HLTAAP002
Confirm physical health status

Learner Guide

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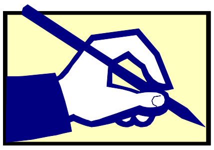


You will find review learning activities at the end of each section. The learning activities in this resource are designed to assist you to learn and successfully complete assessment tasks. If you are unsure of any of the information or activities, ask your trainer or workplace supervisor for help.

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:** ________________

HLTAAP002 Confirm physical health status

Welcome to the unit **HLTAAP002 Confirm physical health status,** which forms part of the **2015 Community services training package**. This unit describes the skills and knowledge required to obtain and interpret information about client health status and to check a client's physical health. It requires a detailed knowledge of anatomy and physiology.

This unit applies to individuals working directly with clients and who assist in the provision of health care services. Some disciplines may be subject to state/territory regulatory determination regarding delegation and supervision.

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: Obtain information about physical health status	1.1 Obtain accurate information about physical health status through observation, questioning or review of documentation 1.2 Interpret information based on understanding of the structure and functioning of body systems 1.3 Use information to identify any actual or potential problems regarding health status 1.4 Take into account factors that may have impacted on an identified physical condition
Element 2: Check physical health status	2.1 Make checks of client health status prior to delivery of health intervention using knowledge of body systems 2.2 Clarify significance of physical health status in relation to a particular intervention in line with job role and organisation requirements 2.3 Clarify implications and significance of physical health status with appropriate people in the case of uncertainty or limits on own capability or authority
Element 3: Identify variations from normal physical health status	3.1 Identify variations from normal health status using standard methods and protocols 3.2 Identify potential factors responsible for significant variations from normal health status 3.3 Identify potential risk factors associated with variations from normal health status 3.4 Recognise and refer potentially serious issues in line with organisation requirements

Element 1: Obtain information about physical health status

Obtain accurate information about physical health status through observation, questioning or review of documentation

The human body is made up of major systems, including the cardiovascular system, digestive system and respiratory system. A person's health may be affected if one or more of these systems are not functioning properly. Therefore, it is important that those working in the health industry understand the structure and physiology of each system and how they interact.

By understanding normal functioning, you are in a position to recognise variations, and then act accordingly, which usually involves observation and questioning to identify a person's physical health status or any health issues they may be experiencing.

We gather information about a person in any interaction. We learn a wide range of things about a person, not only from what they communicate verbally, but through observation of their non-verbal behaviour and of their responses and reactions to what occurs during the interaction. We learn about what they feel, what they do and don't understand, what they believe and think, what they are skilled at and what they are less skilled at.

When working with clients, we gather information to establish a comprehensive picture of their issues and needs, which in turn enables us to determine any support they might require. As mentioned previously, this is an ongoing process, aimed at modifying and adapting goals and expectations to continually match the client's issues and needs.

The information you will be looking for with regards to physical health status will vary according to the nature of the client population you encounter through your organisation – as you are well aware, developmental issues and challenges vary enormously over the lifespan. As a general guideline however, you will be seeking information through observation and questioning regarding the client's circumstances, behaviours, experiences and challenges, in order to gain a comprehensive overview of their developmental status.

You will need to consider health status over the range of categories, i.e.: physical, psychological, cognitive, social and affective. You will gain some understanding of their issues through observation of their behaviour and responses.

Questioning regarding physical health status is likely to focus on:

- Family/domestic situation
- Work/school situation
- Health
- Mental health
- Emotional health
- Friends/social situation.

Asking questions which investigate these areas will enable you to gain an understanding of the client's situation and developmental status. Information gained should highlight areas in which physical health status from normal status. While the specifics will differ for different client groups, what you are seeking (in general) is evidence of issues which compromise the client's everyday life and sense of well-being.

