HLTAAP001
Recognise healthy body systems

Learner Guide

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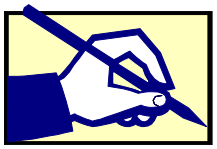


You will find review learning activities at the end of each section. The learning activities in this resource are designed to assist you to learn and successfully complete assessment tasks. If you are unsure of any of the information or activities, ask your trainer or workplace supervisor for help.

The participant will be required to demonstrate competence through the following means:

Methods of assessment

- Observation in the work place
- Written assignments/projects
- Case study and scenario analysis
- Questioning
- Role play simulation
- Learning activities
- Class discussion and group role-plays
- Assessment tasks

Asking for help

If you have any difficulties with any part of this unit, contact your facilitator. It is important to ask for help if you need it. Discussing your work with your facilitator is considered an important part of the training process.

Name of facilitator: _____ **Phone number:** _____

HLTAAP001 Recognise healthy body systems

Welcome to the unit **HLTAAP001 Recognise healthy body systems,** which forms part of the **2015 Community services training package**. This unit describes the skills and knowledge required to work with basic information about the human body and to recognise and promote ways to maintain healthy functioning of the body.

This unit applies to any worker who needs to use and interpret information that includes references to client anatomy and physiology.

The skills in this unit must be applied in accordance with Commonwealth and State/Territory legislation, Australian/New Zealand standards and industry codes of practice.

WHAT YOU WILL LEARN

ELEMENT	PERFORMANCE CRITERIA
Element 1: Work with information about the human body	1.1 Correctly use and interpret health terminology that describes the normal structure, function and location of the major body systems 1.2 Correctly use and interpret information that relates to the interrelationships between major components of each body system and other structures
Element 2: Recognise and promote ways to support healthy functioning of the body	2.1 Review factors that contribute to maintenance of a healthy body 2.2 Evaluate how the relationships between different body systems affect and support healthy functioning 2.3 Enhance quality of work activities by using and sharing information about healthy functioning of the body

Element 1: Work with information about the human body

Correctly using and interpreting health terminology that describes the normal structure, function and location of the major body systems

Anatomy and Physiology

The foundation of medical language is based on the concepts of anatomy and physiology and the disease process of human body. Anatomy is the study of the structure of the human body. The study of the function of the human body is called Physiology.

Anatomy: is the term that describes the structure of the body and the relationship of one part to another.

- **Gross anatomy:** the examination of large body structure visible with the unaided eye
- **Surface anatomy:** general form and surface markings
- **Regional anatomy:** organisation of specific areas of the body
- **Systemic anatomy:** organ systems. Organs that function together in a coordinated manner
- **Developmental anatomy:** development of a new being from conception to maturity
- **Clinical anatomy:** includes all the types of anatomy studies, and compares the normal to the experienced by the client using diagnostic anatomy techniques such as radiology, microscopic anatomy, and surgical anatomy (if required)

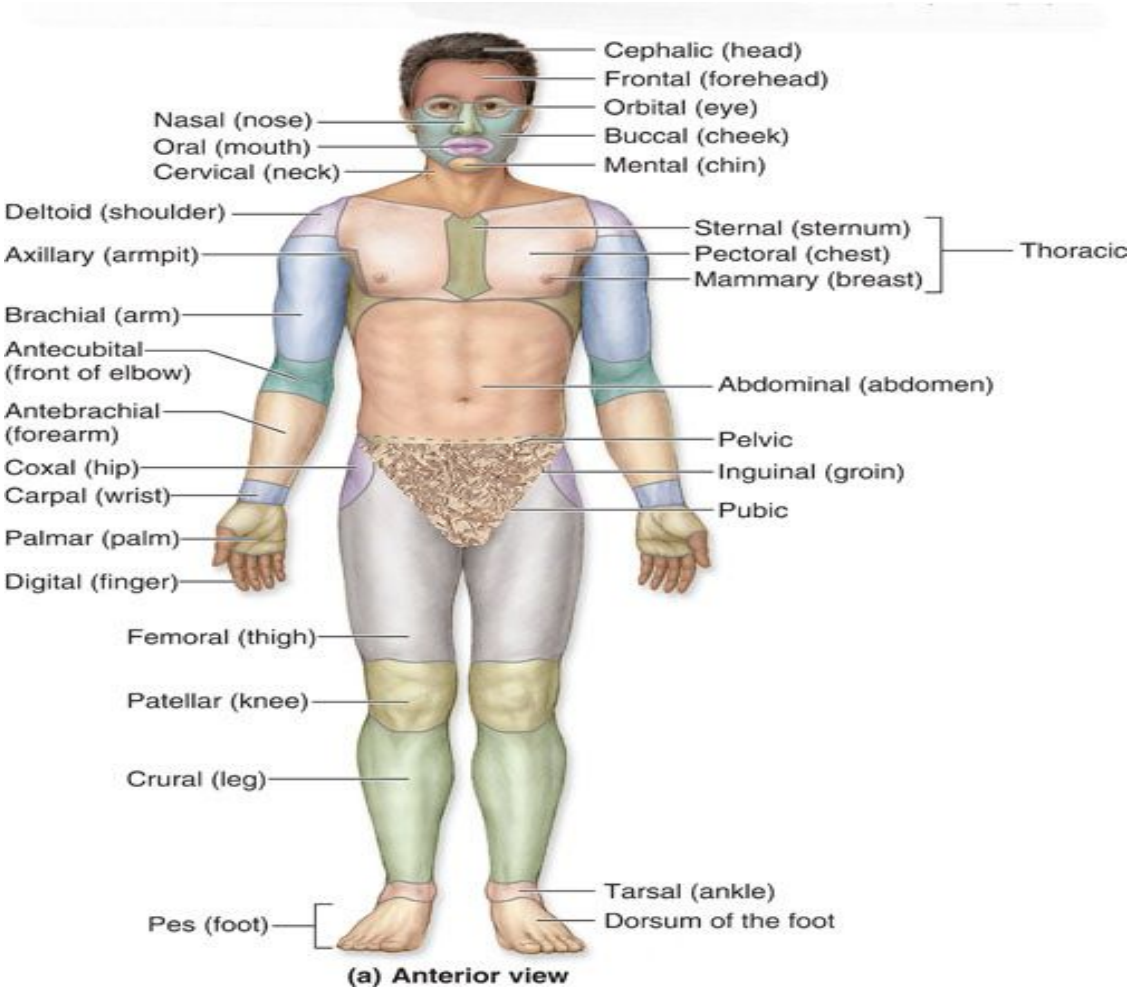
Physiology: Physiology describes the **function** of the body – how all the body parts work and carry out their life-sustaining activities. Physiology is explainable only in terms of the underlying anatomy. As with anatomy, physiology has many subdivisions, most of which consider the operation of specific organ systems. For example, renal physiology considers kidney function and urine production; endocrine physiology examines the control of hormones by the body.

Physiology focuses much on events at the cellular or molecule level because the body's abilities depend on those of its individual cells, and cells' abilities ultimately depend on the chemical reactions that go on within them. An understanding of physiology also rests on principles of physics which help to explain electrical currents, blood pressure and the way muscles use bones to cause body movements.

Physiology of the skin describes the process of how the skin functions to carry out particular activities. When you are exposed to extreme weather conditions, for example, sensors in the skin layer pick up signals of heat/cold from the external environment and communicate the information to the brain for interpretation. If your body is hot, sweating will occur, causing a cooling effect over the skin. The opposite occurs if you are cold – you start to shiver, a warming process. Anatomy and physiology are complementary branches of science that provide the concepts that help us to understand the human body.

- **Embryology:** Considers only those changes that occur from conception to birth.
- **Histology:** This is the study of tissues, collections of cells with similar structure and function.
- **Cytology:** This is the study of parts of a cell and the functions of those parts.

Anatomical Structures



(a) Anterior view

Structural levels of the body

The body is organised at various structural levels, advancing from the least complex to the more complex: atoms and molecules, cells (e.g. red blood cells), tissues (e.g., fat), organ (e.g., lungs), organ system (e.g. respiratory system) and organism (e.g., man).

Body cavities

The two main cavities which contain arrangements of internal organs:

1. Dorsal cavity: contains cranial and spinal cavities.

2. Ventral cavity: contains thoracic, abdominal and pelvic cavities.

Directions and planes of the body

The reference position of the body is the anatomical position i.e., the position where the arms are at the side with the palms, feet and head pointing forward.

The three main planes of the body (or of individual organs) are:

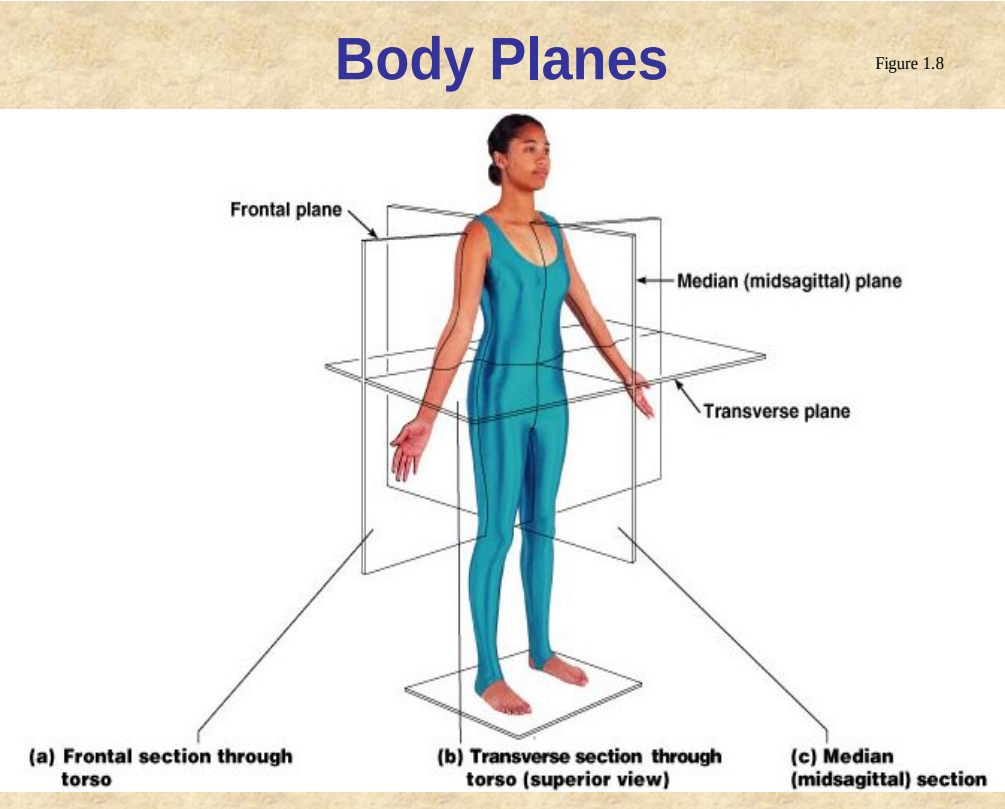
1. **Saggital plane:** divides the body (or parts) into left and right sides.
2. **Frontal plane:** divides the body or into anterior and posterior parts.
3. **Transverse or horizontal plane:** a cross section through the body.

Body planes and sections

Body cavities

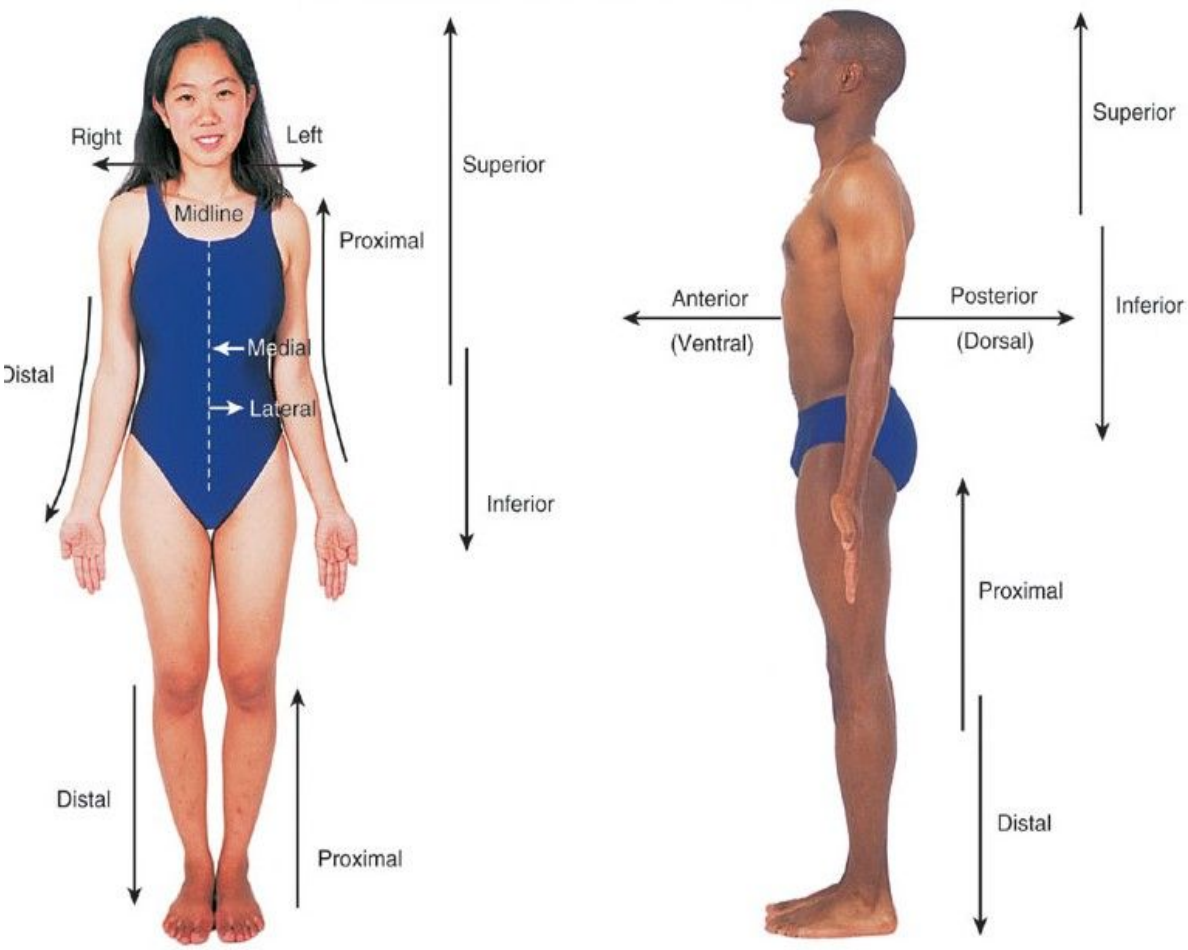
The body has two (2) sets of internal cavities that provide different degrees of protection to the organs that lie within them. These are the:

1. **Dorsal cavity:** that encases the brain and the spine.
2. **Ventral cavity:** which comprises the thorax (chest) – this encases the heart and the lungs and the abdominopelvic cavity which encases our abdominal organs and those of our reproductive system.



Directional terms of the body

There are standard terms that can be used to explain exactly where body parts are in relation to other body parts. When you look at the standing position diagrams given below, you will note that when describing the relationship of one body part to the next, the figure faces forward, arms are slightly outstretched away from the body, the little fingers are near the thighs, and the thumbs are pointing outwards.



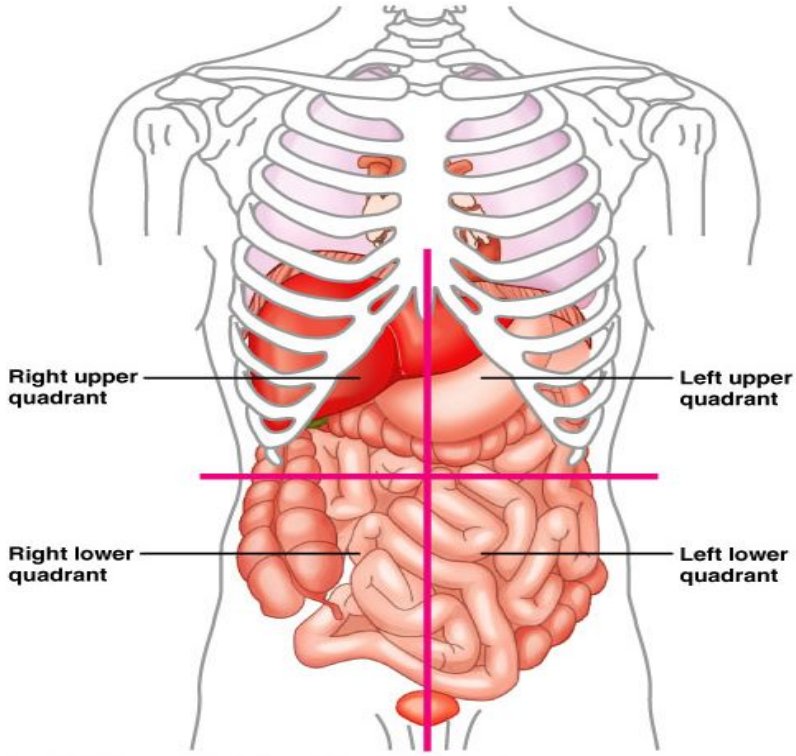
Unless otherwise stated, diagrams are viewed from front to back (anterior to posterior). The following table outlines some directional definitions and examples.

DIRECTIONAL	DEFINITION	EXAMPLE
Superior	Upper or above a structure	Head superior to the neck
Inferior	Below or lower than other structures	Toes inferior to the femur
Anterior	Front part of the body	Structures include nose, sternum, pelvis, knee, toes
Posterior	Back part of the body	Structures include head, neck, back, heels, back of hands, palmer surface of the feet
Medial	Towards the mid-line of a structure	Thumb is medial to the little finger when hand is placed as per directional diagrams
Lateral	Towards the side or away from mid-line of a structure	Position of lying on one's side, eg: while resting in bed
Distal	Furthest from the source	Furthest from insertion point when describing action of a skeletal muscle
Proximal	Nearest the source	Nearest the insertion point when describing action of a skeletal muscle
External	Outer	Skin surface exposed to the environment
Internal	Inner	Major body organ

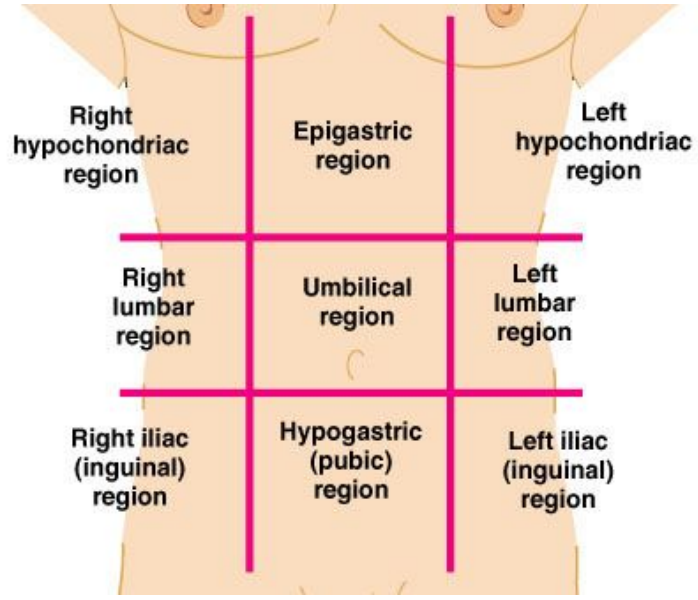
Quadrants and regions

The body is also divided into regions.

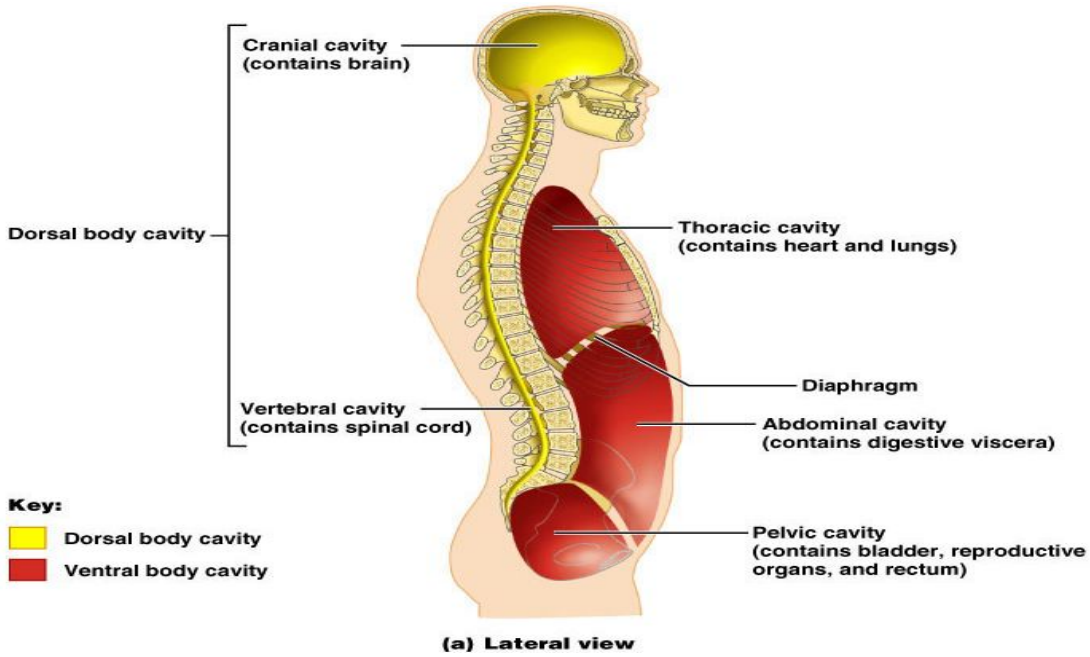
- RUQ Liver
- LUQ Spleen
- RLQ Appendix
- LLQ Sigmoid colon.



Abdominopelvic Regions



Body cavities



Spaces within the body contain the major cavities, namely:

- **Dorsal cavity:** protects the nervous system, and is divided into two subdivisions
- **Cranial cavity:** is within the skull and encases the brain
- **Vertebral cavity:** runs within the vertebral column and encases the spinal cord
- **Ventral cavity:** houses the internal organs (viscera), and is divided into two subdivisions: - Thoracic and Abdominopelvic cavities

Thoracic cavity: is subdivided into pleural cavities, the mediastinum, and the pericardial cavity

a) **Pleural cavities:** each houses a lung.

b) **Mediastinum:** contains the pericardial cavity, and surrounds the remaining thoracic organs

c) **Pericardial cavity:** encloses the heart

d) **The abdominopelvic cavity:** is separated from the superior thoracic cavity by the dome-shaped diaphragm

It is composed of two subdivisions.

1. **Abdominal cavity:** contains the stomach, intestines, spleen, liver, and other organs
2. **Pelvic cavity:** lies within the pelvis and contains the bladder, reproductive organs, and rectum

Other body cavities:

- **Oral and digestive:** mouth and cavities of the digestive organs
- **Nasal:** located within and posterior to the nose
- **Orbital:** house the eyes
- **Middle ear:** contain bones (ossicles) that transmit sound vibrations
- **Synovial:** joint cavities

Structural organisation of the human body

The human body has many levels of structural organisation.

Chemical: The chemical level is the simplest level of the structural hierarchy. At this level atoms (tiny building blocks of matter) combine to form molecules such as water and proteins. Molecules, in turn, associate in specific ways to form organelles, basic components of the microscopic cells.

Cellular: Cells are the smallest units of living things. At the cellular level, all cells have some common functions, but individual cells vary widely in size and shape, reflecting their unique functions in the body. The simplest living creatures are composed of single cells. In complex organisms, cells with similar embryonic origin or function are often organised into larger functional units called tissues.

Tissue

At the tissue level, there are four basic tissue types:

1. **Epithelium:** covers the body surface and lines its cavities
2. **Muscle:** provides movement
3. **Connective tissue:** supports and protects body organs
4. **Nervous tissue:** provides a means of rapid internal communication by transmitting electrical impulses.

Organs: An organ is a discrete structure composed of at least two tissue types (four is the usual) that performs a specific function for the body. At the organ level, extremely complex functions become possible. For example, the stomach lining is an epithelium that produces digestive juices. The bulk of its wall is muscle, which churns and mixes stomach contents (food), its connective tissue reinforces the soft muscular walls and its nerve fibres increase digestive activity by stimulating the muscle to contract more vigorously and the glands to secrete more digestive juices.

Organ system: are organs that work together, to accomplish a common purpose make up an organ system.

Organism: The highest level of organisation is the organism, the living human being. The organismal level represents the sum total of all structural levels.

Maintaining life

Necessary life functions

Organ systems do not work in isolation, but work cooperatively to promote the wellbeing of the entire body.

The functional characteristics important to maintaining life in humans are:

- **Maintaining boundaries** : to keep the body's internal environment distinct from the external environment
- **Movement:** includes activities promoted by the muscular system
- **Responsiveness:** the ability to react to stimuli, a major role of the nervous system
- **Digestion:** the breaking down of food to simple molecules that can be absorbed into the blood
- **Metabolism :**all chemical reactions occurring in body cells
- **Excretion:** the process of removing wastes from the body
- **Reproduction:** provides new cells for growth and repair
- **Growth:** occurs when constructive activities occur at a faster rate than destructive activities.

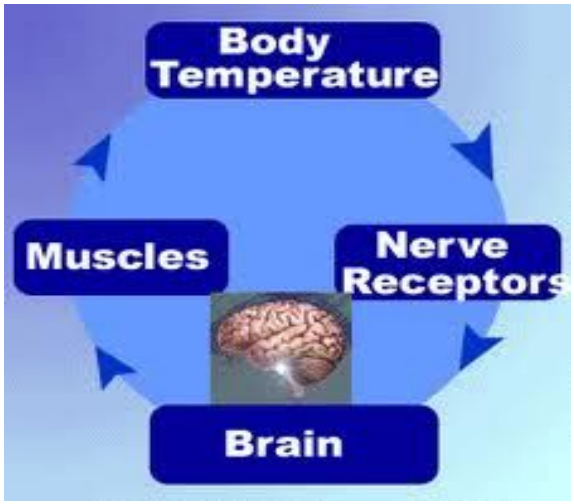
Survival needs

The ultimate goal of all body systems is to maintain life.

This requires several factors which include:

- **Nutrients :**includes carbohydrates, proteins, fats, and minerals
- **Oxygen:** required for the release of energy from food
- **Water:** single substance accounting for over 60% of body weight
- **Normal body temperature:** when too high or too low, physiological activities cease, primarily because molecules are destroyed or become non-functional
- **Atmospheric pressure:** essential for normal operation of the respiratory system and breathing.

Homoeostasis



Homoeostasis is a condition in which the body's internal environment remains relatively constant within certain physiological limits. In general, the body is in homoeostasis when its needs are adequately met and it is functioning smoothly. Almost every organ system plays a role in maintaining the constancy of the internal environment.

All sorts of factors affect the suitability of our body fluids to sustain life; these include properties like:

1. Temperature
2. Salinity
3. Acidity
4. Carbon dioxide
5. And the concentrations of nutrients and wastes (*urea, glucose, various ion, and oxygen)*

Since these properties affect the chemical reactions that keep bodies alive, there are built-in physiological mechanisms to maintain them at desirable levels. This control is achieved with various organs in the body. For example:

Thermal regulation

- The skeletal muscles can shiver to produce heat if the body temperature is too low
- Non-shivering thermogenesis involves the decomposition of fat to produce heat
- Sweating cools the body with the use of evaporation.

Chemical regulation

- The pancreas produces insulin and glucagon to control blood-sugar concentration.
- The lungs take in oxygen and give off carbon dioxide.
- The kidneys remove urea, and adjust the concentrations of water and a wide variety of ions.
- Most of these organs are controlled by hormones secreted from the pituitary gland, which in turn is directed by the hypothalamus.

Homeostasis and its control

Homeostatic mechanisms assist in returning abnormal conditions to within the normal range. The body needs to maintain several factors within a narrow range if it is to work efficiently, or indeed, survive. These include temperature, water, oxygen and pH. Several body organs, including the liver, skin, kidneys and lungs, are involved in the control of these factors. The brain acts as an integrating centre.

Homeostatic control mechanisms are characterised as either:

Feedback

When a change of variable is occurring, there are many types of feedback with which the system to react.

- **Negative feedback:** is a reaction in which the system responds in such a way as to reverse the direction of change. Since this tends to keep things constant, it allows the maintenance of homeostasis. For instance: when the concentration of carbon dioxide in the human body increases, the lungs are signaled to increase their activity and expel more carbon dioxide.
- **In positive feedback:** the response is to amplify the change in the variable. This has a de-stabilizing effect, so does not result in homeostasis. Positive feedback is less common in naturally occurring systems than positive feedback, but it has its applications. For example, in nerves, a threshold electric potential, triggers the generation of a much larger action potential.

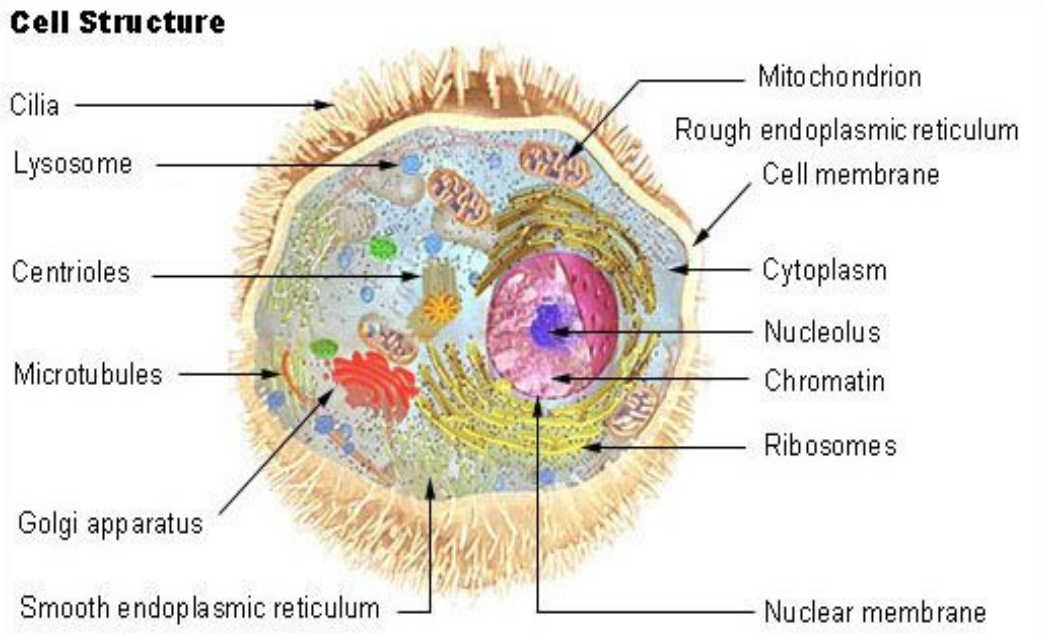
Homeostasis and disease

If homeostasis is not maintained, the body can no longer adapt to its internal or external environment and some degree of vital function is disabled or lost with disease (or death) being the result. With ageing, the body's control systems become less efficient which increases the risk for illness and produces the changes associated.

Cells and tissue

The basic unit of body structure is the **cell.** All cells need food, water, and oxygen to live and function. As cells use or metabolise food and oxygen they give off carbon dioxide and other wastes. The cell is comprised of the cell membrane, which is the outer covering; it encloses the cell and helps it hold its shape.

Here are the most common parts of the cell:



- **The nucleus:** is the control centre; it directs the cell's activities.
- **Cytoplasm:** surrounds the nucleus.
- **Organelles:** are structures that are suspended in the cytoplasm.
- **The protoplasm:** refers to all structures, substances and water within the cell.
- **Chromosomes:** are threadlike structures within the nucleus.

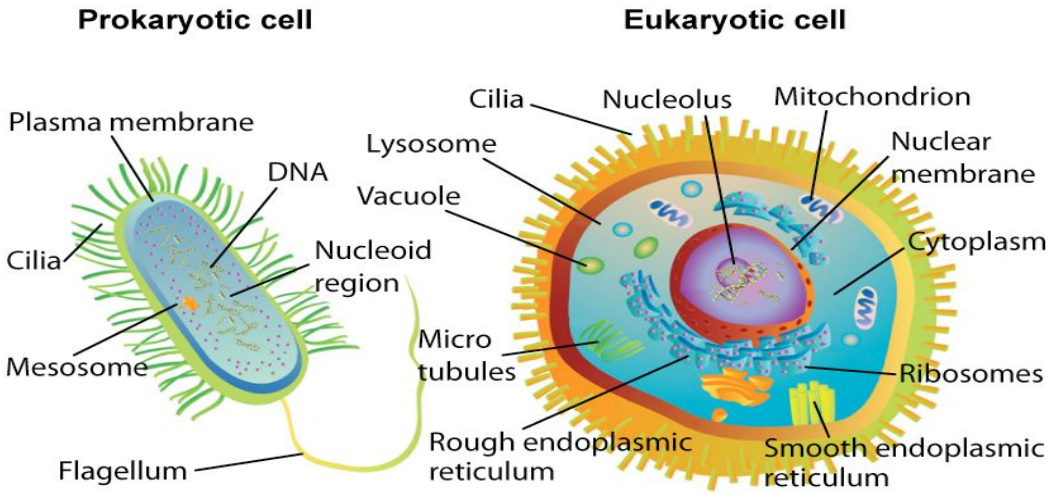
Each cell has 46 chromosomes. Chromosomes contain genes, which determine our physical and chemical makeup. (Sorrentino, 1997)

Cell types

Living cells are divided into two types:

- **Prokaryotic cells**
- **Eukaryotic cells.**

Prokaryotic cells: These cells are the simplest cellular organisms. Prokaryotic cells are fundamentally different in their internal organisation from eukaryotic cells as they lack a distinct nucleus, are simple in structure and have an outer cell wall that gives them shape. Just under the rigid cell wall is the cell membrane which is more fluid. The cytoplasm enclosed within the cell membrane does not exhibit much structure when viewed by electron microscopy. Most bacteria cells are prokaryotic.

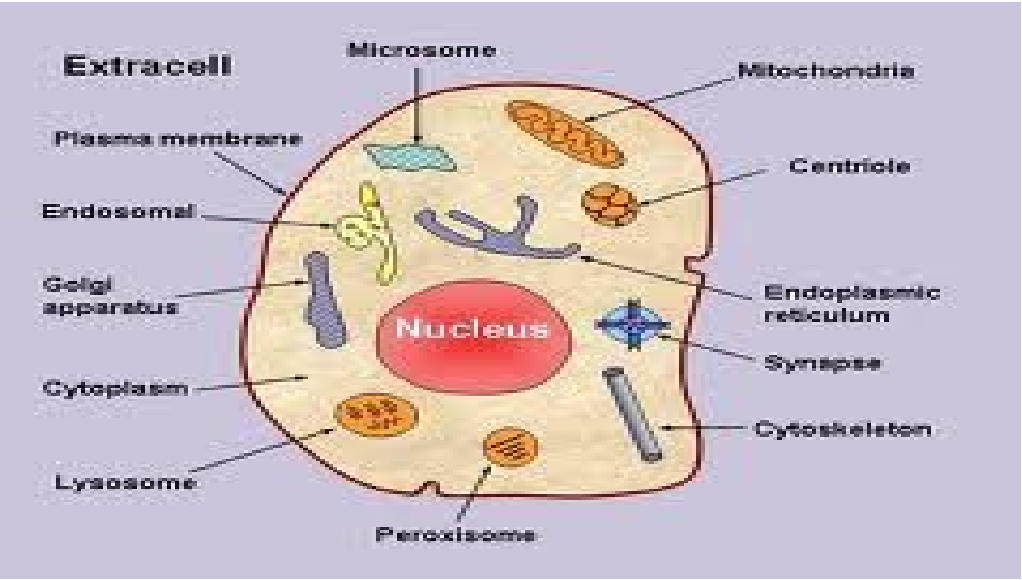


Eukaryotic cells: These cells contain a membrane-bound nucleus and numerous membrane-enclosed organelles, for example, mitochondria, lysosomes, Golgi apparatus. The membrane surrounding the nucleus is a double membrane with many nuclear pores through which material enters and leaves. Animals, plants and fungi are all eukaryotes. Eukaryotic cells are more complex than prokaryotic cells and are found in a great many different forms. These cells tend to be larger than the cells of bacteria and have developed specialised packaging and transport mechanisms that may be necessary to support their larger size.

Most multi cellular organisms are eukaryotic. All eukaryotic cells have within them a functionally interrelated membrane system, the endomembrane system consisting of the nuclear envelope, endoplasmic reticulaum (ER) and Golgi apparatus, vesicles and other organelles derived from them, and the plasma membrane. Many materials are moved around the cell by the endomembrane system, including some proteins.

Structures and organelles in eukaryotic cells: Although diverse in their organisation all eukaryotic cells have common structures that perform unique functions. The following are structures and organelles that commonly occur in these cells.

Cell (plasma) membrane



This outer boundary of the cell consists of a thin membrane that separates the intracellular fluid within cells and the extracellular fluid outside cells. In many respects, the plasma membrane is one of the most important parts of the cell. It acts as a semi-permeable structure that separates the intracellular and extracellular environments. It provides receptors for hormones and other biologically active substances, participates in the electrical events that occur in nerve and muscle cells, and aids in the regulation of cell growth and proliferation.

The cell membrane is made up of a lipid bilayer in which protein is embedded. Most of the specific functions are carried out by the proteins. Some of these proteins provide pathways for transport and regulate the flow of materials into and out of the cell. Other proteins serve as receptors for chemical signals coming from other cells.

Nucleus: The nucleus of the cell appears as a rounded or elongated structure situated near the centre of the cell and is the control centre of the cell. It contains the genetic material – genes, DNA and chromosomes. By expressing information stored in genes the nyucleus directs everyday cell life and reproduction.

The nucleus contains a smaller body, the nucleolus, that consists of densely packed chromosomes regions together with some protein and some RNA strands. The nucleolus initiates the formation of ribosomes, structures that are required for protein synthesis. The nucleus is surrounded by a double membrane that is riddled with pores involved in transporting materials between the nucleus and the rest of the cell.

Cytoplasm: Occupying the space between the nucleus and the plasma membrane, the cytoplasm contains various organelles which function as the organs of the cell. These organelles include the ribosomes, endoplasmic reticulum (ER), Golgi complex, mitochondria, lysosomes, microtubules, filaments and Centrioles.

Ribosomes: These serve as sites of protein synthesis in the cell. They can be found attached to the wall of the ER or as free ribosomes.

Parts of the cell

Cell qualities:

- The cell is the most basic unit of life
- There are cells that are organisms themselves, such as bacteria cells
- There are cells that only function when part of a larger organism
- In the body, there are brain cells, skin cells, liver cells, blood cells and many more
- All of these cells have unique functions and features.

Although cells may be very different and highly specialised, they all have the same basic structure.

They all have:

- **An outer covering:** which is called the membrane
- **A main substance**: which is called the cytoplasm
- **A control centre**: known as the nucleus
- **Organelles:** dispersed within their cytoplasm.
- **The cell membrane:** that protects the cell and regulates the passage of materials into and out of the cell.
- **The nucleus is the control centre of the cell**. DNA, which makes up the genes, is found within the chromatin granules and within the nucleolus is the RNA.

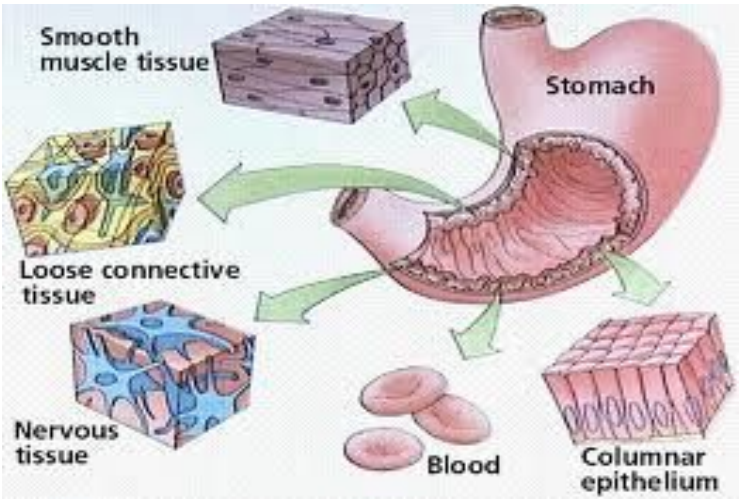
Organelles, which are structures found in the cytoplasm, are the:

- **Mitochondria,** the "**powerhouse"** of the cell, function in cellular metabolism and respiration
- **Endoplasmic reticulum** produces proteins and lipids and transports these substances within the cell
- **Lysosomes** function in intracellular digestion and form the "self-destruct" system of the cell
- **Golgi complex** concentrates some secretions, adds carbohydrates to some secretions and packages secretions for export from the cell
- **Vacuoles** are small cavities within the cell used to store secretions or waste products
- **Centrioles, cilia and flagella** are composed of microtubules
- **Centrioles** are contained in the centrosome and are involved in mitosis (cell division)
- **Cilia** aid in the movement of materials outside the cell. For example, trapping of dust particles in the respiratory tract
- **Flagella** are important in the locomotion of sperm cells.

Functions of the cell

1. **Respiration**: all cells require oxygen to metabolise food.
2. **Ingestion and assimilation**: cells are able to select chemicals from the surrounding fluid for their structure.
3. **Growth and repair**: cells can synthesise new cytoplasm so that growth can occur and repair worn out parts.
4. **Excretion**: waste products are eliminated into surrounding tissue to be transported by the blood for elimination via organs.
5. **Irritability and activity**: cells are able to respond to stimuli. For example a stimulus causes a muscle to contract or relax.
6. **Metabolism:** cells are able to break down and use substances from food as fuel.
7. **Reproduction**: cells reproduce by simple division but some cells can never be replaced once destroyed. For example, central nervous system cells.

Tissue

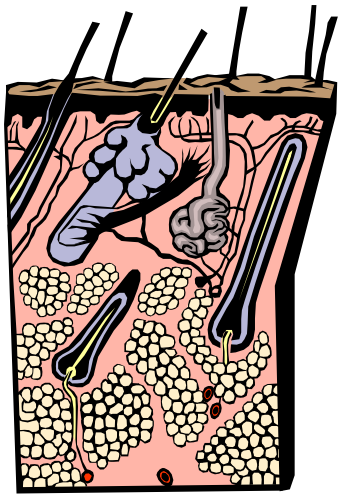


Tissues are made up of lots of cells of the same type, for example, muscle tissue is made up of many muscle cells.

Groups of cells form tissues and there are **four main types**. The structure of tissues reflects their function.

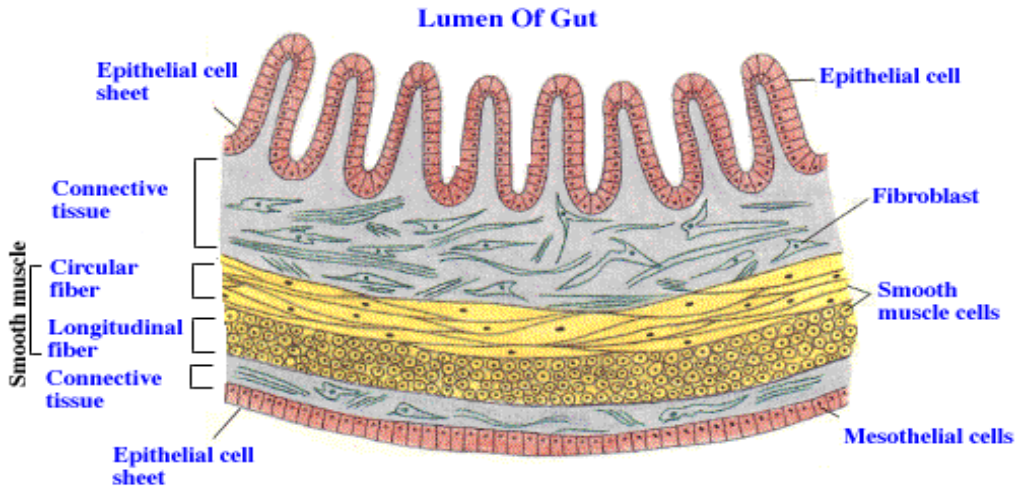
TYPES	FUNCTION	EXAMPLE
1. Epithelial	Protection	Skin
2. Connective	Support	Bones
3. Muscular	Movement	Skeletal
4. Nervous	Communication	Brain

Epithelial tissue



The cells of epithelial tissue pack tightly together and form continuous sheets that serve as linings in different parts of the body. Epithelial tissues serve as membranes lining organs and help to keep the body's organs separate, in place and protected. Some examples of epithelial tissue are the outer layer of the skin, the inside of the mouth and stomach and the tissue surrounding the body's organs.

Connective tissue



There are many types of connective tissue in the body. Generally speaking, connective tissue adds support and structure to the body. Most types of connective tissue contain fibrous strands of the protein collagen which add strength to the connective tissue. Some examples of connective tissue include the inner layers of skin, tendons, ligaments, cartilage, bone and fat tissue. In addition to these more recognisable forms, blood is also considered a form of connective tissue. Blood is the only fluid tissue in the body.

Functions of connective tissue

1. Binding of organs.
2. Support.
3. Physical protection.
4. Immune protection.
5. Movement.
6. Storage.
7. Heat production.
8. Transport.

Categories of connective tissue

- Fibrous connective tissue (a.k.a. connective tissue proper)
- Supporting connective tissue
- Fluid connective tissue

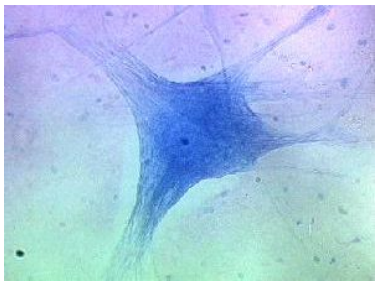
Muscle tissue and nervous tissues

Muscle tissue is a specialised tissue that can contract. Muscle tissue contains the specialised proteins actin and myosin that slide past one another and allow movement. Examples of muscle tissue are found in the muscles throughout the body.

Muscular tissue:

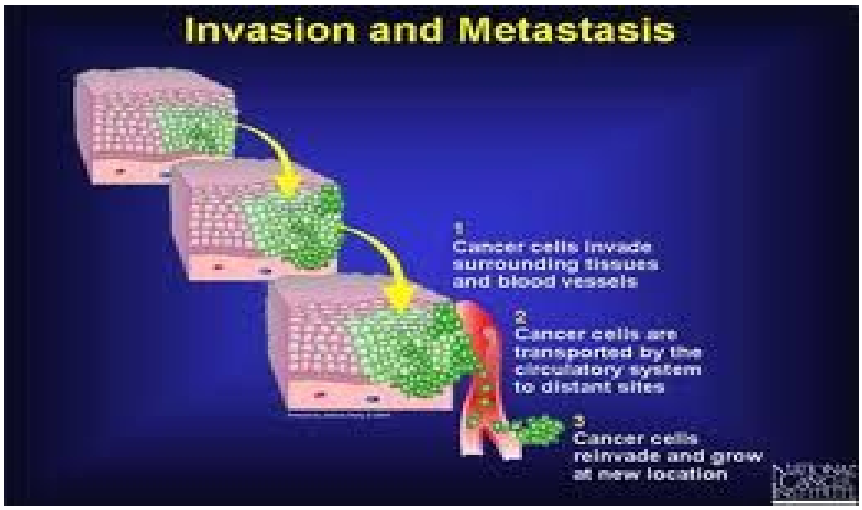
- 3 types: skeletal, cardiac, and smooth.
- Specialised to contract and exert forces on other tissues.

Nerve tissue



Consists of 2 cell types: Neurons and glia. Detects stimuli, integrates information, and transmits signals. Nerve tissue has the ability to generate and conduct electrical signals in the body. These electrical messages are managed by nerve tissue in the brain and transmitted down the spinal cord to the body.

