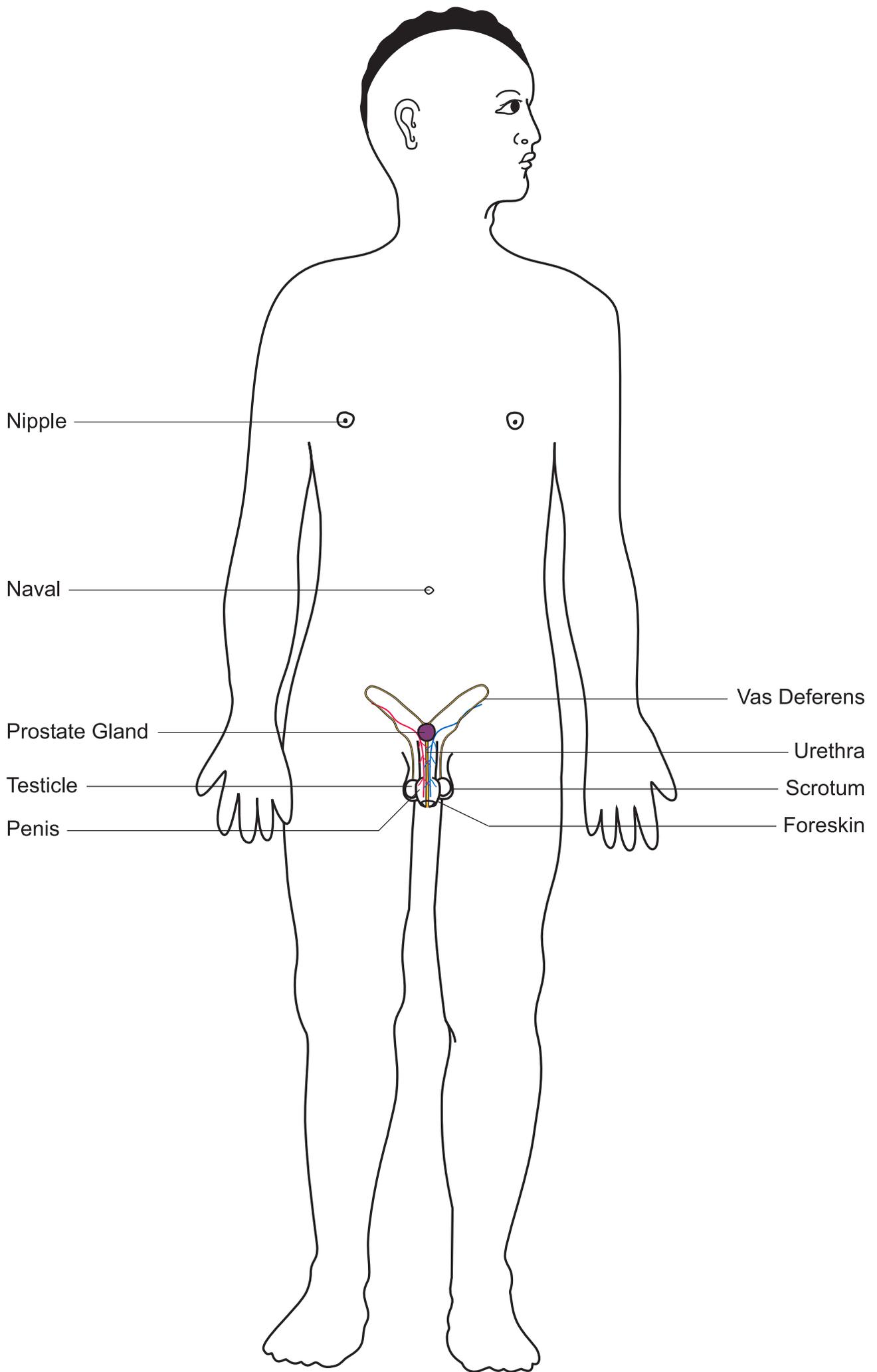
What is the link between TB and HIV?

Tuberculosis (TB) is an infectious disease that can affect any part of the body, but mostly the lungs. TB germs spread from person to person through coughing. This happens when an infected person coughs TB germs into the air and another person inhales them.

Not all people who become infected with TB (inhale the TB germs) go on to develop the disease and become ill. In majority of people, the TB germs enter the lungs where they remain dormant (inactive) and are not passed to others.