Key issues related to health status you are likely to be looking for include:

- Misuse of alcohol and other drugs
- Mental health issues
- Indicators of abuse, neglect or harm, including self-harm
- Having no accommodation, employment or money
- Indications of domestic or family violence
- Any other issues related to development which may be deemed detrimental to the client or to others
- Emotional issues which are impacting on the client's ability to function on a day-to- day basis
- Language and/or learning disabilities and other issues related to cognitive functioning
- Health issues which are compromising daily functioning and well-being.

Communication skills for information gathering

Communication skills are an important part of the information gathering process, as how you communicate will impact on what information the client is prepared to give you. Your ability to observe, listen and interpret what the client communicates will also impact on the quality and depth of information you obtain. Communication, as you are no doubt aware, involves a great deal more than the actual words exchanged. What does your interaction with the client communicate about your intentions, commitment and attitudes towards the client?

Your aim should be to communicate:

- Your interest in determining the client's needs in order to promote their well-being
- Your commitment to maximising the client's potential for expressing their needs and making independent choices
- Your awareness of any factors which might influence the way your communication is perceived (eg: cultural factors, emotional issues, issues related to physical or intellectual disability, language barriers).

When working with clients it is important to be aware of the sorts of questions you use. It is important to know what information you are trying to elicit and to frame your questions in order to most effectively gain this information. It is also important to consider the client's feelings, their state of mind, and their situation and to adapt your manner of approaching them accordingly.

Making statements

Statements may be used in interactions for a number of reasons:

- To provide factual information, eg: about yourself or your organisation, or the range of treatment options available to the client
- To give feedback regarding what you have observed, both within the immediate situation and at other times
- As a way of defining your role or the roles of others
- It is important to remember that while there are many valid reasons for providing information through statements to the client, there are also inappropriate reasons.

Other factors which might impact on the communication process

A range of other factors may impact on the way you communicate with a client. You need to be aware of how any of these may limit the capacity for information sharing.

Consider the following:

- Language ability, i.e.: the client's ability to understand what you are saying and express themselves verbally
- Cultural factors, i.e.: English language capabilities, as well as other communication protocols related to culture
- Emotional difficulties that may impact on the client's ability to communicate in the immediate situation, eg: if the client has been upset by something
- Mental health issues, eg: social phobia, trauma, anxiety, depression
- Substance abuse issues, eg: have difficulty sharing information because they are intoxicated or under the influence of drugs.
- Presence of others who might impede communication, eg: a parent who tends to talk 'over' or for the client, or the presence of someone with whom the client does not wish to share personal information
- The client's sense of safety and comfort in the immediate environment
- The impact of health issues, eg: illness or pain, limiting their ability to participate in the interaction
- The level of rapport that has been established with you. Do they trust you? Do they know you? Do they understand your role?

Informal and formal information gathering

Information gathering can be a formal process (eg: through the use of standard organisational forms and procedures, but it is also important to be alert to what information you might gain from within a range of less formal interactive situations. Informal interactions (i.e.: those that occur spontaneously, not necessarily for the purpose of gathering information) can often provide as much information as more formal, planned information gathering sessions.

Depending on your work situation, you may have many opportunities to interact with clients in a variety of informal situations, such as having a chat in the hallway or the car park or interacting during the course of other activities. Informal settings can provide good opportunities for gathering information. Because they may be more relaxed than formal settings, you may find that the interaction is also more relaxed. Information may be revealed in these more spontaneous circumstances that may not have been revealed in a more formal setting. Just ensure that the conversation is kept confidential, not within earshot of others nearby.

Things to remember about informal interactions:

- Confidentiality still applies – what you hear informally is subject to the same confidentiality protocol and procedures as information obtained in a formal interview.
- Documentation is important – write down things that you observe as soon as you can after the interaction, eg: any behaviours you might have noticed, any issues or concerns raised. Written documentation enables accountability and the formation of a comprehensive picture of the client's circumstances. If you witness behaviour or are told of issues that concern you in an informal situation, make sure you respond to these concerns.
- Report to your supervisor or other appropriate person. You may be alerted to concerns in informal situations which prompt you to begin more formal investigations. Again, make sure these concerns are documented and followed through, according to organisational procedure and policy.