Changes to cells and tissues



Cells differ in shape, size, number and their arrangement in tissues. Cells also differ in their response to injurious agents. Cells have mechanisms enabling them to adapt to altered conditions in the body. Adaptation occurs in response to both normal (physiologic) conditions and adverse (pathological) conditions. For example, pregnancy induces increased breast and uterine tissue and a prolonged exercise program will increase the mass of skeletal tissue. Both of these are normal physiological states. In an adverse condition, such as high blood pressure, myocardial cells are stimulated to enlarge by the increased demand of pumping by the heart.

Cellular damage

Most diseases begin with cellular injury. They may be:

- **Physical:** trauma, temperature extremes, ionising radiation
- **Biological:** bacteria, viruses, parasites
- **Chemical:** toxins, poisons, foreign substances
- **Metabolic:** ischemia (hypoxic injury), toxic build-up of abnormal metabolites, nutritional imbalances/fluid or electrolyte imbalance.

Cellular injury occurs if the cell is unable to maintain homoeostasis in spite of injurious stimuli. Injury may be reversible in which the cells may recover or it may be irreversible, resulting in cell death.

Cellular adaptations

Cellular adaptations are usually only successful in the short-term such as during an exercise session. Long-term or severe stressors can overwhelm the adaptive processes resulting in cellular injury or death. There are several types of cellular adaptations.

Atrophy: Atrophy is a decrease in the size of cells, and may be accompanied by a decrease in cell number, resulting in a reduced tissue mass. It is caused by hypoxia/poor nutrition, disuse of a structure, injurious agents, for example, lack of use of a specified skeletal muscle resulting in atrophy of this tissue, or an allergy to gluten causing atrophy to villi of small intestine.

Hypertrophy: Hypertrophy is an increase in the size of cells which results in an increase in the size of the affected organ tissue. Hypertrophy is caused by situations where the cells are required to do more work. For example consistent exercise will increase skeletal muscle and high blood pressure will increase cardiac muscle. Hypertrophy may also result from hormone stimulation.

Hyperplasia: Hyperplasia is an increase in the number of cells resulting in an enlarged tissue mass. It is caused by increased mitosis, growth factors or hormones. It may be a normal physiological process such as the increased number of endometrial cells during menstruation. It is also a pathological process such as epithelial cells responding to chronic insults with hyperplasia.

Metaplasia: Metaplasia is a change in cell character, that is, replacement of one mature cell type with a different mature cell type. The new tissue may provide resistance to an injury but results mostly in a loss of function. Its causes are irritants, for example ciliated columnar epithelium of the airways may be replaced by stratified squamous epithelium as a result of cigarette smoke injury. This gives greater protection to underlying tissues, but the cleaning function of the cilia is lost.

Dysplasia: Dysplasia is the abnormal change in size, shape and organisation of mature cells. It may result from chronic irritation or infection. Dysplasia is considered to be a 'pre-malignant' condition because if it is not treated appropriately, severe dysplasia will advance to a malignant neoplasm. These cells are often found adjacent to cancerous cells. Dysplastic changes are often seen in epithelial tissue of the cervix and respiratory tract.

Neoplasia: Neoplasia is the abnormal, uncoordinated and excessive cell growth that is caused by carcinogens, increased mitosis and loss of tumour suppressor genes that control cell division. It can occur in any fast dividing cell.

Apoptosis: Apoptosis is a normal physiologic process in which cells disintegrate and are then eliminated. This process is required to remove cells that have died after being injured, to remove cells affected by structural and functional change due to aging and to remove excess cells.

Tissue and organ responses

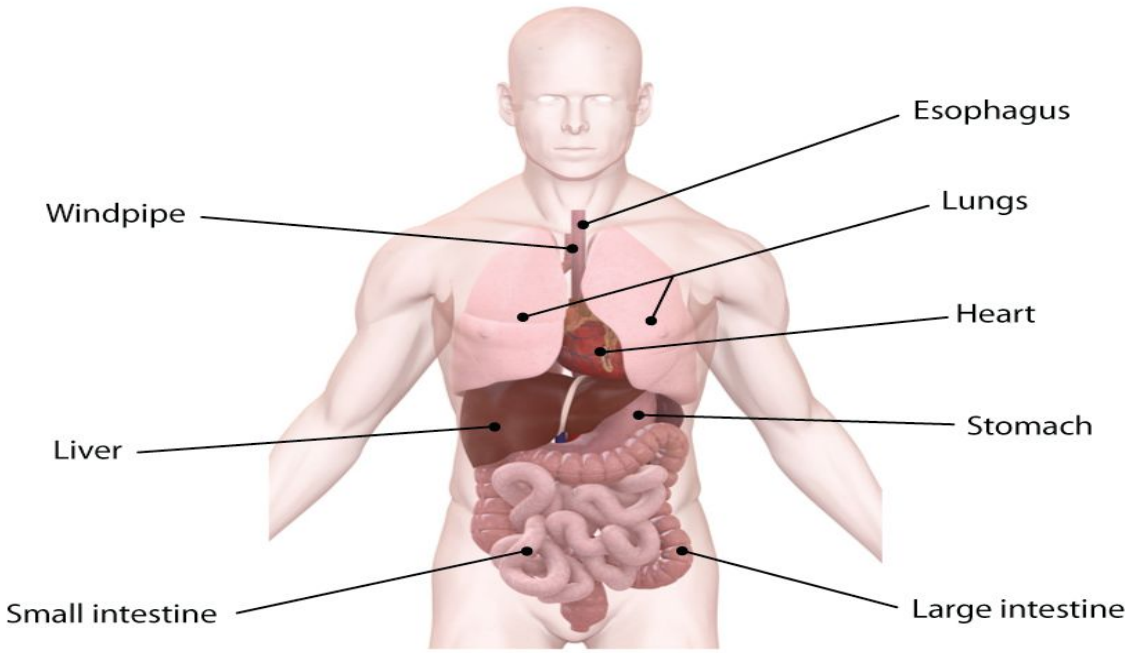
If a sufficient number of cells are damaged, there will be effects seen at tissue and organ level. The tissue response is dependent upon the location and severity of the homoeostatic change.

The organ response depends on altered structure and function of the cells. It may be:

- Hypertrophy or atrophy
- Hyper or hyposecretion of substances
- Overwork leading to exhaustion which leads to organ failure
- Loss of function.

Organs: Organs are the next level of organisation in the body. An organ is a structure that contains at least two different types of tissue working together to carry out a certain function, for example, the heart which contains muscle, membrane and blood tissues. Each organ has a specific function.

ORGAN	FUNCTION
Heart	Circulation
Stomach	Digestion
Brain	Communication/coordination
Uterus	Reproduction



Graphic of some of the organs in the body

There are many different organs in the body – the liver, kidneys, heart; even the skin is an organ. In fact, the skin is the largest organ in the human body and provides an excellent example of an organ as it contains many different tissues that work together to perform particular functions. Organ systems do not work in isolation; they work cooperatively to promote the wellbeing of the entire body.

Health terminology

By understanding the structure, function and location of the major body systems, the terminology (words and phrases) used and the principles for maintaining a healthy body you will be able to play an active role in assisting the older person, or person with a disability, improve their health and prevent illness and disease. In addition you will be able to communicate appropriately with other medical, allied health and welfare professionals involved in the care of the client.

The word terminology can be defined as a set of technical terms or vocabulary. Different professions have different terminologies associated with their disciplines. Medical related professions use what is known as 'medical terminology'. Medical terminology is the language used to describe the human body, its diseases and disorders, and its practitioners and their equipment. 'Health terminology' refers to a wider range of vocabulary that encompasses medical terminology along with many other general and area-specific terms used within the health sector.

Health terminology may relate to:

- Case taking
- Departments/sections in a hospital
- Health conditions and disease processes
- Health insurance
- Health investigations and procedures
- Labelling
- Other health care specialties
- Practice equipment/instruments and specific language/nomenclature
- Prescriptions
- Referrals
- Workcover.

Many occupations use medical words as part of their working language, including medical administrative assistants, scientists, dieticians, occupational therapists, social workers, psychologists, osteopaths, alternative health therapists, nurses and doctors. To be able to work within the allied and complementary health related fields you must be able to interpret, spell and pronounce a comprehensive list of basic medical terms.

There are several reasons why this is important.

- Firstly, you are required in your job role to provide a certain duty of care. This employee responsibility will not only be a requirement of your organisation's policies and procedures, but is one for which you are legally accountable.
- Secondly, many medical terms can sound similar to one another whilst in fact be very different. Always consider the possibility of confusion caused by someone not being familiar with a word, how the word is pronounced, variations in dialect and the context in which the word has been stated.

An example of medical terms that sound similar but have different meanings is outlined below.

- **APHASIA:** is pronounced A FA ZI A and means a disorder of speech.
- **APHAGIA:** is pronounced A FA GI A and means difficulty with swallowing.

This example demonstrates how easy it is to make a communication error if you do not understand the terminology and its application within your work role. The ramifications from this communication error could be fatal to the patient. Ultimately it results in a breach of employee duty of care.

Professional titles

Before going into an in-depth discussion on medical terminology and how it works, listed below are some examples of abbreviated terminology that represent various professional titles within the medical, and allied and complementary health fields.

CA: Certified Acupuncturist

DC: Doctor of Chiropractic

DO: Doctor of Osteopathy

MD: Doctor of Medicine

OT: Occupational Therapist

PhD: Doctor of Philosophy

PT: Physiotherapist

EGN: Enrolled General Nurse.

Diagnostic, symptomatic and operative headings

In medical terminology, terms are grouped under Diagnostic, Symptomatic and Operative headings.

Diagnostic terms: Diagnostic Terms relate to specific clinical disorders, conditions or diseases, indicating the nature of the disease.

Symptomatic terms: Signs and symptoms are grouped under the same heading, although there is a very important difference.

Sign – is "as perceived" or **observable**, for example by the physician. It is objective, external or real - not belonging to consciousness

Symptom – is as perceived or **described** by the patient. It is subjective - e.g. headache, pain.

Operative terms: Procedures and operations are grouped under the same heading, although there is considered to be a difference.

A **procedure** is often for investigation and is non invasive, for example an endoscopy.

Origin of medical terminology

Like every other language, medical terminology has changed over time; however, its basis remains the same. The majority of medical terms are based in ancient Greek or Latin. Also, many medical terms consist either entirely or party of personal names. One such medical term is herpes, which is an inflammatory disease affecting the skin. Herpes is based on the word *herpo*, which is Greek for 'creeping along'. Workers in the medical field choose *herpo* (or herpes) to describe the skin condition because it seems to 'creep along' the skin.

For example:

Strumpell-Marie disease is named after Ernst Strumpell, the first person to completely describe the condition known as ankylosing spondylitis.

Knowledge of the fundamental word structure used in medical terms

Many of the words used in medicine are made up of parts which are also used in other words. Once you know the meanings of the basic parts of the words, you can put them together to understand the meanings of many medical terms.

There are four basic components to most medical terms:

1. Root or stem – often is a body part
2. Prefix – adds meaning to the root or stem
3. Suffix – often is a procedure or condition
4. Combining Vowel – joins word parts

Roots or Stem words

The root or stem is the main part of a word and gives you the central meaning. For example, in the word **cardiology** (kahdi-olo-jee), the root is **cardi**, which refers to the heart. Any word containing this root will have something to do with the heart. A medical term may contain more than one root. For example, in the word **cardiovascular** (kahdioh-vaskyoo- la) there are two roots. **Cardi** which refers to the heart and **vascular** relating to the blood vessels. When the full term is used, the user is referring to the whole circulatory system.

Prefixes

The prefix adds specific meaning to the other parts of the word and is placed at the beginning of the word. For example, the prefix **hypo** can mean "low" or "under" or "below". When used at the beginning of the word **thermia,** which refers to temperature, it forms **hypothermia** which means low temperature or below normal temperature. If the prefix is changed to **hyper,** which can mean "high" or "over" or "above", the meaning of the word changes to high or above normal temperature. You can see from this example that by using the same root and changing the prefix, you can make two medical terms with completely opposite meanings.

Suffixes

The suffix is placed at the end of a word and also adds meaning to the other elements. For example, the suffix **ectomy** means "excision" or "cutting out". If we add this to the end of the root for appendix we get **appendicectomy** (apendi-sekte- mee) which refers to the removal of the appendix. If the suffix is changed to **itis,** which means "inflammation", the word becomes **appendicitis** (apendi-sytis) which refers to inflammation of the appendix. You should begin to see how important it is to use the correct word.

Examples of Prefixes, Suffixes and Roots

The following list defines many commonly used medical prefixes, roots, and suffixes.

a(n)	absence of		**malac**	soft
acou, acu	hear		**mamm(o)**	breast
aden(o)	gland		**mast(o)**	breast
aer(o)	air		**megal(o)**	large
alg	pain		**melan(o)**	black
andr(o)	man		**mening(o)**	membranes
angi(o)	vessel		**my(o)**	muscle
ankyl(o)	crooked, curved		**myc(o)**	fungus
ante	before		**myel(o)**	marrow
anter(i)	front, forward		**nas(o)**	nose
anti	against		**necr(o)**	death
arteri(o)	artery		**nephr(o)**	kidney
arthr(o)	joint		**neur(o)**	nerve
articul	joint		**nutri**	nourish
ather(o)	fatty		**ocul(o)**	eye
audi(o)	hearing		**odyn(o)**	pain
aur(i)	ear		**oma**	tumor
aut(o)	self		**onc(o)**	tumor
bi, bis	double, twice, two		**oophor(o)**	ovaries
brachy	short		**ophthalm(o)**	eye
brady	slow		**opia**	vision
bucc(o)	cheek		**opsy**	examination
carcin(o)	cancer		**orchi(o)**	testes
cardi(o)	heart		**osis**	condition
cephal(o)	head		**osse(o)**	bone
cerebr(o)	brain		**oste(o)**	bone
cervic	neck		**ot(o)**	ear
chol(e)	bile, or referring to gall-bladder		**path(o)**	disease

chondr(o)	cartilage		**ped(o)**	child
circum	around, about		**penia**	deficient, deficiency
contra	against, counter		**peps, pept**	digest
corpor	body 3		**peri**	around
cost(o)	rib		**phag(o)**	eat, destroy
crani(o)	skull		**pharmaco**	drug
cry(o)	cold		**pharyng(o)**	throat
cut	skin		**phleb(o)**	vein
cyan(o)	blue		**phob(ia)**	fear
cyst(o)	bladder		**plasty**	repair
cyt(o)	cell		**pleg(ia)**	paralysis
dactyl(o)	finger or toe		**pnea**	breathing
dent	tooth		**pneum(ato)**	breath, air
derm(ato)	skin		**pneumon(o)**	lung
dipl(o)	double		**pod(o)**	foot
dors	back		**poie**	make, produce
dys	bad, faulty, abnormal		**poly**	much, many
ectomy	excision (removal by cutting)		**post**	after
emia	blood		**poster(i)**	back, behind
encephal(o)	brain		**presby**	elder
end(o)	inside		**proct(o)**	anus
enter(o)	intestine		**pseud(o)**	false
epi	outer, superficial, upon		**psych(o)**	mind
erythr(o)	red		**pulmon(o)**	lung
eu	normal		**pyel(o)**	pelvis of kidney
extra	outside		**pyr(o)**	fever, fire
gastr(o)	stomach		**rachi(o)**	spine
gen	become, originate		**ren(o)**	kidneys
gloss(o)	tongue		**rhag**	break, burst
glyc(o)	sweet, or referring to glucose		**rhe**	flow
gram, graph	write, record		**rhin(o)**	nose
gyn	woman		**scler(o)**	hard
hem(ato)	blood		**scope**	instrument
hemi	half		**scopy**	examination

hepat(o)	liver		**somat(o)**	body
hist(o)	tissue		**spondyl(o)**	vertebra
hydr(o)	water		**steat(o)**	fat
hyper	excessive, high		**sten(o)**	narrow, compressed
hypo	deficient, low		**steth(o)**	chest
hyster(o)	uterus		**stom**	mouth, opening
iatr(o)	doctor		**supra**	above
infra	beneath		**tachy**	fast, quick
inter	among, between		**therap**	treatment
intra	inside		**therm(o)**	heat
itis	inflammation		**thorac(o)**	chest
lact(o)	milk		**thromb(o)**	clot, lump
lapar(o)	flank, abdomen		**tomy**	incision (operation by cutting)
latero	side		**tox(i)**	poison
leuk(o)	white		**uria**	urine
lingu(o)	tongue		**vas(o)**	vessel
lip(o)	fat		**ven(o)**	vein
lys(is)	dissolve		**vesic(o)**	bladder
mal	bad, abnormal		**xer(o)**	dry

Combining Vowel

A vowel is sometimes added between two word elements to join them together and make them easier to say. This is called a combining vowel and it is usually the letter "o" or "i". When the combining vowel is added to the root, the resulting form is called the combining form. If a root is joined to a suffix that begins with a vowel, the combining vowel is sometimes dropped. For example, in the term **gastroenteritis** (gastroh-enter-eytis) there is a combining vowel between **gastr** and **enter** but because **itis** begins with "i", the second combining vowel is dropped.

Component parts

The same components are used in many medical terms. "Spondylo" plus "**itis,"** which means inflammation, forms spondylitis, an inflammation of the vertebrae. The same prefix plus "malacia," which means soft, forms spondylomalacia, a softening of the vertebrae. Knowing the meaning of a small number of **components** can help with interpretation of a large number of medical terms.

Antenatal:

ante = before, nat = birth, al = pertaining to
antenatal - before birth or during pregnancy

Enteropathy:

enter/o = intestine, pathy = disease
enteropathy = disease of the intestine

Pericardium:

peri = around, cardium = heart
pericardium = the tissue around the heart

Cystometry:

Cyst = bladder, metry = measurement
cystometry = measurement of bladder volume (usually an investigation by a urology specialist)

Dermatitis:

dermat = skin, itis = inflammation
dermatitis = inflammation of the skin

Similar sounding words

A **homonym** means a word that has the same sound and sometimes, but not always, the same spelling but has a different meaning, for example:

Right (correct) and *write* (to record).

The best way to remember the difference between these words is to practice putting them into sentences that mean something to you personally. Sometimes it helps to think of hints, for example to remember the difference in stationary and station**e**ry think of the third last letter "**e**" – *paper goes in an* ***e****nvelop****e***. Another hint is for words like **advice/and licence/ license, i**f it ends in *ce* it is a thing (noun) and *se* it is the action (verb).

WORD AND MEANING	SIMILAR SOUNDING WORD AND MEANING
Accept: receive, tolerate	Except: exclude
Addition: to add	Edition: publication
Advice: an opinion (noun)	Advise: the action of offering an opinion (verb)
Affect: influence	Effect: result
Allowed: permitted	Aloud: clear, distinct
Bare: naked, exposed	Bear: animal (e.g. koala), support, breed
Blew: puff of wind	Blue: colour
Bow: bend, front of boat, ribbon	Bough: tree branch
Brake: stop	Break: smash
Caught: past tense of "catch"	Court: enclosure (e.g. tennis), to romance
Compliment: to praise or flatter	Complement: to complete (something)
Decent: proper	Descent: movement downwards Dissent: disagreement
Discreet: reserved, respectful	Discrete: individual, distinct
Elicit: to bring out	Illicit: illegal
Flaw: defect	Floor lower surface (e.g. of a room)
Formally: conventionally	**formerly**: in the past
Forth: forward in time, place or order	**fourth:** follows third
Gorilla: a large ape	Guerilla: soldier

Grate: to shred	Great: wonderful
Heard past tense of to listen	Herd: a group of animals
Here: this place (opposite of there)	Hear: sense with the ears
Higher: further up	Hire: to rent
Hole: an opening	Whole: complete
Its: belonging to it	It's: short for "it is"
Know: to understand	No: negative
Lead: metal, to guide	Led past tense of to guide
Lessen: to make smaller	Lesson: something learned
License: permit from government (noun)	License: action to allow (verb)
Loose: opposite of tight	Lose: opposite of win
Mail: items sent through post	Male: opposite of female
Meat: flesh	Meet: get together
Muscle: fibrous sinew of body	Mussel: shellfish
New: opposite of old	Knew: past tense of know
Patience: endurance	Patients: persons under medical care
Past: time before now	Passed past tense of "to pass"
Piece: portion, part	Peace: quietness, silence
Plain: easy to understand	Plane: an aircraft
Paw: an animal's foot	Poor: opposite of rich Pore: a hole in the skin Pour: to let liquid run
Presence: being there, appearance	Presents: gifts
Principal: important, boss, headmaster,	Principle: law, moral
Rain: downpour, shower, storm	Reign: to rule Rein: to restrain (as in reins of a horse)
Read: to look at a book	Reed: a plant
Right :correct, opposite to left,	Write: to record (often on paper) Rite: ritual, ceremony
Road: highway	Rode: past tense of ride

Scene: where an action occurs	Seen: past tense of to see
Seem: look like	Seam: a join
Sight: vision	Site: place, grounds (e.g. website) Cite quote or make a reference to
So: likewise, therefore, to such a degree	Sew: join together or stitch
Some: a few Soul: spirit	Sum: to add numbers Sole: single, bottom of the foot, fish
Stationary: not moving	Stationery: writing materials
Straight: unbending	Strait: a water passageway
Tail: rear (e.g. dog's tail, shirt tail)	Tale: a story
Tea: a drink	Tee: golf support
Their: belonging to them	There: that place They're: short for "they are"
Theirs: belonging to them	There's: short for "there is"
Threw: past tense of throw	Through: in one side and out the other
To: towards or headed for,	Too: also, excessively Two: the number 2
Vary: make a change in	Very: also, excessively
Waist: middle of the body	Waste: to use up needlessly, garbage
Wait: stop	Weight: heavy
Weak: not strong	Week: seven days
Weather: e.g. rain, sunshine, storms	Whether: alternative, one or the other Wether: male sheep
Which: particular one	Witch: sorcerer
Whose: belonging to whom	Who's: short for "who is" or "who has"
Wood: timber	Would: hopeful
Your: belonging to you	You're: short for "you are"

Examples of Medical conditions terminology/combined list

Please note: The list below is not complete

- **Addison's disease:** Partial or complete failure of secretion of hormones by adrenal cortex.
- **Adrenal-itis:** (**adrenal = relating to the adrenal glands, itis = inflammation of**) Inflammation of the adrenal glands.
- **Adreno-pathy:** (**adren/o = relating to the adrenal glands, pathy = disease of**) Disease of the adrenal glands.
- **Agora-phobia:** (**agora = relating to market, phobia = fear of**) Fear of market places and open places.
- **Ailuro-phobia:** (**ailuro = relating to cats, phobia = fear of**) Fear of cats.
- **Albin-ism:** (**albin = white, ism = state or condition of**) Absence of pigments. A person with albinism (an albino) has white skin and hair due to the inability to form melanin.
- **Aldosteron-ism:** (**aldosteron = relating to aldosterone, ism = state of**) Abnormality of electrolyte metabolism cause by excretion of aldosterone secretion.
- **Alopecia** (**alopec = baldness, ia = pertaining to**) Absence of hair.
- **Alopec-ia- areata:** (**alopec = baldness, ia = pertaining to, areat/o = occurring in patches**) Bald patches that may re-grow.
- **Alopec-ia universalis:** (**alopec = baldness, ia = pertaining to**) Total loss of hair on all parts of the body
- **Alzheimer's disease:** Presenile dementia.
- **A-meno-rrhoea:** (**a = without, men/o = menses, rrhoea = to flow**) without menstrual flow.
- **Amnesia:** Loss of memory
- **Andro-phobia:** (**andro = relating to males, phobia = fear of**) Fear of men.
- **Angio-sarc-oma:** (**angio = relating to blood vessel, sarc = flesh, oma = tumour**) Sarcoma (cancer) of blood vessel tissue.
- **An-hydr-osis:** (**an = without, hydr = water, osis = abnormal condition of**) Lack of sweating.
- **An-ophthalm-ia:** (**an = without, ophthalm = eye, ia = condition of**) Absence of one or both eyes.
- **Anorexia -nervosa:** (**anorexia = want of appetite, nervosa = nervous, tense**)
- A disorder characterised by deliberate weight loss, induced and/or sustained by the patient. The disorder occurs most commonly (but not exclusively) in adolescent girls and young women.
- **An-u-ria:** (**an = without, ur = urine, ia = state of, condition of**) Inability of the kidneys to produce urine.
- **Aphasia:** (**a = without, phas = speech, ia = abnormal condition of**) Loss of the power of expression by speech.
- **Arachnophobia:** (**arachn/o = relating to spiders, phobia = fear of**) Fear of spiders.
- **A-sperm-ia:** (**a = without, sperm = seed, sperm, ia = condition of**) Absence of sperm.
- **A-stigmat-ism:** (**a = without, stigmat = point, ism** = **state or condition of**) An irregular curvature of the cornea that prevents clear focusing.

- **De-ment-ia** (**de = lack of, ment = mind, ia = abnormal state or condition of**) A syndrome due to disease of the brain, usually of a chronic or progressive nature. There is a disturbance of multiple higher cortical functions, including memory, thinking, and orientation, and comprehension, calculation, learning capacity, language and judgement. Consciousness is not clouded.
- **Dermat-itis:** (**dermat = skin, itis = inflammation of**) An inflammation of the skin.
- **Diabetes mellitus:** Metabolic disorder that is the result of inadequate insulin secretion.
- **Cataract** Lens loses its transparency and becomes cloudy and opaque.
- **Cellul-itis:** (**cellul = cellulite, itis = inflammation of**) Severe inflammation of the deep dermis of the skin.
- **Cushing's disease:** abnormally increased production of hormones by adrenal cortex.
- Symptoms include obesity and abnormal distribution of hair.
- **Cyst-adeno-carcin-oma of the ovaries of the ovaries** (**cyst = sac, aden/o = glands, carcin = cancer, oma = tumour**) Carcinoma (cancer) of the ovaries.
- **Dacryo-stenosis:** (**dacry/o = tear, lacrimal; stenosis = narrowing of**) Stricture of the nasolacrimal duct, often resulting from a congenital abnormality or an infection.
- **Endometri-osis:** (**endometri = endometrium, osis = abnormal condition, disease of**)
- Occurs, when the endometrial cells, go into and through the fallopian tubes and are therefore in an abnormal position around the ovary on the outside of the uterus or in the pelvic cavity. They can attach to these tissues, start growing and spread further. The cells can block the fallopian tubes and cause pain
- **Epi-lepsy: epi = upon, lepsy = seizure**) A brain disorder in which clusters of nerve cells in the brain sometimes signal abnormally. The normal pattern of neuronal activity becomes disturbed, causing strange sensations, emotions and behaviour, or sometimes convulsions, muscle spasms, and loss of consciousness.

Identifying medical language

Eponym: is something named after someone. For example, a condition called Shiel's syndrome might be named after someone named Shiel who discovered it or described and clearly delineated it.

Examples of Eponyms include:

- Fallopian tubes
- McBurney sign
- Down's syndrome
- Islets of Langerhans
- Hodgkin's disease
- Haversian canals

Onomatopoeia

This is when a word sounds like the thing it describes. For example, belch, burp, hiccough, and murmur.

Acronym

These are words that are created from the first letter of other words. Examples of acronyms include:

- **AIDS** – Acquired Immunodeficiency Syndrome
- **BCC –** Basal Cell Carcinoma
- **AKA –** Above Knee Amputation

Spelling and pronouncing medical terminology correctly

Spelling used in health terminology

It is essential that medical terms are spelt correctly. Misspelling a medical term can give the word a very different meaning and the consequences of that can be very serious. For example, **oral** (or-ral) and **aural** (or-ral) may sound alike but their spelling is quite different. **Oral** refers to the mouth and **aural** refers to the ear, so you can imagine what can happen if the wrong word is written. When you hear a word and are not sure exactly what you have heard, you must seek clarification. There may be more than one acceptable spelling for a term. In some cases both the Greek and Latin spellings have been adopted. In other cases American spellings may differ from English versions.

Advanced Spelling and Pronunciation Helper

WORD	GUIDE TO PRONUNCIATION
Abdominocentesis	ab-dom-ih-no-sen-TEE-sis
Acoustogram	ah-KOOS-toh-gram
Adenocarcinoma	ad-eh-no-kar-sih-NO-mah
Adenoiditis	ad-eh-noid-EYE-tis
Adenoids	AD-eh-noids
Adhesion	ad-HE-zhun
Aerobe	air-robe
Amniocentesis	am-nee-oh-sen-TEE-sis
Anaemia	ah-NEE-me-ah
Anaesthesia	an-es-THEH-zhia
Anaphylactic	ana-fie-LACK-tick
Anastomosis	ah-nas-toh-MOH-sis
Aneurysm	AN-you-rizm
Aneurysmectomy	an-you-rizm-ECK-toe-me
Aneurysmorrhaphy	an-you-rizmo-RAF-ee
Angiitis	an-je-EYE-tis
Angina	an-JIGH-nah
Angina pectoris	an-JIGH-nah-PECK-toh-riss
Angiocardiography	an-jee-oh-kar-dee-OG-rah-fee
Angiography	an-jee-OG-rah-fee
Angionecrosis	an-jee-oh-neh-KROH-sis
Angiospasm	AN-jee-oh-spazm
Angiostenosis	AN-jee-oh-steh-NO-sis
Ankylosing spondylitis	an-kih-LOH-sing spon-dih-LYE-tis
Ankylosis	an-kih-LOH-sis
Anoplasty	AN-oh-plas-tee
Anorexia	an-oh-RECK-see-ah
Anoscopy	an-OSS-koh-pee
Anthracosis	an-thrah-KOH-sis
Aorta	ay-OR-tah
Aphonia	ah-FOH-nee-ah
Aphthous stomatitis	AF-thus stoma-TYE-tis
Apnoea	ap-NEE-ah
Appendicitis	ah-pen-dih-SIGH-tis
Arrhythmia	ah-RITH-me-ah
Arteriectomy	ar-teh-ree-ECK-toh-me
Arteriosclerosis	ar-tee-ree-oh-skleh-ROH-sis

Arteritis	ar-ter-RYE-tis
Arthralgia	ar-THRAL-jee-ah
Arthrectomy	ar-THRECK-toh-me
Arthritis	ar-THRIGH-tis
Arthrocentesis	ar-throh-sen-TEE-sis
Arthrodesis	ar-throh-DEE-sis
Arthrography	ar-THROG-rah-fee
Arthrolysis	ar-throw-LIE-sis
Arthroplasty	AR-throw-plas-tee
Arthroscopy	ar-throw-SKOH-pee
Asbestosis	ass-bess-TOE-sis
Aspergillosis	ass-per-jil-OH-sis
Asphyxia	ass-FICK-see-ah
Asphyxiation	ass-fick-see-AY-shun
Asthma	ASS-mah
Asymptomatic	ay-simp-toe-MAT-ick
Ataxia	ah-TACK-see-ah
Atelectasis	at-ee-LEK-tah-sis
Atherosclerosis	ath-er-oh-skleh-ROH-sis
Atonic	ah-TON-ick
Autoimmune	aw-toh-im-YOON
Biopsy	BYE-op-see
Blastoma	blas-TOH-mah
Borborygmus	bor-boh-RIG-mus
Bradycardia	brad-ee-KAR-dee-ah
Bronchiectasis	bron-kee-ECK-tah-sis
Bronchitis	bron-KYE-tis
Bronchoconstrictor	bron-koh-kon-STRICK-tor
Bronchodilator	bron-koh-dye-LAY-tor
Bronchopneumonia	bron-koh-neh-MOH-nee-ah
Bronchorrhagia	bron-koh-RAY-jee-ah
Bronchorrhoea	bron-koh-REE-ah
Bronchoscope	BRON-ko-scope
Bronchoscopy	bron-KOS-koh-pee
Bruxism	BRUCK-sizm
Bursectomy	bur-SECK-toh-me
Bursitis	bur-SIGH-tis
Byssinosis	biss-ih-NO-sis
Callus	KAL-us
Candidiasis	kan-dih-DYE-ah-sis
Carcinoma	kar-sih-NO-mah
Cardiocentesis	kar-dee-oh-sen-TEE-sis
Cardioplegia	kar-dee-oh-PLEE-jee-ah
Cardiopulmonary	kar-dee-oh-PUL-mon-eh-ree
Cardiorrhexis	kar-dee-oh-RECK-sis
Carditis	kar-DYE-tis
Catheterisation	kath-eh-ter-eye-ZAY-shun
Chemonucleolysis	kee-moh-new-klee-oh-LIE-sis
Cholecystectomy	ko-leh-sis-TEK-tah-mee
Cholecystitis	koh-lee-sis-TYE-tis
Choledocholithotomy	koh-lee-DOH-lih-THOT-oh-me

Cholelithiasis	koh-lee-LITHY-assis
Cholesterol	koh-LES-ter-ol
Chondromalacia	kon-droh-mah-LAY-she-ah
Chondroplasty	KON-droh-plas-tee
Cirrhosis	sir-ROH-sis
Colectomy	koh-LECK-toh-me
Colposcopy	KOL-po-scop-ee
Complement	COM-ple-ment
Contracture	kon-TRACK-chur
Craniectomy	kray-nee-EK-toh-me
Cranioplasty	KRAY-nee-oh-plas-tee
Craniotomy	kray-nee-OT-oh-me
Crepitation	krep-ih-TAY-shun
Croup	KROOP
Cryptococcal meningitis	krip-toh-KOCK-al men-in-JIGH-tis
Cyanosis	sigh-ah-NO-sis
Defecation	deh-feh-CAY-shun
Defibrillation	dee-fib-rih-LAY-shun
Diastolic	die-ah-STOL-ick
Diphtheria	dip-THEE-ree-ah
Diskectomy	dis-KECKtoh-me
Diverticulectomy	dye-ver-tick-you-LECK-toh-me
Diverticulitis	dye-ver-tick-you-LYE-tis
Dyspepsia	dis-PEP-see-ah
Dysphagia	dis-FAY-jee-ah
Dysphonia	dis-FOH-nee-ah
Dyspnoea	DIS-nee-ah
Dystaxia	dis-TACK-see-ah
Dystonia	dis-TOH-nee-ah
Echocardiography	eck-oh-car-dee-OG-rah-fee
Echocardiogram	eck-oh-CAR-dee-oh-gram
Eclampsia	eh-KLAMP-see-ah
Ectopic	eck-TOP-ick
Edema	eh-DEE-mah
Effusion	eh-FEW-zhun
Electrocardiography	ee-leck-troh-car-dee-OG-rah-fee
Electrocardiogram	ee-leck-troh-CAR-dee-oh-gram
Electromyography	ee-leck-troh-my-OG-rah-fee
Electroneuromyography	ee-leck-troh-new-roh-my-OG-rah-fee
Embolism	EM-boh-lizm
Emesis	EM-e-sis
Emphysema	em-fih-SEE-mah
Empyema	em-pye-EE-mah
Endarterectomy	end-ar-ter-ECK-toh-me
Endocarditis	en-doh-kar-DYE-tis
Endotracheal intubation	en-doh-trah-KEY-al in-tew-BAY-shun
Enteritis	en-ter-EYE-tis
Enterocolostomy	en-ter-oh-koh-LOSS-toh-me
Epiglottitis	ep-ih-glot-TYE-tis
Epistaxis	ep-ih-STACK-sis
Eructation	eh-ruk-TAY-shun

Erythrocytosis	eh-rith-roh-sigh-TOH-sis
Exostosis	eck-sos-TOH-sis
Exudate	ECKS-you-dayt
Faeces	FEE-sees
Fasciectomy	fas-ee-ECK-toh-me
Fasciitis	fas-ee EYE-tis
Fascioplasty	fash-ee-oh-PLAS-tee
Fasciorrhaphy	fash-ee-OR-ah-fee
Fasciotomy	fash-ee-OT-oh-me
Fibrillation	fih-brih-LAY-shun
Fibroma	figh-BROH-mah
Fibromyalgia	figh-broh-my-AL-jee-ah
Fibrositis	figh-broh-SIGH-tis
Flatus	FLAY-tus
Foetal	FEE-tell
Fontanelle	fon-ta-NELL
Frenectomy	freh-NECK-toh-mee
Gastrectomy	gas-TRECK-toh-me
Gastritis	gas-TRY-tis
Gastroenteritis	gas-troh-en-ter-EYE-tis
Gastrorrhagia	gas-troh-RAY-jee-ah
Gastrorrhexis	gas-troh-RECK-sis
Gastrorrhoea	gas-troh-REE-ah
Gastroscopy	gas-TROS-koh-pee
Gastrosis	gas-TROH-sis
Gastrostomy	gas-TROS-toh-me
Gastrotomy	gas-TROT-oh-me
Gingivectomy	jin-jih-VECK-toh-me
Gingivitis	jin-jih-VYE-tis
Gouty arthritis	gow-tee ar-THRIGH-tis
Haemangioma	he-man-jee-OH-mah
Haematemesis	heem-ah-TEM-eh-sis
Haematoma	hem-ah-TOH-mah
Haemolytic	hee-mo-LIGHT-ik
Haemolytic	anaemia he-moh-LIGHT-ick ah-NEE-me-ah
Haemophilia	hee-moh-FILL-ee-ah
Haemorrhage	HEM-or-idj
Haemorrhoidectomy	hem-oh-roid-ECK-toh-me
Haemorrhoids	HEM-oh-roids
Haemostasis	hee-moh-STAY-sis
Haemothorax	hee-moh-THOH-racks
Hemiparesis	hem-ee-PAR-ee-sis
Hemiplegia	hem-ee-PLEE-jee-ah
Hepatectomy	hep-ah-TECK-toh-me
Hepatitis	hep-ah-TYE-tis
Hepatomegaly	hep-ah-toh-MEG-ah-lee
Hepatorrhagia	hep-ah-toh-RAY-jee-ah
Hepatorrhaphy	hep-ah-TOR-ah-fee
Hepatorrhexis	hep-ah-toh-RECK-sis
Hepatorrhoea	hep-ah-toh-REE-ah
Hepatotomy	hep-ah-TOT-oh-me

Hernia	HER-nee-ah
Herniated	HER-nee-ayt-ed
Herniorrhaphy	her-nee-OR-ah-fee
Herpes labialis	HER-peez lay-be-AL-iss
Hiatal hernia	high-AY-tal HER-nee-ah
Hodgkin's	HODJ-kinz
Hyperemesis	high-per-EM-eh-sis
Hyperkinesia	high-per-kye-NEE-zee-ah
Hyperpnoea	high-perp-NEE-ah
Hypertonia	high-per-TOH-nee-ah
Hyperventilation	high-per-ven-tih-LAY-shun
Hypokinesia	high-poh-kye-NEE-zee-ah
Hypopnoea	high-poh-NEE-ah
Hypotonia	high-poh-TOH-nee-ah
Hypoxia	high-POCK-see ah
Ileectomy	ill-ee-ECK-toh-me
Ileitis	ill-ee-EYE-tis
Ileostomy	ill-ee-OS-toh-me
Immunisation	im-you-nigh-ZAY-shun
Immunity	im-YOU-nit-ee
Immunodeficiency	im-you-no-deh-FISH-en-see
Immunoglobulin	im-you-no-GLOB-you-lin
Immunosuppressant	im-you-no-sup-PRESS-ant
Immunosuppression	im-you-no-sup-PRESH-un
Immunotherapy	im-you-no-THER-ah-pee
Influenza	in-flew-EN-zah
Interferon	in-ter-FERRON
Intubation	in-tew-BAY-shun
Intussusception	in-tus-sus-SEP-shun
Ischemia	iss-KEE-me-ah
Jaundice	JAWN-dis
Kaposi's sarcoma	KAP-oh-seez sar-KOH-mah
Kyphosis	kye-FOH-sis
Laminectomy	lam-ih-NECK-toh-me
Laryngectomy	larrin-JECK-toh-me
Laryngitis	larrin-JIGH-tis
Laryngoplasty	lah-RING-goh-plas-tee
Laryngoplegia	larrin-go-PLEE-jee-ah
Laryngoscopy	larrin-GOSS-koh-pee
Laryngospasm	lah-RING-goh-spazm
Lateral	LAT-er-al
Leucoblast	LOO-koh-blast
Leucocyte	LOO-koh-site
Leukaemia	loo-KEE-me-ah
Leukopenia	loo-koh-PEE-nee-ah
Lordosis	lor-DOH-sis
Lumbago	lum-BAY-go
Luxation	luck-SAY-shun
Lymphadenitis	lim-fad-eh-NIGH-tis
Lymphadenopathy	lim-fad-eh-NOP-ah-thee
Lymphangioma	lim-fan-jee-OH-mah

Lymphocytes	LIM-fo-sites
Lymphoma	lim-FOH-mah
Lymphosarcoma	lim-foh-sar-KOH-mah
Mammography	mam-MOG-ruff-fee
Melanoma	mel-ah-NO-mah
Melaena	meh-LEE-nah
Meningitis	men-in-JIGH-tis
Metastasis	meh-TAS-tah-sis
Metastasise	meh-TAS-tah-sighz
Metatarsal	met-ta-TAR-sal
Mittelschmerz	MIT-uhl-schmehrts
Monocytes	MON-oh-site
Mononucleosis	mon-oh-new-klee-OH-sis
Multiple schlerosis	skleh-ROH-sis
Muscular dystrophy	mus-kew-lar DIS-troh-fee
Myalgia	my-AL-jee-ah
Myasthenia gravis	my-as-THEE-nee-ah GRAY-vis
Myectomy	my-ECK-toh-me
Myeloma	my-eh-LOH-mah
Myocardial infarction	my-oh-KAR-dee-al in-FARK-shun
Myocarditis	my-oh-kar-DYE-tis
Myocele	MY-oh-seel
Myolysis	my-OL-ih-sis
Myomalacia	my-oh-mah-LAY-she-ah
Myonecrosis	my-oh-neh-KROH-sis
Myoparalysis	my-oh-pah-RALL-eh-sis
Myoparesis	my-oh-PAR-eh-sis
Myoplasty	my-oh-PLAS-tee
Myorrhaphy	my-OR-ah-fee
Myorrhexis	my-oh-RECK-sis
Myosarcoma	my-oh-sahr-KOH-mah
Myosclerosis	my-oh-skleh-ROH-sis
Myositis	my-oh-SIGH-tis
Myotomy	my-OT-oh-me
Myotonia	my-oh-TOH-nee-ah
Nasogastric intubation	nay-zoh-GAS-trick in-tew-BAY-shun
Nasopharyngitis	nay-zoh-far-in-JIGH-tis
Neuralgia	new-RAL-jee-ah
Neuritis	new-RYE-tis
Neuroblastoma	new-roh-blas-TOH-mah
Neuroma	new-ROH-mah
Neuromalacia	new-roh-mah-LAY-she-ah
Nocardiosis	no-kar-dee-OH-sis
Oedema	eh-DEE-mah
Oesophageal varices	OSSO-fay-jee-al VAR-ih-seez
Oesophagoplasty	OSSO-fay-go-plas-tee
Oesophagoscopy	OSSO-fay-go-skoh-pee
Oncology	ong-KOL-oh-jee
Orchitis	or-KYE-tis
Ostealgia	oss-tee-AL-jee-ah
Ostectomy	oss-TECK-toh-me

Osteitis	oss-tee-EYE-tis
Osteitis deformans	oss-tee-EYE-tis dee-FOR-manz
Osteoarthritis	oss-tee-oh-ar-THRIGH-tis
Osteoarthrosis	oss-tee-oh-ar-THROW-sis
Osteoclasis	oss-tee-oh-CLAY-sis
Osteochondroma	oss-tee-oh-kon-DROH-mar
Osteodystrophy	oss-tee-oh-DIS-tro-fee
Osteoma	oss-tee-OH-ma
Osteomalacia	oss-tee-oh-mah-LAY-she-ah
Osteomyelitis	oss-tee-oh-mah-my-eh-LYE-tis
Osteonecrosis	oss-tee-oh-nee-KROH-sis
Osteoplasty	OSS-tee-oh-plas-tee
Osteoporosis	oss-tee-oh-poh-ROH-sis
Osteorrhaphy	oss-tee-OR-ah-fee
Osteosarcoma	oss-tee-oh-sar-KOH-mah
Osteotomy	oss-tee-OT-oh-me
Paediatrics	pee-de-at-riks
Palatoplasty	PAL-ah-toh-plas-tee
Palpitation	pal-pih-TAY-shun
Pancreatitis	pan-kree-ah-TYE-tis
Papanicolaou	pap-ah-nick-oh-LAY-ooh
Paralysis	pah-RAL-ih-sis
Paraplegia	par-ah-PLEE-jee-ah
Paroxysmal	par-ock-SIZ-mal
Pelvimetry	pel-VIM-eh-tree
Percutaneous diskectomy	per-kyou-TAY-nee-us dis-KECK-toh-me
Pericardial	perry-CAR-dee-al
Pericardiocentesis	perry-kar-dee-oh-sen-TEE-sis
Pericarditis	perry -kar-DYE-tis
Periodontitis	perry -oh-don-TYE-tis
Periosteotomy	perry -oss-tee-OT-oh-me
Periostitis	perry -oss-TYE-tis
Peritonsillar	perry -TON-sih-lar
Pharyngitis	fah-rin-JIGH-tis
Pharyngoplasty	fah-RIN-go-plas-tee
Pharyngorrhagia	fah-ring-go-RAY-jee-ah
Pharyngorrhoea	fah-ring-go-REE-ah
Phimosis	figh-MOH-sis
Phlebitis	fleh-BYE-tis
Phlebography	fleh-BOG-rah-fee
Phlebotomy	fleh-BOT-oh-me
Phlegm	FLEM
Phonocardiography	fo-no-card-ee-OG-ra-fee
Plasmapheresis	plaz-mah-feh-REE-sis
Pleural effusion	PLOOR-al ah-FEW-zhun
Pleuralgia	ploor-AL-jee-ah
Pleurectomy	ploor-ECK-toh-me
Pleurisy	PLOOR-ih-see
Pneumoconiosis	new-moh-koh-nee-OH-sis
Pneumocystis	carnii new-moh-SIS-tis CAR-nigh
Pneumonectomy	new-moh-NECK-toh-me

Pneumonia	new-MOH-nee-ah
Pneumorrhagia	new-moh-RAY-jee-ah
Pneumothorax	new-moh-THOR-racks
Polyarteritis	pol-ee-ar-teh-RYE-tis
Polymyositis	pol-ee-my-oh-SIGH-tis
Preeclampsia	pree-ee-KLAMP-see-ah
Proctectomy	prock-TECK-toh-me
Proctopexy	PROCK-toh-peck-see
Proctoplasty	PROCK-toh-plas-tee
Proctoscopy	prock-TOSS-kop-ee
Prothrombin	pro-THROM-bin
Psychologist	sy-kol-o-gist
Pyloroplasty	pye-LOH-roh-plas-tee
Quadriplegia	kwad-rih-PLEE-jee-ah
Raynaud's	ray-NOHZ
Regurgitation	ree-gur-jih-TAY-shun
Retinoblastoma	ret-ih-no-blas-TOH-mah
Rheumatic	roo-MAT-ick
Rheumatoid arthritis	ROO-mah-toyd ar-THRIGH-tis
Rhinoplasty	RYE-no-plas-tee
Sarcoma	sar-KOH-mah
Sciatica	sigh-AT-ih-kah
Scoliosis	skoh-lee-OH-sis
Septicaemia	sep-tih-SEE-me-ah
Septoplasty	sep-toh-PLAS-tee
Sequestrectomy	see-kwes-TRECK-toh-me
Sequestrum	see-KWES-trum
Sickle cell anaemia	sick-el cell ah-NEE-me-ah
Sigmoidoscopy	sig-moi-DOS-koh-pee
Silicosis	sill-ih-KOH-sis
Singultus	sing-GUL-tus
Sinusitis	sign-you-SIGH-tis
Sphincter	SFING-ter
Spina bifida	SPY-nah BIF-ih-dah
Splenectomy	splee-NECK-toh-me
Splenomegaly	splee-no-MEG-ah-lee
Splenorrhagia	splee-no-RAY-jee-ah
Splenorrhaphy	splee-NOR-ah-fee
Spondylolisthesis	spon-dih-loh-LIS-thee-sis
Spondylosis	spon-dih-LOH-sis
Sputum	SPYOU-tum
Squamous	SKWAY-mus
Sterility	stir-RILL-it-ee
Streptococcal	strep-toe-COCKLE
Synovectomy	sin-oh-VECK-toh-me
Systolic	siss-TOH-lick
Tachycardia	tack-ee-KAR-dee-ah
Tenalgia	ten-AL-jee-ah
Tendinectomy	ten-dih-NECK-toh-me
Tendonitis	ten-doh-NIGH-tis
Tenectomy	tee-NECK-toh-me

Tenodesis	ten-ODD-eh-sis
Tenodynia	ten-oh-DIN-ee-ah
Tenolysis	ten-OL-ih-sis
Tenoplasty	TEN-oh-plas-tee
Tenorrhaphy	ten-OR-ah-fee
Thalassaemia	thal-ah-SEE-me-ah
Thoracocentesis	thoh-rah-coh-sen-TEE-sis
Thoracostomy	thoh-rah-KOS-toh-me
Thoracotomy	thoh-rah-KOT-toh-me
Thrombocytopenia	throm-boh-sigh-toh-PEE-nee-ah
Thrombosis	throm-BOH-sis
Thrombotic occlusion	throm-BOT-ick ock-LOO-zhun
Tonsillitis	ton-sih-LYE-tis
Torticollis	tor-tih-KOL-is
Toxoplasmosis	tock-soh-plaz-MOH-sis
Tracheitis	trah-kee-EYE-tis
Tracheoplasty	TRAH-kee-oh-plas-tee
Tracheorrhagia	trah-kee-oh-RAY-jee-ah
Tracheorrhaphy	trah-kee-OR-ah-fee
Tracheostomy	trah-kee-OS-toh-me
Tracheotomy	trah-kee-OT-oh-me
Triglycerides	try-GLIS-er-eyeds
Tuberculosis	too-ber-kew-LOH-sis
Valvulitis	val-view-LYE-tis
Valvuloplasty	VAL-view-loh-plas-tee
Varicose veins	VAR-ih-kohs VAYNS
Vasculitis	vas-kyou-LYE-tis
Venipuncture	VEN-ih-punk-tyour
Volvulus	VOL-view-lus

American English and Australian English

Spelling differs between American English and Australian English. This can be confusing when using different dictionaries, when referring to certain texts, and when using the spell check on the computer. Therefore, it's important to recognise and understand both variations, but when using health terminology, **Australian English** is recommended.