In those infected persons who do go on to develop the TB disease and become ill. The illness only becomes evident after a period of time. TB is curable if treated correctly.

HIV-positive people are more susceptible to TB because of their weakened immune system and tend to develop the disease more rapidly. TB in patients with HIV can also be cured.



Male Reproductive System

The male reproductive system consists of:

- Scrotum
- Testicles
- Vas Deferens
- Prostate Gland
- Urethra
- Penis

What does the male reproductive system do?

The function of the male reproductive system is to produce the male sex cells or “sperm” (sex refers to gender in this case). It is the union of the sperm and the female’s egg (ovum) that creates new life. This process is **reproduction**.

How does the male reproductive system work?

Puberty

The male begins to produce sperm cells when he reaches puberty. This generally occurs between the ages of 10 – 14, and varies from individual to individual. The physical and emotional changes associated with puberty are partly due to **testosterone**, a hormone produced in the testicles. Testosterone is responsible for controlling male development and the production of sperm inside the testicles. The production of testosterone is triggered by the brain.

Testicles

The testicles are two egg-shaped organs contained in the scrotum. They continually produce sperm throughout the man’s life. Each sperm is very tiny, only 0.05 millimetres long.

Scrotum

The scrotum is a loose pouch of skin the holds and protects the testicles. It lies outside the body because sperm production requires a temperature lower than internal body temperature.

Vas Deferens

The sperm cells pass from the testicles into the vas deferens, two tubes which lead to the urethra.

Prostate Gland

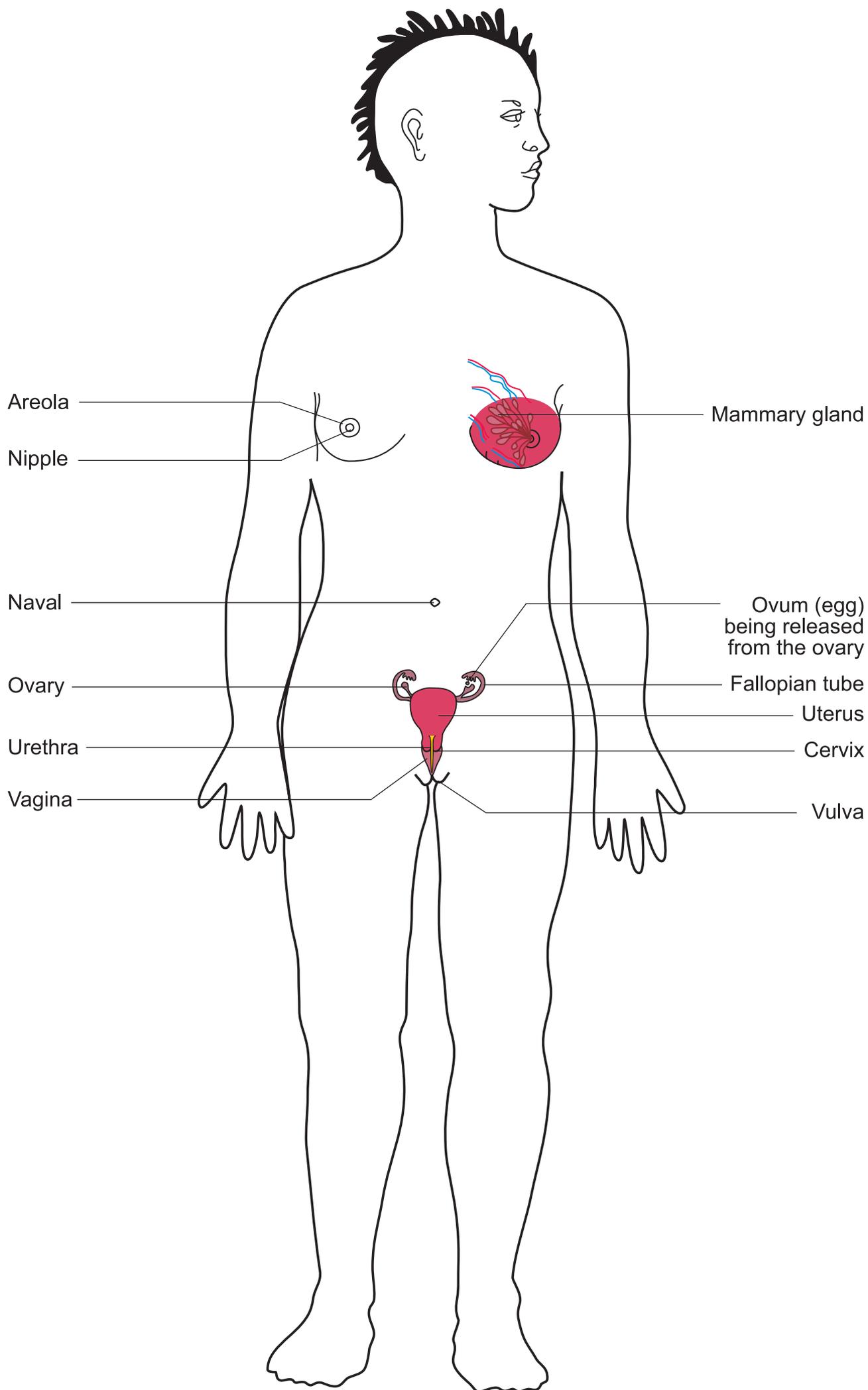
The prostate gland produces a fluid into the vas deferens that provides special nourishment for the sperm cells. The whole mixture of sperm cells and secretions is a thick whitish fluid called semen.