Formal information gathering

Formal information gathering may involve any of the following:

- Use of standard forms for assessment, eg: question forms or survey forms, used within your organisation
- Use of prepared questions, which are aimed at obtaining specific information
- One-on-one interviews or group interviews, eg: with family members, peers, action group/taskforce.

When carrying out an interview:

- Do your preparation.

Think about:

- Exactly what you need to know
- What you already know from documented sources
- What you wish to use the information for, eg: is it to plan programs and intervention, to establish possible referral sources or to determine which programs the client might benefit from?
- The best ways to obtain specific information, eg: the specific language and wording of your questions, especially with regards to client's level of understanding
- The client's specific needs, eg: an interpreter, or if working with a child, the presence of an adult/carer.

Consider the setting. We are all aware that immediate surroundings can have an impact on how relaxed we feel and therefore on how comfortable we feel about sharing information. With regards to the physical setting you provide for a formal interview, it is important to make sure that it is private, free from distractions, comfortable, appropriately furnished, quiet and non-threatening.

Establish rapport. You may or may not know the client. In either case, it is Important to establish a sense of trust and openness in the interview situation. Introduce yourself. Let the individual know what your role is and why they should Trust you. Let them know what the interview is about, what you are trying to Achieve and how you plan to achieve it. Demonstrate warmth and openness in your own behaviour.

Use communication skills to ensure that the client remains comfortable, has the opportunity to express themselves and provides you with sufficient information to make decisions regarding future action.

Ensure confidentiality. Explain your limits of confidentiality so the client is aware of what you need to report.

Also, think about what the client takes away from the interview. Make sure the client has some sense that the information obtained will be used to support them. They need to feel like the interview or information gathering session was useful and that they understood your intentions. Finishing an interview should involve providing some concrete steps for achievable action, or at least reassurance that the information will be acted upon in the near future.

Finishing should also provide some opportunity for the client to provide feedback:

- Does the client feel that the interview achieved what it set out to achieve?
- How does the client feel about the session?
- Do they need to talk about or clarify anything else?
- Have they understood what the interview was for and what it is hoped will be achieved?
- Have other meeting times been set in place?

One

Obtaining accurate information about physical health status through observation, questioning or review of documentation

1. Explain why you should review a person's medical records before obtaining information about a person’s physical health status through observation, questioning is important.

Interpreting information based on understanding of the structure and functioning of body systems

To obtain and check information relating to a client's physical health status, and to identify variations from a normal physical health status, it is critical to understand the normal structure and function of each body system. To assist you with the practical application of anatomy and physiology, the information in this topic aims to explain the terms 'health' and 'disease', the factors that affect them and the role of the health care professional in assessment. This information is related and applied to each body system in the topics and activities that follow.

Anatomy and physiology

Anatomy describes the structure and location of the different components of an organism to provide a framework for understanding. Human anatomy studies the way that every part of a human, from molecules to bones, interacts to form a functional whole.

There are two major types of anatomy.

1. Gross (macroscopic) anatomy is the study of anatomical structures that can be seen by the naked eye, such as the external and internal bodily organs.
2. Microscopic anatomy is the study of tiny anatomical structures such as tissues and cells.

Gross anatomy

Gross anatomy can be further subdivided into three different fields:

1. **Surface anatomy:** (or superficial anatomy) is the study of external anatomical features without dissection
2. **Regional anatomy:** focuses on specific external and internal regions of the body (such as the head or chest) and how different systems work together in that region
3. **Systemic anatomy:** focuses on the anatomy of different organ systems, such as the respiratory or nervous system.

Regional anatomy is widely used in modern teaching because it is easier to apply to a clinical setting than systemic anatomy. The major anatomy textbook, Gray's Anatomy, has recently been reorganised from a systems format to a regional format to reflect this preference. Surface anatomy is also widely used to gauge the position and structure of deeper organs, tissues, and systems.