Pronunciation of medical terms

Incorrect pronunciation can also have serious consequences. When verbal instructions are incorrectly written down, or if the person to whom you are communicating misunderstands the message, it is possible that the wrong treatment or drugs could be given. Even worse is the possibility that a person could undergo the wrong procedure. There are many tragic stories from around the world of people having the wrong kidney removed or the wrong limb amputated. For example, **laryngoscopy** (la-ring-goskohpee) refers to viewing the larynx, and **laryngectomy** (larin-jektemee) refers to removal of the larynx. Obviously there is no room for misunderstanding here.

Even though there are correct ways to pronounce medical terms there are many variations due to individuals' accents and training. Your best guide to correct pronunciation is to listen actively to the health professionals where you work and to refer to the dictionary whenever something is not clear. The golden rule for clinical support workers is that if you are not sure, or if there is any possibility for error, you must clarify the terms being used. It is much better to take the extra few seconds to be sure rather than risk a serious mistake. The process of breaking medical words down into their component parts will make them easier to pronounce. Look for the combining form/s, prefix and suffix, and pause between each one.

For example:

- Pericarditis: becomes peri-card-it-is.
- Bradycardia: becomes brady-card-ia.
- Gastroenteritis: becomes gastr-o-enteritis.

Words can be broken into sections or sounds, called syllables. When pronouncing medical words consider the phonetics (sound) of each syllable and read the medical words out aloud. Practise with someone who has medical knowledge of the words, or it is also good practise to compare pronunciations with other learners/students. Always support your studies with a good medical dictionary, which will provide you with the correct pronunciation of each word.

Here are some useful guidelines to help you with your pronunciation:

- 'ps' is often pronounced like 's', the 'p' is silent, e.g. psittacosis, psoriasis, psychiatry, psychology.
- 'pn' is often pronounced like 'n', the 'p' is silent, e.g. pneumonia, pneumothorax.
- 'pt' is often pronounced like 't', the 'p' is silent, e.g. pterygium, ptosis.
- 'ch' is sometimes pronounced like 'k', the 'h' is silent, e.g. chemical, Chlamydia, chlorine, chronic.
- 'ae' is pronounced 'ee', the 'a' is silent, e.g. faeces, leukaemia, paediatrician.
- 'oe' is pronounced 'ee', the 'o' are silent, e.g. diarrhoea, foetus, oesophagus.
- 'i' at the end of a word to form a plural is pronounced 'eye', e.g. bronchi (the plural of bronchus), fungi (the plural of fungus), nuclei (the plural of nucleus).
- 'c' has a soft sound like 's' when it is before 'e', 'i' and 'y', e.g. centre, circle, cycle.
- 'g' has a soft sound like 'j' when it is before 'e' and 'i' (and sometimes 'y'), e.g. gene, giant, gypsy, laryngitis.
- 'c' and 'g' have a hard sound before other letters, e.g. cardiac, gastric.
- 'e' and 'es', when forming the final letter or letters of a word, are often pronounced as separate syllables, e.g. syncope (pronounced "sin-coe-pea"), testes (pronounced "testeeze").

Pronouncing medical terms over the phone

A medical receptionist may be called on to read medical reports over the telephone to doctors, so it is important to be able to read medical terms correctly. To help with this, we can write the pronunciation of a word by breaking it up into syllables, and spelling it out phonetically. To show that a syllable is emphasised, we write it in **bold**. If it is the major emphasis in the word, we **CAPITALISE** it as well. Some examples are below.

Acoustagram: ah-**KOOS**-toh-gram ('ah' is short like the 'a' sound in 'act')

Laryngitis: lah-rin-**JYE**-tis ('lah' is again short like the 'la' sound in 'lap')

The phonetic pronunciation that **you** write for a word may be different from what someone else writes. The important thing is that is makes sense to you, so that you can read back the word with its correct pronunciation.

Abbreviations, acronyms and symbols

Medical communication also involves medical abbreviations and symbols, which are used daily and can be confusing until you develop an understanding for their meaning. These forms of communication are used extensively in conversation, messages, written medical reports and letters. Again it is important to stress that you should never be embarrassed if you do not understand the medical terminology, and always be responsible and ask for help/clarification of terminology. Again, the medical dictionary is a good source of education, as most will have a list of abbreviations so you can check if you are unsure of a meaning. Medical abbreviations are often based on Latin and do not bear any resemblance to their English meaning.

For example:

A doctor would rarely say a drug was to be given 'twice daily' or 'four times a day'. Instead, they would say BD (which means twice a day) or QID (which means four times a day). When you pronounce abbreviations such as BD or QID, you spell them out, ie: 'bee dee' and 'cue eye dee'.

Symbols can only be used in written communication; they are a type of medical shorthand and only occur in handwritten messages.

Some other examples of medical abbreviations are included in the following list.

- BSL: blood sugar level
- CCU: coronary care unit
- #: fracture
- IV: intravenous (injection)
- IM: intramuscular (injection)
- PO: per oral
- PR: per rectum
- CXR: chest X-ray
- IVT: intravenous therapy
- SOB: shortness of breath
- OD: overdose
- NBM: nil by mouth
- Fx: fracture
- Ua: urinalysis
- DOA: dead on arrival
- PRN: when necessary
- ENT: ear, nose and throat
- THR: total hip replacement.
- NFR: not for resuscitation.
- DNR: do not resuscitate.

Common abbreviations for medical and pharmacological terms

LATIN TERM	ENGLISH MEANING
Ac	Before food/meals
alt	to be given on alternate day
ASAP	as soon as possible
Aq	Water
bd/ bid	twice daily *(bis in die)*
Cap	Capsule
C	With
Die	Daily
Dil	Dilute
Disp	Dispense
EC	enteric coated
Emul	Emulsion
Gutt	Drops
guttae	Guttae-drop/ drops
Hd	at bedtime
Mane	in the morning *(omni mane)*
nocte (omn)	given at night (*omni nocte)*
O or PO	oral taken by mouth
Pc	to be given after meals
PR	by way of the rectum
PRN	as required or 'whenever necessary' *(pro re nata)*
PV	per vagina
Qid	four times daily (*quarter in die)*
SR	sustained release
STAT	to be given immediately
Tab-tablet	Tablet
tid	three times a day *(ter in die)*
Tinct	Tincture
TO	telephone order
Ung	Ointment
4/24	four hourly
1/12	one month
1/52	one week
1/7	one day
1/365	one day

Body positions and directions terms

TERM	MEANING
Afferent	Conveying towards the centre.
Anterior	More to the front of the body than another structure. Describing the front part or surface of the body, limbs, or an organ.
Central	Close to the middle or centre point.
Cephalic	Relating to, or situated near the head.
Coronal	Relating to the crown of the head.
Deep	Away from the surface of the body or an organ.
Distal	Further away from the origin, point of attachment or midline of the body.
Dorsal	Relating to the back or posterior part of an organ.
Efferent	Conveying from the centre to the periphery.
Extension	The straightening out of a joint. The application of traction to a fractured or dislocated limb.
External	Situated outside the body or an organ.
Flexion	Bending or moving a joint so that the bones forming it draw towards each other.
Inferior	Lower in the body than another structure or surface.
Internal	Inside the body or an organ.
Lateral	Further away from the midline or centre of the body or an organ.
Medial	Closer to the centre of the body or an organ.
Peripheral	Away from the centre point.
Posterior	More to the back of the body than another structure. Describing the back part or surface of the body, limbs or an organ
Prone	Lying facing downwards.
Proximal	Closer to the origin, point of attachment or midline of the body.
Superficial	At, or close to, the surface of the body or an organ.
Superior	Above another structure or surface.
Supine	Lying on the back facing upwards.
Transverse	Lying across.
Ventral	Pertaining to a hollow structure or belly. Situated on the abdominal side of the body.

Medico-Legal terms

TERM	EXPLANATION
Assault	The threat (perceived or real) of the application of force to another without consent.
CMR	Confidential Medical Record – Whenever there is a service provided where the issue with the patient is regarded as extremely sensitive, a CMR is generated eg an abuse report, children at risk report etc.
Confidentiality	Health workers have a legal, ethical and professional duty to maintain the privacy of a patient or client in relation to any information. This duty applies to the living and the dead, the healthy and the infirm, the aged and the young.
Consent	Patients have a right to be involved in decisions about their health care. This includes the right to receive information in such a form that will enable them to make an informed decision about whether or not they wish to proceed with treatment. Informed patients or other legally appropriate person must then be able to agree or not agree to undergo particular forms of treatment or care.
Contributory Negligence	An action or set of circumstances in which a person or organisation has contributed to an act of negligence.
Coroner's Act	All deaths occurring under certain conditions must be notified to the Coroner. Health records must be provided to the Coroner.
Disclosure	There are three situations in which confidential information can be disclosed: Disclosure by consent, disclosure required by law and disclosure in the public interest. Police may only have access to confidential information where it falls within one of these three categories. Police do not have privileged access to confidential information.
Ethical Behaviour	Behaviour which is consistent with the values and obligations of the individual and their profession.
Freedom of Information (FOI)	A person has the right to apply for access to health records held by certain agencies under the Freedom of Information Act. Other Acts including the Privacy Act also govern access to information.
Neglect	Potential or actual harm to a child or young person caused by omission to provide physical and emotional security or commission of acts harmful to a child.
Negligence	Negligence is where an appropriate standard/duty of care owed to another person is breached and as a result causes harm to the other person. There are three requirements for a negligence action (1) owing a duty of care, (2) breaching the standard of care owed and (3) damage is caused as a result.
Next of Kin (NOK) Significant Other/s	The Guardianship Act provides the legal framework for obtaining consent to treat those persons incapable of giving consent. These provisions provide for a substituted consent by a "person responsible" (the correct term). In this context "next-of-kin" and "significant others" do not have power to give a substituted consent unless they also meet the requirements for being the person responsible. A "senior available next of kin" may have a role in organ donation or autopsy decisions. In other cases, the patient will nominate the person responsible for notification.

Commonly used symbols

SYMBOL	MEANING
ß	Beta
U	Dead, Death, Died
ò	Decreased
?	(delta) Disease, Diagnosis, Dextrose, Diathermy
8/24; 4/24	8th hourly; 4th hourly
#	Fracture
>	Greater than
ñ	Increased
l	Litre
<	Less than
à	Leading to
µ	Micro (Symbol now condemned)
2°	Secondary
ß	Resulting from
] or Rx	(recipe) "prescription"
+ ve	Positive
- ve	Negative

References

Refer to a medical encyclopaedia: Breaking words down into prefixes, roots and suffixes is a good way to work out the meaning of medical terms. In some instances you will not be able to use this strategy, but you may like to use a medical encyclopaedia or dictionary. Many medical reference books can be found online, which provides ready access.

Refer to anatomical models, charts and labelled diagrams: The body is complex. Reading about the body's systems is one way to gain knowledge. You may find it difficult to gain a good understanding of the body's structures and systems through reading words alone. Some people find that accessing anatomical models, charts and labelled diagrams helps make the location of, and the relationship between the body's various systems and structures much clearer.

Keep a notebook: Keeping a notebook provides two benefits. By making notes you reinforce the information and increase the likelihood that you will remember the information. The notebook also acts as a reference point and may prevent you from having to ask the same question twice.

One

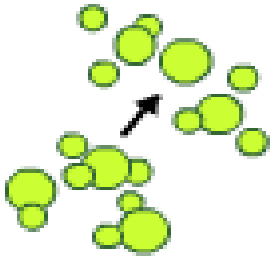
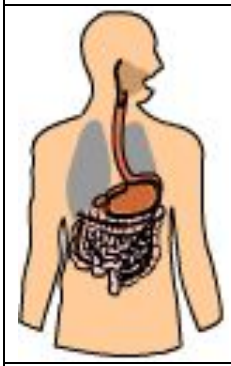
Correctly using and interpreting health terminology that describes the normal structure, function and location of the major body systems

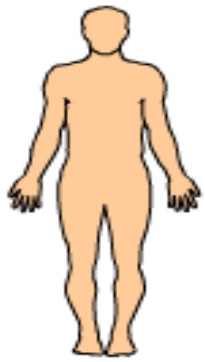
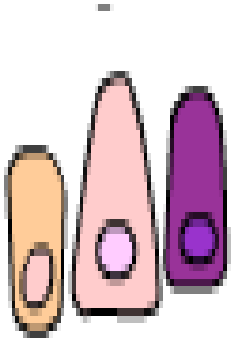
Organisation of the human body

In this activity you will learn about the organisation of the body. Write the name of the level next to the picture.

1. Choose from the following words:

TISSUE LEVEL	**ORGAN LEVEL**	**HUMAN BODY**
CHEMICAL LEVEL	**CELLULAR LEVEL**	**SYSTEM LEVEL**

Structure and function of cells

2. In this activity you will learn about the structure and function of cells. Draw a line from the structure to the correct function.

STRUCTURE		**FUNCTION**
Ingestion and assimilation		Cells are able to break down and use substances from food as fuel
Irritability and activity		Cells can synthesise new cytoplasm so that growth can occur and repair worn out parts
Respiration		Waste products are eliminated into surrounding tissue to be transported by the blood for elimination via organs
Metabolism		Cells are able to select chemicals from the surrounding fluid for their structure
Excretion		Cells reproduce by simple division but some cells can never be replaced once destroyed eg. Central nervous system cells
Growth and repair		All cells require oxygen to metabolise (process) food
Reproduction		Cells are able to respond to stimuli for example, a stimulus causes a muscle to contract or relax

Consider the example of hyperthyroidism and hypothyroidism.

3. Break each of these words into a:

    a) Prefix.

    b) Root word.

    c) Suffix.

The only difference between these words is the prefixes.

4. What does the root word mean?

5. Briefly describe how the prefixes change the meaning of these words.

Identifying Medical elements /combined list

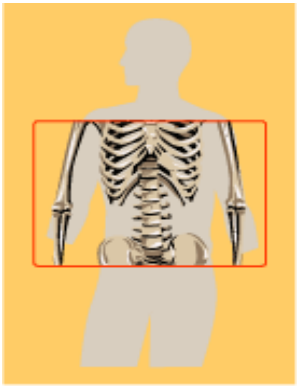
6. Look up the following, medical terminology in a medical dictionary, or other source and write their meaning, in the table below. Break down the meaning of the term as **the example in the table below.**

MEDICAL TERM	**MEANING/breakdown**
Example: A-phak-ia	**(a = without, phak = eye lens, ia = state or condition of)** **Meaning: Absence of the lens of an eye.**
Arachno-phobia	
A-sperm-ia	
Blephar-itis	
Bu-lim-ia nervosa	
Cellul-itis	
Chondro-sarc-oma	
Conjunctiv-itis	
Cyst-it is	
Cyst-adeno-carcin-oma of the ovaries	
De-ment-ia	
Endocrino-pathy	
Glauc-oma	
Haemat-u-ria	
Hyper-glyc-aemia	
Hypo-calc-aemia	
Megalo-mania	
Meningitis	
Micro-cephaly	
Multiple sclera-osis (MS)	
Narco-lepsy	
Neuralgia	
Onycho-malacia	
Oto-scler-osis	
Pharyng-itis	
Photo-phobia (	
Retino-blast-oma	
Thyroid-itis	
Tonsill-itis	
Ur-aem-ia	

Vulvo-vagin-itis	
Xero-derma	
Zoo-phobia	

7. Why is it important for support workers in either the aged care, or disability sector to identify the information sources that are available to them in the workplace to assist them in using the correct term appropriately?

Correctly using and interpreting information that relates to the interrelationships between major components of each body system and other structures



Interrelationships between body systems

Your body works similarly to a machine, with different systems that make up your body and allow it to run effectively. Like a machine, if one system is not running properly, your whole body will be affected. These systems perform different tasks in the body and encompass different organs. Each of the body systems and the organs and structures that make up these systems, are designed to perform specific complex functions. All of the systems work together to ensure the healthy survival of the human body, and the immune system protects the body from disease, infection and illness.

The interrelationship between body systems becomes more obvious when a disease or illness affects one body system and other systems are also affected. While you are not expected to have a full understanding of how the body systems work together, it is important to have some knowledge of the interrelationships of the systems.

Cardiovascular and Respiratory Systems

The cardiovascular system's central organ is the heart, which pumps blood to the different parts of your body. The blood travels from the heart to the lungs, where the respiratory system supplies the blood with oxygen. You inhale air through your nose or mouth; it passes through your pharynx, larynx, trachea and finally to the lungs, where it diffuses in the blood through the alveoli.

Digestive and Excretory Systems

The digestive system is responsible for transforming food into energy. The food enters the digestive system, absorption takes place and the food is transformed into enzymes, glucose and nutrients that the body uses as energy. The excretory system includes the kidneys, which filter wastes and purify the blood. This waste is transformed into urine and flows down two tubes, called ureters, which deliver the urine to the bladder. The urinary bladder is a large structure, similar to a sack, which collects the urine and then releases when full. The urine travels out of the body through a hole called the urethra.

Endocrine and Immune Systems: The endocrine system uses hormones, chemical compounds that regulate metabolic function of cells, to stimulate the metabolic activity of cells. The hormones are released into the bloodstream. The immune system is a network of cells, tissues and organs that work together to attack any pathogens that try to enter your body. The human body is a perfect host for bacteria, parasites and fungi, which cause infection. If any of these organisms gain entry to the body, the immune system works to destroy them and rid your body of illness.

Integumentary and Nervous Systems: Your skin is called the integumentary system, which is your body's first line of defense. It regulates your body temperature, protects underlying layers of tissue from sun damage and prevents pathogens from freely entering your body. The integumentary system is also home to millions of nerves that respond to touch, pressure and pain. There are two interconnected nervous systems: the central nervous system and the peripheral nervous system. The central nervous system includes the spinal cord and the brain, which gets the information from the body and sends out instructions. The peripheral nervous system includes all of the nerves and sends messages from the brain to the rest of the body.

Skeletal and Muscular Systems: The system that provides your body's shape is the skeletal system, and it is made up of cartilage and bone. There are 206 bones in the human skeleton that provide a hard framework able to support the body and protect the organs that they surround. Cartilage provides support with flexibility and resistance, and acts as padding to soften the pressure that is exerted from the bones. Movement in the body is the result of muscle contraction; when muscles combine with the action of joints and bones, obvious movements are performed, such as jumping and walking. The contraction of muscles provides the body posture, joint stability and heat production.

Element 2: Recognise and promote ways to support healthy functioning of the body

Reviewing factors that contribute to maintenance of a healthy body

Support workers need to understand how the body systems function so they can recognise and report signs that suggest there may be a problem. Support workers also need to know about the factors that help people maintain a healthy body so they can help older people, and those in need of care, to maintain their health.

What is health?

The dictionary classifies health as:

1. *The overall condition of an organism at a given time.*
2. *Soundness, especially of body or mind; freedom from disease or abnormality.*
3. *A bodily state in which all parts are functioning properly. Also refers to the normal functioning of a part of the body. A state of normal functional equilibrium; homeostasis*

At the physical level, health is being free from disease or injury and the limitations they might impose. We are more than the sum of our parts and we can be healthy without being perfect. As we expand the definition of health to include how our whole body is functioning, a picture of health that includes a mind/body connection emerges. It doesn't stop there. Health includes a state of mind, a peace and harmony with ourselves and our physical and social environments.

Health and wellness

Australians are generally healthy, and Australia's health and wellbeing is likely to improve. Individuals are gaining a better understanding of their own health and how to maintain it; the science and practice of prevention and treatment is continually advancing; and most Australians have very good access to health services.

Over the course of the previous century the nature of illness and disability dramatically shifted away from infectious diseases to chronic conditions, especially those influenced by lifestyle and behaviour. Some of these lifestyle factors remain of concern: overweight and obesity is endemic in Australia, not enough people have sufficient physical activity, and around one-fifth of the adult population smoke tobacco.

The World Health Organisation (WHO) defines well-being as a 'state of complete physical, mental and social well-being and not merely the absence of disease and infirmity'. Each person has their own definition of health in relation to their own expectations and values. We are constantly adapting to changes in the internal and external environments.

Wellness links closely with the WHO definition of well-being. It refers to a balance between physical, psychological, social and spiritual factors in a person's life. Wellness behaviours contribute to the prevention of illness and the promotion of health, eg exercising regularly and eating a balanced diet.

The Australian Health System

The Australian health system is world-class in both its effectiveness and efficiency: Australia consistently ranks in the best performing group of countries for healthy life expectancy and health expenditure per person (WHO 2003).

These achievements are largely the result of partnerships between individual Australians and families and health care professionals. People's decisions about lifestyle, self-care, and seeking and acting on professional help, and their participation in the development of public policy at many levels, all contribute to shaping the Australian health system. Increasingly, individuals are using information from sources such as the World Wide Web to actively manage their health in partnership with health care providers.

Overall coordination of major components of the health care system is provided by the Australian Health Ministers' Advisory Council (AHMAC)—a committee of the heads of the Australian Government, state and territory health authorities, and the Australian Government Department of Veterans' Affairs. AHMAC advises the Australian Health Ministers' Conference on policy, resources and financial issues. Specific national bodies have been established by AHMAC or the ministers to coordinate information, advice and program implementation, such as the:

- **National Health Priority Action Council:** which aims to drive improvements in priority health areas;
- **Australian Council for Safety and Quality in Health Care:** which leads national efforts to improve the safety and quality of health care, with a particular focus on minimising the likelihood and effects of error;
- **National Public Health Partnership:** which plans and coordinates national public health activities;
- **National Health Information Group:** coordinates and directs the implementation of the National Health Information Agreement.

Australia health facts at a glance

- Population of 20 million, including about 460,000 Indigenous Australians (2% of total)
- Average life expectancy at birth is 82.6 years for females, 77.4 for males
- Fertility rate (1.75 births per woman) is below replacement level; middle-ranked among developed countries
- Climate varied but mainly dry; high exposure to solar radiation
- Highly urbanised; most people live in south-east seaboard region
- Many cultural backgrounds; 22% of residents born overseas
- 77% of 15–19-year-olds are at school or other educational institution
- Per person gross domestic product (GDP) 12th among 30 OECD countries
- Services sector main contributor to GDP (61%)
- Unemployment under 6% in early 2004
- Health expenditure 9.3% of GDP in 2001–02

Lifestyle issues which impact on health

When you think about your life in 10 years time one of the things you may think about is your lifestyle. What we choose to do with our weekdays and weekends can have an impact on our future life. Our choices will provide either a positive or negative impact on our future lifestyle and quality of life. Few of us are young, physically fit, eating a perfectly balanced diet, taking regular exercise, avoiding workplace or financial stressors and with a large circles of supportive friends, strong religious or spiritual beliefs and a loving family that is concerned for our physical, social and emotional well being.

Some of us have habits that will impact on our health many years from now. These are not necessarily the obvious ones like smoking or drinking too much alcohol, lack of exercise or eating too many fatty foods, but it may be much more insidious such as working in a 'sick' building, being exposed to city traffic pollutants, suffering in drought stricken areas and stress in the workplace or exposure to radiation through telecommunications devices. Each of these has an impact on our health. The causes (risk factors) of chronic diseases are well established and well known; a small set of common risk factors are responsible for most of the main chronic diseases.

These risk factors are modifiable and the same in men and women:

- Unhealthy diet
- Physical inactivity
- Tobacco use.

These causes are expressed through the intermediate risk factors of raised blood pressure, raised glucose levels, abnormal blood lipids, overweight and obesity. The major modifiable risk factors, in conjunction with the non-modifiable risk factors of age and heredity, explain the majority of new events of heart disease, stroke, chronic respiratory diseases and some important cancers. The relationship between the major modifiable risk factors and the main chronic diseases is similar in all regions of the world.

There has been a lot of focus on preventative care as a measure to reduce the prevalence of chronic disease. This includes interventions that detect and reduce the risk of disease as well as complications from an existing disease *(Department of Health and Ageing 2008).* Often chronic disease is a result of a lifestyle that when younger involved risk factors such as unhealthy diets, high blood cholesterol, tobacco addiction, lack of exercise, obesity and possibly stress.

Poor diet and nutrition

The foods we eat provide nutrients needed to maintain our health, including carbohydrates, adequate amounts of nutrition required to nourish our bodies while avoiding harmful excesses of some nutrients. The National Health and Medical Research Council recommend a diet that is high in fruits and vegetables, with sufficient amounts of iron, calcium and fibre, but is low in fat, salt and sugar. A poor diet can contribute to chronic diseases directly or indirectly through a range of other risk factors such as high blood cholesterol and high blood pressure.

It typically includes overconsumption of food in general, or diets high in energy-rich components such as fat. It may also be low in dietary fibres or complex carbohydrates, and/or deficient in certain vitamins and minerals. The 2004–05 National Health Survey (NHS) indicated that most adults have inadequate fruit (46%) and vegetable (86%) consumption *(Australian Institute of Health and Welfare 2006).*

Lack of physical activity and exercise

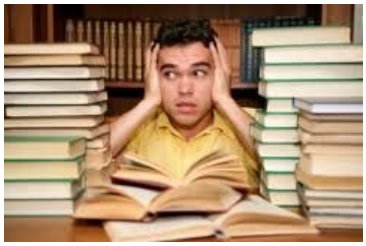
Australia is one of the most obese nations in the world. An increasingly sedentary lifestyle coupled with the increasing availability of highly processed food means that Australia is considered one of the world's fattest nations. The 2004-05 NHS reported that 34% of Australian adults engaged in very low physical activity.

Obesity

One of the strongest and best-known trends in Australia's health has been the marked and steady increase in bodyweight over the past few decades. Obesity is becoming a huge issue in health care. Fast food is not the only culprit. Lack of knowledge about food groups and the components of a healthy diet can lead to the consumption of foods with little nutritional value and a high fat and glucose component. Families may have insufficient resources to buy the healthier products offered in our supermarkets so a healthy diet can be out of reach of the people who most need it — children.

The rise in overweight and obesity has occurred among Australian males and females of virtually all ages. Many experts are concerned about the effect this may have on our rates of diabetes, heart disease and other disorders, perhaps even on our life expectancy. Based on measured height and weight in 2007–08, 25% of children aged 5–17 years were overweight or obese and this rose to 61% of adults.

Work/life balance



What is work-life balance?

The term 'work-life balance' describes a person's ability to effectively manage their paid work commitments with their career goals, personal, community and cultural responsibilities, interests and obligations. Work-life balance has also been described as:

"…a self defined, self determined state of well being that a person can reach, or can set as a goal, that allows them to manage effectively multiple responsibilities at work, at home, and in their community; it supports physical, emotional, family, and community health, and does so without grief, stress or negative impact." (Human Resources and Social Development)

Work-life balance is achieved when an individual's right to an enriched life both within and outside paid work is **recognised** and **valued**. The need to examine the balance between work and life is likely to impact on most people during their employment resulting in the need for flexible work arrangements at some stage, even for a short period of time. Adjustments to work arrangements may take the form of leave or a reduction in working hours, usually on a temporary and sometimes on a permanent basis.

Life cycle demands that may cause people to request or seek change in their work arrangements include:

- Pregnancy
- The birth or adoption of a child
- Becoming a parent, guardian or grandparent
- The need to care for a family member who is ill or has a disability
- The desire to spend quality time with the family – at any stage
- The onset of short-term or long-term illness or disability
- Deciding to return to study
- Feeling tired, stressed and unenthusiastic at work
- Spending too much time travelling to and from work each day
- The desire to pursue broader personal and/or community interests, such as volunteer work or sporting activities
- Considering retiring from the paid workforce.

Work Life Balance initiatives can assist employers and employees to be productive and healthy in their work and community lives. They give employees greater flexibility in how they work and offer employers the competitive business edge in attracting and retaining employees.

The range of Work Life Balance initiatives available can be grouped into 4 main areas:

1. Leave provisions (such as parental and family leave).
2. Flexible hours provisions (including job sharing, flexible start and finish times).
3. Supportive structures and programmes (such as child care provision or assistance); and,
4. Social policy initiatives.

What are the consequences of living in imbalance?

The more out of balance and out of control a persons life is, the longer hours they work, and the more intense their work experience, the greater the likelihood is that they pay a physical and emotional price. They probably won't eat as well. They will consume more caffeine, more alcohol, more sugar, more fat.

People are less likely to exercise on a regular basis. They are less likely to be getting enough sleep. People are less likely to have a sense of satisfaction or accomplishment and commitment to the organisation. They have got a greater likelihood of either getting sick, getting sick more often, or being sicker whenever you get sick, and have a greater likelihood of having relationships that are either unhealthy or unstable, and that are more prone to breaking apart.

Alcohol and other drugs use/misuse

The 2004-05 National Health Survey reported that: risky alcohol consumption increased significantly from 1995 (8%) to 2004-05 (13%). The National Alcohol Strategy indicates that nearly 3,000 people die each year as a result of excessive alcohol consumption. Heavy consumption over a long period can cause permanent damage to vital organs such as the brain and liver. It is also associated with cancer, cardiovascular disease, and neurological damage as well as psychiatric problems such as depression, anxiety, and antisocial personality disorder. Illicit drug use contributes directly and indirectly to HIV, arthritis and other rheumatologic problems, respiratory and heart problems. Alcohol and drug use also contribute to infant morbidity and mortality. Drug dependence can be classified as a chronic disease in itself.

Tobacco smoking

Tobacco smoking is the largest single preventable cause of death, followed closely by high blood pressure and obesity *(Australian Institute of Health and Welfare 2008).* It is a key risk factor in heart disease, Cerebrovascular disease and lung cancer and is attributed to around 80% of all lung cancer. According to the 2004-05 National Health Survey (NHS) 3.2 million Australian adults are daily smokers and there are still large numbers of young people becoming addicted to nicotine despite the clear evidence between smoking and chronic disease.

Psychosocial stress also plays a role

Various published stress scales (measures of the stress imposed by various factors in peoples' lives), consistently place the death of a spouse at the top of their lists as being the most stressful event that can take place.

Other factors which rate highly on these scales include the following:

- Death of a close family member
- Personal injury or illness
- Retirement
- Changes in the health of a family member
- Sex difficulties
- Changes in financial state
- The death of a friend
- Spouse stopping work
- Changes in the living environment
- Changes in personal habits
- Moving house
- Less recreation
- Poor diet
- Changes in sleeping habits.

Defining stress is like describing happiness, everybody knows it when they feel it but it may feel differently for different individuals. Generally, stress is the psychological and physical experience of being faced with a challenge that is difficult for us to cope with. Research completed by the psychiatrists, Thomas Holmes and Richard Rahe in the late 60's made the connection between stress and illness. They looked at thousands of clients and the life events that surrounded their illness and found that the more stress that was present in the person's life, the higher the incidence of illness. As a result they developed 'The Social Readjustment Scale' in 1967.

When people filled in the stressful incidents in their lives on the questionnaire it provided an indication of the likelihood of them developing an illness. Holmes and Rahe tried the questionnaire on many different nationalities and found it was a good predicator for all nationalities. A modified scale was also developed for younger people. It is similar to the adult scale, where stress points for life events in the past year identified and added and then compared to the indicators for how stress affects health but the questions are more meaningful to young people.

Hygiene

Personal hygiene refers to the activities a person takes to keep their body clean. If a person neglects their personal hygiene it can have a detrimental effect on their physical and psychological health and can cause them discomfort.

Many factors influence a person's ability to attend to their personal hygiene needs and these include:

- Personal preference
- Cultural values
- Religious beliefs and values
- Lifestyle
- Level of independence
- Physical capabilities
- Intellectual capacity
- Emotional state
- Economic status
- Knowledge of the significance of hygiene
- Climate / Environment
- Availability of facilities such as water and infrastructure.

Many people are able to attend to their own hygiene needs, however some may require partial or total assistance from a carer. When assessing a person for their hygiene needs and formulating a care plan, it is important their usual routine is followed as closely as possible. If the person prefers a bath to a shower, or wishes to shower in the evening or every other day, these preferences should be accommodated as closely as possible.

When assessing the person's hygiene needs the team leader should take into account the following:

- Limitations in mobility
- Poor vision
- Dizziness and loss of balance
- Decreased sense of touch
- Ability to remember how to attend to their hygiene needs.

A number of aids such as shower stools, mechanical lifters and handheld showers can be used to assist with personal care. It may be necessary to arrange for the addition of support rails, handheld showers, toilet lifters and other aids to be installed in the person's home by a home maintenance service.

It is important for the carer to remember that it can be very embarrassing for a person if they are unable to meet their own hygiene needs without assistance. There is a lack of privacy and the loss of independence can be very demoralising and depressing. If the person is receiving care support in their own home, they may also feel that this is an invasion of their personal space and the sanctity that their own home provides. A calm sensitive and caring approach can help to reduce these fears.

The person must give their consent to receive assistance with their hygiene needs. The meeting of personal hygiene requirements includes care of the skin, hair, nails and mouth. If the skin is not washed regularly dirt, sebum, dried sweat and dead skin cells collect, providing an ideal medium for the growth of bacterial and fungal infections. Hair should be washed regularly. If it is not, it may become oily or dry and can become lank, or brittle. Some people wash their hair daily, while others prefer to have it washed every two or three days and up to weekly.

Oral health

The most common issues that affect a person's oral health are:

The buildup of plaque: This is a problem as it is responsible for dental cavities. Plaque corrodes the tooth enamel and causes inflammation of the gums (periodontal disease). It is caused by the build-up of micro-organisms from food debris left for too long in the mouth. If the teeth are not regularly brushed and flossed, plaque will build up. Another factor that increases the build-up of plaque is sugar. All sugars and sweet foods, such as cordial, soft drinks, flavoured milks, honey and dried fruits increase the risk of cavities.

Dry mouth (xerostomia): Production of saliva may be slowed by some medications and as people age. This affects the person's ability to chew food. An adequate fluid intake and the chewing of raw vegetables can assist this. If the person is not able to do this, specific toothpastes and gels are available to assist with saliva production.

Tooth wear and damage: Cracks and rough edges on teeth can cause ulcers, pain and discomfort. This is causes poor mastication and a reluctance to brush and floss the teeth.

Tooth loss : This can impact on a person's bite and swallowing and the person may need partial or complete dentures.

Poor mastication (ability to chew): Chewing of food is the first part of the digestive process. Poor mastication may slow the process of digestion and reduce the absorption of vital nutrients.

Ill fitting dentures: If dentures do not fit properly they can cause pain and ulceration, poor mastication and changes to the appearance of the person, which can affect their self-esteem and mental and social health.

People at great risk of dental disease and poor dental hygiene

These include those who:

- Do not regularly attend the dentist
- Are smokers
- Are financially disadvantaged
- Are physically frail
- Are physically dependent
- Have cognitive impairment
- Are not able to hold and manage a toothbrush
- Have impaired sensory function
- Have swallowing problems
- Have carers who are not aware of the need for dental hygiene.

Strategies to reduce the risk of poor oral hygiene

These include:

- Limiting snacking between meals (acids start to attack the teeth 20 minutes after eating sweet foods)
- Brushing and/or flossing teeth as soon as possible after consuming sweet foods and at regular intervals during the day
- Snacking on raw vegetables such as carrots, celery and capsicum to assist salivation
- Chewing on sugarless gum to increase salivation
- Maintaining regular dental care
- Ensuring sufficient fluid intake.

For the person at a higher risk of oral hygiene problems, additional strategies include:

- Regular tooth brushing and cleaning of dentures
- Having assistance to perform oral hygiene
- Reviewing medication (in consultation with an appropriate professional) to identify if the person is taking medications which have 'dry mouth' as a side effect
- Using an electric toothbrush or a modified toothbrush and dental equipment to assist the carer to access the person's mouth.

A person with cognitive impairment may have difficulty in understanding the need for oral hygiene and resist attempts to maintain this. Communication and behavioural management may be needed to assist the carer with this process.

Disease and illness

Disease is a disruption in the normal structure or function of any aspect of a person – mind, body and emotions. Diseases are classified according to cause, acquisition, or body system affected. Essentially, illness is signalling an imbalance in the body between internal and external environments.

Diseases can be caused by a single factor or a combination of factors, and there are a range of factors that can cause disease.

- **Pathogens** : any micro-organism capable of causing disease, eg bacteria, virus.
- **Genetic conditions:** diseases inherited or passed down from one generation to the next.
- **Birth defects:** abnormality present at birth either inherited or due to environmental factors.
- **Nutritional deficiencies:** Deficiencies of a single nutrient or vitamin, or many that results in disease, eg iron deficiency Anaemia.
- **Trauma:** physical injury of cells or tissues, eg temperature extremes, motor vehicle accidents, fractured bones.
- **Toxins:** substance that is harmful or poisonous to the system.
- **Environmental factors:** pollution, insecticides, trace metals (eg lead), alcohol and drugs.
- **Degenerative changes :** gradual deterioration over time resulting in decrease or loss of function. The loss of normal control mechanisms, eg the uncontrolled growth of cancer cells.

It is important that workers, within the boundaries of their job role and responsibilities, are able to identify:

- Common disorders, problems and complaints associated with each body system
- Factors that may be responsible for abnormal readings
- Information that should be provided to clients regarding their health status.

Causes of disease

Disease is the malfunction of organs or organ systems resulting from the body's failure to maintain homeostasis (a relatively stable or constant internal environment). The disease process might initially affect a tissue, an organ, or a system. It can ultimately lead to changes in the function or structure of cells within and throughout the body. Diseases either occur suddenly (sudden onset) or may have a more insidious approach, where symptoms are at first non-specific. There are different kinds of disease, and different causes of disease. The major disease categories are outlined following.

Infectious diseases

Infectious diseases are transmitted from the environment or from another person.

Mechanisms of transmission include:

- Person-to-person
- Environmental (eg: waterborne, airborne, soil-borne, food-borne)
- Vector transmission (transmission by living organisms, eg: flies/mosquitoes).

Diseases are caused by pathogens. A pathogen may be microscopic (eg: bacteria, viruses) and may also include parasites such as tapeworms, roundworms and liver fluke.

Viruses enter cells and replicate themselves. They can only replicate in living cells. Examples of viral diseases include the flu, which affects the respiratory system, mumps, which affects the digestive system, and shingles, which affects the nervous system. Examples of bacterial diseases include trachoma (eye infections) which affects the integumentary system, cholera which affects the digestive system, and Q fever, which affects the respiratory system.

Infectious diseases which can be spread from one person to another are called communicable infectious diseases. Highly communicable diseases (eg: chickenpox, or the flu) are called contagious diseases. Non-communicable infectious diseases are not able to be spread from person-to-person, and include food poisoning and tetanus.

Inherited diseases

Inherited diseases are caused by abnormal genes, or are those that are passed from one generation to another. All cells go through a division and reproduction process. Normal cell division (mitosis) is where the cell divides and produces two duplicated daughter cells, each with identical DNA material (46 chromosomes). However in the sex organs, the process differs. This is called **meiosis**, where the cell divides to form a daughter cell with only half the amount of DNA contained in other body cells (23 chromosomes). You may recall that these cells join with other cells during fertilisation, thus producing a new individual.

Some genetic disorders are caused by mistakes occurring during meiosis, where too much or too little DNA information is contributed to the cell. Down syndrome, for example, is a genetic disorder where individuals have an extra chromosome in each cell. This chromosome is called number 21.

Klinefelter Syndrome is another disease which is caused this way. Individuals with Klinefelter syndrome have a total of 47 chromosomes instead of the normal 46. In this syndrome, the individual is always male, and the extra chromosome results in sterility and slightly enlarged breasts. Inherited diseases (those passed from generation to generation) are caused by single genes. Huntington's disease, colour blindness and cystic fibrosis are all examples of inherited diseases.

Neoplastic diseases{ Neoplasia is the process of new growth, and a neoplasm (or tumour) is the tissue mass produced by this abnormal cell growth and division. Almost everyone has several benign tumours of the skin, eg: freckles and moles. Benign (non-cancerous) tumours do not spread to other parts of the body and are less dangerous. Malignant (cancerous) tumours can spread and are much more dangerous. Microscopic examination of a tissue sample (a biopsy) can determine whether a tumour is malignant or benign. Skin cancers are the most common form of cancer.

Immunity-related diseases

These diseases develop when the immune function either deteriorates, or is unable to protect itself.

Examples of immunity related diseases include:

- Allergies, eg: hay fever
- Immune deficiency diseases, eg: aids (acquired immune deficiency syndrome)
- Myasthenia gravis, which results in general, progressive muscular weakness, with a mortality rate of 5-10%.

Degenerative diseases: These are diseases associated with the ageing process. As we age our systems become less adaptable and less efficient. There is, for example, significant reduction in bone mass, respiratory capacity, cardiac efficiency and kidney filtration. As a result, when the ageing body is exposed to stresses, the weakened systems are not able to cope and symptoms of disease result.

Within the cardiovascular system, the ageing process can impact on blood. The clotting system becomes more sensitive when we age and as a result, abnormal or excessive clotting can occur, which may lead to the development of a thrombus, or blood clot. Parkinson's disease is a degenerative disease of the brain which causes voluntary movements to become hesitant and jerky. This disease results from degeneration in the brain. Alzheimer's disease is the most common age-related degenerative disease, and produces a gradual deterioration of mental organisation, including loss of memory, verbal and writing skills, and emotional control.

Nutritional deficiency diseases

Nutritional diseases result from an inadequate diet, when the balance of proteins, essential amino acids, essential fatty acids, vitamins, minerals or water is disturbed. Scurvy, for example, is a disease caused by a deficiency in Vitamin C.

Endocrine diseases

These diseases result from excessive or inadequate hormone production. The endocrine system comprises a system of glands which secrete chemicals called hormones into the bloodstream. Hormone, in Greek, means 'to set in motion'. The role of hormones is to set in motion the activities of other cells. The major glands of the endocrine system include the pituitary, thyroid and adrenal glands, the pancreas, and hypothalamus.

The thyroid hormones stimulate the general rate of body metabolism, the adrenal glands stimulate glucose synthesis and storage by the liver, and the pancreas releases hormones which decrease or increase glucose levels in the blood.

Iatrogenic diseases

These occur as a result of treatment from either a Doctor or health professional. Iatrogenic diseases, for example, may be caused by scar tissue formation after surgery, adverse reactions to drugs, and infections acquired while in hospital or other facility, such as a nursing home. In some circumstances, isolation or quarantine might be necessary.

Environmental diseases

Environmental diseases result from exposure to environmental poisons or toxins. Lung disease, resulting from breathing high levels of asbestos fibres for a long time, resulting in scar-like tissue in the lungs and in the pleural membrane (lining) that surrounds the lung, is one example. Similarly, silicosis is related to overexposure to silica which is a risk factor of pottery workers.

Idiopathic diseases

These are diseases that result from unknown causes. The descriptions above are very simplistic. You might like to research specific diseases and body functions to gain a deeper understanding of the symptoms and impact of disease on the body systems and homeostasis.

Common disorders, problems and complaints

In this section, we will investigate each body system and discuss some of the common disorders which you may notice or be able to relate to in your working environment. Some of these are quite common and you will probably have heard of them either in your private life or as part of your employment; others are less common. We will review several problems or disorders from each body system in a little more detail, discussing what they are and how they are identified.

Cardio vascular problems

The cardiovascular system plays a key role in supporting all other body systems. All body systems require blood to supply oxygen and nutrients and to dispose of waste, however blood must be kept moving. The most common forms of heart disease result from problems with the blood vessels that supply blood to the heart. Infection and inflammation of the heart include carditis (endocarditis, myocarditis and pericarditis) and rheumatic heart disease.

Cardiomyopathy (disease of the heart muscle) is a degenerative heart disorder. Blood supply problems include coronary artery disease, and functional disorders of the blood system include hypertension, hypotension and oedema. Degenerative blood disorders (disorders that present with the ageing process) include arteriosclerosis and varicose veins.

Congestive cardiac failure

Congestive cardiac failure (CCF) is a condition in which the heart's function as a pump is inadequate to meet the body's needs. The symptoms of congestive heart failure may include fatigue, reduced exercise capacity, shortness of breath, and peripheral oedema (eg: swollen ankles). Congestive heart failure can affect many organs of the body. Reduced supply blood supply to the kidneys, for example, will influence their normal ability to excrete salt (sodium) and water, causing the body to retain more fluid. The lungs may become congested with fluid (pulmonary oedema) and the individual's ability to exercise will decrease. Fluid may accumulate in the liver, reducing its capacity to rid the body of toxins.

Angina Pectoris

Commonly known as angina, this is severe chest pain caused by ischemia (death of tissues due to reduced blood supply) of the heart muscle.

The restriction of blood and oxygen supply to the heart can be caused by a number of factors, including:

- Atherosclerosis (the formation of yellow cholesterol plaques on the internal surface of the arteries, which in turn causes stiffness and narrowing of the arteries)
- Thrombus
- Vascular spasm
- Exertion
- Stress.

Symptoms include a crushing or heavy central chest pain that radiates to the neck, jaw or left arm and shortness of breath. Angina tends to occur on exertion, and may be relieved with rest and oxygen.

Cardiac arrest: Sudden cardiac arrest (SCA) occurs when the heart's electrical system malfunctions, causing rhythms that are rapid (ventricular tachycardia) or chaotic (ventricular fibrillation) or both. This irregular heart rhythm (arrhythmia) causes the heart to suddenly stop beating in any coordinated manner. The heart muscle quivers or fibrillates rather than pump blood. Vital organs are immediately deprived of oxygen, causing the individual to collapse. Brain death and irreversible damage begin in four to six minutes after someone experiences cardiac arrest.

Signs of cardiac arrest may include:

- Sudden collapse
- Loss of consciousness
- No breathing
- Loss of pulse
- No sign of life.

SCA is the leading cause of death in Australia, and is often confused as a heart attack. Heart attack is a 'plumbing' problem, usually caused by a blocked artery, while cardiac arrest is an electrical problem, where the heart is not pumping oxygenated blood to vital organs.