Urethra

The semen passes from the vas deferens into the urethra, a tube that runs through the centre of the penis. It provides an outlet for both semen and urine.

Penis

The penis consists of the **shaft** (main part) and **glans** (the tip or the head). The **foreskin** is a fold of skin that covers the glans and is sometimes removed by **circumcision**. The tissue inside the penis has many special blood vessels which can fill with blood, making the penis hard and straight. This called an **erection**.



Female Reproductive System

The female reproductive system consists of:

- Ovaries
- Fallopian tubes
- Uterus (Womb)
- Cervix
- Vagina
- Vulva

What does the female reproductive system do?

The function of the female reproductive system is to produce female sex cells (eggs or ova), and to facilitate pregnancy and child birth.

How does the female reproductive system work?

Puberty

Egg production takes place in the **ovaries**. The eggs begin to form before birth which means that at birth, a girl will have in her ovaries all the eggs that she will ever have. It is not until puberty that the eggs are ready for release from the ovaries, which continues until she reaches menopause around the age of 50. The ovaries also produce **hormones**, including oestrogen and progesterone, which control egg production and are responsible for the physical and emotional changes associated with puberty.

Menstruation

The **menstrual** cycle is a period of time during which egg-release from the **ovaries (ovulation)** takes place. During the first part of the cycle, the lining of the uterus thickens to receive the fertilized egg. An egg (usually one per cycle) is released from the ovary and enters the **fallopian tube**. If fertilization does not take place, the lining of the uterus is shed, along with the unfertilized egg (**menstrual bleeding**), after which the cycle begins again.

The menstrual cycle is controlled by the hormones **oestrogen** and **progesterone**, which in turn are triggered by the brain. The cycle lasts for approximately 28 days, but can be longer or shorter for some women.

Fallopian tubes and Uterus

Once the egg is released from the ovary it enters the **fallopian tube**, which leads to the **uterus (womb)**. The uterus is about the size of a fist with a thick muscular wall that can expand over 1000 times in volume to hold a developing baby.