Microscopic Anatomy

Within microscopic anatomy, two topics of study are of great importance:

- Cytology, the study of the structure and function of cells
- Histology, the study of the organisation and details of biological tissues.

Physiology

Physiology is the study of how the components of the body function, and biochemistry is the study of the chemistry of living structures. Together with anatomy, these are the three primary disciplines within the field of human biology. Anatomy provides information about structure, location, and organisation of different parts of the body that is needed to truly understand physiology. Together, anatomy and physiology explain the structure and function of the different components of the human body to describe what it is and how it works.

- **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.

Structures of the Human Body

Human beings are arguably the most complex organisms on this planet. Imagine billions of microscopic parts, each with its own identity, working together in an organized manner for the benefit of the total being.

The human body is a single structure but it is made up of billions of smaller structures of four major kinds:

1. **Cells:** have long been recognised as the simplest units of living matter that can maintain life and reproduce themselves. The human body, which is made up of numerous cells, begins as a single, newly fertilized cell.
2. **Tissues:** are somewhat more complex units than cells. By definition, a tissue is an organisation of a great many similar cells with varying amounts and kinds of nonliving, intercellular substance between them.
3. **Organs:** are more complex units than tissues. An organ is an organisation of several different kinds of tissues so arranged that together they can perform a special function. For example, the stomach is an organisation of muscle, connective, epithelial, and nervous tissues. Muscle and connective tissues form its wall, epithelial and connective tissues form its lining, and nervous tissue extends throughout both its wall and its lining.
4. **Systems:** are the most complex of the component units of the human body. A system is an organisation of varying numbers and kinds of organs so arranged that together they can perform complex functions for the body.

Body functions and Life Process: Body Functions

Body functions are the physiological or psychological functions of body systems. The body's functions are ultimately its cells' functions. Survival is the body's most important business. Survival depends on the body's maintaining or restoring homeostasis, a state of relative constancy, of its internal environment.

More than a century ago, French physiologist, Claude Bernard (1813-1878), made a remarkable observation. He noted that body cells survived in a healthy condition only when the temperature, pressure, and chemical composition of their environment remained relatively constant. Later, an American physiologist, Walter B. Cannon (1871-1945), suggested the name homeostasis for the relatively constant states maintained by the body. Homeostasis is a key word in modern physiology. It comes from two Greek words - "homeo," meaning the same, and "stasis," meaning standing. "Standing or staying the same" then is the literal meaning of homeostasis. However, as Cannon emphasized, homeostasis does not mean something set and immobile that stays exactly the same all the time. In his words, homeostasis "means a condition that may vary, but which is relatively constant." Homeostasis depends on the body's ceaselessly carrying on many activities. Its major activities or functions are responding to changes in the body's environment, exchanging materials between the environment and cells, metabolising foods, and integrating all of the body's diverse activities.

The body's ability to perform many of its functions changes gradually over the years. In general, the body performs its functions least well at both ends of life - in infancy and in old age. During childhood, body functions gradually become more and more efficient and effective. During late maturity and old age the opposite is true. They gradually become less and less efficient and effective. During young adulthood, they normally operate with maximum efficiency and effectiveness.

Life process

All living organisms have certain characteristics that distinguish them from non-living forms. The basic processes of life include organisation, metabolism, responsiveness, movements, and reproduction. In humans, who represent the most complex form of life, there are additional requirements such as growth, differentiation, respiration, digestion, and excretion. All of these processes are interrelated. No part of the body, from the smallest cell to a complete body system, works in isolation. All function together, in fine-tuned balance, for the well being of the individual and to maintain life. Disease such as cancer and death represent a disruption of the balance in these processes.