Digestive system problems: The digestive system is responsible for the breaking down of food for absorption and use by the body. Digestive tract disorders commonly occur as a result of inflammation and infection. Within the oral cavity, this results in gingivitis, thrush, mumps and dental issues. Within the intestines, problems include enteritis and irritable bowel syndrome. Within the stomach, there may be ulcers. Other disorders include tumours (eg: stomach, liver, esophageal cancers), congenital disorders (eg: cleft palate), or malabsorption disorders (eg: lactose intolerance).

Gastro-intestinal (GI) bleeding: This may be termed upper or lower bleeding, depending on the location of the bleeding within the gastrointestinal tract. Upper GI bleeding may be symptomatic of peptic (gastric) ulcer disease. Peptic ulcers break down the intestinal walls, resulting in damage to blood vessels and causing bleeding. Certain drugs, such as non-steroidal anti-inflammatory drugs or aspirin might cause ulcers, as may smoking and alcohol use.

Swelling in the veins of the oesophagus or stomach can occur as a result of liver disease. When the swelling bleeds, it can occur without warning and be catastrophic. Lower GI bleeding might include diverticulosis, where small pockets form on the wall of the large intestine. This may result from prolonged constipation.

Polyps (non-cancerous tumours) can occur in the GI tract, usually in older people. Colonic polyps sometimes bleed rapidly, or occasionally bleed slowly and go undetected. Acute gastrointestinal bleeding will first appear as vomiting of blood, bloody bowel movements, or black, tarry stools. Blood may look like coffee grounds. Symptoms associated with blood loss can include fatigue, weakness and shortness of breath, abdominal pain or pale appearance.

Gastroenteritis: Gastroenteritis is a condition that causes irritation and inflammation of the stomach and intestines. The most common symptoms are diarrhoea, crampy abdominal pain, nausea and vomiting, and may include flu-like symptoms such as headache, muscle aches and respiratory symptoms. Common causes of gastroenteritis include bacteria, parasites or food borne illnesses.

Viruses and bacteria are very contagious and can spread through contaminated food or water. In up to 50% of outbreaks, no specific cause is found, however the infection can quickly spread from person to person, commonly because of improper hand washing. 50 to 70% of cases of gastroenteritis in adults are caused by the noroviruses group of viruses. These viruses are highly contagious and spread rapidly.

Endocrine system problems: As mentioned previously, endocrine cells secrete hormones which affect the activities of other cells and therefore influence the body systems. Endocrine disorders, therefore, affect other functions. Hyperthyroidism, for example, is an endocrine disorder which can affect cardiovascular function and metabolism. Cushing's disease affects metabolism. Gynecomastia is an endocrine disorder which affects reproductive function. Disorders within the pituitary gland will affect growth.

Diabetes mellitus

Diabetes mellitus refers to a set of related diseases which result in the body not being able to regulate the amount of sugar (specifically, glucose) in the blood. Glucose is produced by the liver and transported by the blood, and gives you energy to perform daily activities. In a healthy person, blood glucose level is regulated by several hormones, including insulin. Insulin is produced by the pancreas, a small organ between the stomach and liver. Insulin allows glucose to move from the blood into the cells of the body, where it is used for fuel.

In diabetes, glucose in the blood cannot move into cells, so it stays in the blood. This not only harms the cells that need the glucose for fuel, but also harms certain organs and tissues exposed to the high glucose levels.

People with diabetes do not produce enough insulin (Type 1 diabetes), cannot use insulin properly (Type 2 diabetes), or both, which occurs with several forms of diabetes. Common symptoms of both major types of diabetes include fatigue, unexplained weight loss, excessive thirst, excessive urination, excessive eating, poor wound healing, frequent infections, altered mental state and blurry vision.

Complications of diabetes: Both forms of diabetes ultimately lead to high blood sugar levels, a condition called hyperglycemia. Over a long period of time, hyperglycemia damages the retina of the eye, the kidneys, the nerves and the blood vessels. Damage to the nerves from diabetes is a leading cause of foot wounds and ulcers, which frequently lead to foot and leg amputations. Damage to the nerves can lead to paralysis of the stomach, chronic diarrhoea, and the inability to control heart rate and blood pressure during postural changes (eg: when moving from sitting to standing).

Diabetes accelerates the formation of fatty plaques inside the arteries, which can lead to blockages or a clot (thrombus). Such changes can then lead to heart attack, stroke, and decreased circulation in the arms and legs.

Hypoglycemia, or low blood sugar, occurs from time to time in most people with diabetes. It results from taking too much diabetes medication or insulin, missing a meal, doing more exercise than usual, drinking too much alcohol, or taking certain medications for other conditions. Headache, feeling dizzy, fainting, seizures, poor concentration, tremors of hands and sweating are common symptoms of hypoglycemia.

Musculo-skeletal system problems: Common disorders within this system include bone and joint disorders such as osteomyelitis (as a result of infection of the bone) and other infection related problems, such as rheumatic fever, or viral arthritis. Nutritional disorders such as rickets and scurvy also affect this system, as do degenerative disorders such as osteoporosis or osteoarthritis.

A bone fracture or broken bone occurs when a force exerted against a bone is stronger than it can structurally withstand. The most common sites for bone fractures include the wrist, ankle and hip. Treatment options include immobilising the bone with a cast. The symptoms of a bone fracture depend on the particular bone and the severity of the injury, but may include pain, swelling, bruising, deformity and inability to use the limb. Soft tissue injuries include injuries to muscles, tendons and ligaments (but not bones). When soft tissues are damaged, there is usually pain, swelling and often bruising. A lot of swelling can slow the healing process. The length of recovery time depends on your age, general health and the severity of the injury.

Nervous system problems

The nervous system, consisting primarily of the brain and spinal cord, is responsible for information transfer throughout the body. Problems or disorders within the nervous system are related to the blocking of communication within the body, and include Multiple Sclerosis (MS). MS is an autoimmune disease that causes muscular hardness and sensory losses through the systematic destruction of the information pathways within the nervous system. Symptoms include partial loss of vision and/or speech, balance and general motor coordination.

Spinal shock is a form of trauma which may impact on the transfer of information within the nervous system, as are infections, eg: shingles (herpes zoster), and Hansen's disease (leprosy). Polio is another disease which impacts on the nervous system, however immunisation programs have virtually eliminated the occurrence of polio in the Western Hemisphere. Other disorders of the nervous system include diphtheria, sciatica, heavy metal poisons, tumours, and spinal concussion, laceration or compression.

Cerebrovascular accident: Stroke, also called apoplexy or cerebrovascular accident, is a blockage or haemorrhage of a blood vessel leading to the brain, causing reduced oxygen supply. Depending on the extent and location of the abnormality, stroke results in such symptoms as weakness, paralysis of parts of the body, speech difficulties, and if severe, loss of consciousness or death.

There are two main types:

1. Ischaemic (85%), which can be due to a thrombus (a clot forming in one of the blood vessels supplying the brain) or an embolus (a clot which travels from another site, usually the heart, to block off one of the arteries in the brain).
2. Haemorrhagic (15%), which is due to rupture of one of the arteries in the brain, usually due to an aneurysm.

Stroke commonly presents with loss of sensory and/or motor function on one side of the body, change in vision, gait (walking), ability to speak or understand, or sudden, severe headache.

Seizures: Generalised seizures are the result of abnormal activity in the whole brain. Symptoms of a seizure depend on what part of the brain is involved.

Symptoms occur suddenly and may include:

- Change in alertness, eg: the person cannot remember a period of time
- Mood changes, eg: unexplainable fear, panic, joy, or laughter
- Change in sensation of the skin, usually spreading over the arm, leg, or trunk
- Vision changes, including seeing flashing lights
- Hallucinations, ie: seeing things that aren't there
- Falling, loss of muscle control, occurring very suddenly
- Muscle twitching that may spread up or down an arm or leg
- Muscle tension or tightening that causes twisting of the body, head, arms, or legs
- Shaking of the entire body
- Tasting a bitter or metallic flavour.

Causes of seizures can include:

- Abnormal levels of sodium or glucose in the blood
- Brain injury (such as stroke or a head injury)
- Brain injury that occurs to the baby during labour or childbirth
- Congenital brain defects
- Brain tumour or bleeding in the brain
- Dementia
- High fever
- Illnesses that cause the brain to deteriorate
- Infections that affect the brain, such as meningitis, encephalitis, neurosyphilis, or aids
- Kidney or liver failure
- Phenylketonuria (PKU), which can cause seizures in infants
- Drug use or drug withdrawal
- Alcohol withdrawal.
- Sometimes no cause can be identified.

Dementia: Dementia has early warning signs and symptoms. An early diagnosis will help manage a person's dementia. Signs may be vague, but may include loss of memory, particularly for recent events, confusion, apathy, withdrawal and the loss of ability to do everyday tasks. Other common symptoms include confusion, personality change, apathy and withdrawal, loss of ability to do everyday tasks. Other conditions have symptoms similar to dementia.

Reproductive system: Disorders of the reproductive system might include tumours (eg: testicular or prostate cancer, ovarian or uterine cancer), uterine associated disorders (eg: endometriosis), inflammation or infection (eg: sexually transmitted diseases, pelvic inflammatory disease, or candidiasis).

Prostatic cancer

The prostate forms part of the male reproductive system, located immediately below the bladder and just in front of the bowel. Its main function is to produce fluid which protects and enriches sperm. In younger men, the prostate is about the size of a walnut and surrounds the beginning of the urethra, the tube that conveys urine from the bladder to the penis. The nerves that control erections surround the prostate. Prostate cancer occurs when some of the cells of the prostate reproduce far more rapidly than in a normal prostate, causing a swelling or tumour. Prostate cancer is usually one of the slower growing cancers.

Symptoms of prostate cancer might include:

- Waking frequently at night to urinate
- Sudden or urgent need to urinate
- Difficulty in starting to urinate
- Slow flow of urine and difficulty in stopping
- Discomfort when urinating
- Painful ejaculation
- Blood in the urine or semen
- Decrease in libido (sex urge)
- Reduced ability to have an erection.

Candidiasis: Vaginal yeast infection, which is the most common form of vaginitis, is often referred to as vaginal candidiasis. However candidiasis is a yeast infection which can occur anywhere in the body. Under certain conditions, yeast fungi can become so numerous they cause infections, particularly in warm and moist areas. Examples of such infections are vaginal yeast infections, thrush (infection of tissues of the oral cavity), and skin and nail bed infections. Usually your skin effectively blocks yeast, but any breakdown or cuts in the skin may allow this organism to penetrate.

In adults, oral yeast infections become more common with increased age. Adults also can have yeast infections around dentures, in skin folds under the breast and lower abdomen, nail beds, and beneath other skin folds. Most of these infections are superficial and clear up easily with treatment. Infections of the nail beds may require prolonged therapy.

Yeast infections that return may be a sign of more serious diseases such as diabetes, leukaemia or AIDS. Antibiotic and steroid use is the most common reason for yeast overgrowth, however pregnancy, menstruation, sperm, diabetes and birth control pills can also contribute to getting a yeast infection. Yeast infections are more common after menopause.

In people who have a weakened immune system because of cancer treatments, steroids, or diseases such as AIDS, candidal infections can occur throughout the entire body and can be life-threatening. The blood, brain, eye, kidney and heart are most frequently affected, but Candida can also grow in the lungs, liver and spleen.

Genitourinary conditions

Genitourinary conditions are those that relate to the genital area and urinary system.

Urinary tract infection (UTI)

Urinary tract infections are bacterial infections that occur in any part of the urinary tract. Symptoms include frequently feeling the need and/or needing to urinate, pain during urination and cloudy urine.

Urinary incontinence (UI): This refers to any involuntary leakage of urine. It is a common and distressing problem, which may have a profound impact on quality of life. Urinary incontinence almost always results from an underlying treatable medical condition, but is often underreported to medical practitioners due to embarrassment. There is also a related condition for defecation known as faecal incontinence.

Types of urinary incontinence include:

- **Stress incontinence:** due to insufficient strength of the pelvic floor muscles
- **Urge incontinence** : involuntary loss of urine occurring for no apparent reason while suddenly feeling the need or urge to urinate
- **Overflow incontinence:** when people find they cannot stop their bladders from constantly dribbling or continuing to dribble for some time after they have passed urine
- **Mixed incontinence:** not uncommon in the elderly female population and can sometimes be complicated by urinary retention
- **Functional incontinence:** occurs when a person recognises the need to urinate but cannot make it to the bathroom. Causes of functional incontinence include confusion, dementia, poor eyesight, poor mobility, poor dexterity, unwillingness to toilet because of depression, anxiety or anger, drunkenness, or being in a situation in which it is impossible to reach a toilet
- **Bedwetting:** episodic while asleep, which is normal in young children transient incontinence – a temporary version of incontinence. It can be triggered by medications, adrenal insufficiency, mental impairment, restricted mobility, and stool impaction (severe constipation), which can push against the urinary tract and obstruct outflow.

Dysuria: Dysuria is the feeling of pain, burning, or discomfort upon urination. Infection of the urinary tract (urethra, bladder or kidneys) is the most common cause of dysuria. The most common type of infections are cystitis (bladder infection), kidney infection, prostatitis (prostate infection), and urethritis (inflammation of the tube (urethra) that drains the bladder to the outside of the body). Sexually transmitted diseases can also produce symptoms of dysuria, as can hormonal changes, some nerve conditions, cancer or medical conditions such as diabetes mellitus.

Respiratory system problems

Disorders of the respiratory system might include:

- Inflammation and infection, eg: common cold, sinusitis, bronchitis
- Tumours, eg: lung cancer
- Immune disorders, eg: asthma
- Trauma, eg: nose bleeds
- Cardiovascular disorders, eg: pulmonary embolism
- Degenerative disorders, eg: emphysema, chronic obstructive pulmonary disease (COPD)
- Congenital disorders, eg: cystic fibrosis.

Bronchospasm (asthma and anaphylaxis)

Asthma: is a disorder affecting the airways of the lungs. People with asthma have very sensitive airways that narrow in response to certain 'triggers', leading to difficulty in breathing. The airway narrowing is caused by inflammation and swelling of the airway lining, the tightening of the airway muscles, and the production of excess mucus. This results in a reduced airflow in and out of the lungs. The most common asthma symptoms are shortness of breath, wheezing, chest tightness, and/or a dry, irritating and continual cough (especially at night/early in the morning, or with exercise or activity).

Anaphylaxis: or anaphylactic shock, is a sudden, severe and potentially life-threatening allergic reaction to food, stings, bites, or medicines. Symptoms of anaphylaxis can include:

- Difficulty breathing or noisy breathing
- Swelling of the tongue
- Swelling/tightness in the throat
- Difficulty talking and/or a hoarse voice
- Wheezing or persistent coughing
- Loss of consciousness and/or collapse
- Young children may appear pale and floppy
- Abdominal pain or vomiting (when associated with an allergic reaction to an insect sting or bite).

Upper respiratory tract infection: The upper respiratory tract includes the sinuses, nasal passages, pharynx and larynx. These structures direct the air we breathe in to the trachea and eventually to the lungs in order for respiration to take place. Upper respiratory infection is generally caused by the invasion of the inner lining (mucosa or mucus membrane) of the upper airway by a virus or bacteria. Symptoms might range from runny nose, sore throat or cough to breathing difficulty and lethargy. Other less common symptoms may include foul breath, poor smelling sensation, headache, shortness of breath, sinus pain, itchy and watery eye (conjunctivitis), nausea, vomiting and body aches.

Skin condition, infections and wounds: The integumentary system comprises the skin, the largest organ in the body. Common disorders of the skin include viral infection (eg: blisters, chicken pox, shingles, warts), fungal infection or parasitic infection (eg: scabies, pediculosis). Environmental stresses to the skin might result in dermatitis, corns, calluses or psoriasis. Tumours such as moles, melanoma or carcinomas might affect the skin, as will traumas such as abrasions (wounds), incisions (open wounds), or burns. Degenerative skin disorders might include xerosis or alopecia.

Impetigo: Also known as school sores, impetigo is a skin infection caused by the bacteria Staphylococcus and Streptococcus. The infection is characterised by inflamed blisters that pop, weep and form crusts. Impetigo looks unsightly, but it isn't dangerous and doesn't cause any lasting damage to the skin, however, it is highly contagious.

Dermatitis

Dermatitis is an inflammation which begins in a portion of the skin exposed to infection or irritated by chemicals, radiation or mechanical stimuli (eg: rubbing on the skin). Dermatitis may cause no physical discomfort, or it may produce itching. Dermatitis symptoms vary with all different forms of the condition, and range from skin rashes to bumpy rashes or blisters. Some forms of dermatitis can be painful and the inflammation can spread.

The next three sections refer to common conditions you may observe within your employment, involving the mouth, ears and nose.

Dental conditions

Gingivitis

Gingivitis is inflammation of the gums. A form of periodontal disease, gingivitis involves inflammation and infection that destroys the tissues that support the teeth, including the gums, the periodontal ligaments, and the tooth sockets (alveolar bone). Gingivitis is due to the long-term effects of plaque deposits. Injury to the gums from any cause, including overly vigorous brushing or flossing of the teeth, can cause gingivitis. General illness, poor dental hygiene, pregnancy and uncontrolled diabetes can increase the risk of gingivitis. Symptoms of gingivitis include bleeding gums, bright red or red/purple gums, tender gums, mouth sores, swollen or shiny gums.

Halitosis: Halitosis (bad breath) is a common condition caused by sulphur-producing bacteria that live within the surface of the tongue and in the throat. The treatment for halitosis will depend on the underlying cause. Smoking, dry mouth caused by medications, alcohol use, stress or a medical condition, dental infections and nasal or sinus infections can cause bad breath.

Symptoms of halitosis include a white coating on the tongue, especially at the back of the tongue, dry mouth, build up around teeth, morning bad breath and a burning tongue, thick saliva and a constant need to clear your throat. Halitosis can have a major social impact on a person as other people may back away or turn their heads, resulting in a loss of confidence and self-esteem.

Ear conditions

Otitis media: Otitis media is the general term referring to inflammation in the middle ear. It occurs in the area between the tympanic membrane and the inner ear, including a duct known as the eustachian tube. It is one of the two categories of ear inflammation that can underlie what is commonly called an earache. Medical intervention is recommended, as if left untreated there is a risk of hearing loss and repeated (chronic) infections.

Hearing loss: Signs of hearing loss might include delayed speech or development, not responding to soft speech or when called from another room, frequent requests for repetition, liking the television up loud, an aversion to loud sounds, shouting or whispering while speaking, general withdrawal from the social setting and confusion. Hearing tests can determine the type and degree of hearing loss, with an audiogram used to display the results. There are three types of hearing loss, all of which may be acquired or congenital.

Conductive hearing loss: Conductive hearing loss is caused by blockage or damage in the outer and/or middle ear and leads to a loss of loudness. It can often be helped by medical or surgical treatment.

Causes include:

- Blockages of the ear canal by impacted wax or foreign objects
- Outer ear infection, sometimes the result of swimming
- Middle ear infection (glue ear)
- Perforated eardrum
- Otosclerosis, a hereditary condition where the bone grows around the tiny stirrup
- Bones in the middle ear
- Partial or complete closure of the ear canal.

Sensorineural hearing loss: Sensorineural hearing loss is caused by damage to/malfunction of the cochlea or the hearing nerve and leads to a loss of loudness as well as a lack of clarity.

Causes of acquired sensorineural hearing loss include:

- Ageing
- Excessive exposure to noise
- Diseases, such as meningitis and meniere's disease
- Viruses, such as mumps and measles
- Drugs which can damage the hearing system
- Head injuries.

Causes of congenital sensorineural hearing loss include:

- Inherited hearing loss
- Premature birth, lack of oxygen at birth or other birth traumas
- Damage to the unborn baby from a virus such as rubella
- Jaundice.

Mixed hearing loss

Mixed hearing loss results when there is a problem in both the conductive pathway (in the outer or middle ear) and in the nerve pathway (the inner ear), eg: conductive loss due to a middle-ear infection combined with a sensorineural loss due to damage associated with ageing.

Eye conditions

Myopia: Myopia (nearsightedness) is when light entering the eye is focused incorrectly, making distant objects appear blurred. Close up objects are seen more clearly. Nearsightedness affects males and females equally. People who have a family history of nearsightedness are more likely to develop it. Most eyes with nearsightedness are healthy, but a small number of people with severe myopia develop a form of retinal degeneration.

Nearsightedness is often first noticed in school-aged children or teenagers, and gets worse during the growth years. Children often cannot read the blackboard, but they can easily read a book. People who are nearsighted need to change glasses or contact lenses often. It usually stops progressing as a person stops growing in his or her early twenties.

Cataracts: In a normal eye, light passes through the transparent lens to the retina. Once it reaches the retina, light is changed into nerve signals that are sent to the brain. The lens must be clear for the retina to receive a sharp image. The lens is made of mostly water and protein, with the protein arranged in a precise way to keep the lens clear and lets light pass through. With the ageing process, some of the protein may clump together and start to cloud a small area of the lens. This is a cataract. Over time, the cataract may grow larger and cloud more of the lens, making it harder to see. A cataract can occur in either or both eyes, however cannot spread from one eye to the other. It is thought that smoking and diabetes might also impact on cataract development and growth.

Disease prevention

The move towards primary health care

In both health and disease, the ability of the body to adapt physically and psychologically to stress is affected by age, health status, and psychosocial resources. Successful adaptation is more likely where there is a gradual rather than a sudden change in health status because the body has a greater chance to maintain internal and external balance. Also affecting the body's ability to adapt is the level at which disease prevention occurs.

1. **Primary prevention:** removing risk factors so the disease does not occur, eg immunisation.
2. **Secondary prevention:** disease detected when person still asymptomatic and treatment to cure can be implemented, eg pap smear.
3. **Tertiary prevention:** prevention of further deterioration or reduction of complications of a disease through clinical intervention.

The emphasis is on disease prevention and health promotion. Seen as a solution to an inadequate illness management system, PHC provides a balanced system of treatment and disease prevention that are:

- Locally based
- Affordable and accessible
- Well integrated
- Sustainable.
- Focussed on Health promotion
- Focussed on disease prevention and illness treatment
- Rehabilitation services.

Primary Health Care (PHC): PHC – a set of principles guiding a vision for community health that focuses on empowered citizens making informed decisions for health and harmony within the environment.

(McMurray, 2007 p.26)

Secondary Health Care: This is an intermediate level of health care, which is concerned with the provision of specific technical, therapeutic or diagnostic services. Specialist consultation procedures and hospital admissions fall into this category of care. These services are episodic and usually focused on a particular health problem. Continuity of care is less critical. Secondary Health Care is provided to a larger group of people from a larger geographic area than those served by PHC.

Tertiary care: Tertiary prevention is the 'management of established disease so as to minimise disability'. This has been defined more specifically as 'measures aimed at softening the impact of long term disease and disability by eliminating or reducing impairment, disability and handicap, minimising suffering; and maximising potential years of useful life'. This involves rehabilitation or long-term care provide by rehabilitation centres, hospitals and aged care facilities.

Health promotion

Health Promotion is the process of enabling people to mange and improve their health. To reach a state of complete physical, mental and social well-being, an individual or group must be able to identify and to realise aspirations, to satisfy needs, and to change or cope with the environment. Health is a positive concept emphasising social and personal resources, as well as physical capacities. Therefore, health promotion action is not just the responsibility of the health sector, but goes beyond life-styles to well-being.

Health promotion can be described as any activity that improves public awareness of disease, health services or risk factors for disease. Brochures, television and radio advertisements, community programs, school based programs, flyers, etc, are all typical methods that may be employed to promote health in your community.

There are five approaches to health promotion, these are explained as follows:

1. **The Medical approach:** This is a preventative approach that aims to keep diseases such as cancer, heart and lung disease or other illnesses at bay. This includes immunisation against diseases, screening for cervical cancer, regular blood tests and screening for diabetes.
2. **The Behavioural approach:** This approach aims to change the attitudes and beliefs of the individual to encourage then to adopt a healthy lifestyle.
3. **The Educational approach:** This approach is as it sounds, it involves educating the older person with knowledge and understanding of health issues how to live and maintain a healthier lifestyle. The basis of this approach is to ensure that information is given that is correct and relevant to the individual. The individuals are then encouraged to make their own decisions about their health and lifestyle.
4. **The Client-centred approach:** This approach involves working with the client to assess their needs and wants in order to adopt a holistic approach to the decisions that affect their lifestyle. Client-centred involves listening to the client and discussing their options with them.
5. **The Societal approach:** This approach may be adopted by a health care and aged care facility with the aim to change the physical, social and economic environment so that it encourages a healthy lifestyle. The aim is to change the overall attitudes of the individuals within a residential facility rather than the individual people themselves. An example of this would be converting the facility to be non-smoking and prohibiting smoking in closed public areas.

Remember, however, that in this situation, the individual who chooses to smoke still has the right to do so in designated areas, depending on the facilities of the organisation. While working in the aged care industry it is important that you promote a healthy and positive lifestyle at all times. By doing this you will find over time that your clients will slowly adopt a positive healthy lifestyle themselves.

The Ottawa Charter

The first International Conference on Health Promotion was held in Ottawa, Canada in 1986. The aim of the conference was to inspire action to achieve the objectives of WHO's Health for All by the Year 2000 initiative. The consequent Ottawa Charter for health promotion followed on from the Declaration of Alma Ata and consequent primary health care conferences that occurred over the following years.

The Ottawa Charter states that the fundamental conditions and resources needed for good health are:

- Peace
- Shelter
- Education
- Food
- Income
- A stable ecosystem
- Sustainable resources
- Social justice and equity.

The Ottawa Charter also identifies three basic strategies for health promotion:

- Advocate – the need for advocacy in regard to achieving health and health services
- Enable – work to reduce differences in current health status and ensure everyone has the opportunities and resources required to achieve their full health potential, and that they are able to control those things that determine their health
- Mediate - health promotion demands coordinated action by all concerned.

Two

Reviewing factors that contribute to maintenance of a healthy body

Maintaining a healthy body

Read the case study. Write down, or tell your trainer, your responses to the following tasks.

Case study

1. Mr. Bevac, 49 has a mild intellectual disability. As part of his care his service provider assists him to:
   - ❑ Learn about screening and health assessments for older people.
   - ❑ Learn about binge drinking.
   - ❑ Make and keep appointments with GPs.
   - ❑ Learn how to budget and go shopping.
   - ❑ Prepare a range of nutritional meals.
   - ❑ Access appropriate and relevant courses and other learning opportunities.
   - ❑ Gain the interpersonal skills needed to meet new people and join in activities.
   - ❑ Identify and participate in age-appropriate social activities.
2. Use the following list to identify the actions taken to assist Mr. Bevac in maintaining his body's systems in a state of health.

QUESTIONS	YES	NO	NA
Does the plan include medical check-ups?	❑	❑	❑
Is nutrition covered?	❑	❑	❑
Does the plan provide the client with the opportunity to exercise regularly?	❑	❑	❑
Does the plan provide opportunities to stimulate their mind?	❑	❑	❑
Does the plan include a strategy designed to support the client to cease smoking if applicable?	❑	❑	❑
Does the plan include a strategy designed to assist the client to achieve a healthy weight if they are underweight or overweight?	❑	❑	❑
Does the plan include a strategy designed to assist the client to use aids safely?	❑	❑	❑
Does the plan include strategies designed to support them in meeting new people and participating in activities?	❑	❑	❑

3. Investigate some of the more common musculoskeletal problems that could impact your clients. Prepare a short article, including diagrams, that identifies the problem, its causes, symptoms, diagnosis, treatment and prevention. Stroke and osteoporosis could be investigated, for example.

Evaluating how the relationships between different body systems affect and support healthy functioning

Major body systems

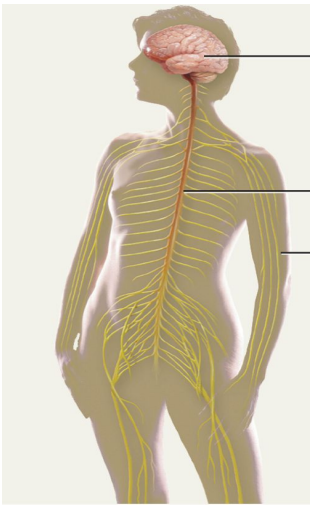
Anatomy and physiology are complementary branches of science that provide the concepts that help us to understand the human body.

There are eleven major organ systems in the human body.

1. **The nervous system:** The nervous system is the body's main control system. It consists of the brain, the spinal cord and a network of nerves that extend out to the rest of the body. The nervous system includes the sensory system.
2. **The respiratory system:** The respiratory system is centered on the lungs, which work to get life-giving oxygen into the blood. They also remove carbon dioxide, a waste product from the body.
3. **The muscular system:** The main role of the muscular system is to facilitate movement. Muscles work in pairs to move limbs and allow the body mobility. Muscles also control the movement of materials through some organs, such as the stomach and intestines and the heart and circulatory system.
4. **The cardiovascular system:** The cardiovascular system consists of the heart and a network of vessels that carry blood. The term cardio refers to the heart and the term vascular refers to the blood vessels. The main role of the cardiovascular system is to supply oxygen and nutrients to the body's cells and remove waste products from these tissues. The system consists of the heart which pumps blood through the blood vessels which act as pipes throughout the body carrying the blood to and from the tissues.
5. **The endocrine system:** Many body processes, such as growth and energy production, are directed by hormones. The glands of the endocrine system release these chemicals.
6. **The lymphatic system:** The lymphatic system is responsible for transporting fluids around the body and also plays a vital role in the operation of the immune system to protect the body from disease.
7. **The skeletal system:** The adult skeleton is a framework of bone and cartilage that protects organs and makes it possible for the body to move. The skeleton is a strong yet flexible framework of bones and connective tissue. It provides support for the body and protection for many of its internal parts.
8. **The integumentary system;** The integumentary system is the largest organ system. It is the system that covers and protects the human body from damage – the word integument means covering. It includes the skin and its appendages such as hair and nails. The skin covers our entire body and accounts for about 7% of our total body weight.
9. **The urinary system:** The urinary system filter out cellular wastes, toxins and excess water or nutrients from the circulatory system it consists of the kidneys, the ureters, the urinary bladder and the urethra.
10. **The reproductive system:** The main role of the reproductive system is to manufacture cells that allow reproduction. The male and female parts of the reproductive system produce the sperm and eggs needed to create a new person. They also bring these tiny cells together.

11. **The digestive system:** The digestive system takes in the food the body needs to fuel its activities. It breaks the food down into units called nutrients and absorbs the nutrients into the blood. The digestive process is also responsible for converting waste into material that can be excreted.

The Nervous System



The nervous system is the master controlling and communicating system of the body. Every thought, action and emotion reflects the activity of the nervous system. The nervous system uses electrical signals to communicate rapidly and specifically to the body. These signals are received from the external environment, conditions outside the body, and from the internal environment, conditions inside the body. The nervous system allows the body to detect changes in the environment and respond to those changes to maintain homeostasis (the human body's ability to regulate itself in response to changes in the external environment).

The nervous system operates in three ways:

1. It uses sensory receptors to monitor changes and gather information (inputs) occurring both inside and outside the body.
2. It processes and interprets the sensory input and decides appropriate responses.
3. It causes a response by activating effector organs (muscles and glands).

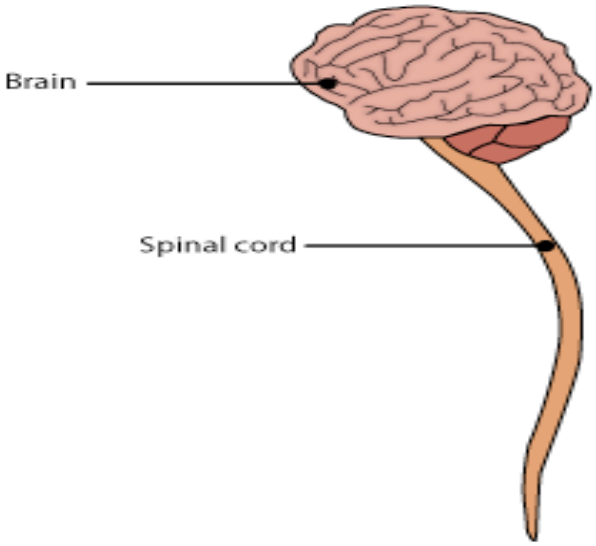
There are two principal divisions of the nervous system:

1. **Central nervous system:** this contains the brain and the spinal cord.
2. **Peripheral nervous system:** this contains the nerves that extend from the brain and spinal cord and the receptors.

Major role; The main role of the nervous system is to relay electrical signals through the body. The nervous system directs behaviour and movement and, along with the endocrine system, controls physiological processes such as digestion and circulation.

Major organs: Brain, spinal cord and peripheral nerves.

Central nervous system Functions



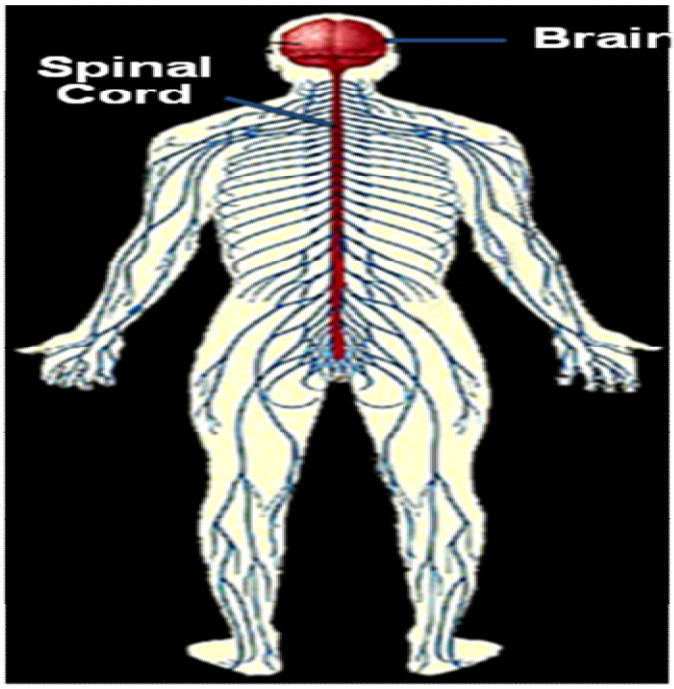
The central nervous system (CNS) receives information from the body via the peripheral nervous system (PNS). It integrates the information it receives and activates muscles and glands via the PNS.

Location and protection

The brain and the spinal cord are contained and protected within the dorsal cavity (cranium and vertebral column). The structures surrounding the CNS are:

- Bone which forms the cranial cavity and vertebral column
- Meninges, the multilayered 'wrapping' of the brain and spinal cord
- Cerebrospinal fluid in ventricles and subarachnoid space.

Components of the Central Nervous System



There are 11 major components of the central nervous system.

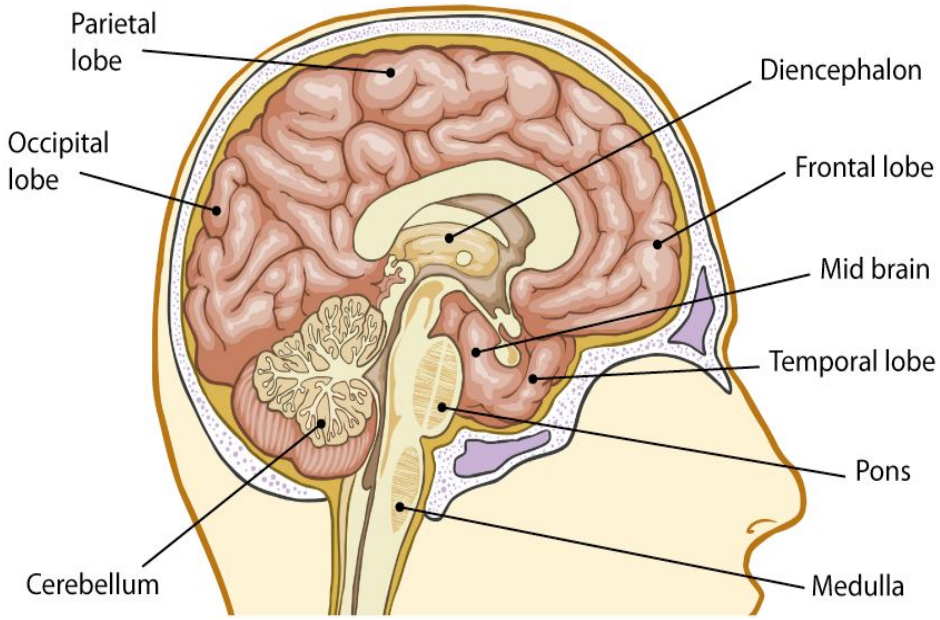
Cerebral hemispheres

Two hemispheres form the superior part of the brain. Most of the surface is marked by elevated ridges of tissue (gyri) and separated by shallow grooves called sulci. Fissures (deeper grooves) separate large regions of the brain. The longitudinal fissure separates the two hemispheres.

Each hemisphere has three regions:

1. A superficial cortex of grey matter.
2. An internal white matter.
3. The basal nuclei which are islands of grey matter situated deep within the white matter.

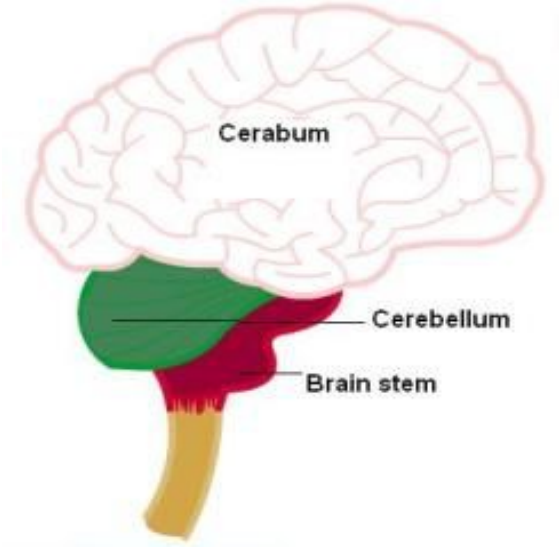
Each hemisphere is subdivided into four lobes which are responsible for different human functions – **frontal** (higher level intellectual functions and personality), **temporal** (auditory and olfactory), **parietal** (motor and speech) and **occipital** (visual).



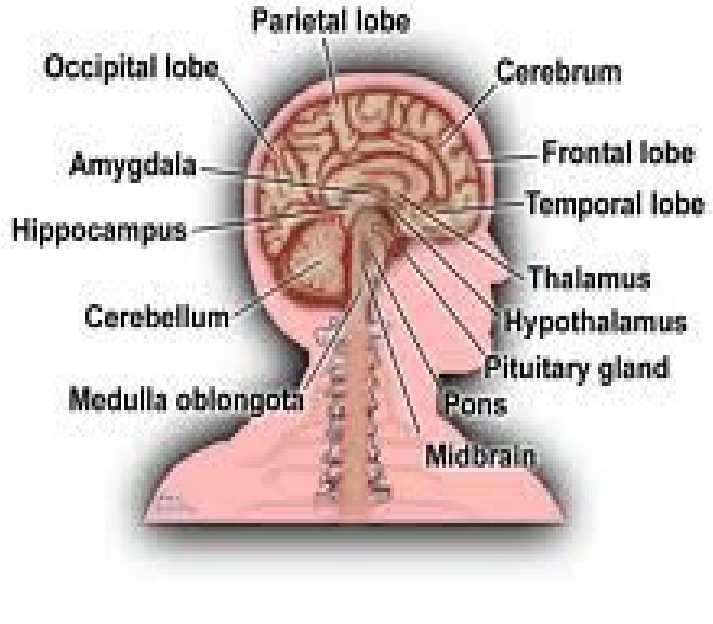
The brain

The brain is a mass of soft nerve tissue, which is encapsulated within the skull. It is made up of grey matter, mainly nerve cell bodies, and white matter which are the cell processes. The grey matter is found at the periphery of the brain and in the centre of the spinal cord. White matter is found deep within the brain, at the periphery of the spinal cord and as the peripheral nerves.

The brain is divided into:



Cerebrum



This is the largest part of the brain which is made up of the two hemispheres of the forebrain.

Cerebral cortex

The cerebral cortex is responsible for conscious thought processes and intellectual functions. It is also responsible for memory storage and processing, conscious and subconscious regulation of skeletal muscle contraction. Being composed of gray matter, the cerebral cortex consists of neuron cell bodies, dendrites and unmyelinated axons, but no fibre tracts.

It contains three kinds of functional areas:

1. **Motor areas:** control voluntary movement
2. **Sensory areas:** concerned with conscious awareness of sensation (namely the parietal, temporal and occipital lobes)
3. **Association areas:** areas that communicate ('associate') with the motor cortex and with other sensory association areas to analyse and act on sensory inputs with regards to past experience, and others that are not connected with any of the sensory cortices. Each hemisphere is generally related to the sensory and motor functions of the opposite side of the body. There is some specialisation of cortical functions. However, no functional area of the cortex acts alone. The entire cortex is involved in conscious behaviour in some way.

Cerebral white matter/cerebral medulla; This is responsible for communication between cerebral areas and between the cerebral cortex and lower CNS centres.

Basal nuclei or basal ganglia: These are clusters of cell bodies or gray matter located deep among the tracts of cerebral hemisphere. They are important in controlling and coordinating skeletal muscle activity, inhibiting excessive/unnecessary movements and initiating accessory and often involuntary actions.

Diencephalon: The diencephalon forms the central core of the forebrain and is surrounded by the cerebral hemispheres. It integrates conscious and unconscious sensory information and motor command. It consists of the thalamus, hypothalamus and epithalamus.

Areas of grey matter that enclose the third ventricle are the:

- Thalamus which contains the relay and process centres for sensory information
- Hypothalamus which has a key role in maintaining homoeostasis in the body. It connects the brain to the pituitary gland which is the major gland of the endocrine system. It contains the centres controlling emotions, autonomic function and hormone production
- Epithalamus is involved in the maintenance of circadian rhythms. The pineal gland extends from here and secretes the hormone melatonin.

Brainstem

This is the connecting link to the spinal cord. Nuclei of cranial nerves are also located in the brainstem, so it is heavily involved with innervation of the head. The following centres produce the rigidly programmed, automatic behaviours necessary for survival.

The **medulla oblongata** relays sensory information to the thalamus and other portions of the brainstem. Autonomic centres for regulation of visceral function (cardiovascular, respiratory and digestive system activities).

The **pons** relays sensory information to the cerebellum and thalamus.

- **Subconscious somatic and visceral motor centres**. It is composed of conduction tracts which course in two directions, afferent (incoming) and efferent (outgoing). It is the connecting link of the brain to the spinal cord.
- The **midbrain** (or mesencephalon) is responsible for the processing of visual and auditory data. It generates the reflexive somatic motor responses and maintains consciousness. The midbrain is the headquarters of the reticular activating system.

Cerebellum

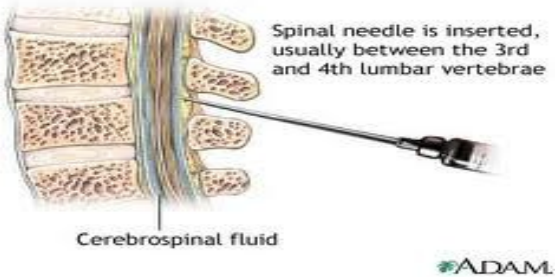
The cerebellum coordinates movement and maintains posture and equilibrium by assessing and adjusting output of other somatic motor centres in the brain and spinal cord.

The Meninges

The meninges consist of three continuous connective tissue membranes covering the brain and spinal cord.

- The dura mater is the outermost layer and is a double layered membrane
- The arachnoid mater is the middle meningal layer. Some people think it looks a little like a spider web
- The pia mater is the innermost layer and is very delicate.

Cerebral spinal fluid



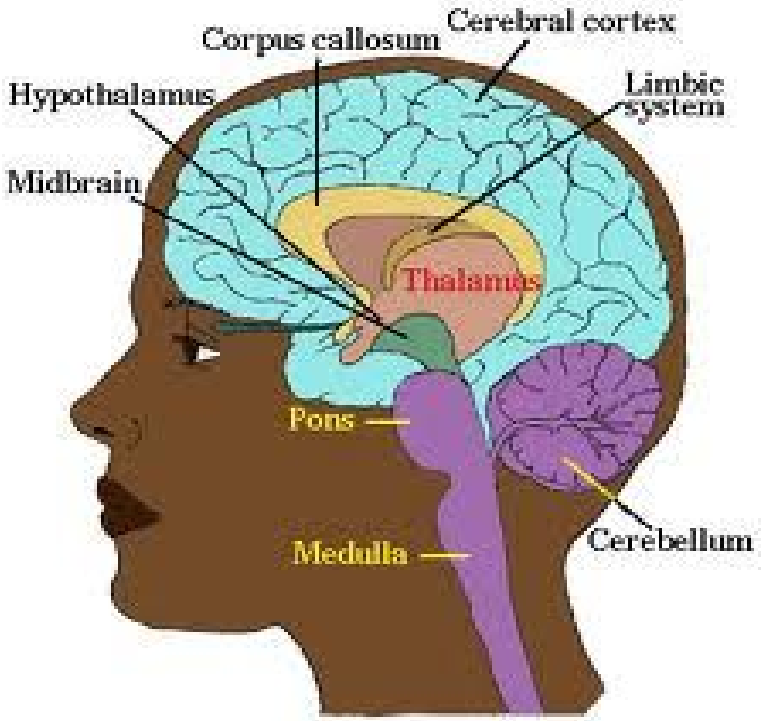
This fluid provides a cushion for the brain and spinal cord. It is a clear, almost colourless liquid, with a concentration of electrolytes, glucose and protein. It forms constantly in the choroid plexuses in the ventricles from where it flows into the subarachnoid space and circulates around the brain and spine. It is absorbed into the venous blood through the arachnoid villi. This maintains a relatively constant pressure within the skull (intracranial pressure).

Blood-brain barrier

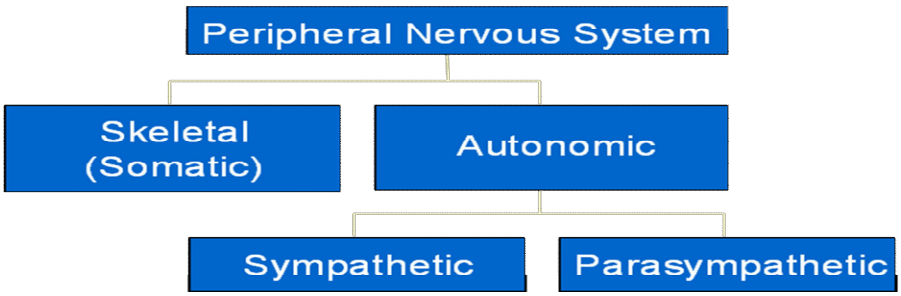
This barrier is a protective mechanism that limits the passage of potentially damaging materials into the brain and controls the balance of electrolytes, glucose and proteins in the brain. A similar blood-cerebral spinal fluid barrier is at the choroid plexus to control the constituents of cerebral spinal fluid.

Brain has 2 Hemispheres

- Left & Right sides are separate
- Corpus Callosum : major pathway between hemispheres
- Some functions are 'lateralised':
- Language on left
- Math, music on right
- Lateralisation is never 100% .



Peripheral nervous system



The peripheral nervous system (PNS) connects the CNS to the organs and limbs of the body. The PNS reacts to impulses carried to and from the brain by the cranial nerves and to impulses carried to and from the spinal cord by the spinal nerves.

Functional divisions

The PNS has two divisions, the afferent and the efferent, which have different functions. The organisation of the PNS in relation to the CNS may be seen in the following diagram:

Afferent system (sensory)

The afferent system consists of neurons which are nerve fibres that convey impulses to the CNS from sensory receptors located throughout the body. Impulses from skin, skeletal muscles and joints are conveyed by somatic fibres. Impulses from visceral organs are conveyed by visceral fibres.