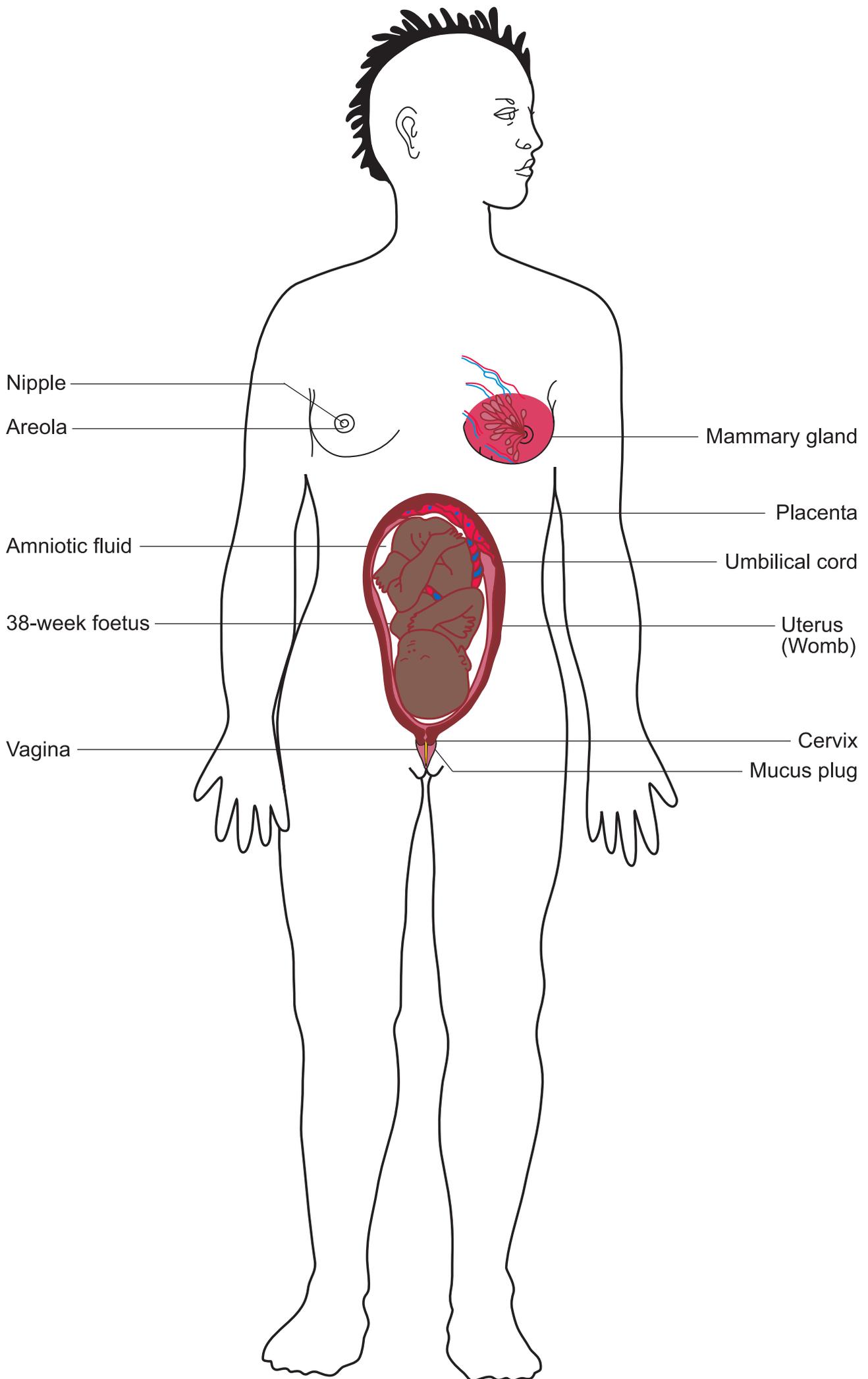
Cervix and Mucus Plug

The narrow opening at the bottom of the uterus is the **cervix**. The cervix has a very delicate lining of cells that produce a thick mucus that helps to protect both the cervix and the uterus from germs. During pregnancy it is closed with a plug of mucus. During labour this **mucus plug** is expelled and the cervix stretches to allow childbirth.

Vagina

The **vagina** is the muscular tube that extends from the cervix to an opening on the outside. Like the cervix, the vagina also stretches in childbirth. It also has a very delicate lining. Cells in the vagina's lining produce vaginal fluid that plays a vital part in protecting the vagina from injury and germs. The **hymen** is a thin piece of skin that usually partially covers the external vaginal opening. It sometimes tears during first sexual intercourse and may bleed a little. In some women it tears for other reasons without them knowing.

The visible exterior of the reproductive system is called the **vulva**. The vulva includes the **labia (lips)** which protect the vaginal opening, the urethral opening and the **clitoris**. The clitoris is a small sensitive mound of skin.



Reproduction

What is reproduction?

Reproduction is the process of producing a new human being.

How does reproduction happen?

Sexual intercourse and Fertilization

Sperm cells enter the female's body during sexual intercourse. **Semen** is ejaculated into the **vagina** where it mixes with vaginal fluid. There is also some leakage of semen from the penis prior to ejaculation. The **sperm** swim through the **cervix** and into the **uterus**. If an **egg** has been released from one of the **ovaries**, the first sperm to reach it penetrates the surface of the egg, and union between the sperm and egg takes place (**fertilization**). This event usually occurs in the **fallopian tube** or in the uterus. Twins occur when the two eggs are released and fertilized by two sperm. Identical twins occur when a single egg splits into two following fertilization.