The following are a brief description of the life process:

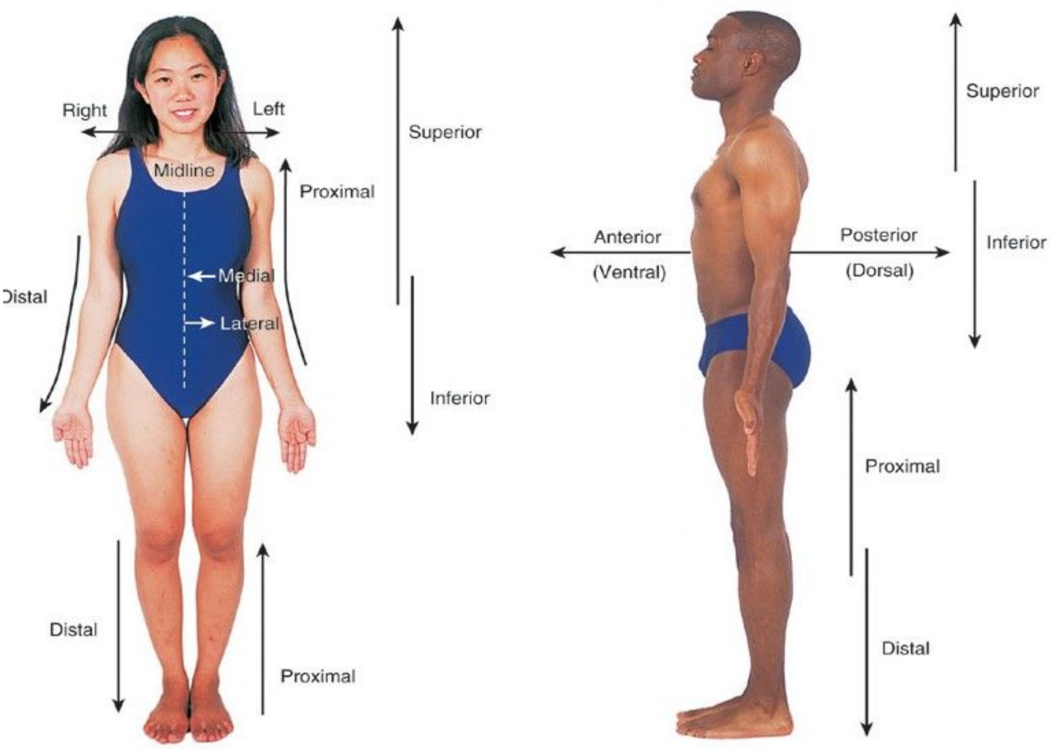
- **Organisation:** At all levels of the organisational scheme, there is a division of labour. Each component has its own job to perform in cooperation with others. Even a single cell, if it loses its integrity or organisation, will die
- **Metabolism:** Metabolism is a broad term that includes all the chemical reactions that occur in the body. One phase of metabolism is catabolism in which complex substances are broken down into simpler building blocks and energy is released
- **Responsiveness:** Responsiveness or irritability is concerned with detecting changes in the internal or external environments and reacting to that change. It is the act of sensing a stimulus and responding to it
- **Movement:** There are many types of movement within the body. On the cellular level, molecules move from one place to another. Blood moves from one part of the body to another. The diaphragm moves with every breath. The ability of muscle fibres to shorten and thus to produce movement is called contractility
- **Reproduction:** For most people, reproduction refers to the formation of a new person, the birth of a baby. In this way, life is transmitted from one generation to the next through reproduction of the organism. In a broader sense, reproduction also refers to the formation of new cells for the replacement and repair of old cells as well as for growth. This is cellular reproduction. Both are essential to the survival of the human race
- **Growth:** Growth refers to an increase in size either through an increase in the number of cells or through an increase in the size of each individual cell. In order for growth to occur, anabolic processes must occur at a faster rate than catabolic processes
- **Differentiation:** Differentiation is a developmental process by which unspecialised cells change into specialized cells with distinctive structural and functional characteristics. Through differentiation, cells develop into tissues and organs
- **Respiration:** Respiration refers to all the processes involved in the exchange of oxygen and carbon dioxide between the cells and the external environment. It includes ventilation, the diffusion of oxygen and carbon dioxide, and the transport of the gases in the blood. Cellular respiration deals with the cell's utilisation of oxygen and release of carbon dioxide in its metabolism
- **Digestion:** Digestion is the process of breaking down complex ingested foods into simple molecules that can be absorbed into the blood and utilised by the body
- **Excretion:** Excretion is the process that removes the waste products of digestion and metabolism from the body. It gets rid of by-products that the body is unable to use, many of which are toxic and incompatible with life. The ten life processes described above are not enough to ensure the survival of the individual. In addition to these processes, life depends on certain physical factors from the environment. These include water, oxygen, nutrients, heat, and pressure.