Efferent system (motor)

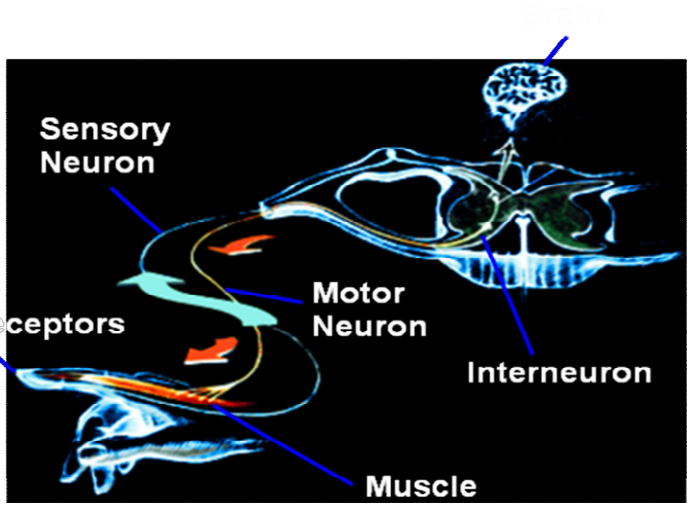
The efferent system contains neurons that transmit impulses from the CNS to effector organs. Muscles in the body contract and cause the glands to secrete hormones in response.

The efferent division has two subdivisions:

- The somatic nervous system
- The autonomic nervous system.

The somatic nervous system

The somatic nervous system: conducts impulses from the CNS to skeletal muscles and is under voluntary control.



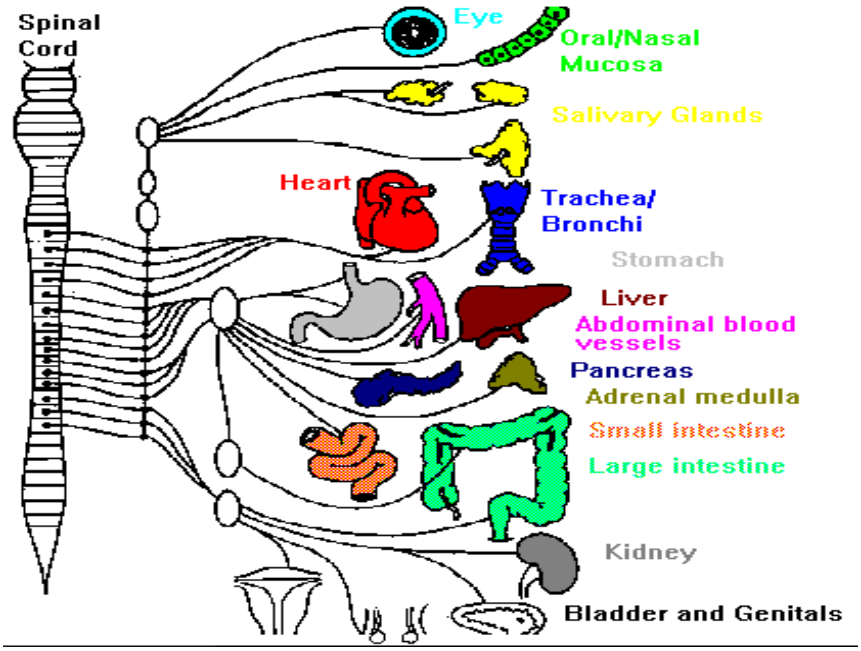
- Nerves to/from spinal cord
- Control muscle movements
- Somatosensory inputs
- Both voluntary and reflex movements
- Skeletal reflexes
- Simplest is spinal reflex arc.

The Autonomic Nervous System

The autonomic nervous system conducts impulses from the CNS to cardiac muscles, smooth muscles and glands, and is under involuntary control.

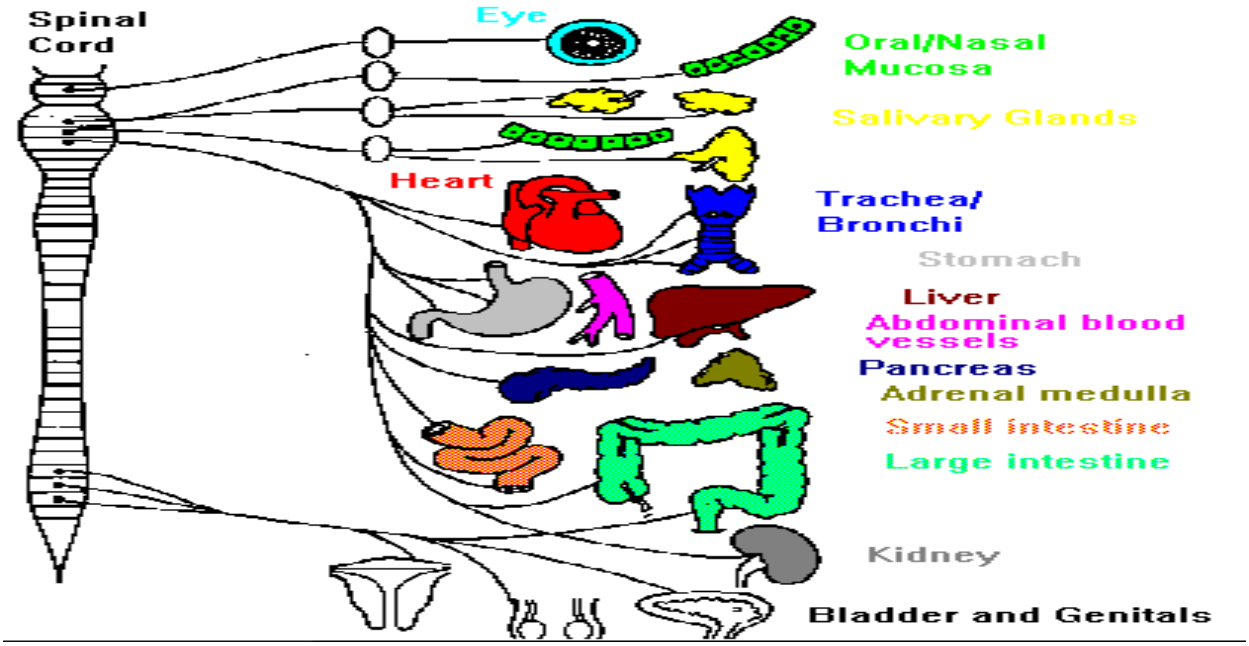
The autonomic nervous system has two further functional subdivisions:

1. **Sympathetic nervous system:** (arouses the body)



- Fight or flight" response
- Release adrenaline and noradrenaline
- Increases heart rate and blood pressure
- Increases blood flow to skeletal muscles
- Inhibits digestive functions.

2. **Parasympathetic nervous system:** (calms after arousal).

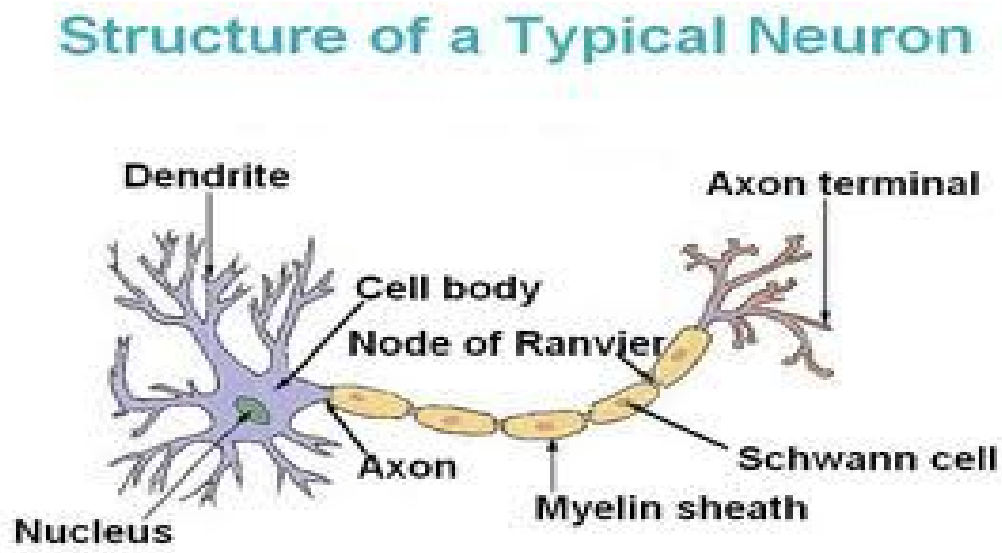


- Rest and digest ” system
- Calms body to conserve and maintain energy
- Lowers heartbeat, breathing rate, blood pressure .

Nervous tissue

Nervous tissue is made up of supporting cells – smaller cells that surround and wrap delicate neurons, such as neuroglial cells (in the CNS) and Schwann cells (in the PNS). These provide structural support and nutrition for the neurons which are the excitable nerve cells that transmit electrical impulses.

Neurons or nerve cells



Neurons are the structural units of the nervous system. They are highly specialised cells that transmit nerve impulses/messages from one part of the body to another. They have extreme longevity but cannot replace themselves if destroyed. Neurons cannot undergo cell division. In the PNS, axons may be able to regenerate if the cell body is viable. Neurons are highly irritable and stimulate other cells via action potentials. These action potentials, or nerve impulses, are electrical impulses carried along the length of axons. They are always the same regardless of stimulus and are the underlying functional activity of the nervous system. Neurons: require continuous and large supplies of oxygen and glucose as they have an exceptionally high metabolic rate. They are complex cells which vary in structure.

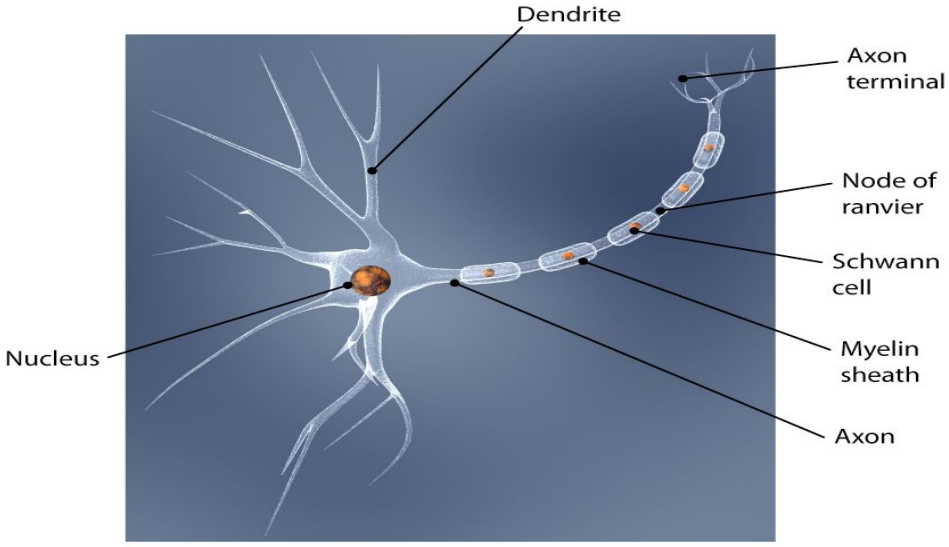
Neurons have three components:

1. **Cell body:** The plasma membrane is the site of electrical signaling. Most cell bodies are located within the CNS; those in the PNS usually are found in groups called ganglia. The cell body contains a nucleus.
2. **Dendrites:** Dendrites of motor neurons are diffusely branching extensions and are the main receptive or input regions. These provide a huge surface area for receiving signals from other neurons. They convey incoming messages toward the cell body and on to the axon. Therefore impulses always move in one direction only.
3. **Axon:** The axon is the conducting component of the neuron, carrying nerve impulses and transmitting them away from the cell body toward an effector site or connecting neuron. Each neuron has only one axon which can be very short, or absent, or nearly the entire length of the neuron.

The axon is covered with a segmented layer of lipid material called myelin. The whole membrane is referred to as the myelin sheath. Myelin is an insulating substance. It prevents loss of the electrical impulses, and also increases the speed at which the impulse is conducted. Myelinated fibres conduct nerve impulses rapidly while unmyelinated fibres conduct impulses quite slowly. The myelin sheath consists of a series of Schwann cells arranged along the length of the axon. This outer layer of the Schwann cell membrane is called a neurilemma.

Gaps occur at regular intervals in the myelin sheath and are called nodes of Ranvier. It is at these nodes that axons can branch extensively. Regions of the brain and spinal cord containing dense collections of myelinated fibres are referred to as white matter. These are primarily fibre tracts. Grey matter contains mostly nerve cell bodies and unmyelinated fibres.

Components of neurons



Classification of neurons

Neurons are classified structurally and functionally.

Structural classification

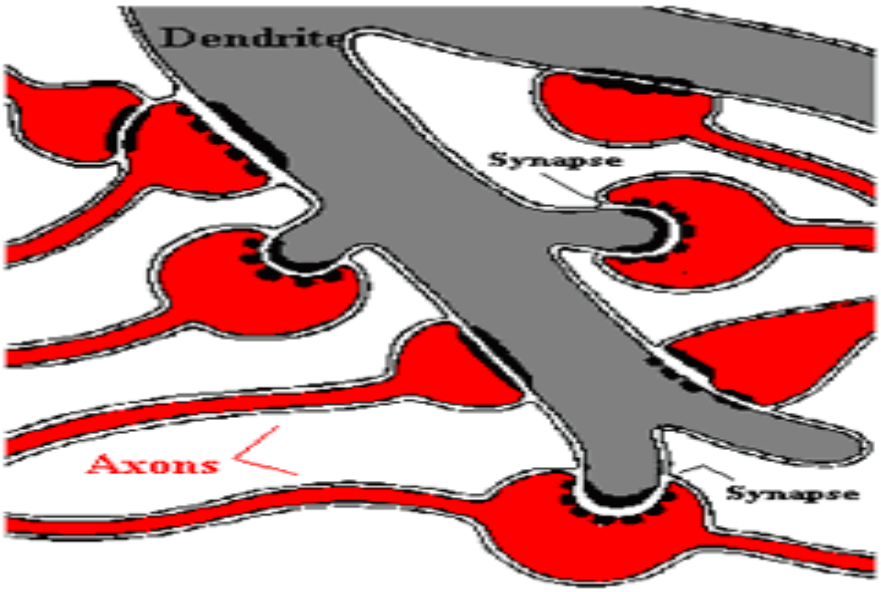
Neurons are structurally classified on the basis of the number of processes (projections) extending from the cell body.

They can be:

1. **Unipolar:** one process that branches shortly after leaving the cell body.
2. **Pseudo-unipolar:** also have one process but originated as bipolar.
3. **Bipolar:** have two distinct processes arising from the cell body.
4. **Multi-polar:** have multiple processes capable of extensive branching.

Functional classification: Neurons are functionally classified according to the direction in which the nerve impulse travels relative to the CNS. Sensory or afferent neurons transmit impulses from sensory receptors in the skin or internal organs toward the CNS. Motor or efferent neurons carry impulses away from the CNS to the effector organs (muscles and glands). Motor neurons are multi-polar. Interneurons lie between motor and sensory neurons in neural pathways shuttling signals through CNS pathways where integration occurs.

Synapses



Neurons have specialised projections called **dendrites** and **axons**. Dendrites bring information to the cell body and axons take information away from the cell body. Information from one neuron flows to another neuron across a **synapse**. The synapse contains a small gap separating neurons.

The synapse consists of:

1. **A presynaptic:** ending that contains neurotransmitters, mitochondria and other cell organelles.
2. **A postsynaptic:** ending that contains receptor sites for neurotransmitters.
3. **A synaptic cleft:** or space between the presynaptic and postsynaptic endings.

There are two types of synapses:

1. **Electrical synapses:** the current moves directly from one cell to the next via gap junctions. It is less common than a chemical synapse and occurs in the CNS.
2. **Chemical synapses:** the transmission of signals across chemical synapses depends on the release, diffusion, and receptor binding of neurotransmitter molecules. This results in unidirectional communication between neurons which convert electrical signals to chemical signals (neurotransmitters) across the synapse to the post synaptic cells which convert them back into electrical signals. The best understood chemical synapse is the neuromuscular junction (motor nerve and skeletal muscle fibre).

Neurotransmitters

Neurotransmitters (NT), along with electrical signals, are used for neural communication with the body and the brain.

They can be grouped into several chemical classes based on their molecular structure:

- Acetylcholine
- Amines
- Amino acids
- Polypeptides
- Purines
- Gases
- Lipids.

Somatic nervous system

The somatic nervous system is made up of peripheral nerve fibers that send sensory information to the central nervous system and motor nerve fibers that send information to skeletal muscle. The main somatic nervous system functions are to control voluntary movements of your body and to help you feel through all your senses. The brain and the spinal cord are connected to the skeletal muscles and the external receptors with the nerves of the somatic nervous system. This is the system that helps you feel the touch, smell, sight, taste and sound.

The autonomic nervous system is further subdivided into sympathetic and parasympathetic nervous systems. A third division, the enteric nervous system, is also sometimes taken into consideration while studying the parts of nervous system.

How does SNS function? During any movement, the SNS carries impulses from the brain to the muscle to be moved, while in its sensory capacity, the SNS carries impulses from the sensory organ to the brain. Thus there are two portions of the somatic nervous system, the afferent and the efferent. The impulses from sense organs are carried to the central nervous system by afferent or sensory neurons and the impulses from the central nervous system are transmitted to the muscles by efferent or motor neurons.

Neurons which comprise the SNS, emerge from the brain or spinal cord and reach the muscle or sense organ directly. Their cell body (the soma) is situated in the brain or spinal cord and the axons (long nerve filaments) travel to or from the cell body, ending in the muscle, skin or sense organ. They carry electrochemical impulses along with them. The average adult brain contains about 100 billion neurons

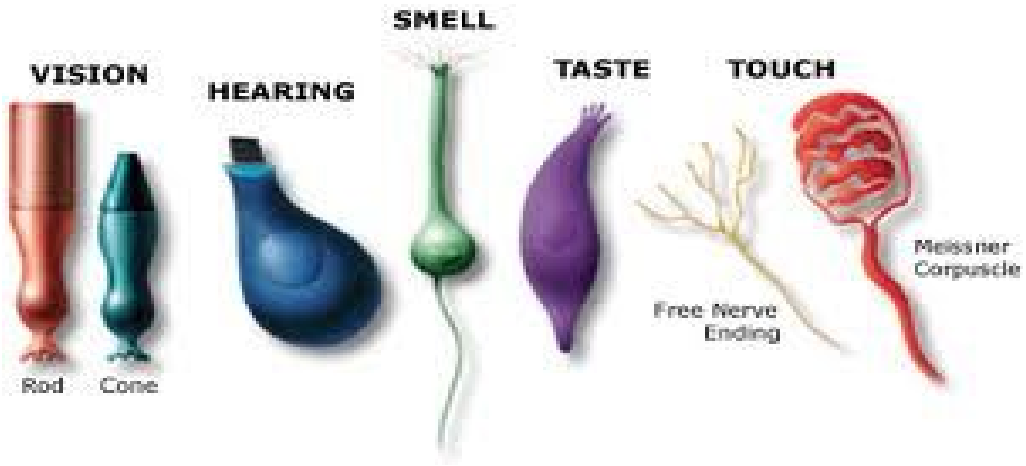
Autonomic nervous system

The autonomic nervous system provides motor and sensory innervations to smooth muscle, cardiac muscle and glands. Ach and norepinephrine are the two major neurotransmitters of the autonomic nervous system.

Sympathetic activation: The sympathetic nervous system (SNS) mobilises the body during extreme situations such as the 'fight-or-flight' or stress response. It exerts long-lasting, diffuse effects because NE is inactivated more slowly than Ach. NE uses a second messenger system and epinephrine is released into the blood.

Parasympathetic activation: The parasympathetic nervous system (PSNS) exerts short-lived, highly localised control. Parasympathetic fibres decrease heart and respiratory rates and allow for digestion and the discarding of wastes. The PSNS performs maintenance activities and conserves body energy. It involves the 'D' activities – digestion, defecation and diuresis (urination).

The Sensory Organs



The sensory system is vital for survival, growth, development, and the experience of bodily pleasure. Smelling smoke, we interpret a potentially life threatening situation. Seeing a person smile and hearing we did a great job bolsters our self-esteem. Feeling someone's hands stroking our body gives us a feeling of pleasure and sensual delight.

Sense perception depends on sensory receptors that respond to various stimuli. When a stimulus triggers an impulse in a receptor, the action potentials travel to the cerebral cortex, where they are processed and interpreted. Only after this occurs is a particular sensation perceived. Some senses, such as pain, touch, pressure, and proprioception, are widely distributed in the body. These are called general senses. Other senses, such as taste, smell, hearing, and sight, are called special senses because their receptors are localized in a particular area. Other senses such as taste, smell, hearing, and sight, are called special senses because their receptors are localized in a particular area.

The sensory system is part of the nervous system that processes information in response to an impulse from a sensory organ or peripheral components like the skin, muscles and joints. The resulting response is called a 'sensation' and it is a conscious process in the brain.

Sensation requires four stages to occur:

1. A stimulus that activates a sensory neuron.
2. A receptor made up of specialised nervous tissue, responds to the stimuli and converts it to a nerve impulse.
3. The nerve impulse is conducted along a neural pathway to the brain.
4. The sensory reception area in the brain interprets the impulse.

A point to remember is that although it is the brain that interprets the message it is projected back to the initial receptor site and is actually felt in the contact area. Each sensory organ is structured to only be receptive to the particular stimulus for that sense eg sound waves are the stimulus for the auditory nerve in the ear and will have no effect on the nose or eyes.

- **Receptors:** are involved in the production of a sensation. These are:
- **Exteroceptors:** located near the surface of the body and transmit sensations of sight, smell, hearing, taste, pressure, temperature and external pain.
- **Enteroceptors:** located inside the body in blood vessels and organs and transmit sensations of hunger, thirst, internal pain and nausea
- **Proprioceptors:** located in the muscles and joints and internal ear and transmit sensations of external pain from body movement and posture that produce muscle, tendon and joint tension.

General senses

General senses are found throughout the body. The visceral organs control these senses with the skin, muscles, and joints.

The general senses include:

- Touch
- Pressure
- Proprioception
- Temperature
- Pain.

Sense of touch (tactile sensation) (skin)

Minute sensory areas are situated in the skin and they correspond to various nerve endings. The number of receptors for one type of sensation can vary on different areas of the skin and thus can be more sensitive in one area than another eg fingertips sense more pain than upper arms. The sensations felt by the skin are touch, pressure and vibration and are detected by mechanoreceptors.

The sensation of touch is picked up by receptors directly under the skin. They are located in hair roots, in the dermal papillae of the skin, especially in fingertips, eyelids, tip of tongue and other sensitive areas. Pressure is detected in deeper tissues and is usually sensed over a wider area, lasts longer and its intensity can vary. Receptors are located in subcutaneous tissues around joints, tendons, muscles, in mammary glands and external genitalia. Vibrations are detected by receptors associated with the touch sensation – a very rapidly repeated sensory signal produces the vibration. The receptors are located in the dermal papillae of the skin and in the subcutaneous tissue.

Thermoreceptive sensation

Thermoreceptors are free nerve endings and are not uniformly distributed but in discreet points on the skin surface. They sense heat and cold from as low as 10 °C to as high as 45 °C. Once below 10 °C and above 45 °C, pain receptors are activated and the sensations of freezing or burning are produced. Thermoreceptors are able to adapt to constant stimulation and this can easily result in frostbite or burns.

Temperature

The temperature receptors lie directly under the skin and are widely dispersed throughout the body. The sense of temperature is stimulated by cold and heat receptors. There are many more cold receptors than heat receptors. The degree of stimulation depends on the number of each type of receptor stimulated.

These receptors are strongly stimulated by an abrupt change in temperature. Extremes in temperature stimulate pain receptors. Below 10 degrees C, pain receptors produce a freezing sensation. As the temperature increases above this measurement, pain impulse cease but cold receptors begin to be stimulated. At temperatures about 25 degrees C, heat receptors begin to be stimulated and cold receptors fade out. Finally, as temperatures approach 45 degrees C, heat receptors fade out and pain receptors are stimulated to produce a burning sensation.

Pain sensation

Pain is an important component of the human physiology. It provides information about harmful stimuli and protects us from possible tissue damage. The object of pain is to produce an automated withdrawal reflex.

Nociceptors: are the receptors for pain and are free nerve endings. They are widespread in the superficial layers of the skin and found in varying concentrations in every body tissue. They respond to any type of stimuli. Over stimulation of other receptors can also stimulate nociceptors causing pain. Excessive stimulation of a sense organ like an eye can cause pain. Other stimuli include physiological chemical re-actions (inflammatory prostaglandins produced during injury), restricted blood flow to an organ (cardiac ischaemia) or excessive muscular contractions (intense exercise).

Most pain is recognised in the cerebral cortex. In the case of somatic pain (related to the body and skeletal muscle) the pain is directed back to the stimulated area eg pain from a finger cut is felt in the finger. In some forms of visceral pain (related to the internal organs) the pain is experienced on the skin over the organ or in a surface area, quite removed from the point of stimulation eg a prolapsed lumbar disc cause's lower limb pain because of its impact on the sciatic nerve root. This is termed 'referred' pain.

Phantom pain: is another phenomenon. An amputee still experiences pain in their 'amputated' limb. An explanation for this is that the brain interprets the stimuli transmitted by the remaining proximal nerve fibres as coming from the non-existent part.

Sense of smell (nose): The receptors for smell and taste are chemoreceptors ie they respond to chemicals in an aqueous solution. Smell receptors are stimulated by air-borne chemicals that dissolve in the mucous membranes lining the nasal cavity and taste receptors are stimulated by food chemicals that dissolve in saliva.

Smell is dependent on:

- **The first cranial or olfactory nerve:** situated in the nasal cavity mucous membrane
- **The olfactory bulb:** and tract that transmits the impulse to the brain
- **The olfactory centre:** in the brain.

Olfactory receptors are located in the superior and medial nasal cavity. The cilia which are attached to the olfactory neuron dendrite react to odours in the air and thus stimulate the receptor. The stimulus for the sense of smell has to be in a gaseous form or in minute particles that are soluble in the secretions of the nasal mucous membrane. Smell is a very delicate sensation and can easily be dampened eg a perfume after some time is indistinguishable to the wearer but is quite evident to a new contact. Smell is also closely associated with the sense of taste as a majority of taste sensations are closely linked to smell.

Sense of taste (mouth): The end-organs that respond to the stimulus of tastes are the tastebuds, a group of cells that are surrounded by sensory nerve endings. They are heavily concentrated on the base and sides of the tongue with a lesser number on the soft palate, the inner surface of the cheeks and throat. The tastebuds are mainly located on the top of mushroom shaped papillae and they each contain gustatory receptors.

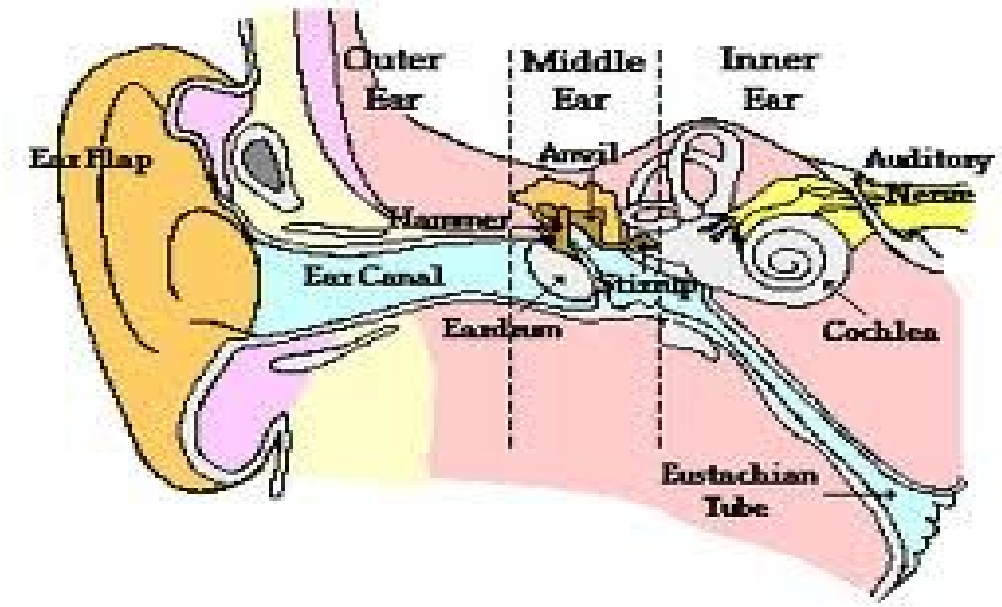
Each receptor has a gustatory hair that extends to the surface through the taste pore which picks up the taste stimuli. The taste impulse is transmitted along cranial nerves V11 (facial), 1X (glossopharyngeal) and X (vagus) to the thalamus via the medulla oblongata and finally to the gustatory area in the cerebral cortex.

There are four primary tastes localised in the tongue – sour, salty, bitter and sweet. All other flavours are modified and appreciated more by the sense of smell. Taste is 80% smell. The sour taste is caused by acids, the salty by ionized salts, the sweet taste by organic chemicals such as sugars, glycols, alcohols, esters and amino acids. The bitter taste is caused by organic chemicals such as alkaloids eg caffeine and nicotine. The bitter taste has a self-regulatory effect as high intensity bitterness will cause vomiting. Many poisonous plants and deadly toxins are thus self-regulatory.

Sense of hearing

The ear enables the sense of hearing.

Parts of the ear



The ear is divided into three distinct parts:

1. External ear.
2. Middle ear.
3. Internal ear**.**

External ear

The external war includes the visible pinna or auricle that is mainly made of skin and cartilage. It also contains the external auditory meatus which is an s-shaped canal that passes through the temporal bone. The tympanic membrane at the end of the meatus seals off the external ear from the middle chamber.

Middle ear

The middle ear starts at the tympanic membrane. It is an air-containing chamber situated in the temporal bone. It contains 3 ear bones called the auditory ossicles:

- **The malleus:** a hammer shaped bone
- **The incus:** an anvil shaped bone
- **The stapes:** a stirrup shaped bone.

The bones are arranged such that movement of the tympanic membrance causes movement through the bones to the inner ear.

Internal ear

The internal ear is located deep in the temporal bone, behind the eye socket. It is made up of a bony labyrinth. The bony labyrinth contains perilymph, a plasma-like fluid that holds membranous sacs. These sacs contain a thicker fluid called endolymph.

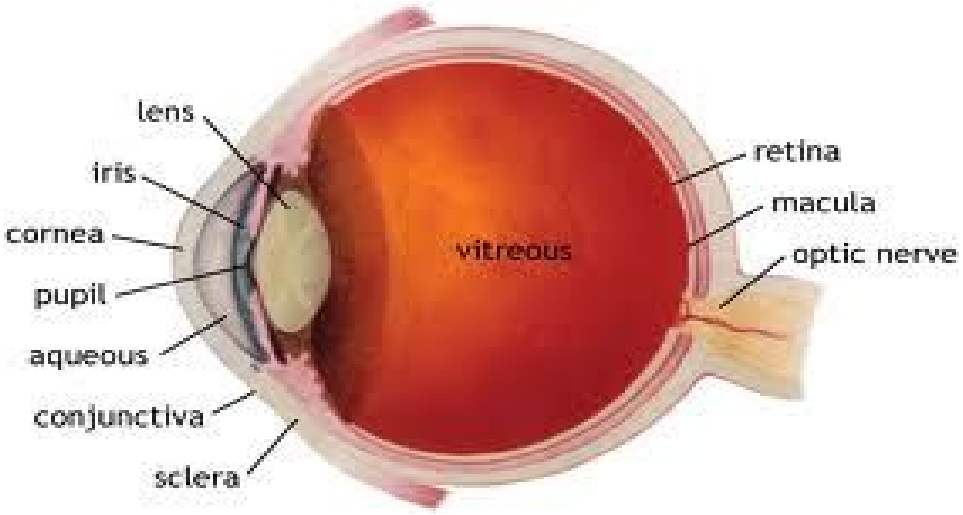
The internal ear has three parts:

1. **The cochlea:** a spiral shaped passage that contains the cochlear duct.

Within this duct is the organ of corti that has the hearing receptors or hair-like cells. These cells pick up the vibrations that are caused by sound waves produced through vibrations of the middle ear. The impulse is then transmitted along the cochlear nerve to the hearing centre in the temporal lobe.

2. **The vestibule:** the middle part of the bony membrane contains two sacs, the saccule and utricle. These two sacs contain the equilibrium receptors known as maculae – they respond to gravity and help maintain equilibrium.
3. **The semicircular canals:** helps maintain body balance and does not have any part in the sense of hearing. Each canal contains a membranous semicircular duct with an enlarged swelling at one end, called the ampulla. The ampulla contains the equilibrium receptor, the crista ampullaris. They also contain a fluid with minute hair cells that bend when the liquid moves with body or head motion. The receptors transmit the impulse via the vestibular nerve to the cerebellum to maintain body equilibrium.

Sense of sight (the eye)



The sense of sight relies on the eye. Measuring about 2.5 cm in diameter, the eye sits in the orbital socket of the skull. The eye is protected by the socket, the eyelids and the eyelashes.

Anatomy of an eye

Cornea: The cornea is a transparent tissue in the front part of the eye. It is a curved spherical structure that is responsible for focusing the light onto the inside of the eye. Contact lenses sit on top of the cornea to change its curvature and eliminate the need for glasses. The Vision Correction Procedures discussed in this website attempt to improve vision by changing the shape of the cornea.

Iris: The iris is the colored part of the eye. It opens up in dark rooms and at night to let more light into the eye. Conversely, in bright lights the iris constricts to decrease the amount of light that enters the back of the eye.

Pupil: The pupil is the black spot in the center of the iris. Actually, the pupil is the name given to the opening in the iris through which light passes.

Lens: The lens is responsible for helping to fine adjust the focus of the eye. The lens changes shape to allow clear vision both in the distance and for reading.

Vitreous: The vitreous is a clear jelly-like material which fills the inside of the eyeball. Light passes through the vitreous on its way to being focused onto the retina.

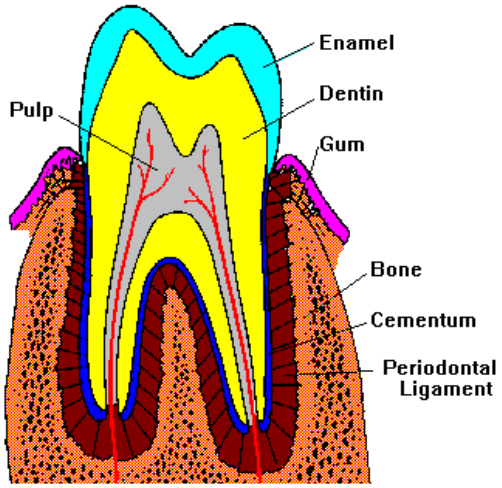
Retina: The retina is a thin film of tissue (like film in a camera) where images are brought into focus. The retina lines the inside surface of the eyeball. The retina is connected to the brain where the visual signals are processed.

Anterior Chamber: Between the cornea and the iris, is a space called the anterior chamber. This space is filled with a clear water-like solution.

Eye lubrication

Tears, secreted by the lacrimal glands located above the lateral end of the eye, constantly bathe the eye and drain into the lacrimal canals and sacs located at the medial end, and finally into the nasolacrimal duct that drains into the nasal cavity. The meibomian glands on the edges of the eyelids are sebaceous glands that produce an oily secretion to lubricate the eyes. Modified sweat glands, the ciliary glands, are located between the eyelashes. The conjunctiva, a delicate membrane that covers part of the eye, secrets mucous which also keeps the eye moist.

The Tooth



The tooth is an amazing sensory organ. The outside of the tooth, the **enamel**, is the hardest tissue in the human body. The enamel surrounds another layer of the tooth called the **dentin**. The tooth pulp lies in the middle of the tooth. The pulp contains blood vessels, nerve fibers and other connective tissue. Although the pulp has several functions, including the formation of dentin, the sensory function of teeth is quite interesting.

The nerve fibres inside teeth are exquisitely sensitive to stimulation when they can be activated. If you have ever had a cracked tooth or had a cavity in a tooth, you know that the message sent to the brain by the teeth is **PAIN!** (The existence of a non-painful sensory function of teeth is being debated in the current scientific literature). Children usually have 20 baby teeth (also called milk teeth). Adults have 32 permanent teeth. The 32 teeth in adults include the 3rd molars, also called the wisdom teeth. In some people the wisdom teeth do not come in at all.

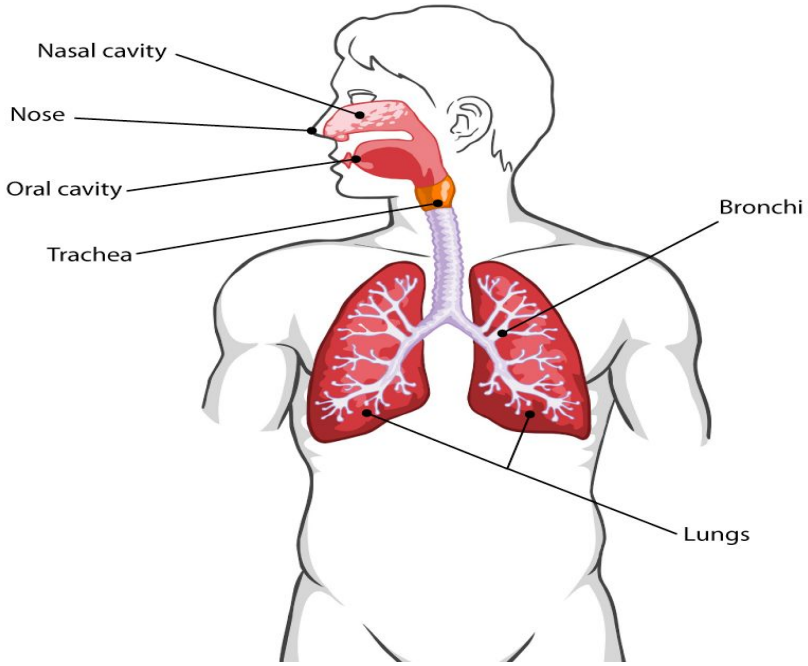
Sense of smell (olfactory) disorders

There are several types of olfactory disorders:

- **Anosmia:** is the absence of the ability to smell
- **Hyposmia:** is the decreased ability to smell
- **Hyperosmia:** is increased sensitivity to an odorant
- **Dysosmia:** is distortion in the perception of an odour
- **Phantosmia:** is perception of an odorant where none is present
- **Agnosia:** is the inability to classify, contrast, or identify odour sensations verbally, even if one can normally distinguish or recognize between odorants
- **Presbyosmia:** is the decrease or loss of sense of smell due to aging.

The Respiratory System

The major function of the respiratory system is to supply the body with oxygen and remove carbon dioxide.



Major role

The main role of the respiratory system is to provide gas exchange between the blood and the environment. Primarily, oxygen is absorbed from the atmosphere into the body and carbon dioxide is expelled from the body.

Major organs

Nose, trachea and lungs.

Respiration

The four main events of respiration are:

1. **Pulmonary ventilation/breathing:** movement of air into (inhalation) and out of (exhalation) the lungs so the gases are continuously exchanged.
2. **External respiration:** movement of oxygen from the lungs to the blood and carbon dioxide from the blood to the lungs.
3. **Transport of respiratory gases (via the cardiovascular system):** transport of oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs.
4. **Internal respiration:** movement of oxygen from blood to the tissue cells and of carbon dioxide from tissue cells to blood.

Structures of the respiratory system

For ease of identification, the respiratory system is identified as having upper and lower sections. The upper structures are the tubes and passageways that move the air from the nose to the lungs and vice versa. They include the nasal cavity, pharynx and larynx. The lower structures are the trachea, the bronchi and where the interchange of oxygen and carbon dioxide takes place in the lungs.

The upper respiratory system: When we breathe in, air enters the body through the nose. In the nasal cavity there are specialised epithelial cells that clean and warm the air. Have you noticed when you breathe through your mouth on a bitterly cold day how this extreme cold hurts your face? This process means that the air has not been warmed, as the mouth does not have the warming/filtering processes of the nose. Air then passes into a tube-like structure, the pharynx (throat).

It is in this area that there is a common link to a passageway for both food and air. The next stage is when air enters the larynx (voice box). The larynx contains vocal cords that allow us to speak. So that food does not enter the lungs when you are swallowing, the larynx is pulled upwards and forwards. This action closes the entrance (the epiglottis, a piece of cartilage that acts like a lid) to stop any food or fluid from entering the trachea.

The lower respiratory system: The trachea (windpipe) is a tube that leads from the larynx to the bronchi, which divide into left and right to enter the lungs.

The lungs: The lungs are situated in the thoracic cavity. The tissue is light and spongy and consists of bronchioles, alveoli and blood vessels and support tissue. The elastic nature of the tissue enables the lungs to expand and recoil freely. Lung tissue is divided into lobes. There are three lobes on the right side and two on the left (the heart takes up space on this side).

The lung is cone shaped with the base of each lung resting on the diaphragm. The apex extends to just above each clavicle. A double layer of continuous closed membrane (the pleura) covers each lung. One part is attached to the surface of the lung; the other is attached to the chest wall. The pleura, secretes a thin film of fluid which prevents friction between the two layers during breathing.

Physiology of respiration

The alveoli (air sacs) have thin walls allowing the oxygen and waste products to be passed in and out of the sacs to the bloodstream.

Respiration is:

- The act of breathing
- The movement of air into and out of the lungs
- The cycle of breathing in (inhalation) and out (exhalation).

The process of respiration

During inhalation signals are sent to the respiratory muscles (intercostals) and the diaphragm which both contract, enlarging the size of the thoracic cavity in each direction as the diaphragm flattens and the ribs are moved upwards and outwards? This produces more space and a negative pressure which causes air to be sucked in to fill the space. Watch your own chest rise upwards as you take a deep breath in and then relax.

In the exhalation phase the muscles of respiration relax, allowing the ribs and diaphragm to return to their original positions. The elastic lungs recoil and air is forced out through the respiratory passages. The exchange of gases (oxygen and carbon dioxide) is known as external respiration. It occurs between the air in the alveoli and the blood in the surrounding capillaries.

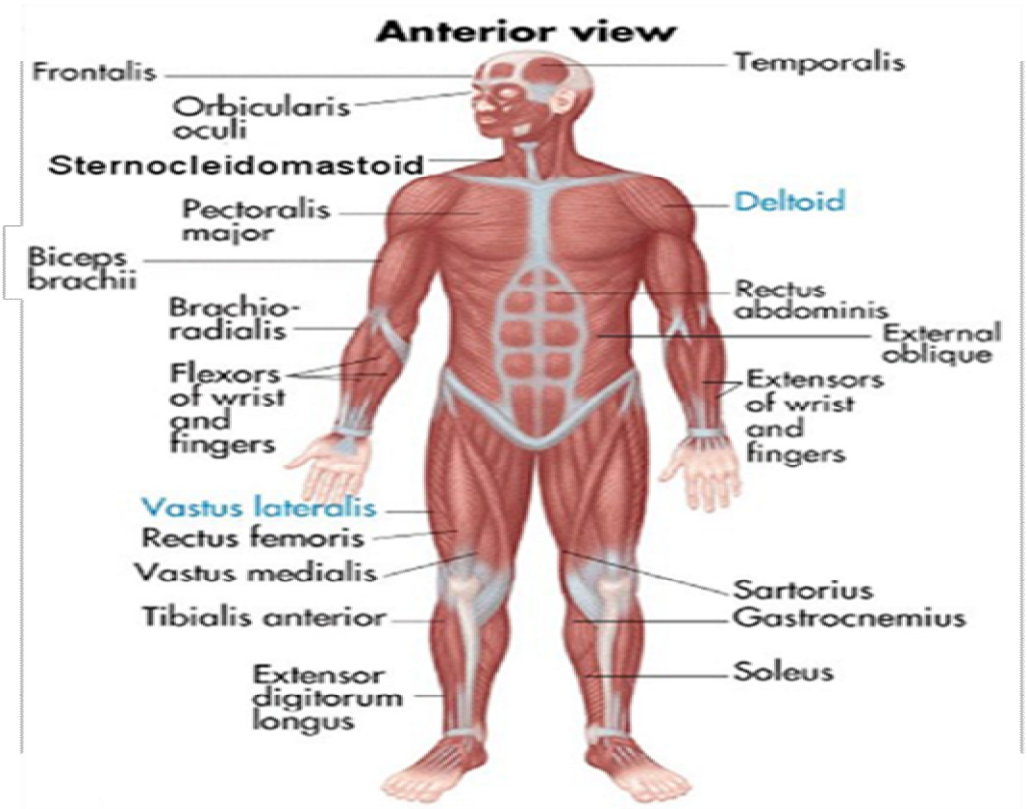
During this exchange, gases diffuse through the semi-permeable walls of the alveoli and capillaries, until the pressure is equal on both sides. Atmospheric air normally contains about 21% oxygen. Oxygen moves from the higher concentration in the alveoli to the lower concentration in the capillary blood that has been pumped from the heart to be oxygenated. Carbon dioxide level in the blood is higher than in the atmospheric air, therefore, carbon dioxide moves from the higher concentration in the capillary blood to the alveoli air in the sacs.

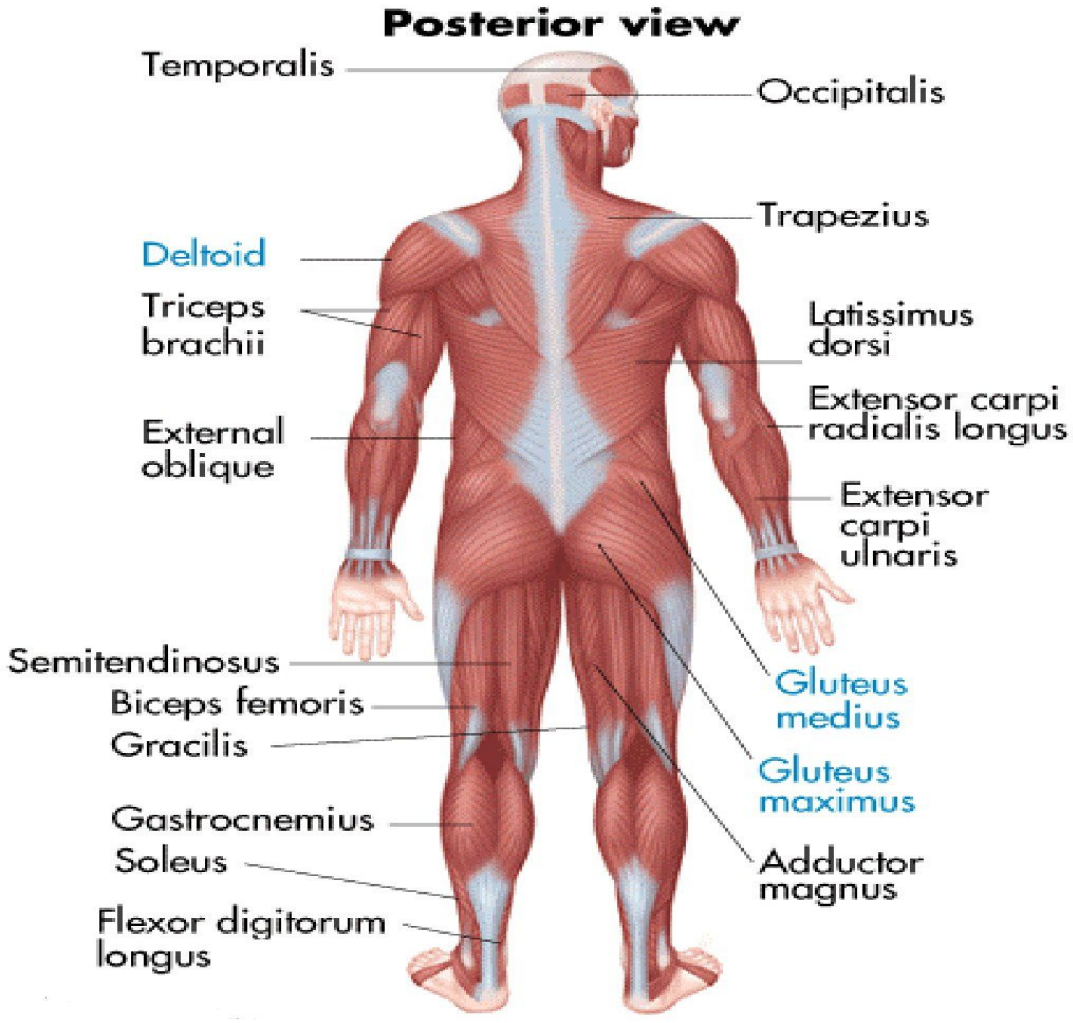
Think of blowing up an ordinary oval-shaped balloon and the effort required to swell the walls of the balloon to its desired shape. You generally undertake this task by blowing into the entry point. If the balloon stretches outwards it will contain air inside its walls. Suddenly it starts to deflate, loses its shape and the contained air. Applying this to respiration, air is forced into the lungs when we inhale, with air being forced out when we exhale.