Pregnancy

The fertilized egg embeds itself in the thickened lining of the uterus. The cells of this new individual continue to divide to form the tissues, organs and systems that form a human body. There is a heartbeat at 4 weeks. During the first 8 weeks of life the baby is called an **embryo**. After 8 weeks it is called a **foetus**, which is the term we will use from now on. The foetus is protected by special fluid that surrounds and cushions it (**amniotic fluid**). A plug of mucus in the cervix seals the uterus and muscular wall of the uterus stretches to accommodate the foetus as it grows.

The growing foetus requires oxygen and nutrients just as it will after birth and throughout its lifetime. The **placenta** is an organ that is formed in pregnancy and is attached to the lining of the uterus. Its function is to nourish the foetus and remove foetal waste products. Oxygen and nutrients pass from the mother's circulatory system, through the placenta and into the foetal blood circulation via the **umbilical cord**. This is why the mother's diet is so important. Foetal waste is passed back in the same way.

The placenta also acts as a screen to protect the foetus from any harmful germs and chemicals circulating in the mother's blood. However, some chemicals can cross the placenta from the mother to the foetus, such as alcohol and nicotine (in cigarettes). Some germs also cross the placenta. HIV can cross from an HIV-positive mother to her foetus, although this does not occur in all cases.

Birth

Childbirth or labour occurs when the foetus has spent about 40 weeks in the uterus and usually described in three stages.

In **Stage 1** contractions of the uterus begin, the mucus plug in the cervix is expelled and the cervix widens. The amniotic fluid is released ("waters breaking").

In **Stage 2** the uterine contractions strengthen, pushing the baby through the vagina (birth canal). The baby is born (delivered). Blood flow through the umbilical cord ceases and the cord can be cut.

Stage 3 last from the birth of the baby until the placenta (after birth) is expelled (delivered). If the mother is HIV positive, the virus can be passed during the trauma of child birth, due to blood-to-blood contact between the mother and baby.

Lactation

During pregnancy the mother's breasts enlarge and milk-secreting glands (**mammary glands**) develop. Maternal nutrition is very important as nutrients pass from the mother's bloodstream into her milk. HIV can also pass from an infected mother's blood into her milk.

The Centre for Social Science Research

The CSSR is an umbrella organisation comprising five units:

The **AIDS and Society Research Unit (ASRU)** supports innovative research into the social dimensions of AIDS in South Africa. Special emphasis is placed on exploring the interface between qualitative and quantitative research. By forging creative links between academic research and outreach activities, we hope to improve our understanding of the relationship between AIDS and society and to make a difference to those living with AIDS. Focus areas include: AIDS-stigma, sexual relationships in the age of AIDS, the social and economic factors influencing disclosure (of HIV-status to others), the interface between traditional medicine and biomedicine, and the impact of providing antiretroviral treatment on individuals and households.

The **Data First Resource Unit ('Data First')** provides training and resources for research. Its main functions are: 1) to provide access to digital data resources and specialised published material; 2) to facilitate the collection, exchange and use of data sets on a collaborative basis; 3) to provide basic and advanced training in data analysis; 4) the ongoing development of a web site to disseminate data and research output.

The **Democracy in Africa Research Unit (DARU)** supports students and scholars who conduct systematic research in the following three areas: 1) public opinion and political culture in Africa and its role in democratisation and consolidation; 2) elections and voting in Africa; and 3) the impact of the HIV/AIDS pandemic on democratisation in Southern Africa. DARU has developed close working relationships with projects such as the Afrobarometer (a cross national survey of public opinion in fifteen African countries), the Comparative National Elections Project, and the Health Economics and AIDS Research Unit at the University of Natal.

The **Social Surveys Unit (SSU)** promotes critical analysis of the methodology, ethics and results of South African social science research. Our core activities include the overlapping Cape Area Study and Cape Area Panel Study. The Cape Area Study comprises a series of surveys of social, economic and political aspects of life in Cape Town. The Cape Area Panel Study is an ongoing study of 4800 young adults in Cape Town as they move from school into the worlds of work, unemployment, adulthood and parenthood.

The **Southern Africa Labour and Development Research Unit (SALDRU)** was established in 1975 as part of the School of Economics and joined the CSSR in 2002. In line with its historical contribution, SALDRU's researchers continue to conduct research detailing changing patterns of well-being in South Africa and assessing the impact of government policy on the poor. Current research work falls into the following research themes: post-apartheid poverty; employment and migration dynamics; family support structures in an era of rapid social change; the financial strategies of the poor; public works and public infrastructure programmes; common property resources and the poor.