Anatomical terminology

It is necessary to learn some useful terms for describing body structure. Knowing these terms will make it much easier for us to understand the content of this unit. Three groups of terms are introduced here:

Directional terms of the body

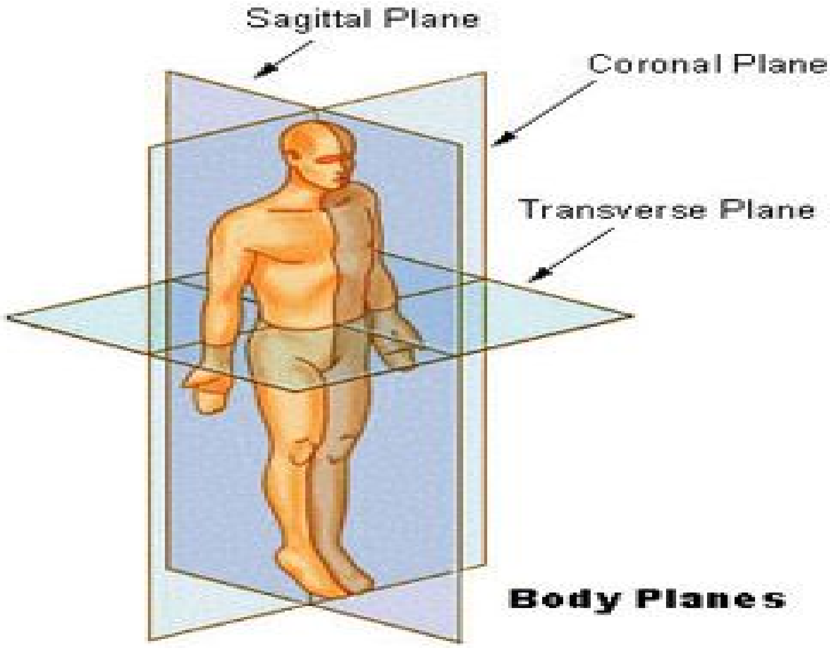
There are standard terms that can be used to explain exactly where body parts are in relation to other body parts. When you look at the standing position diagrams given below, you will note that when describing the relationship of one body part to the next, the figure faces forward, arms are slightly 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.