Regulation of respiration

Rate and depth of ventilations (breathing in and out) are regulated by a section of the brain stem that contains a respiratory centre. Nerve pathways transmit information and impulses travel back to the diaphragm and the intercostal muscles, triggering their contraction. Adjustments occur depending on the level of carbon dioxide in the blood, which stimulates the breathing process.

The Muscular/Skeletal System





The main role of the muscular system is to facilitate movement. Muscles work in pairs to move limbs and allow the body mobility. Muscles also control the movement of materials through some organs, such as the stomach and intestines and the heart and circulatory system.

Function of muscle tissue

Muscle tissue has four different characteristics that determine the functioning of muscles:

1. **Excitability or irritability:** the ability to receive and respond to stimuli.
2. **Contractility:** the ability to shorten forcibly.
3. **Extensibility:** the ability to be stretched or extended.
4. **Elasticity:** the ability to recoil and resume the original resting length.

Types of muscle tissue

The muscular system consists of three types of muscle tissue – smooth, cardiac and skeletal muscle. These differ in structure, location, function and means of activation. Muscles are covered in a fibrous tissue called **fascia**. This sheath extends to become tendons which attach the muscle to bone. They vary in length and thickness. Fascia allows the muscles to glide easily past each other.

Smooth muscle: Smooth muscle is found in the walls of hollow visceral organs, such as the stomach, esophagus, intestines, uterus, blood vessels and bladder. It is an involuntary muscle because it is not under our conscious control.

Cardiac muscle; Cardiac muscle is found only in the heart. It contracts at a fairly steady rate set by the heart's pacemaker. Neural controls allow the heart to respond to changes in bodily needs. It is of a similar composition to skeletal muscle.

Skeletal muscle: Skeletal muscle is anchored to the bones of the skeletal structure by tendons. The muscular system refers specifically to skeletal muscle as it makes up the largest proportion of human body mass. It is under voluntary control.

Functions of skeletal muscle

The main functions of skeletal muscles are to:

- Maintain posture (tone)
- Produce movement
- Stabilise joints
- Maintain body temperature by generating heat.

Structure of skeletal muscle

Each muscle is a discrete organ composed of muscle tissue, blood vessels, nerve fibres and connective tissue. Skeletal muscle consists of bundles of muscle fibres (cylindrical cells) which extend the length of the muscle. Each muscle fibre is surrounded by a plasma membrane called the **sarcolemma.** The fibres contain **myofibrils**, **T-tubules** and **sarcoplasmic reticulum**.

Myofibrils

Myofibrils are densely packed, rod-like contractile elements that make up most of the muscle volume. The arrangement of myofibrils within a fibre is such that a perfectly aligned repeating series of dark A-bands and light I-bands is apparent. This gives the muscle fibre its striped appearance. Myofibrils contain two types of overlapping proteins called **filaments** which lie side by side. The thinner filaments are called **actin** and the thicker filaments are called **myosin**. The thin filaments contain the active sites to which myosin heads attach during contraction.

T-tubules and Sarcoplasmic reticulum

T-tubules and Sarcoplasmic reticulum provide tightly linked signals for muscle contraction. The sarcoplasmic reticulum surrounds each myofibril. Its function is the regulation of intracellular calcium levels. The T-tubules are a continuation of the sarcolemma. They conduct impulses to the deepest regions of the muscle. These impulses signal the release of calcium from adjacent terminal cisternae.

Muscle contraction

When a muscle contracts it shortens and thickens. This is because thin filaments slide past the thick ones so that the actin and myosin filaments overlap to a greater degree. In the relaxed state, thin and thick filaments overlap only slightly. Upon stimulation, myosin heads bind to actin and the sliding begins. For a skeletal muscle to contract a stimulus must be applied to it. Such a stimulus is normally transmitted by nerve cells called **neurons**.

A neuron that transmits a stimulus to muscle tissue is called a motor neuron. The point at which a motor nerve enters a muscle is called the motor point. A motor nerve branches out the ends of which are called motor end plates and these rest on muscle fibres. When a nerve impulse reaches a motor end plate, small vesicles in the terminal branches of the nerve fibre release a chemical called acetylcholine (ACh).

ACh transmits the nerve impulse from the neuron to the muscle fibre, thus initiating contraction. This electrical charge travels over the surface of the sarcolemma and into the T-tubules. When the impulse is conveyed from the T-tubules to the sarcoplasmic reticulum, the sarcoplasmic reticulum releases the calcium ions from storage into the sarcoplasm surrounding the myofilaments. The calcium ions move to the myosin heads and activate the myosin so that it can catalyse the breakdown of adenosine triphosphate (ATP).

Energy is then released and used for the attachment and movement of the myosin head, and thus the sliding of the myofilaments. As the thin myofilaments slide past the thick myofilaments, the Z-lines are drawn toward each other and the sarcomere shortens causing the muscle to contract. There are two main categories of muscle contractions, isotonic and isometric.

Isotonic contractions

Isotonic contractions are where muscles shorten under tension. In isotonic contractions, the muscle changes in length (changing the angle of the joint) and moves the load.

The two types of isotonic contractions are:

1. **Concentric :** the muscle shortens and does work
2. **Eccentric:** the muscle contracts as it lengthens.

Isometric contractions: Isometric contractions are those in which tension is developed, but the length of the muscle is not changed. Tension increases the muscle's capacity, but the muscle neither shortens nor lengthens. Contractions occur if the load is greater than the tension the muscle is able to develop.

Muscle tone

Muscles, even when relaxed, are almost always slightly contracted. This continuous slight tension is involuntary and known as muscle tone. It keeps muscles firm, healthy and ready to respond to stimulation. It helps stabilise joints and hold our posture. The degree of muscle tone varies depending on the amount of exercise or activity a person does. Muscles with a lower muscle tone are said to be **flaccid**. Muscles with a high degree of tone are called **spastic**. Regular exercise and massage can help maintain the elasticity of muscle fibres, improving muscle tone.

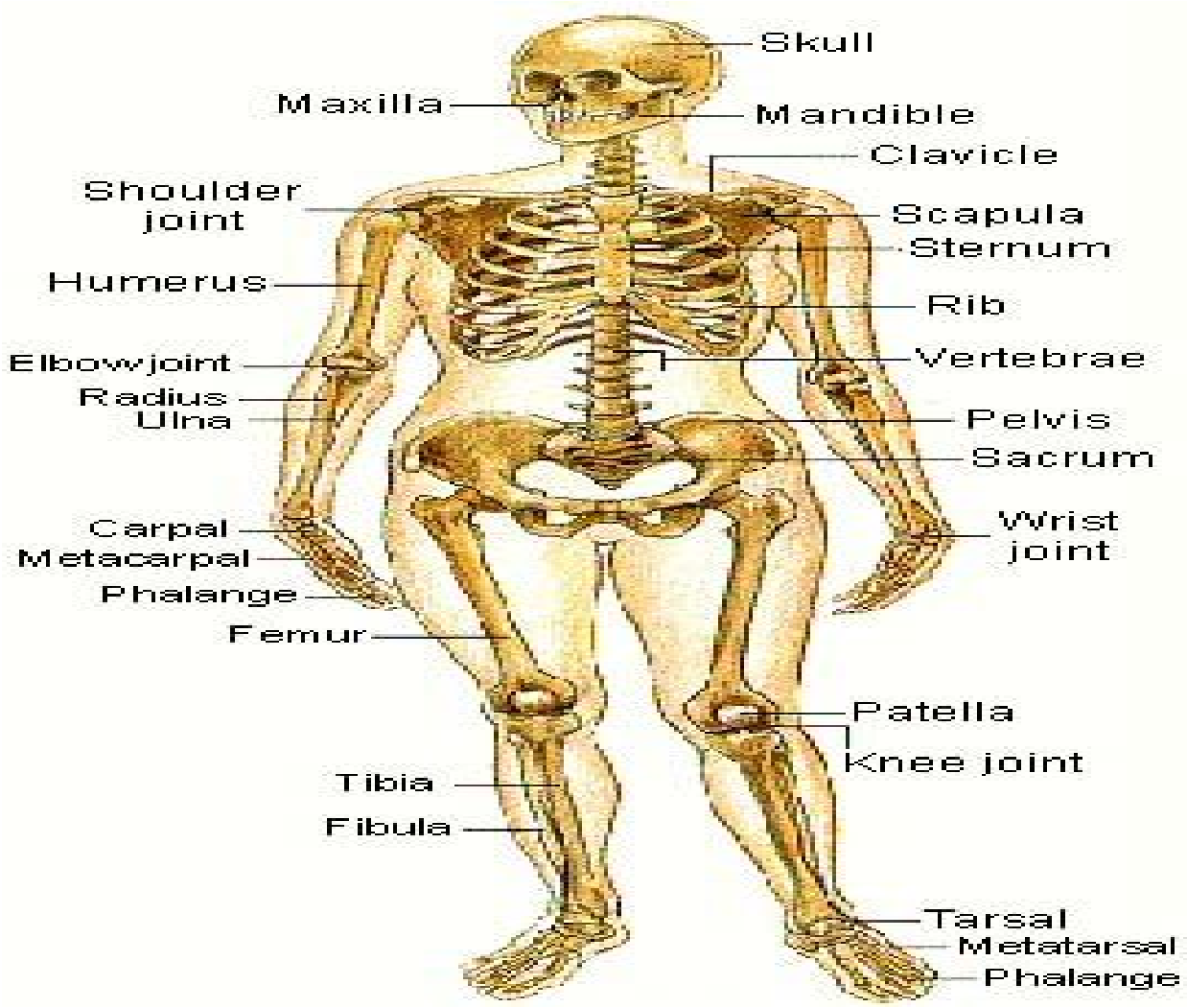
Muscle fatigue: Muscle fatigue is a state of physiological inability to contract even though the muscle may be receiving stimuli. With continued exertion the glucose stores in muscle cells and oxygen (used to burn the glucose to make energy) are exhausted. Muscles contract less and less effectively, with muscle fatigue resulting. An accumulation of waste products, such as lactic acid and carbon dioxide build up in the affected muscle causing pain and stiffness.

Muscle attachment: The origin of a muscle is its fixed or immovable point of attachment. The insertion of a muscle is its attachment on the movable bone. The insertion is the part farthest away from the spine. Muscles generally move towards their origins. Muscles normally work in pairs to produce movement – whatever one muscle or muscle group can do, another muscle or group of muscles opposes the action. The prime mover is the muscle that provides the major force for producing a specific movement, ie contraction. The antagonist is the muscle that opposes a particular movement, ie relaxation.

The skeletal system

The adult skeleton is a framework of bone and cartilage that protects organs and makes it possible for the body to move.

Skeletal System Diagram



Major role: The main role of the skeletal system is to provide support for the body, protect delicate internal organs and provide attachment sites for the organs.

Major organs: Bones, cartilage, tendons and ligaments.

Bones and skeletal tissue

The human skeleton is initially made up of cartilages and fibrous membranes; however, most of these early supports are soon replaced by bone during growth.

Skeletal cartilages

Skeletal cartilage consists primarily of water. It has the ability to bounce back to its original shape after being compressed. It contains no blood vessels or nerves and is surrounded by the perichrondrium. It is dense, irregular connective tissue that resists outward expansion. There are three types of cartilage tissue: **hyaline, elastic and fibro** cartilage. Cartilage growth ends during adolescence when the skeleton stops growing. The cartilage remaining in adults are found in areas where flexible skeletal tissue is required.

Classification of bones

The 206 bones of the human skeleton are divided into the following types.

Axial skeleton: These are the bones of the skull, vertebrae column and rib cage that are involved in supporting, protecting, or carrying other body parts.

Appendicular skeleton: These are the bones of the upper and lower limbs, shoulder and hip that are involved in locomotion and manipulation.

Classification of bones by shape

- **Long bones:** are longer than they are wide, eg the humerus. They have a shaft and two ends. Long bones reach their peak density between the ages of 35 – 40.
- **Short bones:** are cube-shaped bones of the wrist and ankle. They are the bones that form within tendons, eg the patella.
- **Flat bones:** are thin, flattened and slightly curved, eg the sternum and most skull bones.
- **Irregular bones:** are bones with complicated shapes, eg vertebrae and hip bones.

Functions of bones

- **Support**: Bones support the body by forming its framework and cradling the soft organs.
- **Protection**: Bones provide a protective case for the brain, spinal cord and vital organs.
- **Movement**: Bones provide levers for muscles.
- **Mineral storage**: Bones are a reservoir for minerals, especially calcium and phosphorous. The blood vessels regulate calcium levels.

Blood cell formation: Haematopoiesis occurs within the marrow cavities of bones.

Bone markings

External bone surfaces are rarely smooth and featureless. There are bulges, depressions, and holes that serve as sites of attachment for muscles, ligaments and tendons. They also serve as joint surfaces and conduits for blood vessels and nerves to pass.

Bone textures

Compact bone: Is the dense outer layer.

Spongy bone (or cancellous bone): Is a honeycomb of trabeculae (small needle-like or flat pieces) filled with red or yellow bone marrow. In infants, all the bone marrow (upper and lower limbs) is red. In adults this is replaced with yellow marrow except for the head of the femur and the sternum. Spongy bones are densest between the ages of 25 – 30.

Bone marrow:

- **Red:** where process of haemopoiesis take place
- **Yellow:** filled with fat

Structure of long bone

Long bones consist of a diaphysis and an epiphysis.

Diaphysis: This is the tubular shaft that forms the axis of long bones. It is composed of compact bone that surrounds the medullary cavity. Yellow bone marrow is contained in the medullary cavity.

Epiphysis: This is the expanded end of a long bone. The exterior is compact bone and the interior is spongy bone. The joint surface is covered with hyaline (articular) bone. The epiphyseal line separates the diaphysis from the epiphysis in adults. It is a remnant of the epiphyseal plate (disc of hyaline cartilage) which grows during childhood to lengthen the bone.

Structure of short, irregular and flat bones: The thin plates of periosteum-covered compact bone are on the outside with endostenum-covered spongy bone (diploes) on the inside. They have no diaphysis or epiphysis and contain bone marrow between the trabeulae.

Location of haematopoietic tissue (red marrow): In infants, this is found in the medullary cavity of the diaphysis and all areas of spongy bone. In adults, this is found in the diploe of flat bones and the head of the femur and humerus. The red marrow in the diploe of flat bones (sternum) and some irregular bones (hip bone) is much more active in haematopoiesis.

Bone membranes

Periosteum is the double-layered protective membrane. The outer fibrous layer is dense, irregular connective tissue. The inner osteogenic layer is composed of osteoblasts and osteoclasts.

Osteoblasts

Osteoblasts are bone-forming cells, which are responsible for new bone during growth and repair.

Osteoclasts

Osteoclasts are bone-destroying cells. They are important for bone resorption. They are richly supplied with nerve fibres, blood and lymphatic vessels which enter the bone via nutrient foramen (opening). They are secured to underlying bone by perforating fibres.

Endosteum

Is the delicate membrane covering the internal surfaces of bone?

Microscopic structure of bone

Compact bone

- **The Haversian system or osteon:** is the structural unit of compact bone.
- **Lamella:** are weight bearing, column-like matrix tubes composed mainly of collagen.
- **The Haversian or central canal:** is the central channel containing blood vessels and nerve fibres that serve the needs of the cell.
- **Volkmann's canals:** are the channels that lie at right angles to the central canal which connect blood and nerve supply of the periosteum to that of the Haversian canal.
- **Osteocytes:** are mature bone cells 'trapped' in lacunae (small cavities in bone).
- **Canaliculi:** are hair-like canals between the various lacunae of ossified (cartilage has turned to bone) bone.

Chemical composition of bone

Organic components of bone are osteoblasts, osteocytes (mature bone cells), osteoclasts and osteoid. Unmineralised bone matrix is composed of proteoglycans; glycoproteins and collagens Inorganic components of bone are hydroxylapatites or mineral salts which are 65% of bone by mass. They are mainly calcium phosphates and are responsible for bone hardness and its resistance to compression.

Bone development

Osteogenesis and ossification are the processes of bone tissue formation which leads to:

- The formation of the bony skeleton in embryos
- Bone growth until early adulthood
- Bone thickness, remodelling and repair.

Control of remodelling and repair

Bone is a dynamic and active tissue. Small changes in architecture occur continually. Every week, 5 – 7% of our bone mass is recycled. Spongy bone is replaced every 3 – 4 years and compact bone is replaced about every 10 years.

Two control loops regulate bone remodelling in the adult.

1. Hormonal mechanism maintains calcium homoeostasis in the blood.

2. Mechanical and gravitational forces acting on the skeleton.

The remodelling units are the adjacent osteoblasts and osteoclasts which deposit and resorb bone, at both surfaces of the periosteum and endosteum.

Hormonal mechanism

The calcium homoeostatic of blood is 9 – 11 mg/100 ml. Rising calcium ions in blood levels trigger the thyroid to release calcitonin which stimulates calcium salt deposit in bone. Falling blood calcium levels signal the parathyroid glands to release parathyroid hormone (PTH) which signals osteoclasts to degrade bone matrix and release calcium into the blood.

Response to mechanical stress

Wolff's Law states that a bone grows or remodels in response to the forces or demands placed upon it.

Observations explained by Wolff's Law are that:

- Long bones are thickest midway along the shaft (where the bending stress is greatest)
- Curved bones are thickest where they are most likely to buckle.

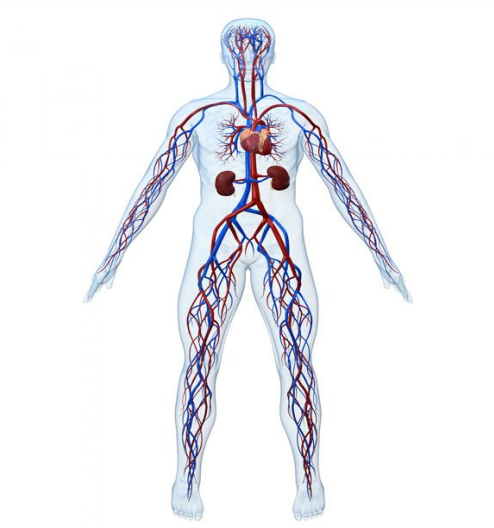
Bone deposition

Bone deposition occurs where bone is injured or added strength is needed. This requires a healthy diet rich in proteins Vitamins C, D and A, calcium, phosphorus, magnesium and manganese. Alkaline phosphatase is essential for mineralisation of bone (an enzyme shed by osteoblasts).

Bone Resorption

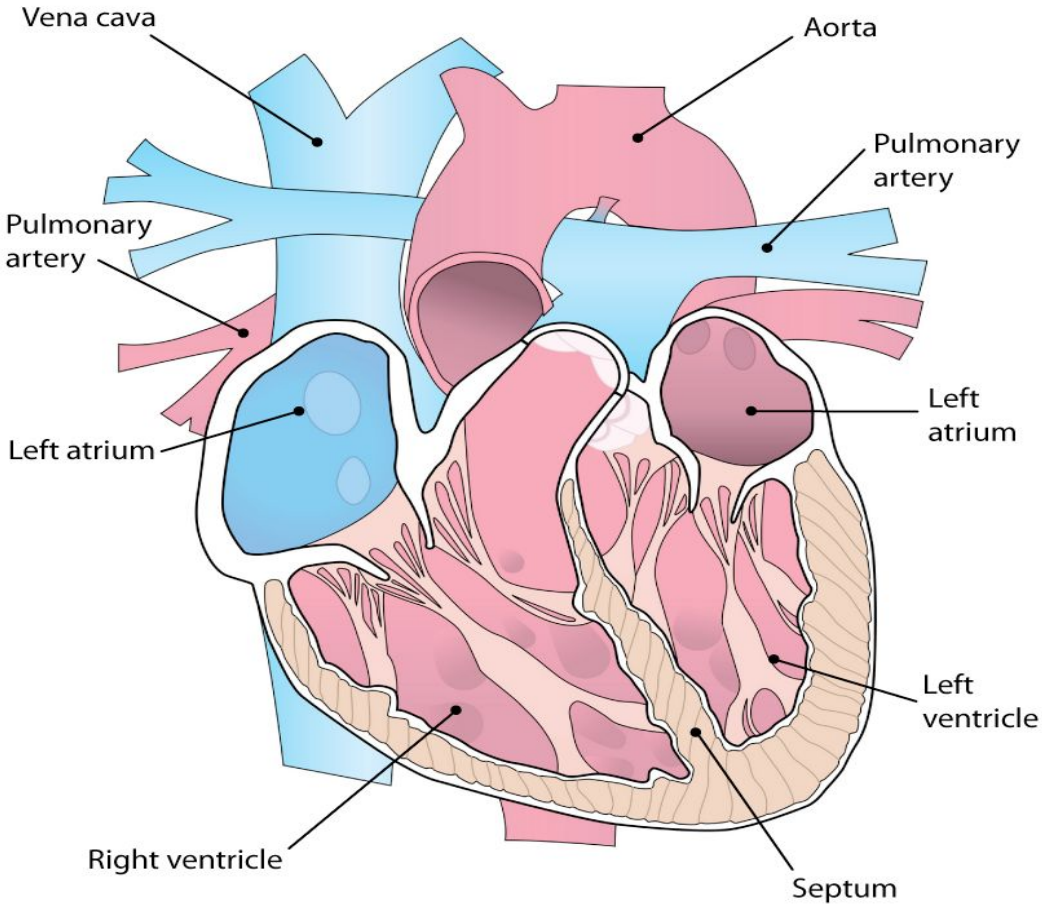
Resorption is accomplished by osteoclasts. Resorption bays are grooves formed by osteoclasts as they move along a bone surface and break down the bone matrix. Resorption involves osteoclast secretion of lysosomal enzymes that digest the organic matrix, and hydrochloric acid that converts calcium salts into soluble forms. Osteoclasts may also phagocytise demineralised matrix and dead bone cells.

The Cardiovascular System



The cardiovascular system consists of the heart and a network of vessels that carry blood. The term cardio refers to the heart and the term vascular refers to the blood vessels. The main role of the cardiovascular system is to supply oxygen and nutrients to the body's cells and remove waste products from these tissues. The system consists of the **heart** which pumps **blood** through the **blood vessels** which act as pipes throughout the body carrying the blood to and from the tissues.

The heart



The heart is about the size of a clenched fist with a mass between 250 and 350 grams. It rests on the diaphragm between the two lungs, well enclosed within the mediastinum, the medial cavity of the thorax.

Coverings of the heart

There are three layers of the heart.

1. **Pericardium:** the outer layer of the heart. It is a sac-like structure with three layers.
2. **Myocardium:** the middle layer of the heart. It is composed mainly of cardiac muscle which is responsible for the pumping action of the heart.
3. **Endocardium:** the inner layer of the heart. It consists of a thin layer of endothelial cells which is continuous with the endothelial linings of the blood vessels which enter and leave the heart.

Chambers of the heart

The heart consists of four chambers:

- The right atrium
- Left atrium
- Right ventricle and
- Left ventricle.

The upper chambers together are called the atria and are receiving chambers for blood returning to the heart after circulation. The lower chambers of the heart are called the ventricles and are the discharging chambers or actual pumps of the heart. As a result ventricles are reflected in the much more massive ventricular walls. The left ventricle is three times thicker than the right, as it is the systemic pump that has to pump blood through the entire systemic circulation process against high resistance. The right side of the heart is separated from the left side by a muscular wall called the septum.

Heart valves

Blood flows through the heart in one direction. The heart contains four valves to prevent the blood from flowing backwards. The valves open and close in response to differences in blood pressure on their two sides. The bicuspid and tricuspid valves prevent regurgitation of blood back into the atria. The semilunar valves (aortic and pulmonary) prevent reflux of blood back into the ventricles.

Properties of cardiac muscle fibres

The heart is a muscular organ of the body. The heart's muscle fibres are striated and they contract by the sliding filament mechanism (similar to skeletal fibres). The heart cells are short, fat, branched and interconnected. The entire myocardium (the muscular wall of the heart) behaves as a single coordinated unit. Large mitochondria make up 25% of the volume of cardiac cells compared with 2% volume in skeletal muscle. The mitochondria give cardiac cells a high resistance to fatigue but also a greater dependence on oxygen for energy metabolism.

Heart physiology

The **conduction system** within the heart is composed of specialised muscle tissue that generates and distributes the electrical impulses which stimulate the cardiac muscle fibres to contract.

These tissues are the:

- Sinoatrial (SA) node
- Atrioventricular (AV) node
- Atrioventricular bundle consisting of right and left bundle branches and ventricular walls (or Purkinje fibres).

The SA node: is located in the right atrium just below the entry of the superior vena cava and is the heart's pacemaker. Its characteristic rhythm, the sinus rhythm, determines the heart rate. All parts of the conducting system are capable of initiating beats, but the SA node depolarises most rapidly and therefore sets the pace for the heart. An impulse generated in the SA node spreads out over both the atria causing them to contract and at the same time depolarising the AV node.

The AV node: is located on the right side of the interatrial septum immediately above the tricuspid valve. Conduction over the atria to the AV node is relatively slow, and it is also rather slow within the AV node. Once through the AV node, the signalling impulse is rapidly conducted over the AV bundle to the ventricle.

The AV bundle: arises from the AV node and passes down the superior part of the interventricular septum only briefly before it divides into the right and left bundle branches.

The **bundle branches** descend on either side of the septum toward the heart apex and continue up the right and left sides of the heart, giving off numerous branches to the myocardium. These are known as the Purkinje fibres.

The terminal Purkinje fibres: branch throughout the subendocardial surface and penetrate to reach deeper muscle fibres resulting in contraction of the ventricles. Conduction through this system is rapid. In a healthy human heart, the total time between initiation of an impulse by the SA node and depolarisation of the last of the ventricular muscle cells is about 0.22 seconds. The atria and ventricles are connected electrically. The AV node is the only electrical connection between the atria and the ventricles.

Problems with the heart

Defects in the conduction system can cause:

- Irregular heart rhythms
- Arrhythmias – uncoordinated atrial and ventricular contractions
- Fibrillation – rapid and irregular or out-of-phase contractions. Here, the SA node's control of heart rhythm is taken away by rapid activity in other heart regions.

A defective SA node will have an effect on the pacemaker causing abnormal or premature conduction. Any damage to the AV node interferes with the ability of the ventricles to receive pacing impulses. This is referred to as heart shock.

Measuring heart activity

An electrocardiogram or ECG is a graphic record of the electrical activity of the heart.

A typical ECG has three distinguishable waves:

1. P wave represents atrial depolarisation (contraction).
2. QRS complex represents ventricular depolarisation.
3. T wave represents ventricular repolarisation (relaxation).

Blood vessels

There are five types of blood vessels.

1. **Arteries:** Arteries carry blood away from the heart to body tissues. Most arteries carry oxygenated blood except for the pulmonary arteries. Arteries are usually deep-seated apart from where they cross a pulse point, for example the carotid artery in the neck and the radial artery in the wrist. Blood flow in arteries is rapid and in spurts.
2. **Arterioles;** Arterioles are smaller arteries which arise from arteries branching off as they get further from the heart. These then lead into the capillaries.
3. **Capillaries;** Capillaries are microscopic vessels composed of a single layer of smooth muscle cells around endothelial lining. They connect arterioles and Venules. Capillaries permit exchange of nutrients and wastes between the body's cells and the blood. The number of capillaries depends on the tissue nutrient requirements. Muscles, the liver, the kidneys and nervous system have extensive capillary networks as they are body tissues with high metabolic requirements.
4. **Venules:** Venules are larger vessels which connect with capillaries. By the time the blood reaches the Venules it has become deoxygenated. Blood flows through the Venules to larger vessels called veins.
5. **Veins:** Veins are the larger vessels for blood. Veins convey blood, called venous blood, towards the heart. Most veins carry deoxygenated blood except for the pulmonary veins. Blood flow in veins is slow and even.

Composition of blood vessels

The walls of all blood vessels, except capillaries, have three layers of tissue.

1. **Tunica interna/intima vasorum:** This is the innermost layer of blood vessels and contains simple squamous epithelium.
2. **Tunica media vasorum:** This is the middle layer and consists of smooth muscle cells and elastic tissue.
3. **Tunica externa/adventitia vasorum:** This is the outermost layer which contains mainly elastic and collagen fibres.

In a vein, the middle and inner layers are thinner and less elastic than blood vessels and contain valves to prevent backflow of blood.

The cardiac cycle

The cardiac cycle includes all events associated with the blood flow through the heart during one heartbeat. There is a continuous changing of pressure of blood volume in the heart.

Blood pressure

Blood pressure (BP) is the pressure exerted by the blood on the walls of the blood vessels. Contraction of the ventricles generates blood pressure.

BP depends on a number of factors:

- Blood volume
- Cardiac output
- Total peripheral resistance.

Blood volume

Any decrease in the normal volume of blood, for example as a result of haemorrhage, decreases the amount of blood that is circulated through the arteries. Dehydration increases blood pressure.

Cardiac output

Cardiac output is the amount of blood pumped by each ventricle in one minute. It is equal to stroke volume (SV) multiplied by the heart rate (HR).

SV = amount of blood ejected from each ventricle with each contraction.

HR = the number of contractions of the ventricles each minute.

During exercise both stroke volume and heart rate are increased.

Total peripheral resistance

Total peripheral resistance is the opposition to blood flow due to friction between blood and the walls of blood vessels. A rise in vascular resistance will mean a rise in blood pressure. Total peripheral resistance depends on the total blood vessel length. When the total length of all blood vessels in the body is increased, there is an increase in resistance to blood flow. Additional blood vessels develop where there is extra fat. This explains why those who are overweight may have higher blood pressure. The smaller the average blood vessel diameter, the greater resistance there is to blood flow.

Regulation of blood pressure

Blood pressure varies with movement and with a person's physical condition. Exercise, physical or emotional distress or trauma and increased body temperature all influence blood pressure.

- The body uses various controls to maintain a 'normal' blood pressure
- The cardiovascular centre in the brain stem (the medulla oblongata) regulates the heart rate/force of contraction of ventricles/blood vessel diameter
- Baroceptors, pressure receptors located in the aorta, internal carotid arteries and other large arteries in the neck and chest, regulate the nervous system. Chemical receptors monitor levels of O2, CO2 and H+.
- The renin-angiotensin-aldosterone system regulates hormones. If blood flow to the kidneys is inadequate, the kidneys secrete the enzyme **renin** into the bloodstream. The activity of renin results in the formation of the converting enzyme **angiotensin II** which raises blood pressure by vasoconstriction. This leads to the release of the active hormone **aldosterone** which is involved in the reabsorption of Na+.
- Adrenaline/noradrenalin is released during stress situations which raises the heart rate and vasoconstriction.

Reading blood pressure

	
Drawing of a hand felling the neck of a person **The carotid pulse**	Drawing of a hand feeling the wrist of a person **The radial pulse**

Blood pressure is the amount of force exerted against the walls of an artery by the blood. The heart muscle contracts and relaxes. The period of contraction is called systole and the period of relaxation is called diastole

Systolic blood pressure: is the force with which blood is pushing against arterial walls during ventricular contraction. It is a clue to the integrity of the heart, arteries and the arterioles.

Diastolic blood pressure: is the force exerted by the blood remaining in the arteries during ventricular relaxation. The diastolic pressure which is constantly present on the arterial walls directly indicates blood vessel resistance.

Pulse pressure: is the difference between the systolic and diastolic pressure.

The pulse pressure tends to parallel the stroke volume.

The following factors may affect the accuracy of blood pressure readings:

- White coats (just seeing a health professional can elevate blood pressure)
- Caffeine consumption
- Smoking
- Heavy physical activity
- Rushing
- Emotional upset.

Taking blood pressure

Requirements:

- BP is measured in the brachial artery in the left arm. Avoid using this arm if there has been damage to vessels, removal of axillary lymph nodes, or there is a shunt in-situ for dialysis.

The following are required when taking blood pressure:

- Sphygmomanometer of appropriate size for person (note that sphygmo means pulse). The cuff bladder should be 20% wider than the diameter of the extremity in use
- Stethoscope
- Quiet, relaxed atmosphere
- Client seated or lying with arm supported and level with the heart.

Steps to follow

1. Ensure the cuff is completely deflated.
2. Put the centre of the cuff around the upper arm (with the tubes lying over the cubital fossa) and wrap the cuff evenly and snugly.
3. Place the stethoscope in your ears.
4. Locate the brachial pulse in the anterior cubital fossa and place the diaphragm of your stethoscope over the pulse point and hold it in place.
5. Close the valve on the pump making sure not to over tighten.
6. Inflate sphygmomanometer until the pulse sound disappears then pump for an extra 20 – 30 mm Hg beyond that. The artery is now occluded.
7. Gradually release the valve on the pump allowing air to slowly leak out. Watch the gauge carefully to get the next reading.
8. The systolic pressure is the reading at the first return of sound – a tapping, whooshing sound.
9. Keep deflating the cuff slowly and when sound disappears, note the reading which gives the diastolic pressure.
10. Open the valve to let the remainder of the air out of the cuff.
11. Record the BP reading as systolic/diastolic.

Blood

Functions of blood

Blood performs a number of functions which relate to:

- Substance distribution such as oxygen and carbon dioxide movement around the body
- Regulation of blood levels of particular substances such as water content and ph of cells
- Body protection such as temperature control.

Blood transports:

- Oxygen from the lungs and nutrients from the digestive tract to all cells of the body and carbon dioxide from cells back to the lungs
- Metabolic wastes from cells to the organs for elimination – the lungs and kidneys
- Hormones from endocrine glands to the target organs.

Blood maintains:

- Appropriate body temperature by absorbing and distributing heat throughout the body and to the skin surface
- Normal ph in body tissues using buffer systems such as blood proteins and other blood borne solutes
- Adequate fluid volume in the circulatory system by influencing levels of salts and blood proteins.

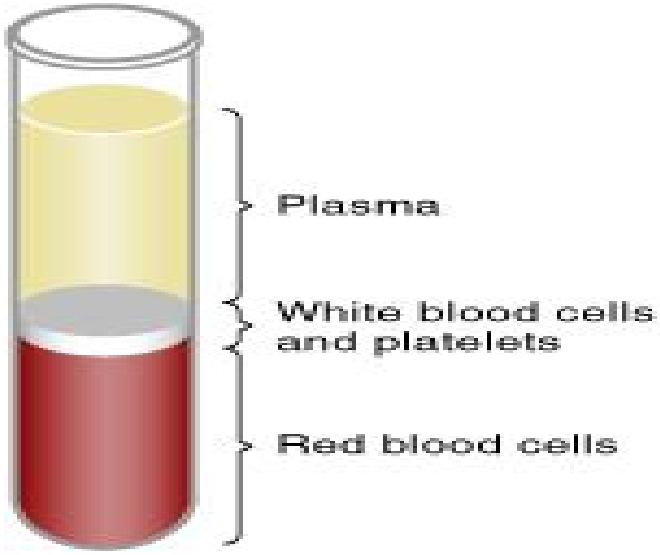
Blood protects:

- The body by preventing blood loss by activating plasma proteins and platelets and by initiating clot formation when a vessel is damaged
- The body from infection by helping to defend the body against foreign invaders by synthesizing and utilising antibodies activating complement proteins and white blood cells.

Physical characteristics of blood: Blood is a sticky opaque fluid with a metallic taste. Its colour varies from scarlet (which is oxygen rich) to dark red (oxygen poor) and has a pH of 7.35 – 7.45. Blood has a temperature of 38 °C which is slightly higher than 'normal' body temperature. Blood accounts for approximately 8% of body weight.

Composition of blood: Blood is the body's only fluid tissue and is a specialised type of connective tissue. It is composed of liquid plasma (matrix) and formed elements (cells or cellular components).

Blood plasma



Plasma is a straw coloured, sticky fluid of which water is about 90% of the volume. Blood plasma contains over 100 solutes which include:

- **Proteins** such as albumin, globulins and clotting proteins, make up 8% by weight of plasma volume (most are produced by the liver)
- **Non-protein nitrogenous substances** such as urea and creatinine □ **organic nutrients** such as glucose, carbohydrates, amino acids, lactic acid, cholesterol and vitamins
- **Electrolytes** such as sodium, potassium, calcium, chloride and bicarbonate
- **Respiratory gases** such as oxygen and carbon dioxide.

Formed elements

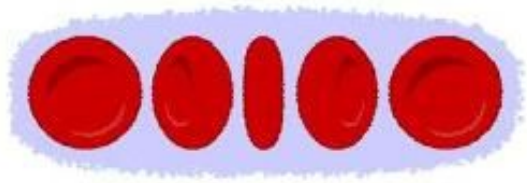
Erythrocytes, leukocytes and platelets, make up the formed elements. Only white blood cells are complete cells. Red blood cells have no nuclei or organelles, and platelets are just cell fragments. Most formed elements survive in the bloodstream for only a few days. Most blood cells do not divide but are renewed by division of cells in bone marrow.

Formed elements include:

- Erythrocytes, or red blood cells: which account for 45% of the total blood volume
- Leukocytes or white blood cells
- Platelets.

Together, leukocytes and platelets account for less than 1% of blood volume.

Erythrocytes



Erythrocytes or red blood cells (RBC) are biconcave discs with no nucleus and essentially have no organelles. They are filled with haemoglobin (Hb), a protein that functions in gas transport. They contain the plasma membrane protein spectrin and other proteins that give them flexibility and allow them to change shape as necessary.

Erythrocytes are an example of how structure and function are complementary. The structural characteristics of red blood cells contribute to their gas transport function. Their biconcave shape has a huge surface area relative to volume which makes them particularly effective at gas exchange in the body. Discounting water content, erythrocytes are more than 97% haemoglobin. Erythrocytes are dedicated to respiratory gas transport. Haemoglobin binds to and transports respiratory gases. Adenosine thriphosphate (ATP) is generated anaerobically by erythrocytes because they lack mitochondria. Therefore, they do not consume the oxygen they transport.

Hematocrit: is the percentage of red blood cells in blood. A hematocrit value of 50 means that 50% of the blood volume is red blood cells. A sharp drop in hematocrit can indicate anaemia, but the value can vary considerably depending on a person's lifestyle and their level of fitness.

Function

Erythropoiesis (formation of erythrocytes): is hormonally controlled and depends upon adequate supplies of proteins, carbohydrates and lipids. Iron, Vitamin B12, and Folic acid (B12 and Folic acid are necessary for normal DNA synthesis) are all required. The number of circulating erythrocytes remains constant and reflects a balance between RBC production and destruction. Too few RBCs, leads to tissue hypoxia – **oxygen deprivation**. Too many RBCs causes undesirable blood viscosity. The body stores iron in Hb (65%), the liver, spleen and bone marrow to a much lesser extent. Iron is stored inside cells as protein-iron. In blood, iron is loosely bound to the transport protein transferrin. The developing erythrocytes take up iron to form haemoglobin as they need it.

Life span: The life span of an erythrocyte is 100 – 120 days. Old erythrocytes become rigid and fragile and their Hb begins to degenerate. Dying erythrocytes are engulfed by macrophages. Heme and globin are separated and iron is salvaged for reuse. The balance of heme is degraded to a yellow pigment called bilirubin. The liver secretes bilirubin into intestines as bile. The intestines metabolise bilirubin into urobilinogen and this degraded pigment is excreted in faeces and urine. Globin is metabolised into amino acids which are released into circulation.

Leukocytes

Leukocytes are white blood cells (WBC). These are the only blood components that are complete cells. They make up less than 1% of the total blood volume and are crucial to our defence against disease. They can leave capillaries via diapedesis. They move through tissue spaces where they are needed to mount inflammatory or immune responses. Leukocytes are made up of granulocytes and agranulocytes.

- **Granulocytes:** These include **neutrophils**, **eosinophils** and **basophils** and make up about 75% of WBC and are made in bone marrow. They contain cytoplasmic granules and are larger and usually shorter-lived than RBCs. They have lobed nuclei. All granulocytes are phagocytic cells which are able to engulf and digest bacteria and other harmful matter.
- **Agranulocytes:** These include **lymphocytes** and **monocytes** and lack visible cytoplasmic granules. They are mostly produced in the lymphatic system.

Platelets

Platelets are fragments of megakaryocytes which are not cells in the strict sense. Their granules contain serotonin which enhances vascular spasm. They also contain calcium ions, enzymes, ADP which attract more platelets to the area and cause them to release their contents and platelet-derived growth factor (PDGF). Platelets are essential for the clotting process. They form a temporary plug that helps seal breaks in blood vessels by sticking to a damaged site. The stem cell for platelets is the hemocytoblast.

Haemostasis

Haemostasis is a process that prevents excessive blood loss in the body. There are three primary mechanisms employed to control bleeding, *vascular spasm*, *platelet plug*, and *blood clotting*.

There are three stages:

1. Vascular spasm: constriction of the damaged blood vessel resulting in reduced blood flow.
2. Platelet plug formation.
3. Coagulation.

Vascular Spasm

Vascular spasm occurs when a blood vessel is punctured. The smooth muscle surrounding the vessel contracts and pinches off blood supply to the area. This mechanism can be seen as the 'first-aid' system of the body and it can hold for minutes to hours. The exact cause of vascular spasm is not understood, but may be related to damaged nerve endings in the muscle itself and from reflexes set up by pain receptors.

Platelet Plug Formation

Platelet plug formation is a more complex process than vascular spasm, and it occurs in three phases:

1. **Platelet adhesion -** The first phase begins when platelets detect damage to a blood vessel and begin to adhere to the exposed surfaces.
2. **Platelet release reaction -** Once stuck to a site of damage, the platelets begin to change. Firstly they create extensions so that they can contact each other, and then they release their contents.
3. **Platelet aggregation -** The ADP acts to make the nearby platelets sticky and adhere to the other recruited platelets, and when the collection is large enough it creates a platelet plug stopping the loss of blood through holes in small vessels.

The clotting process/ Coagulation

Clotting or Coagulation is the most complex haemostatic process. The aim of the process is to turn liquid blood into a gel. The gel is called a clot and is composed of protein fibres called fibrin in which the formed elements of blood are trapped. The gel effectively forms a cap over a wound.

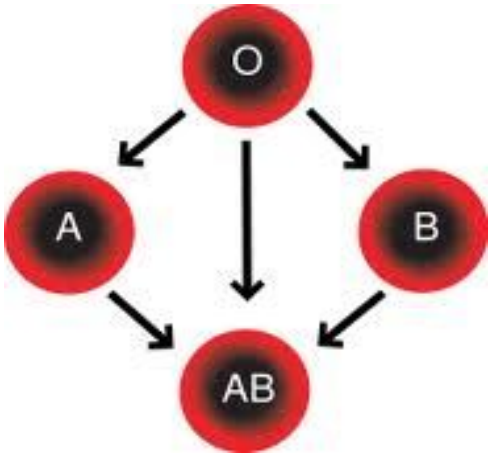
Clotting involves several substances called clotting factors; these are typically numbered from one to thirteen using Roman numerals. The clotting factors act upon each other to create a cascade of interactions that ultimately results in clot formation. The clotting process occurs with a positive feedback mechanism: once a clot is formed it continues to expand and external factors are required to hold it in check. Clotting occurs in three stages. The first stage can occur via two distinct pathways, intrinsic or extrinsic**,** and results in the formation of the enzyme *prothrombinase*. This phase can be described as a cascade of interactions between clotting factors.

- **The extrinsic pathway:** occurs quickly and involves fewer steps than the intrinsic pathway. It is so named because it requires the release of *Tissue Factor* (TF) from outside the blood vessels through tissue trauma, in order to form prothrombinase.
- **The intrinsic pathway:** occurs more slowly and uses activators within the blood to reach prothrombinase.

In the **second stage** of the process, prothrombin is catalysed by prothrombinase and calcium ions to the enzyme thrombin.

In **stage three,** thrombin converts fibrinogen to loose fibrin threads. Fibrin stabilising factor (XIII) is also activated by thrombin, aids with the strengthening and stabilisation of fibrin. Two positive feedback effects are brought about by thrombin: it accelerates the formation of prothrombinase and it activates platelets stimulating their activity.

Blood groups



Red blood cell plasma membranes have antigens – glycoproteins – on their surface which give us our unique identity. There are 30 varieties of naturally occurring RBC antigens. The presence or absence of each antigen therefore allows us to be classified into several different blood groups, ABO and Rh blood groups. The person's ABO blood group will be **A, B, AB or O** depending on what the person inherited. There are at least 8 different types of Rh factors.

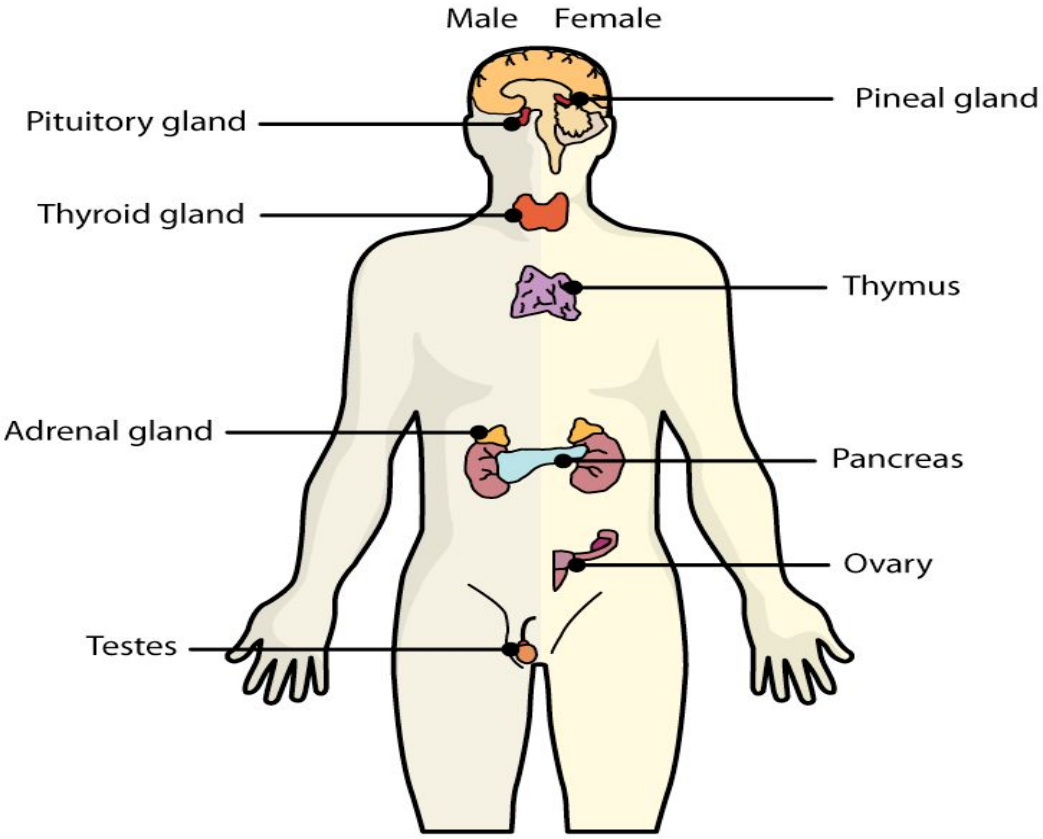
Type O blood groups: lack A and B antigens and are therefore considered the universal donor because type O blood can be given to a person of any blood type.

Type AB: is the universal recipient because a person with this blood type can receive blood from all other blood groups.