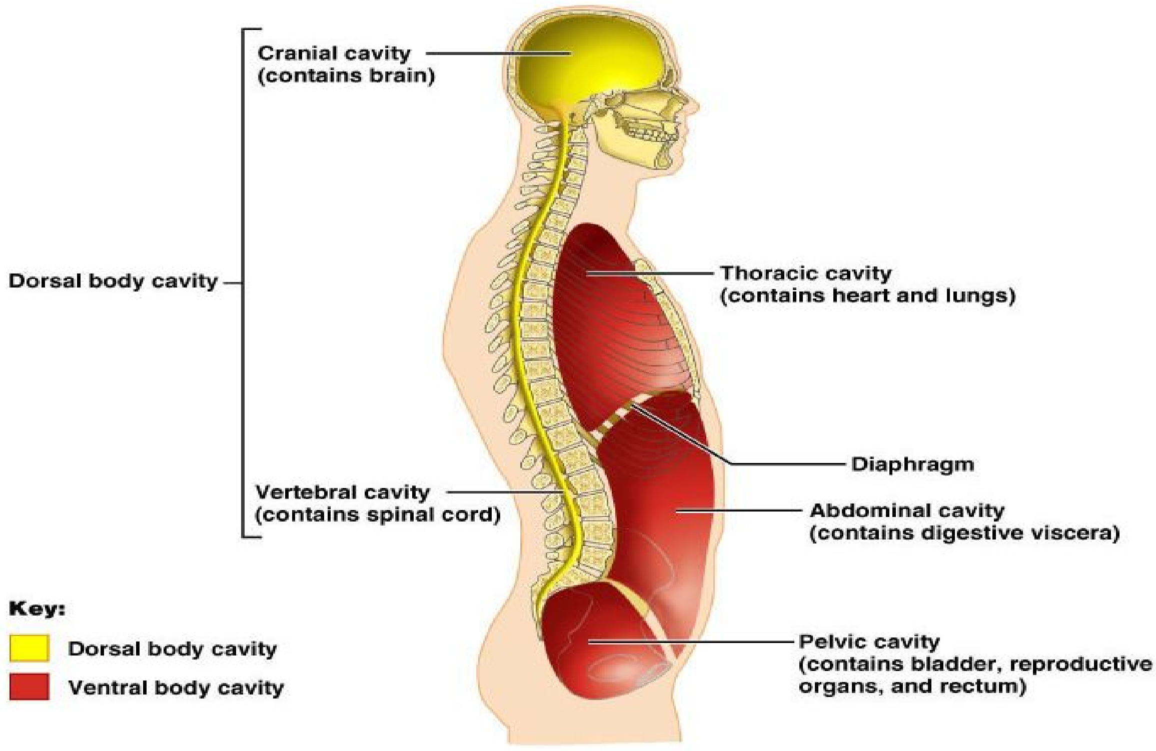
DIRECTIONAL	DEFINITION	EXAMPLE
Superior	Upper or above a structure	Head superior to the neck
Inferior	Below or lower than other structures	Toes inferior to the femur
Anterior	Front part of the body	Structures include nose, sternum, pelvis, knee, toes
Posterior	Back part of the body	Structures include 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

Planes of the body



- **Coronal Plane (Frontal Plane) -** A vertical plane running from side to side; divides the body or any of its parts into anterior and posterior portions
- **Sagittal Plane (Lateral Plane) -** A vertical plane running from front to back; divides the body or any of its parts into right and left sides
- **Axial Plane (Transverse Plane) -** A horizontal plane; divides the body or any of its parts into upper and lower parts
- **Median plane -** Sagittal plane through the midline of the body; divides the body or any of its parts into right and left halves.

Body cavities



(a) Lateral view

Spaces within the body contain the major cavities, namely:

1. **Dorsal cavity:** protects the nervous system, and is divided into two subdivisions.
2. **Cranial cavity:** is within the skull and encases the brain.
3. **Vertebral cavity:** runs within the vertebral column and encases the spinal cord.
4. **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

- **Pleural cavities:** each houses a lung
- **Mediastinum:** contains the pericardial cavity, and surrounds the remaining thoracic organs
- **Pericardial cavity:** encloses the heart
- **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.