The Rh factor: may cause blood incompatibility if the mother is Rh-negative and the foetus is Rh-positive. In cases of emergencies where blood volume needs to be replaced immediately to restore adequate circulation, **plasma** can be administered without a concern about a transfusion reaction. The antibodies it contains are harmlessly diluted in the recipient's blood. Colloidal solutions or isotonic salt solutions are other options. As people have different blood groups, blood matching is critical before a blood transfusion takes place. Transfusion of incompatible blood can lead to death.

The Endocrine system

Many body processes, such as growth and energy production, are directed by hormones. The glands of the endocrine system release these chemicals.



The nervous system controls the body through electrical impulses delivered by neurons. The body's other control system, the endocrine system, and affects bodily activities by releasing chemical messengers, called hormones, into the bloodstream from a variety of glands and organs. The nervous and endocrine systems interact to coordinate and integrate their activities to direct the functioning of the cells in the body. For example, this can be compared to the canal-linked city of Venice. A telephone call can deliver a message instantaneously, just like a nerve transmission. However, a slower message can be sent by using a fleet of gondolas through the canals of Venice – one of them will reach any specific destination in the city, just like a chemical message that is sent in the blood.

The endocrine system has a profound influence on the regulation of:

- Energy and metabolism
- Stress response
- Growth and development
- Behaviour
- Fluid, electrolyte and nutrient balance
- Immunity.

All body systems are affected by hormonal influence. Hormones influence metabolic activity in cells by increasing or decreasing the normal metabolic process by activating enzymes. Endocrine glands secrete hormones to maintain homoeostasis. These actions may be targeted to specific cells or broad-based to target organs.

Chemistry of hormones: Most hormones are amino acid-based. These include amino acids, peptides and proteins. Hormones are usually water-soluble. Steroids (only gonadal and adrenocortical hormones) are synthesised from cholesterol. Eicosanoids, which include leukotrienes and prostaglandins, are local hormones which are biologically active lipids.

Mechanism of hormone action

Hormones travel from endocrine organs to their targets via the blood. The target cells are cells that have receptors for specific hormones on them. Hormones are potent chemicals exerting profound effects on their target organs at very low concentrations. Hormones alter cell activity by increasing or decreasing rates of normal cell processes. Hormones may be transported in the blood freely or bound to a carrier protein. Amino acid-based hormones cannot penetrate the plasma membranes of tissue cells. They therefore bind to external receptors on cell membranes and exert their signalling effects via a second messenger system (eg, cyclic AMP).

Cyclic AMP

Amino acid-based hormone (first messenger) diffuses to target issue

Hormone blinds to specific receptor

Activates G protein which activates adenylate cyclase

Generates the second messenger CAMP from ATP

Specific response

Control of hormone release

Hormone release is normally regulated by a negative feedback system.

Endocrine glands are stimulated by three types of stimuli:

1. **Humoral stimuli** – direct response to changing levels of certain ions and nutrients in the blood, eg blood glucose levels affect insulin/glucagon release
2. **Neural stimuli** – direct nerve innervation, eg sympathetic nerves stimulate adrenal medulla to release adrenalin
3. **Hormonal stimuli** – releasing and inhibiting hormones, eg thyroid-stimulating hormone (TSH) stimulates thyroid gland to release thyroxine.

The nervous system may also modulate the activity of the endocrine system.

Major endocrine glands

These are the 8 endocrine glands:

1. Pituitary gland (hypophysis) – anterior and posterior.
2. Thyroid gland.
3. Parathyroid glands.
4. Adrenal glands.
5. Pancreas.
6. Gonads.
7. Pineal gland.
8. Thymus.

The pituitary gland

This small gland, just a little larger than a pea, is situated at the base of the brain partially surrounded by bone. It is often referred to as the master gland because it releases hormones that affect the workings of other glands. The hypothalamus region of the brain controls the pituitary gland. When you look at a diagram of the brain, it is the area that looks like it is connected by a stalk.

This gland is divided into two lobes:

- The front (anterior) lobe
- The back (posterior) lobe.

The anterior pituitary gland produces the following hormones:

- **Growth:** regulates growth and development.
- **Thyroid:** regulates the function of the thyroid.
- **Adreno-cortico:** regulates the function of the adrenal cortex.
- **Follicle stimulating:** regulates the reproductive organs both male and female.
- **Luteinising:** regulates the reproductive organs, both male and female.
- **Prolactin:** initiates milk production in females who are breastfeeding.

The **posterior pituitary** has a direct link with the hypothalamus in the brain and produces the following hormones:

Anti-diuretic: controls the amount of water being produced.

Oxytocin: stimulates contraction of the uterine wall before birth.

With so many functions and control of other glands, it is easy to see why the pituitary is often referred to as the master gland.

Pineal gland: The pineal gland is situated in the middle of the brain. At one time it was thought that this gland atrophied when a person reached puberty. This has not been proved. The pineal gland produces the hormone melatonin, which may delay the onset of puberty. Melatonin is believed to be produced during the dark period of the day when light cannot enter the eyes.

Thyroid gland: The thyroid gland is located in the neck just below the larynx with one lobe either side of the trachea and a narrow strip joining them.

Parathyroid glands: There are four tiny glands embedded in the posterior wall of the thyroid gland. The parathyroid glands secrete the parathyroid hormone, which promotes the release of calcium (needed for nerve and muscle function) from bone tissue and increases the absorption of calcium from the intestine by causing an increase in Vitamin D formation. It also regulates the re-absorption of phosphate (needed for bones and teeth) in the renal tubules of the kidneys.

Thymus gland: The thymus gland is situated in the upper thorax behind the sternum. It is more important early in life and becomes smaller in the adult. It produces thymosine which helps in the development of white blood cells called T cells. T cells are important to the immune system in protecting the body against infection.

Adrenal glands: The adrenal glands (sometimes called the supra-renals) are two small glands located above the kidneys. They are actually two separate parts in the one gland, each part producing its own hormone. Like the kidneys, the outer section is called the cortex and the inner part is the medulla.

Adrenal medulla hormones: Adrenalin/noradrenalin provides the body's quick response to a sudden incident or emergency, eg: somebody comes up behind you unexpectedly. You hear the footsteps and you become scared. Your body reacts immediately and prepares all systems for a quick burst of energy to run away from the situation. You experience the fear, fight and flight response. Your heart beats faster, your breathing quickens and you have a heightened sense of awareness of what is going on around you.

Adrenal cortex hormones: There are three groups of hormones, each with unique functions that are necessary for the body's survival. Glucorticoids regulate the metabolism of carbohydrates. This ensures that the body receives enough energy for repair and replacement of cells. They also assist in controlling the effect of stress on the body. Mineral corticoids assist in regulating the amount of water and salt/minerals that can be lost or absorbed by the kidney filtration process and through excretion. Sex hormones – small amount of male and female hormones.

Pancreas: The pancreas is primarily an accessory organ of digestion, but it has another role in that it secretes two hormones, both of which help to regulate the amount of glucose in the blood. Small groups of cells called Islets of Langerhans are scattered throughout the pancreas.

Pancreatic hormones

Insulin: Controls the use of glucose by increasing the uptake of glucose into cells and reduces the release of glucose from the liver, thereby decreasing the levels of glucose in the blood. It is essential for the use of glucose by the body cells. If too much insulin is produced, the level of glucose in the blood falls.

Glucagon: Causes the liver to release stored glucose (carbohydrate/sugars), enabling the blood sugar levels to rise.

Reproduction glands (sexual characteristics): The sex glands, the ovaries in the female and the testes of the male, not only produce sex cells (egg and sperm) but also are important endocrine organs. The hormones produced by these organs are needed in the development of the sexual characteristics and the maintenance of reproductive functioning following puberty. Both males and females produce male and female sex hormones, but male hormones predominate in men and female hormones predominate in women. In both men and women, these hormones control sexual maturity, the development of secondary sex characteristics and the ability to reproduce.

Gonads: These produce the steroid hormones.

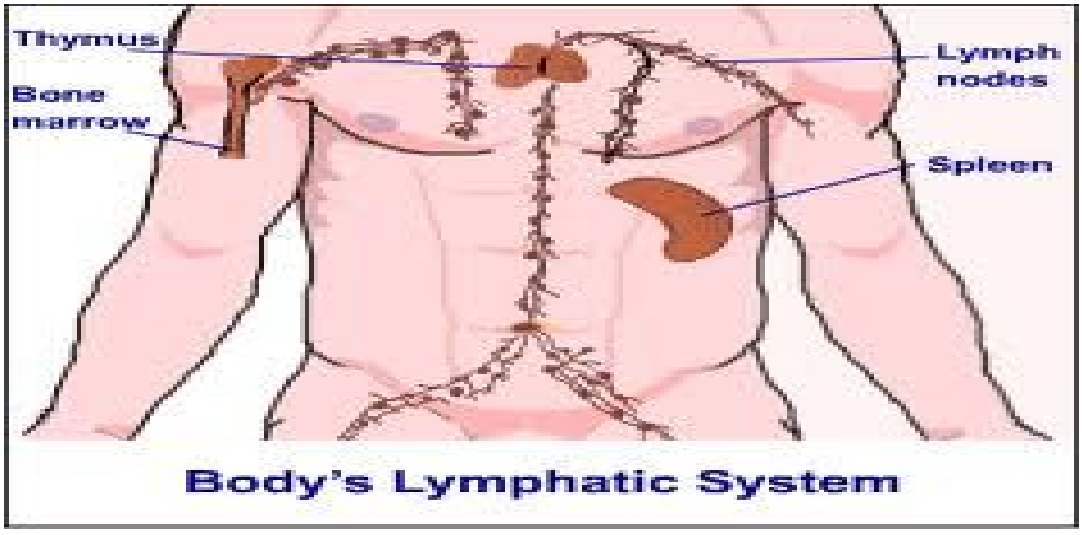
Ovaries: secrete the female sex hormones; oestrogen and progesterone, and the peptide hormone, inhibin.

Oestrogen: is responsible for maturation of the reproductive organs and the manifestation of the secondary sex characteristics at puberty. Progesterone is important after ovulation for maintaining the integrity of the uterine lining, and during pregnancy. Inhibin regulates the secretion of follicle-stimulating hormone (FSH) from the anterior pituitary in a negative feedback mechanism.

Many women of all ages, not just postmenopausal women, have too much oestrogen and produce insufficient progesterone (rather than being deficient in oestrogen). This problem is being accelerated by an excess of toxic oestrogenic chemicals found in our food, water and environment (petrochemical byproducts such as pesticides, plastics, clothing, soaps, etc). These are called xeno-oestrogens and mimic oestrogen-like activity in our bodies.

Testes: secrete the male sex hormone, testosterone and the peptide, inhibin. Testosterone aids in the development of gametes, is responsible for secondary sex characteristics and controls libido. Inhibin regulates the secretion of FSH by the anterior pituitary.

The lymphatic system/ (also known as circulatory system)



The lymphatic system is responsible for transporting fluids around the body and also plays a vital role in the operation of the immune system to protect the body from disease.

Major role

The main role of the lymphatic system is to return fluid to the cardiovascular system. This includes proteins and fluids that have not been absorbed. The lymphatic system also removes fat and excess fluids from the blood. The immune system is part of the lymphatic system. Its role is to destroy and remove invading microbes and viruses from the body.

Major organs

Lymph, lymph nodes and vessels, white blood cells, T and B cells.

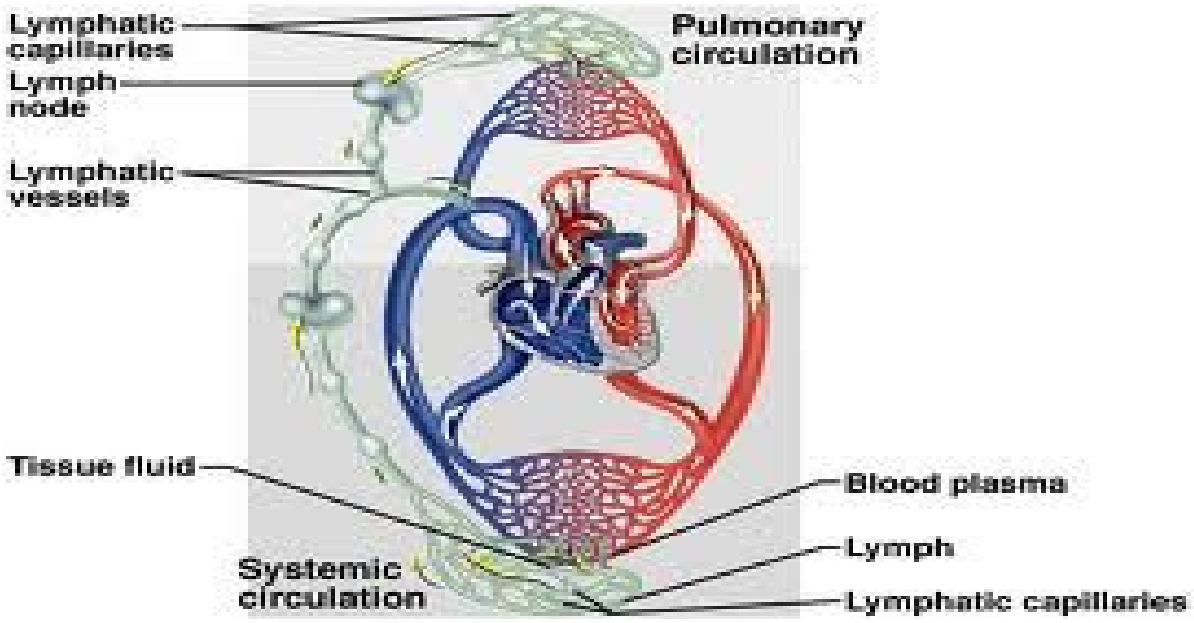
Function of the lymphatic system

The lymphatic system consists of two semi-independent parts:

1. A meandering network of lymphatic vessels.
2. Lymphoid tissues and organs scattered throughout the body.

Nutrients, wastes and gases are exchanged between the blood and the interstitial fluid (tissue fluid) as the blood circulates around the body. The osmotic pressures, which operate at the capillary beds, force fluid out of the blood at the arterial ends of the bed and cause much to be reabsorbed at the venous ends. However, the fluid that remains behind in the tissue spaces can be as much as three litres per day. This leaked fluid (interstitial fluid) and plasma proteins are collected and returned to the bloodstream by the lymphatic vessels or lymphatics. Once this fluid enters the lymphatics it is called lymph. Note that lymph means 'clear water'. The lymphatics ensure that the cardiovascular system has enough blood volume to operate properly.

Structures of the Lymphatic System



Lymphatic vessels

These vessels form a one-way system in which lymph fluid flows towards the heart. Lymph vessels include:

- Microscopic, permeable, blind-ended lymphatic capillaries
- Lymphatic collecting vessels
- Trunks and ducts.

Lymphatic capillaries

The capillaries weave between the tissue cells and blood capillaries in the loose connective tissues of the body.

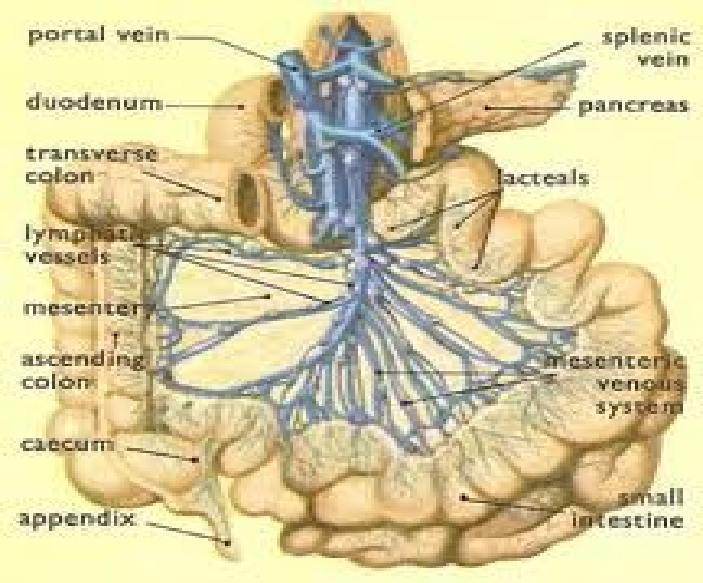
They are similar to blood capillaries, however:

- They are remarkably permeable
- The walls are loosely joined endothelial mini-valves
- They withstand interstitial pressure and remain open.

The mini-valves in the capillaries function, as one-way gates that allow interstitial fluid to enter lymph capillaries. They do not allow lymph to escape from the capillaries. When tissues are inflamed, lymph capillaries can absorb even larger particles such as cell debris, pathogens (bacteria and viruses) and cancer cells. Pathogens and cancer cells can travel via the lymphatics around the body. However, the lymph travels through lymph nodes where it can be cleansed of debris and 'examined' by cells of the immune system.

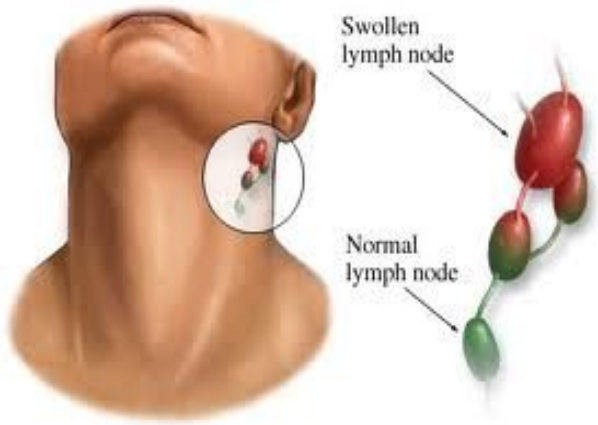
Lacteals: are highly specialised lymphatic capillaries found in the villi of the intestinal mucosa. At this point the lymph is milky white (called chyle) because the lacteals absorb digested fats from the intestine. It is received into the cisterna chy'li, a pouch at the beginning of the thoracic duct. From here, it is carried up the duct to the bloodstream.

Lymphatic collecting vessels



Lymph capillaries drain lymph into collecting vessels called lymphatics. These vessels are similar in structure to veins with smooth muscle walls but the walls are thinner with more internal valves. As the vessel collects more lymph it enlarges. It is called the **afferent lymph vessel** as it enters a lymph node. The vessel that removes lymph from a lymph node is called the **efferent lymph vessel**. Lymph is transported to progressively larger vessels within the body which end in the right lymphatic duct (for lymph from the right side of the upper body) and the thoracic duct (for the rest of the body).

Lymph nodes



Lymph nodes are the principal lymphoid organs of the body. Nodes are imbedded in connective tissue and clustered along lymphatic vessels. Aggregations of these nodes occur near the body surface in cervical, Axillary and inguinal regions of the body.

Their two basic functions are:

1. **Filtration:** they destroy microorganisms and debris.
2. **Immune system activation:** they monitor antigens and can mount an attack against them.

Lymphatic trunks

Lymphatic trunks are formed by the union of the largest collecting ducts.

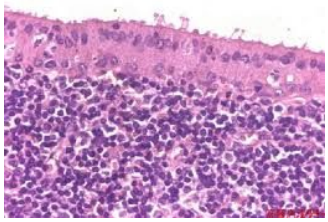
Lymph is delivered into one of the two large trunks:

1. **The right lymphatic duct:** which drains the right upper arm and the right side of the head and thorax.
2. **The thoracic duct:** drains the rest of the body.

Lymph is delivered from the large trunks back into veins called the subclavian veins.

Lymph transport: The lymphatic system lacks an organ that acts as a pump. Lymphatic vessels are low pressure conduits. The lymphatic system uses the same mechanisms as veins to propel lymph fluid. This is created by the 'milking' action of active skeletal muscles and the pressure changes in the thorax during breathing. The valves in the lymphatic vessels prevent backflow of fluid. Lymph flow is promoted by pulsations of nearby arteries and contractions of smooth muscle in the walls of the lymphatics.

Lymphoid cells and tissues



Lymphocytes develop in red bone marrow and mature into T cells. T cells (T lymphocytes) or B cells (B lymphocytes) both protect the body against antigens.

- T cells manage the immune response. Some T cells directly attack and destroy foreign cells
- B cells produce plasma cells that secrete antibodies into the blood.

Antigens are immobilised by antibodies until they can be destroyed by phagocytes. Lymphoid tissue stores and provides a proliferation site for lymphocytes. The tissue acts as a surveillance vantage point for lymphocytes and macrophages. Lymphocytes reside for short periods in the lymphoid tissue, then leave to patrol the body again.

Other lymphoid organs

Spleen: The spleen is situated in the left hypochondriac region of the abdomen. It curls around the anterior aspect of the stomach. The spleen cleanses blood by extracting aged and defective blood cells and platelets from the blood. Its macrophages remove debris and foreign matter from the blood flowing through it. The spleen stores some of the products of red blood cell breakdown for reuse and releases others for processing in the liver. The spleen is the site of erythrocyte production in the foetus where it stores blood platelets. It provides a site for lymphocyte proliferation as well as immune surveillance and response.

Thymus: The thymus is large at birth. It is a lymphatic mass low in the throat near the heart. The thymus is most active during childhood, and then shrinks with age. It does not directly fight antigens. The thymus is the site of lymphocyte maturation. It stimulates the lymphocytes to become immuno-competent.

Tonsils: The tonsils are lymphatic tissue which line the throat. They trap bacteria and particulate matter which work their way into lymphoid tissue.

Peyer's patches: Peyer's patches resemble tonsils and are located in the wall of the distal part of the small intestine. They prevent bacteria from penetrating the wall of the intestine by capturing and destroying it. All of these lymphoid organs are composed of reticular connective tissue and all help protect the body, however, only lymph nodes filter lymph.

Immune System – Body defences

Immunity is the way the body protects us against disease or a condition, eg: an allergic reaction. Put simply, when a foreign organism enters the body a reaction occurs.

- **Antigens:** are like a foreign body, one that the body does not want. They cause the body to react, call up the lymphatic system, increase white blood cell production and produce **antibodies**.
- **Antibodies:** have the ability to destroy unwanted substances. In some instances, the body may take a few days to develop and activate the process. When you are not feeling well, you are sometimes not sure what the problem is because it takes a few days for the symptoms to show, eg: wondering if you have the flu or a cold.

Definitions for immunity

- **Immunity:** The ability of the body to resist an infectious disease resulting from the presence of specific antibodies.
- **Innate immunity:** An effective defence against potentially harmful micro-organisms with which we are born and which provides us with species immunity, racial immunity and even individual immunity.
- **Acquired immunity:** Not present at birth but is developed during life. May be acquired actively or passively.
- **Passive immunity:** Transfer of immuno-globulins (antibodies) to an individual without any involvement of that individual's tissues. Is only temporary immunity, providing protection for approximately 2-3 weeks.
- **Active immunity:** Result of the stimulation of an individual's immune system – more permanent, providing protection for years to a lifetime. May result from: an attack of an infectious disease repeated sub-clinical attack of a disease.
- **Artificially acquired immunity:** Vaccination or immunisation.

The integumentary system

The integumentary system is the largest organ system. It is the system that covers and protects the human body from damage – the word integument means covering. It includes the skin and its appendages such as hair and nails. The skin covers our entire body and accounts for about 7% of our total body weight.

Functions of the integumentary system

The integumentary system has many functions that assist the body's homeostasis (the body's ability to regulate itself in response to changes in the environment).

Protection: Skin provides chemical barriers (skin secretions and melanin) and physical or mechanical barriers (continuity of skin, the hardness of its keratinised cells, waterproofing glycolipids of the epidermis) that protect the body and its organs.

Body temperature regulation: Temperature regulation is accomplished by vasodilation (cooling) and vasoconstriction (warming) of dermal vessels. The skin can increase sweat gland secretions to cool the body. Under normal resting conditions as long as the environmental temperature is below 31 – 32 °C, we lose about 500 ml of sweat a day.

Cutaneous sensation: Exteroceptors, which are part of the nervous system, exist in the integumentary system. These allow us to sense touch, pressure, pain, cold and heat and to recognise objects from their feel and shape.

Metabolic functions: The exposure of the skin to ultraviolet light (UV) enables the synthesis of Vitamin D in dermal blood vessels which is required to maintain organ systems. The liver and kidneys also produce enzymes which work in conjunction to produce Vitamin D.

Blood reservoir; Skin blood vessels store up to 5% of the body's blood volume. They hold 8 – 10% of blood volume at rest. When exercising blood is pumped to the muscles and other organs.

Excretion: Limited amounts of nitrogenous wastes are eliminated from the body in sweat.

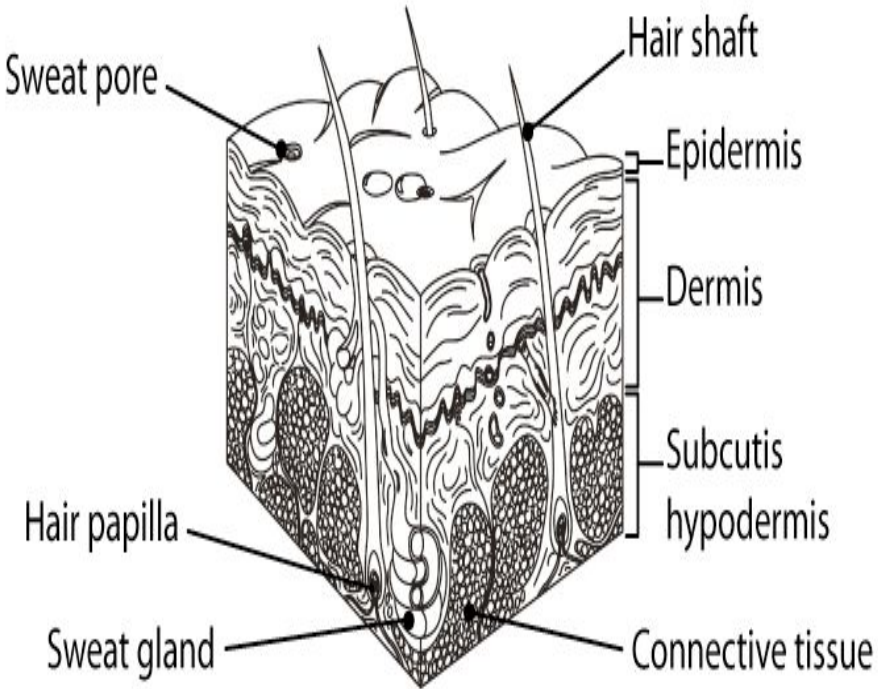
The skin

The skin is the largest organ in the body. It is also a system because it includes smaller organs such as glands, special sense receptors and hair and nails to become a specialised unit. Skin has several important qualities. It is smooth to touch because there are natural oils to keep it soft. It is elastic, it stretches over the body framework – a good example of this stretching process is seen during pregnancy. In normal circumstances, the skin is durable, resists water entering the body (eg: when washing dishes), but has the ability to absorb some creams such as moisturisers.

Skin structure

The skin is divided into three primary layers:

1. **Epidermis:** the outermost superficial region.
2. **Dermis (cutis):** the middle region.
3. **Subdermis (hypodermis/superficial fascia) :** the deepest region.



Functions of the skin system

Maintenance of body temperature

Body temperature is regulated through variations in the flow of blood through the dermis. If blood flow is to be increased, the blood vessels dilate, allowing more blood to be delivered to the required point. The opposite occurs when blood flows are regulated to provide major organs with supplies limiting the periphery, eg: when the body is exceptionally cold, the brain regulates blood flow to the major organs, limiting blood flow to the limbs, hands and feet.

When the body is hot, blood flow is increased to the skin and vice versa when the body is cold. Although the sensors in the skin pick up the variations in temperatures, there is a centralised regulating program, the brain. In this instance the part of the brain organising the processes is the hypothalamus.

Protection: Skin provides a protective cover to lessen the risk of injury to the body and the entry of chemicals, bacteria and ultraviolet rays – as long as the skin remains intact. The skin's dense cell structure forms a physical barrier over the internal organs/systems. Skin secretions (eg: sebum, a secretion from the sebaceous glands) when mixed with sweat produce an acid film over the skin – an antibacterial agent.

Perception of stimuli: Skin acts as a sense organ for touch, pain, heat and cold. Information from the external environment is communicated via the nerve receptor pathways to the brain. If you knock your hand against a fixed object, you will immediately feel the pain, later, you will notice the bruising.

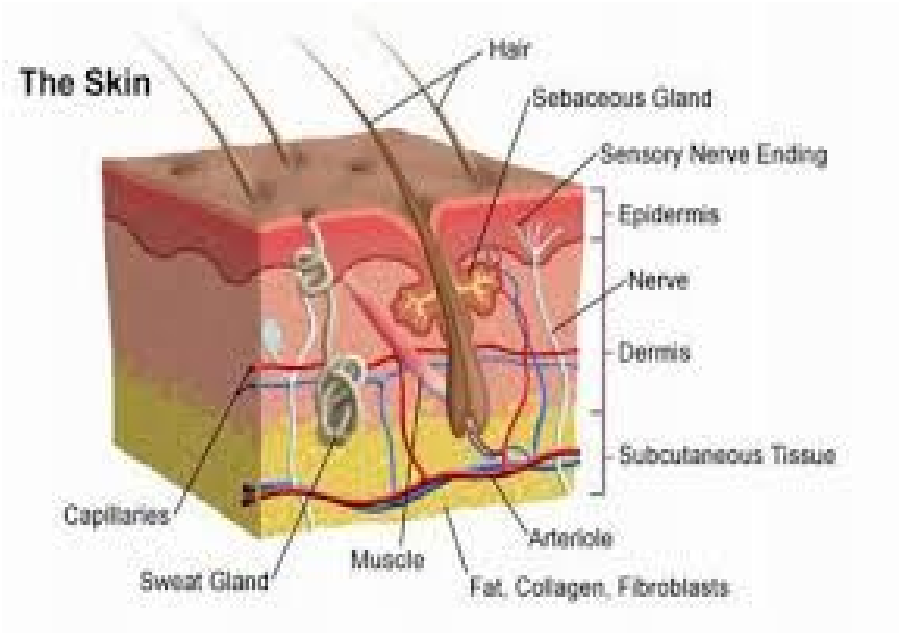
Excretion: Excretion of sweat occurs as a normal body-cooling process. Sweat evaporates on the skin's surface and therefore cools. It contains some water, salts, urea and other wastes that are excreted from the body.

Synthesis of Vitamin D: Sun rays on the skin start the process of Vitamin D production. Vitamin D is required for the formation of bones.

Immunity: Normal skin flora is slightly acid, like a mild disinfectant. As previously stated, it is a protective mechanism because it inhibits the growth of some bacteria. Highly alkaline soaps and detergents disturb this acid mantle, rendering the skin more vulnerable.

Metabolism: Regulatory feedback processor that ensures the right amount of fluids, electrolytes and Vitamin D are available for correct functioning of the body.

Structure of the skin



The skin has two main layers: the epidermis (outer layer) and the dermis (inner layer).

Epidermis: The epidermisis the outer epithelial layer is composed of epithelial cells. It varies in thickness depending on the degree of protection a part of the body requires, eg: the soles of the feet require more protection than eyelids. The epidermis layer contains no blood vessels. Epithelial tissue also lines the inside of the nostrils.

Cilia are attached and help trap unwanted particles before being inhaled. For ease of defining what happens to the cells in the epidermis, there is a three-tier process. The outer layer is composed of dead cells, where the nucleus and organelles are replaced by a protein known as keratin. The conversion of the cells to keratin is part of the waterproofing process of the skin. This layer of dead cells constantly flakes off, is removed when bathing and normally we are not aware of this process. Then there are two to three layers where the conversion process to keratin occurs.

The number of layers depends on the area of the body and the thickness of the skin, eg: the soles of the feet are thicker than the eyelids. The cells nearest the dermis (inner layer) are pushed upwards, becoming flatter. They lose moisture as they near the surface, become dry and flake off the skin. Skin cells become dry due to the fact that there is no blood supply to the epidermis, except where the layers nearest the inner layer are able to receive moisture from the dermis.

The inner layer immediately next to the dermis is capable of cell division – it's where new cells are constantly being produced. Also found in this layer is melanin, which produces cells that protect the skin against ultraviolet rays. It takes approximately 28 days for new cells to move to the top to flake off as dead keratinised cells. This process is faster in small children and slows down as we age.

Dermis: The dermislies beneath the epidermis. It is a thick, dense layer, with a network of connective tissue. It has a rich blood and nerve supply. Other structures include hair follicles, sweat and sebaceous glands. Beneath the dermis lies a fat layer known as adipose tissue, which serves as an anchorage for underlying tissues and organs

Skin colour

Three pigments contribute to skin colour.

Melanin: is the only one made in the skin. It ranges in colour from yellow to reddish-brown to black pigment and is responsible for dark skin colours.

- All humans have the same relative number of melanocytes
- Individuals and racial differences in skin colour is reflected in the relative kind and amount of melanin made and retained
- Freckles and pigmented moles result from local accumulations of melanin.

Carotene: is a yellow to orange pigment most obvious in the palms and soles of the feet.

Haemoglobin: is the reddish pigment responsible for the pinkish hue of the skin.

Appendages of the skin: The integumentary system includes several derivatives of the epidermis. They include hair follicles and hair, nails, sweat glands and sebaceous glands.

Sweat glands

There are two types of sweat glands:

1. **Eccrine sweat glands:** (also called merocrine sweat glands) are found in palms of the hands, soles of the feet and forehead. They originate in the dermis and extend to pores in the epidermis. Eccrine gland secretion (sweat) is 99% water, salts, Vitamin C, antibodies and toxins. They are regulated by the sympathetic nervous system. Their primary function is thermoregulation.
2. **Apocrine sweat glands:** are found primarily in axillary and anogenital areas. They secrete a milky substance. Their secretion is similar to eccrine secretion, plus proteins and fatty substances on which bacteria thrive. This is the cause of body odour. They are controlled by hormones which become active at puberty. They also function as scent glands, playing a part in sexual attraction and the recognition of mothers by their babies.

Ceruminous glands: Ceruminous glands are modified apocrine glands in external ear canal that secrete cerumen.

Mammary glands: Mammary glands are specialised sweat glands that secrete milk.

Sebaceous glands: These are simple alveolar glands found all over the body except on palms and soles. They secrete an oily secretion called sebum which is usually secreted into a hair follicle or occasionally to a pore on the skin surface. Sebum has a bactericidal action. Hormones control the activity of these glands. Secretion of sebum decreases with age, causing the skin to become drier. Sebum and sweat mix together on the skin to form an acid mantle which maintains the pH of the skin at 5.5 – 5.6.

Hair

Hair is filamentous strands of dead keratinised cells produced by hair follicles. It contains hard keratin which is tougher and more durable than soft keratin of the skin. It is made up of the shaft projecting from the skin and the root embedded in the skin. The shape of the shaft determines the appearance of the hair, for example curly or straight. Hair is pigmented by melanocytes at the base of the hair follicle.

Hair functions include:

- Helping to maintain warmth
- Alerting the body to presence of insects on the skin
- Guarding the scalp against physical trauma, heat loss and sunlight.

Hair is distributed over the entire skin surface except:

- Palms, soles and lips
- Nipples and portions of the external genitalia.

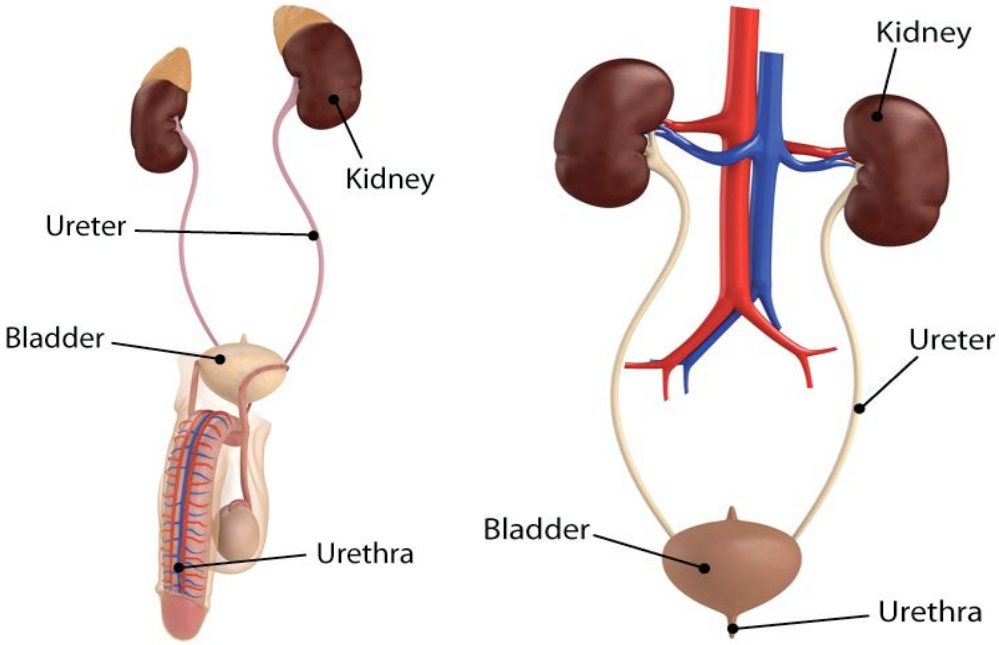
Hair follicles: A hair follicle is a root sheath extending from the epidermal surface into the dermis. Its deep end is expanded to form a hair bulb. A knot of sensory nerve endings (root hair plexus) wraps around each bulb, bending the hair stimulates these. Attached to each hair follicle is a bundle of smooth muscle cells called arrector pili muscles. Their contraction pulls the hair follicle into an upright positioning in response to cold external temperatures or fear (creating goosebumps). These trap air between the skin and hair which is then warmed by body heat to help keep the body warm. Sebaceous glands are associated with hair follicles.

Nails: Nails are a scale-like modification of the epidermis that forms a clear covering on the dorsal surface of the distal part of a finger or toe. Each nail has a free edge, a body and a proximal root.

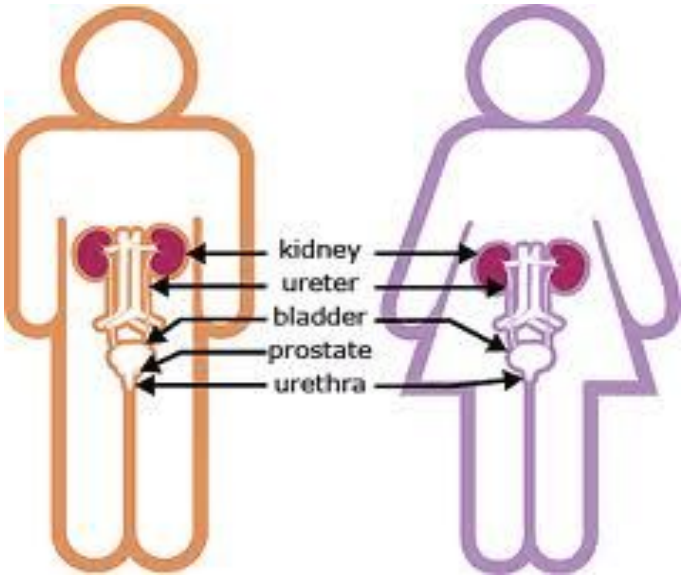
The urinary system

The urinary system filter out cellular wastes, toxins and excess water or nutrients from the circulatory system it consists of the **kidneys**, the **ureters**, the **urinary bladder** and the **urethra.**

Male urinary systems **Female urinary system**



Kidneys



The function of the kidneys is to keep the blood healthy by filtering it. All unwanted materials, water and salts are removed in urine, thus maintaining the composition of the blood at a constant level. The kidneys are bean-shaped structures which lie in a retroperitoneal position in the superior lumbar region (extending approximately from T12 to L3). They are surrounded by three layers of supportive tissue.

The renal capsule: is a fibrous transparent capsule that prevents infections in surrounding areas from spreading to the kidneys.

The adipose capsule: is a fatty mass that secures the kidney to the posterior body wall and also protects it. Renal ptosis is an event where one or both kidneys may drop to a lower position. This may cause a ureter to become kinked and urine to back up into the kidneys, exerting pressure on its tissue, leading to kidney damage.

The renal fascia: is an outer layer of dense fibrous connective tissue that secures it to surrounding structures.

There are three distinct regions in the kidneys.

1. The renal cortex is the most superficial region in which the majority of glomeruli are located.

2. The renal medulla is the inner section consisting primarily of the tubules and collecting ducts.

3. The renal pelvis is a flat, funnel shaped tube which is continuous with the ureter which transports the urine to the bladder to be stored.

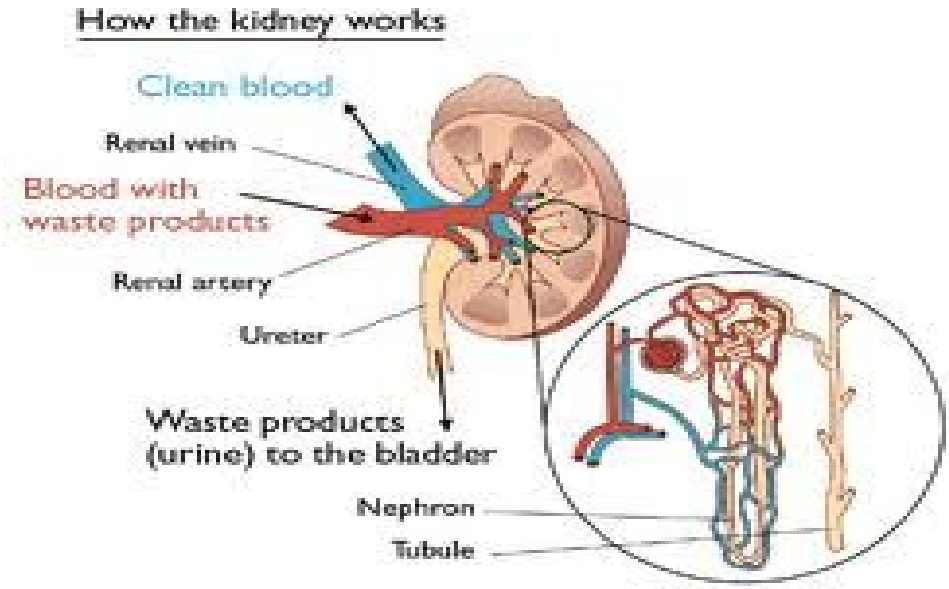
Branching extensions of the pelvis form **major calyces** which subdivide to form several **minor calyces** that enclose the **papillae.**

Functions of the kidneys

- Filtering and removing metabolic wastes (nitrogenous and acidic)
- Removing toxins such as hormones, drugs and other foreign material from the body
- Regulating and maintaining proper balance between water, electrolytes, acids and bases in the body
- Secreting erythropoietin which stimulates red blood cell (RBC) production
- Metabolising vitamin d to its active form (calcium balance)
- Producing the enzyme renin which helps regulate blood pressure and kidney function
- Gluconeogenesis during prolonged fasting.

The walls of the calyces, pelvis and ureters contain smooth muscle. They have a rich blood supply. The large renal arteries deliver 25% of the total cardiac output (about 1200 ml) to the kidneys each minute. The renal plexus provides the nerve supply of the kidney and its ureter. It is largely supplied by sympathetic fibres which course along with the renal artery to reach the kidney regulating renal blood flow.

Structural functioning of the kidney



The structural and functioning units of the kidney are called nephrons. They have a particular structure that allows for the capillary exchange of substances. It is in the nephrons that filtration, re-absorption of selected substances and the formation of urine occurs. The various functional elements or parts of the nephron ensure that the body has the correct balance of fluids, electrolytes and various minerals for its needs. All of these structures are quite easily seen by the naked eye. However, the complicated process by which the blood is filtered takes place in microscopic units called nephrons. There are approximately one million nephrons in each kidney.

A nephron consists of:

- Bowman's capsule
- Glomerulus
- First convoluted tubule
- Loop of Henle
- Second convoluted tubule
- Straight collecting tubule.

Each tubule begins in the cortex in a cup-shaped filter called the Bowman's capsule. A capillary from the renal artery form bunches within the Bowman's capsule and are called the glomerulus. The first convoluted tubule, which leads from the Bowman's capsule, is situated in the cortex. From this, the long loop of Henle passes down into the medulla of the kidney and then returns to the cortex to become the second convoluted tubule. From this, straight collecting tubules pass to the medulla of the kidney and into the pelvis of the kidney.

Urine formation

Approximately 1200 ml of blood passes through the glomeruli each minute. Of this, 650 ml is plasma and about one fifth of this is forced into the renal tubules. The kidneys draw on 20 – 25% of all oxygen used by the body at rest for this task. Filtrate and urine are not the same. Filtrate contains blood plasma excluding proteins. By the time it has got into the collecting ducts, it has lost most of its water, nutrients and ions and contains mostly metabolic wastes and unneeded substances, and is now called urine. Of the 180 litres of blood-derived fluid the kidney processes daily, only about 1% actually leaves the body as urine, the rest returns to the circulation.

The three processes involved in urine formation and the adjustment of blood composition are:

- Glomerular filtration
- Tubular re-absorption
- Tubular secretion.

The collecting ducts work together with the nephrons to concentrate or dilute the urine.

Glomerular filtration

This is a passive, non-selective process in which hydrostatic pressure forces fluids and solutes through a membrane. The combined effect of forces favouring or opposing filtration determines the filtration pressure.

The glomeruli function as filters. High glomerular blood pressure (55 mm Hg as opposed to 18 mm Hg or less in other capillary beds) occurs because the glomeruli are fed and drained by arterioles. This results in a higher net filtration pressure with the kidneys producing about 180 litres of filtrate daily. Molecules smaller than 3 mm in diameter, like water, electrolytes, amino acids, glucose and nitrogenous wastes, pass freely from the blood into the renal tubule.

Consequently, these substances generally show similar concentrations in the blood and the glomerular filtrate. Larger molecules pass with greater difficulty. Anything larger than 7 – 9 mm is generally barred from entering the tubule such as proteins or blood cells are. The plasma proteins in the capillaries maintain the colloid osmotic pressure of the glomerular blood, thereby preventing the loss of all its water into the renal tubules.

Tubular re-absorption

Normally, 99% of the glomerular filtrate is reabsorbed. Tubular re-absorption begins once the filtrate enters the proximal tubules. Transported substances move through three membrane barriers to reach the blood. The substances that are needed are removed from the filtrate by tubule cells. Virtually all organic nutrients such as glucose and amino acids are completely reabsorbed by healthy kidneys, so as to maintain or restore normal plasma concentrations, while re-absorption of water and many ions is continuously regulated and adjusted in response to hormonal signals. The re-absorption process may be passive or active, and this depends on the substances transported.

Tubular secretion: An important means of clearing plasma of unwanted substances is the failure of the tubule cells to reabsorb some solutes. Tubular secretion is another similar mechanism which is essentially, reabsorption in reverse. Substances move either from the blood of the peritubular capillaries through the tubule cells, or directly from the tubule cells into the filtrate. The urine eventually excreted therefore, contains both filtered and secreted substances.

The purpose of tubular secretion is:

- To dispose of substances not already in the filtrate, like certain drugs
- To eliminate undesirable substances or end products, such as urea and uric acid, that have been reabsorbed by passive processes
- To remove excess potassium (k+) from the body
- To control blood pH.

Regulation of urine concentration and volume: The osmolarity of a solution is the number of solute particles dissolved in one litre of water. This reflects the solution's ability to cause osmosis. The milliosmol (mOsm) is used to describe the solute concentration of body fluids. The osmotic concentration of plasma is about 300 mOsm, and one crucial renal function is to keep the solute load of body fluids at this constant by regulating urine concentration and volume. This is accomplished by the workings of the loop of Henle.

Three factors contribute to this regulation process:

1. The descending limb of the loop of Henle is relatively impermeable to solutes and freely permeable to water.
2. The ascending limb is permeable to solutes, but not to water.
3. The collecting ducts in the deep medullary regions are permeable to urea.

Characteristics of urine

Colour and transparency

Urine is typically clear and pale to deep yellow.

Odour: Fresh urine is slightly aromatic. On standing, it develops an ammonia odour due to bacteria metabolizing its urea solutes. Some drugs, diseases and vegetables alter the usual smell of urine.

pH; The pH of urine is usually slightly acidic, around pH 6.0. Changes in body metabolism or diet can cause variations in pH from about 4.5 to 8.0.

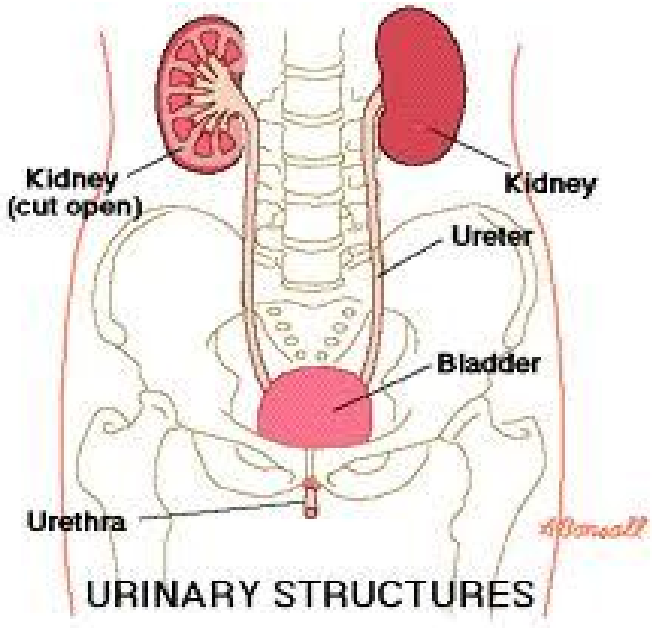
Specific gravity: Specific gravity is the term used to compare the mass of a substance to the mass of an equal volume of distilled water which is 1.0. The specific gravity of urine ranges from 1.001 to 1.035 depending on the urine's solute concentration.

Chemical composition

- 95% of urine volume is water with the remaining 5% being solutes (chemicals dissolved in water)
- Urea, derived from the normal breakdown of amino acids, is the largest component by weight (apart from water)
- Other nitrogenous wastes include uric acid and creatinine
- Normal solutes in decreasing order of concentration are urea, Sodium (Na+), Potassium (K+), Phosphates (PO4 2-), Sodium Cholride (SO4 2-), creatine and uric acid
- Calcium (Ca2+), Magnesium (Mg2+) and Amonia (NH4 +), are present in smaller and variable amounts
- Substances not normally found in urine include glucose, proteins, erythrocytes, white blood cells (pus), and haemoglobin and bile pigments and may indicate pathology
- Daily urinary volume is normally 1.5 – 1.8 L. However, this depends on the state of hydration of the body.

There is a variety of diagnostic tests available, for example urinalysis or further blood tests depending on the nature of the problem.

Urinary structures



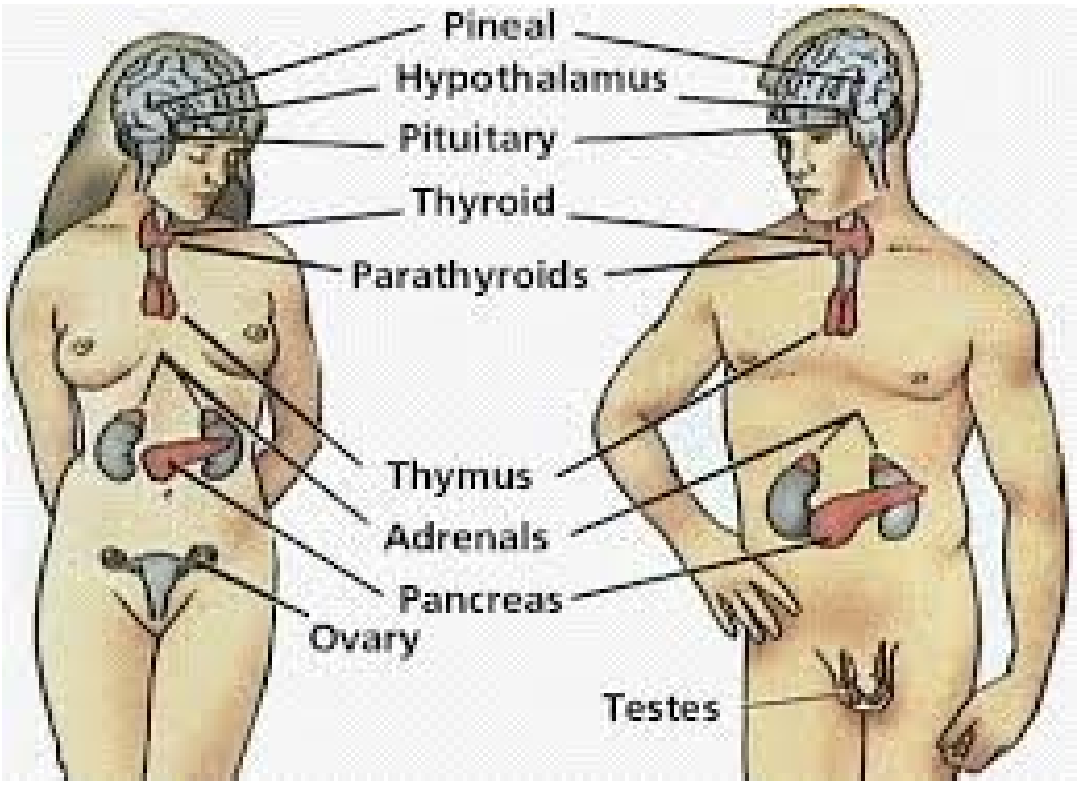
Ureters: Ureters are slender tubes that convey urine from the renal pelvis of the kidneys to the urinary bladder. The mucosal lining is transitional epithelium, middle is smooth muscle, and external surface is fibrous connective tissue. They conduct urine by peristalsis.

Urinary bladder: The urinary bladder is a distensible muscular sac that lies posterior to the pubic synthesis which functions to store urine temporarily. In males, the prostate gland surrounds the bladder neck inferiorly where it empties into the urethra. In females, the bladder is anterior to the vagina and uterus. The bladder wall consists of transitional epithelium-containing mucosa, a three layered muscular layer and an adventitia. Bladder capacity and tone decrease with age, resulting in frequent micturition, (frequent use) and incontinence.

Urethra: The urethra is a muscular tube that conveys urine from the bladder to outside the body. Mucosal lining is mostly stratified columnar epithelium. Where the urethra leaves the bladder, it is surrounded by an internal urethral sphincter. This involuntary smooth muscle sphincter keeps the urethra closed when urine is not being passed as well as preventing leaking between voidings.

The external urethral sphincter, formed of skeletal muscle, surrounds the urethra where it passes through the urogenital diaphragm. It is voluntarily controlled. In females the urethra is 3 – 4 cm long and conducts only urine. Being very short and because its external orifice is close to the anal opening, bacteria can easily be carried into the urethra. Those with improper toilet habits as well as sexually active women are prone to urinary tract infections. In males the urethra is 20 cm long. It runs within the prostate gland, through the urogenital diaphragm, and through the penis. It conducts both urine and semen.

The Reproductive System

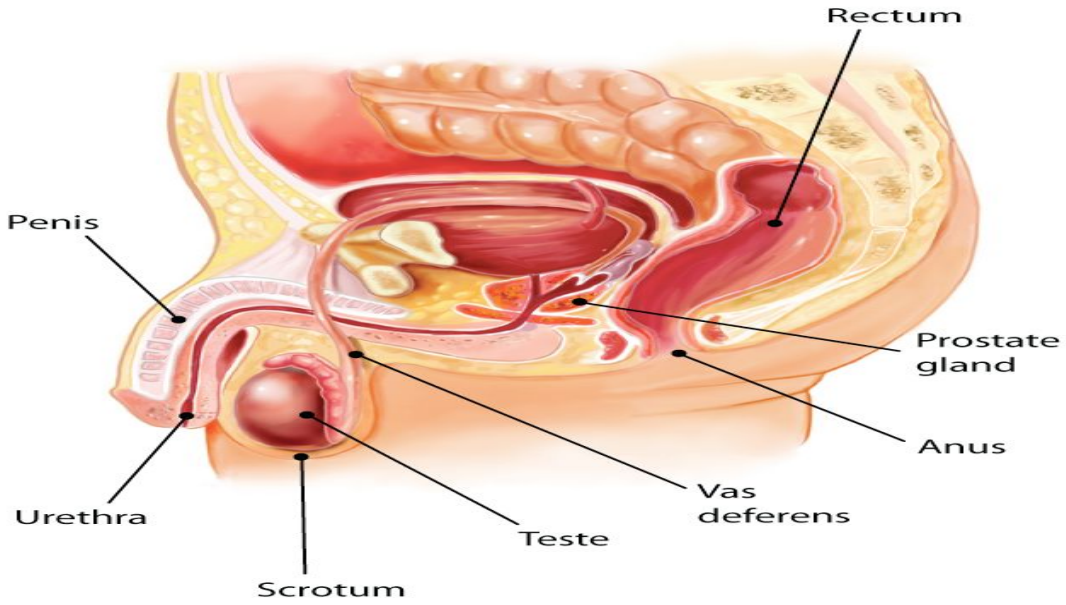


The main role of the reproductive system is to manufacture cells that allow reproduction. The primary sex organs, or gonads, are the testes in the male and the ovaries in the female. The gonads produce sex cells or gametes and secrete sex hormones. The remaining reproductive structures are referred to as accessory reproductive organs. These are the ducts, glands and external genitalia. The male's reproductive role is to manufacture male gametes called sperm and deliver them to the reproductive tract.

The complementary role of the female is to produce female gametes, called ova or eggs. When these events are appropriately timed, a sperm and egg fuse to form a fertilised egg, the first cell of the new individual, from which all body cells will develop. The sex hormones are not only essential in both the development and function of the reproductive organs but influence the growth and development of many other organs and tissues of the body. Sex hormones also influence sexual behaviour and sexual drives. The reproductive system is in a juvenile state during the first decade of life. Hormone-directed changes start to occur in both sexes at about age ten. This period, where secondary sexual characteristics begin to develop, is called puberty. The potential for sexual reproduction is then reached.

Anatomy of the male reproductive system

The testes or male gonads produce sperm and secrete hormones. Through a system of ducts, including the epididymis, vas deferens, ejaculatory duct and urethra, the sperm are transported to the exterior. The accessory sex glands; the seminal vesicles, prostate gland, and bulbourethral glands, empty their secretions into the ducts during ejaculation.



Penis

The penis is a passageway for the ejaculation of semen and the excretion of urine. It consists of an attached root and a body that ends in an enlarged tip called the glans penis. In an uncircumcised penis the loosely fitting covering of the glans penis is called the prepuce, or foreskin. The body of the penis is composed of three cylindrical masses of tissue bound together by fibrous tissue called tunica albuginea. Within the penis, are the spongy urethra and three long cylindrical bodies of erectile tissue (a spongy network of connective tissue and smooth muscle with many vascular spaces).

The Scrotum

- Encloses and protects the testes
- Testes
- Produce spermatozoa. Produce and secrete male sex hormones (testosterone)
- Vas deferens
- Store spermatozoa
- Convey spermatozoa to ejaculatory ducts
- Ejaculatory ducts
- Receive sperm and additives to produce seminal fluid.

The testes

The testes develop near the kidneys and usually begin their descent into the scrotum through the inguinal canals towards the end of the seventh month of foetal development.

Each plum-sized teste is surrounded by two tunics:

1. **The outer tunic, the tunica vaginalis testis**, is a serous membrane derived from the peritoneum.
2. **Internally is a dense white fibrous capsule, the tunica albuginea**. It extends inward forming septa that divide the testis into 250 to 300 wedge-shaped lobules, each containing one to four tightly coiled seminiferous tubules, where sperm are produced.

The testes therefore have two functions, sperm-producing and hormone-producing.

Prostate Gland: Secretes an alkaline fluid that helps neutralise acidic seminal fluid and enhances motility of sperm.

Urethra: Serves the dual purpose of conveying urine from the body and semen.

Physiology of male reproductive system

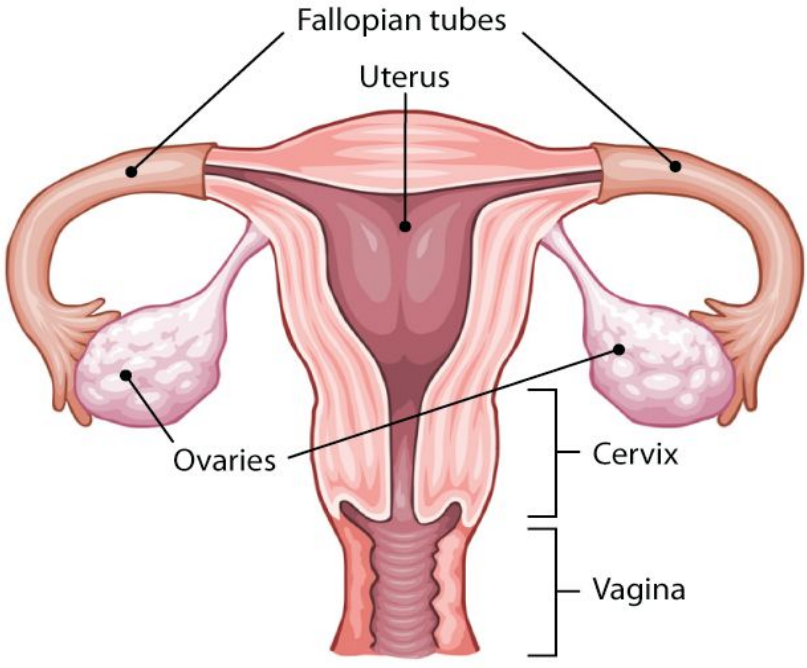
The male reproductive system relies on the normal functioning of both hormonal and neural mechanisms. Hormones are primarily responsible for the development and maintenance of functions, eg: development of sexual characteristics, control of sperm maturation and the production and influence of sexual behaviour. Neural mechanisms involve the sexual act and expressions of sexual behaviour. It is the pituitary gland that has a major role to play.

The major function of testosterone is to stimulate the development of the reproductive organs and the male secondary sex characteristics, which are:

- The deepening of the voice due to the lengthening and thickening of the vocal cords
- The appearance of pubic, axillary and facial hair
- An increase in activity of the sebaceous glands
- The broadening of the shoulders and an increase in muscle mass
- An increase in length and width of the penis and genital pigmentation
- An activation of the secretion of fructose from seminal vesicles to nourish sperm.

Anatomy of the female reproductive system

The organs of the female reproductive system include the ovaries (female gonads), the accessory ducts (the uterine or fallopian tubes) the uterus, the vagina and the external organs which are collectively called the vulva.



Structure of the female reproductive systems

There are external and internal structures of the female reproductive system.

External structures

The external structures (vulva) consist of the labia, clitoris, perineum, urethral and vaginal openings, Bartholin's glands and mons pubis.

- **Mons pubis:** protects pelvic bones and enhances sexual arousal.
- **Labia:** majora and minora general protective coverings and a source of sexual pleasure.
- **Clitoris:** erectile tissues containing an abundance of free nerve endings. Situated between the folds of the labia minora.
- **Perineum:** area of skin and tissues between the vaginal orifice and the anal orifice.
- **The muscles:** provide sphincter activity for the urethra, vagina and anus.
- **Bartholin's glands:** two small glands just inside the vagina that produce a lubricating fluid that helps to maintain moistness.

Internal structures

The internal structures are the vagina, uterus, fallopian tubes and ovaries. The vagina is a musculo-membranous passageway that leads from the uterus to the vulva. It has smooth muscle lined by mucous membrane and arranged in folds. The vagina is capable of stretching greatly during childbirth. It receives the penis during sexual intercourse and provides a passageway for menstrual flow to leave the body as well as for the foetus during birth.

The uterus is a hollow pear-shaped muscular organ located at the centre of the pelvic cavity behind the bladder and in front of the rectum. It is secured in position by folds of the peritoneum which forms its outer layer. The muscle layer is thick, smooth muscle and the inner layer or lining is mucous membrane, the endometrium. The upper two-thirds of the uterus is the uterine body and the cervix is the lower one third which protrudes into the vagina. It receives the fertilised ovum which implants into the endometrium, sheds the superficial layer of endometrium if fertilisation does not occur, provides nourishment for the foetus and expels the foetus at the end of pregnancy.

The fallopian tubes are muscular tubes, approximately 10 cm long, which extend from the uterus into the peritoneal cavity where they fan out into tissue called fimbriae which attaches to the ovary. Their function is to transport the ovum from the ovary to the uterus by means of peristalsis.

The ovaries are almond-shaped organs attached to ligaments that suspend them in the pelvic cavity. The outer layer of each ovary is made of a single layer of epithelium. Beneath this layer the ova are produced. The ova are present at birth, but only complete a maturing process or 'ripening' in ovarian follicle wall if stimulated by the follicle stimulating hormone (pituitary gland) to secrete oestrogen which enhances the maturation process. Ovulation is the rupturing of a mature follicle to release an ovum. After ovulation the ruptured follicle changes to corpus luteum which begins to secrete the hormone progesterone. Thus the ovaries are concerned with the production of mature ova and the hormones oestrogen and progesterone.

Oestrogen is responsible for the development of the female secondary sex characteristics, which are:

- The enlargement of uterus, vagina and external genitals
- The development of breasts
- An increase in fat deposits (hips and breasts)
- The widening of the pelvis
- The onset of the menstrual cycle
- The appearance of pubic and axillary hair
- The stimulation of the lining of the uterus to prepare for the reception of a fertilised ovum.

The function of progesterone is to:

- Promote the final preparation of the uterine lining to receive the fertilised ovum
- Inhibit contractions of uterine walls
- Suppress further ovulation
- Stimulate the mammary glands to produce milk
- Have an indirect effect on fluid and electrolyte balance.

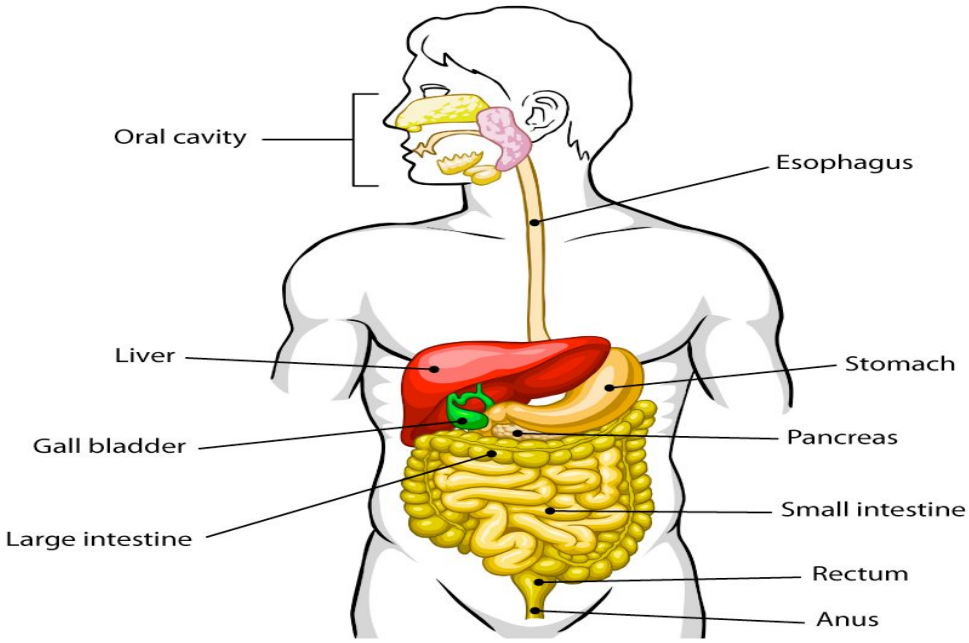
Effects of oestrogens and progesterone

Puberty: Is the interval when reproductive organs mature and become functional, generally between the ages of 10 and 15 years? The changes occur in response to rising levels of gonadal hormones. It begins in males with penile and scrotal growth, and in females with breast development.

Menopause: Is between the ages of 46 and 54 years; when ovarian function declines and ovulation and menstruation cease – an event called 'menopause'. Some women experience hot flushes and mood changes (including irritability and depression) and the decline in oestrogen is associated with atrophy of reproductive organs and breasts. The vagina becomes dry and vaginal infections become increasingly common, bone mass is lost and the risk of cardiovascular disease increases.

The Digestive System

The digestive system takes in the food the body needs to fuel its activities. It breaks the food down into units called nutrients and absorbs the nutrients into the blood. The digestive process is also responsible for converting waste into material that can be excreted.



Major role: The main role of the digestive system is to break down and absorb nutrients that are necessary for growth and maintenance.

Major organs: Mouth, esophagus, stomach, small and the large intestines.

Functions of the digestive system

Ingestion: Is the taking in of food via the mouth into the digestive system.

Propulsion: Involves movement of food through the alimentary canal by two processes:

1. **Voluntary process** – swallowing
2. **Involuntary process or peristalsis –** which is the process of contraction and relaxation of muscles in the organ walls which results in the squeezing and mixing of food in the digestive tract.

Mechanical digestion: Involves the following processes:

- Chewing or mastication, when saliva is mixed with the food by the tongue
- Churning of food in the stomach (peristalsis)
- Segmentation, which occurs in the intestines by rhythmic local constrictions wherein food is mixed with digestive juices. The repetitive movement of different parts of the food in the intestinal wall makes absorption more effective.

Chemical digestion: Is the stage when food molecules are broken down by enzymes. This enzymatic action on the food starts in the mouth and ends in the small intestine.

Absorption: Is when the digested food is passed from the lumen of the gastrointestinal tract through the mucosal cells, either by active or passive transport, into the blood or lymph. The small intestine is the site of major absorption.

Defecation: Is when indigestible substances are eliminated from the body in the form of faeces via the anus.

Structure of the digestive system and organ functions: The digestive system is made up of the digestive tract or alimentary canal and other accessory digestive organs which assist in digestion.

Alimentary canal: This is the continuous, muscular, digestive tube, approximately nine metres long that winds through the body. It digests; breaking down food into smaller pieces and absorbs the digested fragments into the blood through the alimentary canal lining.

There are four layers in the alimentary canal.

Mucous membrane: Is the innermost, moist epithelial membrane lining the canal from mouth to anus.

Functions

- Secretes mucus, digestive enzymes and hormones
- Absorbs digested end products into the blood
- Serves as protection against infections and diseases.

The mucous membrane has three layers:

1. **Epithelium:** which is composed of mucus-secreting goblet cells. The mucus protects some digestive organs from being digested by enzymes working within their cavities. It allows food passage along the alimentary canal.
2. **Lamina propria:** is the loose areolar connective tissue beneath the epithelium which contains lymphoid follicles which help the body defend itself against bacteria and pathogens. It absorbs the digested nutrients and nourishes the epithelium through its capillaries. A large accumulation of lymphoid follicles are found in the pharynx and in the appendix.
3. **Muscularis mucosae:** is composed of smooth muscle cells. Movements of this layer enables food particles that get stuck to the mucosa to be dislodged. It increases the surface area of the mucosa in the small intestine through a series of folds.

Submucosa: Is composed of dense connective tissue with blood and lymphatic vessels, lymphoid follicles and nerve fibres.

Functions: The elastic fibres allow the stomach to regain its normal size after storage of a large meal. It provides the blood supply to the surrounding tissue of the gastrointestinal tract wall.

Muscularis externa: Lies beneath the submucosa. It is composed of smooth muscle cells with inner circular and outer longitudinal layers.

Functions

It is involved in the process of segmentation and peristalsis.

The muscularis externa has two layers:

- The inner circular layer thickens and forms **sphincters** which serve as valves. These valves control the passage of food from one organ to the next and prevent backflow.
- The outer layer works to reduce the length of the gut by increasing the diameter of the lumen. These actions work together to produce the action of **peristalsis**.

Serosa

Visceral peritoneum: is the protective outermost layer of the intraperitoneal organs composed of areolar connective tissue with a single layer of squamous epithelial cells (mesothelium). **Adventitia** is fibrous connective tissue that replaces the **serosa** in the oesophagus and binds the oesophagus to the surrounding structures. The alimentary canal consists of a number of organs.

Mouth

The mouth is also known as the oral cavity or the buccal cavity.

The mouth is lined with mucosa and the anterior opening is termed oral orifice. It is composed of:

- Lips – anterior
- Cheeks – lateral
- Palate – superior
- Tongue – inferior.

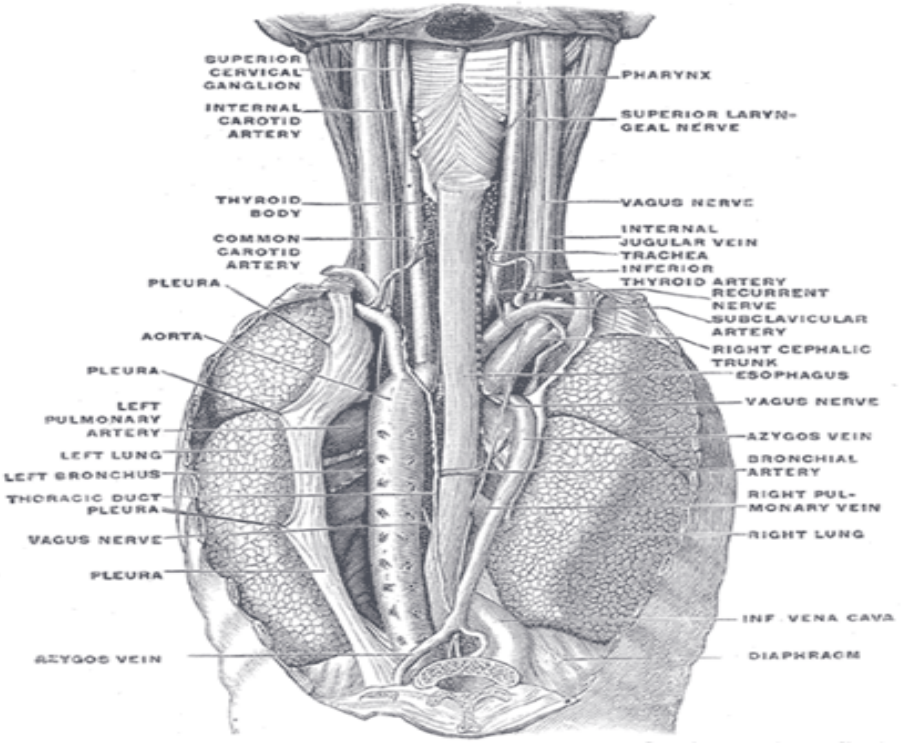
Stratified squamous epithelium lines the walls of the mouth. Keratinized epithelium on the gums, hard palate and dorsum of the tongue give protection from abrasions during eating.

Defensins, antimicrobial peptides are produced in the oral mucosa to keep the mouth healthy.

Pharynx

This is the area of the gastrointestinal and respiratory tracts which lies between the mouth and the esophagus. The pharynx is a cone-shaped tube about 11 cm long. At its upper end, it connects with the mouth and nasal passages, and connects with the ears via the eustachian tubes. The lower end of the pharynx connects with the esophagus. It is also connected to the larynx by an opening that is covered by the epiglottis during swallowing, thus preventing food from entering the trachea.

Esophagus



This is the tube that connects the pharynx with the stomach. It lies between the trachea and the spine. It passes down the neck, pierces the diaphragm just to the left of the midline and joins the cardiac upper end of the stomach. When food is swallowed, the muscular walls of the esophagus contract to push food down into the stomach. Glands in the lining of the esophagus produce mucus which keeps the passageway moist and facilitates swallowing.

Stomach

A sac-shaped digestive organ that is located in the upper abdomen under the ribs. The upper part of the stomach connects to the esophagus and the lower part leads into the small intestine.

Small intestine

This is the longest portion of the digestive tract – it is more than 6 metres long and is located within the middle of the abdomen. It has three sections, the duodenum, jejunum and ileum. The function of the small intestine is to digest fats, proteins and carbohydrates. The resulting nutrients produced are absorbed through the lining of the small intestine and transferred to the bloodstream.

Large intestine

This is the part of the digestive system where waste products from food is collected and processed into faeces. The large intestine is about 1.5 m long and consists of the caecum, appendix, colon and rectum – which are distributed in the abdominal cavity.

The large intestine performs the following functions:

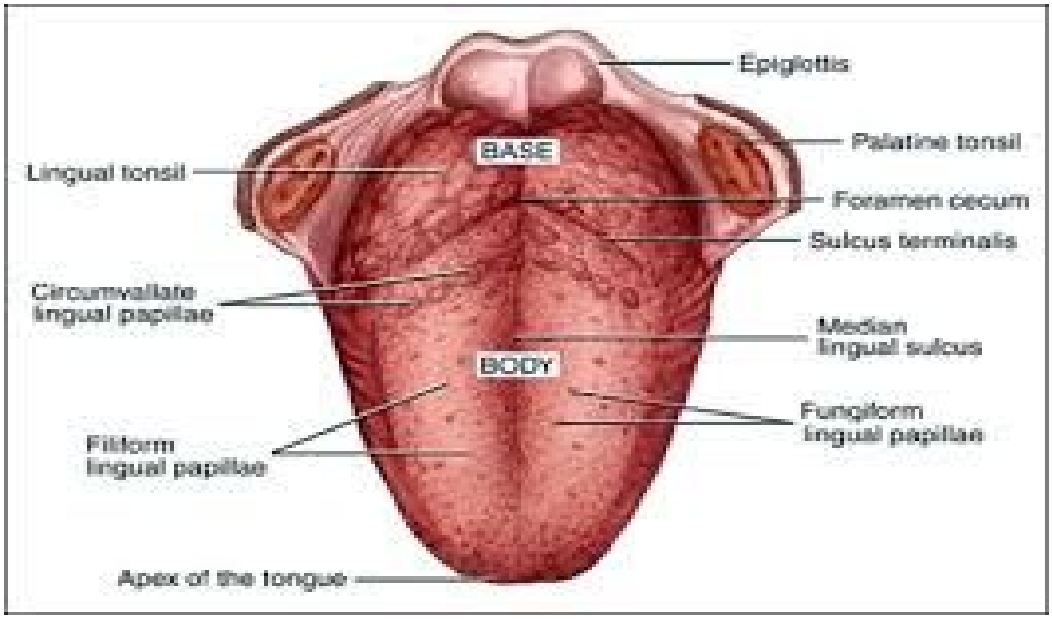
- Reabsorbs water and maintains the fluid balance of the body
- Absorbs certain vitamins
- Processes undigested material (fibre)
- Stores waste before it is eliminated.

Anus: This is an opening at the opposite end of the digestive tract from the mouth. Its function is to expel faeces, the unwanted semi-solid matter produced during digestion.

Accessory digestive organs: These contribute to the breakdown of food.

Teeth: These are structures found in the jaw that are used to tear and chew food. There are thirty-two permanent teeth, twenty of which are primary teeth.

Tongue



The tongue lies on the floor of the mouth and fills up the oral cavity when the mouth is closed. It consists of skeletal muscle fibres that are interlaced.

There are:

- **Intrinsic muscles:** which are attached to the tongue only They allow the tongue to change shape as required for swallowing and speech
- **Extrinsic muscles:** which extend from the bones of the skull or the soft palate to the tongue. They change the tongue's position, protrusion, retraction and side to side movement.

Salivary glands

- **Extrinsic salivary glands:** Lie outside the oral cavity and produce most of the saliva. These glands are paired compound tubuloalveolar glands that developed from the oral mucosa
- **Intrinsic salivary glands:** Assist the extrinsic salivary glands in producing saliva
- **Parotid glands:** Are located anterior to the ear between the masseter muscle and the skin. The facial nerve branches pass through the parotid gland onto muscles that control facial expression. Facial paralysis can result from surgery to parotid glands.

Submandibular glands: Lie along the medial aspect of the mandibular body. The size of a walnut, its duct goes under the mucosa of the oral cavity floor and opens at the base of the lingual frenulum

Sublingual glands: Are anterior to the submandibular gland under the tongue. They have 10 – 12 ducts that open into the floor of the mouth.

Composition of saliva

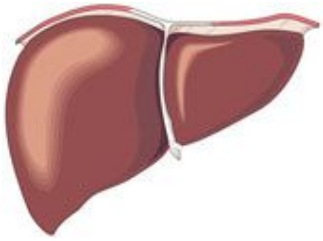
Saliva is 97% – 99.5% water and is hypo-osmotic. The osmolarity depends on the glands that are active and the type of stimulus for salivation. It is slightly acidic with a variable pH of 6.75 to 7.00.

Solutes

- **Electrolytes :**Na+, K+, Cl-, PO4, HCO3
- **Digestive enzyme:** amylase
- **Mucin:** forms thick mucus when dissolved in water that lubricates the oral cavity and hydrates food particles
- **IgA antibodies:** protect against micro-organism
- **Lysozymes:** prevent bacterial growth in the mouth and helps prevent tooth decay
- **Defensins:** act as cytokines calling defensive cells into the mouth
- **Cyanid compound:** protects against micro-organisms
- **Metabolic wastes :**urea and uric acid
- **Lingual lipase:** a fat-digesting enzyme from secretions of intrinsic salivary glands and active with an acid pH.

Control of salivation: The average saliva output is 1000 – 1500 ml per day. Salivation is controlled by the parasympathetic division of the autonomic nervous system. The intrinsic salivary glands secrete sufficient saliva to moisten the mouth. The extrinsic salivary glands are activated to produce more saliva when food is introduced into the mouth.

Liver

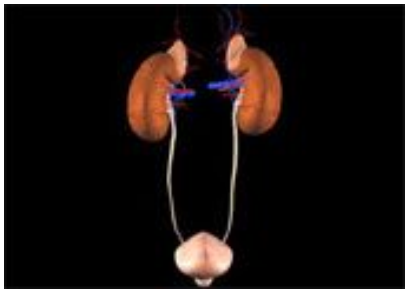


The liver is the largest gland in the body and plays a major role in metabolism. It has a number of functions, including glycogen storage, decomposition of red blood cells, plasma protein synthesis and detoxification. It lies below the diaphragm in the thoracic region of the abdomen. It produces bile, an alkaline compound which aids in digestion, via the emulsification of lipids. It also performs and regulates a wide variety of high-volume biochemical reactions requiring very specialised tissues.

Gall bladder

The gall bladder (or cholecyst) is a small non-vital organ which aids in the digestive process and concentrates bile produced in the liver. The gall bladder stores about 50 ml of bile, which is released when food containing fat enters the digestive tract, stimulating the secretion of cholecystokinin (CCK). The bile, produced in the liver, emulsifies fats and neutralises acids in partly digested food. After being stored in the gall bladder the bile becomes more concentrated than when it left the liver, increasing its potency and intensifying its effect on fats.

Bladder



The urinary bladder is a solid, muscular and distensible (or elastic) organ that sits on the pelvic floor. It is the organ that collects urine excreted by the kidneys prior to disposal by urination. Urine enters the bladder via the ureters and exits via the urethra. In males, the base of the bladder lies between the rectum and the pubic symphysis. It is superior to the prostate and separated from the rectum by the rectovesical excavation. In females, the bladder sits inferior to the uterus and anterior to the vagina. It is separated from the uterus by the vesicouterine excavation. In infants and young children, the urinary bladder is in the abdomen even when empty.

Three

Evaluating how the relationships between different body systems affect and support healthy functioning

1. Body System questions

   The brain is part of the _____ system

   The stomach is part of the _____ system

   Small intestine is part of the _____ system

   Artery is/are part of the_____ system

   Neuron is part of the _____system

   The oesophagus is part of the _____system

   The heart is part of the _____system

   The lungs are part of the _____system.

2. In this activity you will revise the functions of the **different body systems**. Match the body system listed in **Column 1 to the correct group of organs in Column 2**. Write the letter next to the body system.

COLUMN 1	**COLUMN2**
_____ Integumentary.	A. Heart, vessels, blood.
_____ Cardiovascular.	B. Trachea, bronchus, lungs.
_____ Nervous.	C. Brain, spinal chord
_____ Urinary.	D. Skin
_____ Reproductive.	E. Kidney, bladder
_____ Digestive.	F. Glands, hormones
_____ Lymphatic.	G. Lymph glands, vessels.
_____ Respiratory.	H Ovaries, testes, uterus, penis
_____ Musculoskeletal	I. Mouth, oesophagus, intestines, rectum
_____Endocrine.	J. Muscles, bones

Cardiovascular system.

3. In one to two paragraphs, explain the functions of the cardiovascular system.

The heart

4. Check the diagram of a cross-section of the heart. You can trace the flow by following the arrows. You may like to colour in this diagram.

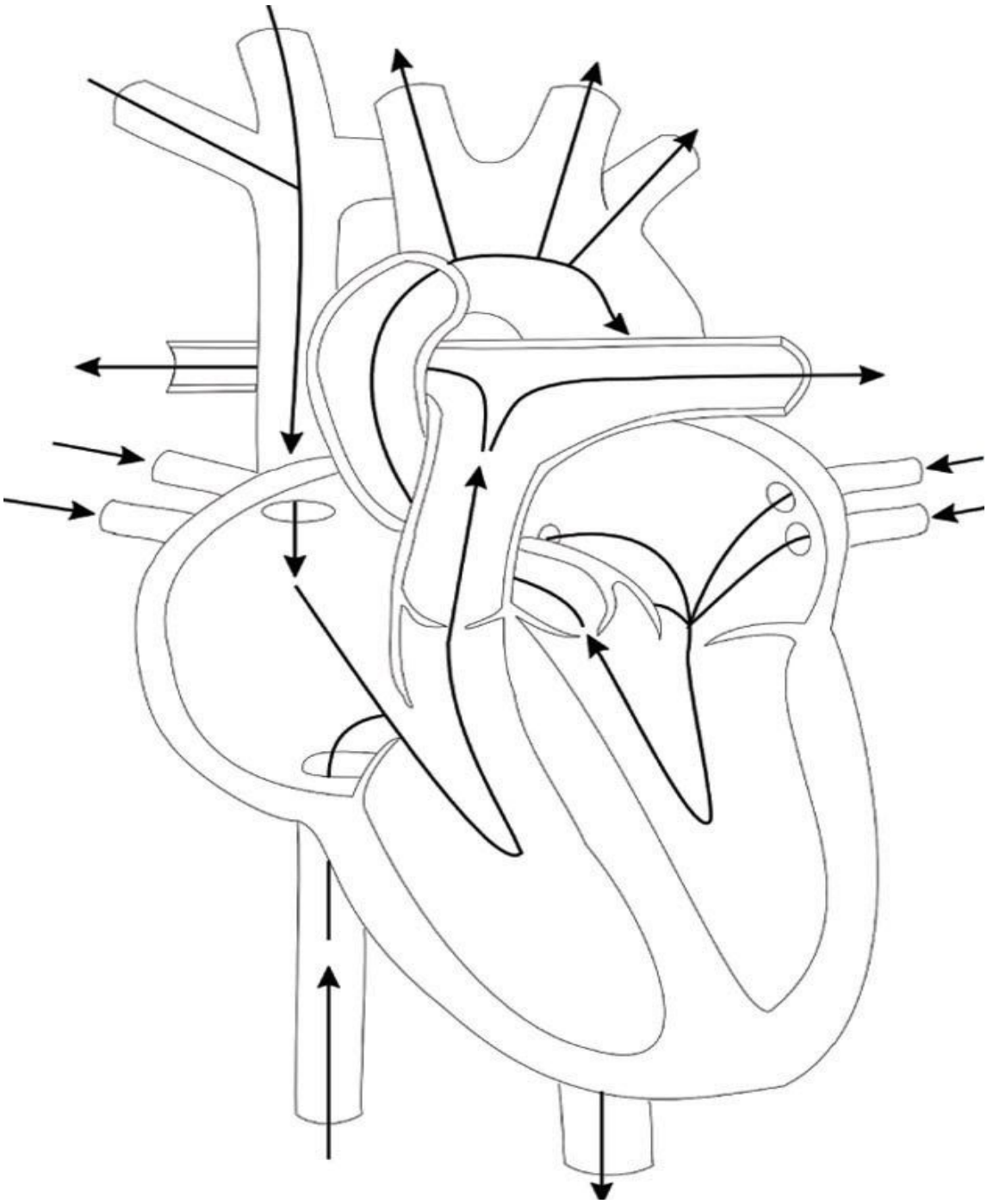
Use blue for deoxygenated blood in vessels and heart chambers

Your blue area should include:

- Inferior vena cava
- Superior vena cava
- Pulmonary arteries
- Right side of heart.

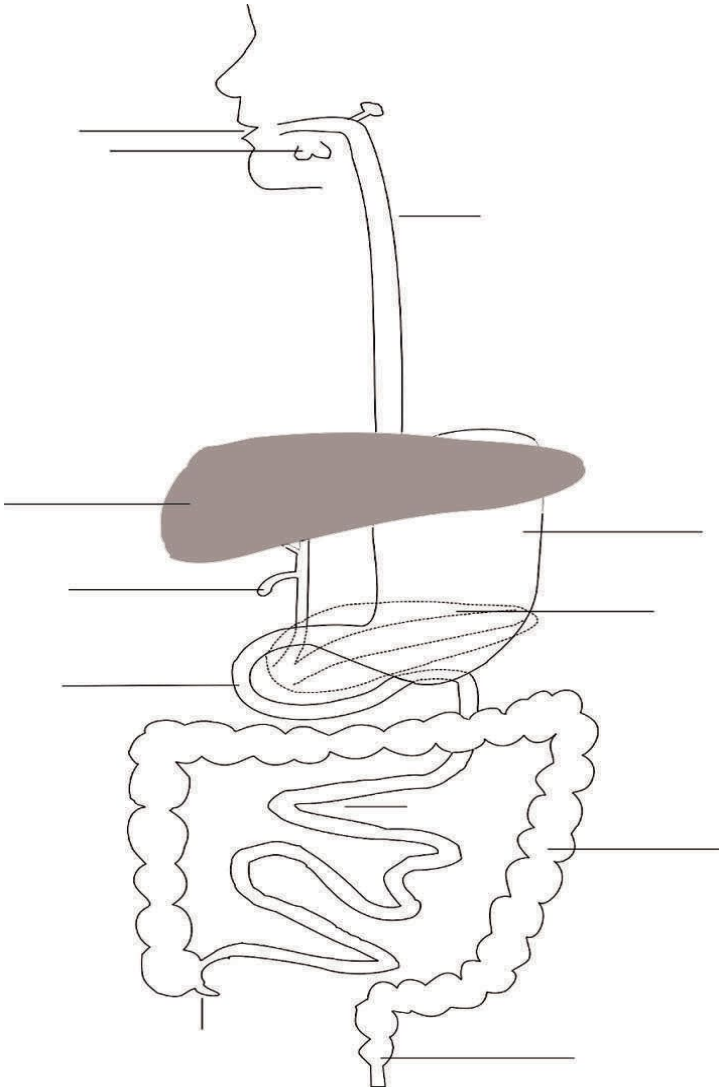
The rest should be coloured red, including:

- Left side of the heart
- Aortic arch
- Pulmonary veins.



The Digestive System

5. Use your reference materials to help you name and identify the location of the major organs and accessory organs of the digestive system on the following diagram.



Respiratory System

6. Draw an arrow to link up the parts of the respiratory system to their location on the diagram.

Nasal cavity

Pharynx

Larynx

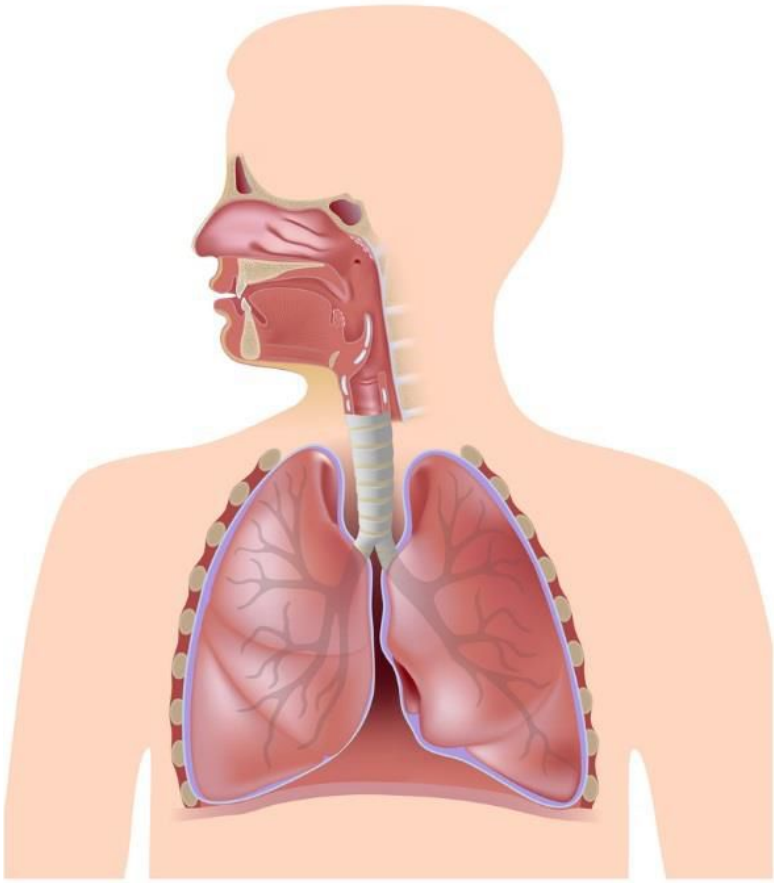
Trachea

Right lung

Right main bronchus

Bronchiole

Pleura



Reproductive system

7. Read the relevant sections in your reference materials and then write a brief overview on the functions of the following male and female hormones.

   a) Oestrogen

   b) Progesterone

   c) Testosterone

Sense organs

8. Identify the special sense organs and its functions.

SPECIAL SENSE ORGAN	FUNCTION
Eye	
Ear	
Nose	
Tongue	
Skin	

Blood

9. Besides distributing body temperature and nutrients to cells, what other functions does blood have? Refer to your resource materials for information and then complete the following chart to identify how the components of the blood carry out their function.

Type of activity that the blood undertakes	How does the blood undertake these functions?
Transportation	Uses a network of blood vessels.
Supply	
Protection	
Regulation	
Prevention	

Enhancing quality of work activities by using and sharing information about healthy functioning of the body

People who have active social lives, participate in a range of activities, have a good diet, consume a moderate amount of alcohol and maintain a healthy weight are more likely to enjoy good health and less likely to develop health problems. People are social creatures. Unfortunately as people age or develop disabilities, their social network diminishes. Older people may lose confidence and feel worthless as they grow older. Those who once defined themselves through their work or through their roles as parents may have lost their sense of self as their children grow and eventually leave home.

Maintain a healthy level of interaction

Friendships and relationships are essential to good psychological health. Clients must be supported and encouraged to meet new people. Participating in activities is one way to help clients socialise. The focus is on the activity, rather than the making of friends. This can mean meeting people is less daunting and allow them to make friends without feeling pressured. Meeting new people and participating in activities is important for health and wellbeing. It helps people build up their social networks and feel valued. It provides people with a chance to gain mental stimulation and exercise their mind and body, and provides people with a sense of purpose.

Meet new people and participate in activities

People with disabilities may find that their social networks are difficult to establish or older people may find that their networks may diminish over time. They may not be able to participate in their old clubs. They may no longer be able to work. They may also find that some of their old friends can't cope with their disability and stop contacting them. However, networking issues are not limited to older people; many younger people may also experience problems with maintaining a network for many reasons.

It may be difficult to maintain a social network due to:

- Lifestyle changes, such as retirement or changing a job
- Friends moving away or joining different social groups
- The death of friends and family members.

Four

Enhancing quality of work activities by using and sharing information about healthy functioning of the body

1. Describe why sharing information about how to maintain healthy functioning of the body would be helpful to people with disabilities.

2. Give two reasons why clients must be supported to establish networks and encouraged to meet new people.

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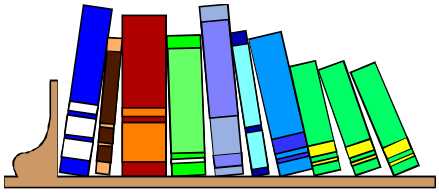

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