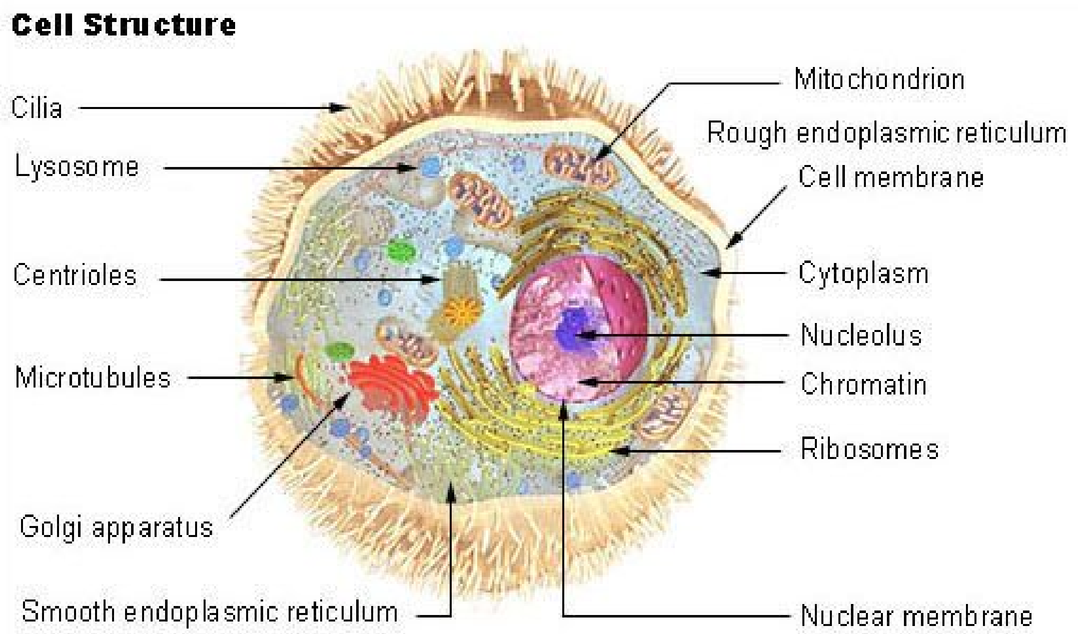
Cells, tissues, and membranes

Cell structure and function

Cells, the smallest structures capable of maintaining life and reproducing, compose all living things, from single-celled plants to multibillion-celled animals. The human body, which is made up of numerous cells, begins as a single, newly fertilized cell. Almost all human cells are microscopic in size. To give you an idea how small a cell is, one average-sized adult body, according to one estimate, consists of 100 trillion cells!

Cell structure

Ideas about cell structure have changed considerably over the years. Early biologists saw cells as simple membranous sacs containing fluid and a few floating particles. Today's biologists know that cells are infinitely more complex than this.



There are many different types, sizes, and shapes of cells in the body. For descriptive purposes, the concept of a "generalised cell" is introduced. It includes features from all cell types. A cell consists of three parts: the cell membrane, the nucleus, and, between the two, the cytoplasm. Within the cytoplasm lie intricate arrangements of fine fibers and hundreds or even thousands of miniscule but distinct structures called organelles.

Cell membrane: Every cell in the body is enclosed by a cell (Plasma) membrane. The cell membrane separates the material outside the cell, extracellular, from the material inside the cell, intracellular. It maintains the integrity of a cell and controls passage of materials into and out of the cell. All materials within a cell must have access to the cell membrane (the cell's boundary) for the needed exchange. The cell membrane is a double layer of phospholipid molecules. Proteins in the cell membrane provide structural support, form channels for passage of materials, act as receptor sites, function as carrier molecules, and provide identification markers.

Nucleus and Nucleolus: The nucleus, formed by a nuclear membrane around a fluid nucleoplasm, is the control center of the cell. Threads of chromatin in the nucleus contain deoxyribonucleic acid (DNA), the genetic material of the cell. The nucleolus is a dense region of ribonucleic acid (RNA) in the nucleus and is the site of ribosome formation. The nucleus determines how the cell will function, as well as the basic structure of that cell.

Cytoplasm: The cytoplasm is the gel-like fluid inside the cell. It is the medium for chemical reaction. It provides a platform upon which other organelles can operate within the cell. All of the functions for cell expansion, growth and replication are carried out in the cytoplasm of a cell. Within the cytoplasm, materials move by diffusion, a physical process that can work only for short distances.

Cytoplasmic organelles: Cytoplasmic organelles are "little organs" that are suspended in the cytoplasm of the cell. Each type of organelle has a definite structure and a specific role in the function of the cell. Examples of cytoplasmic organelles are mitochondrion, ribosomes, endoplasmic reticulum, golgi apparatus, and lysosomes.

Cell function

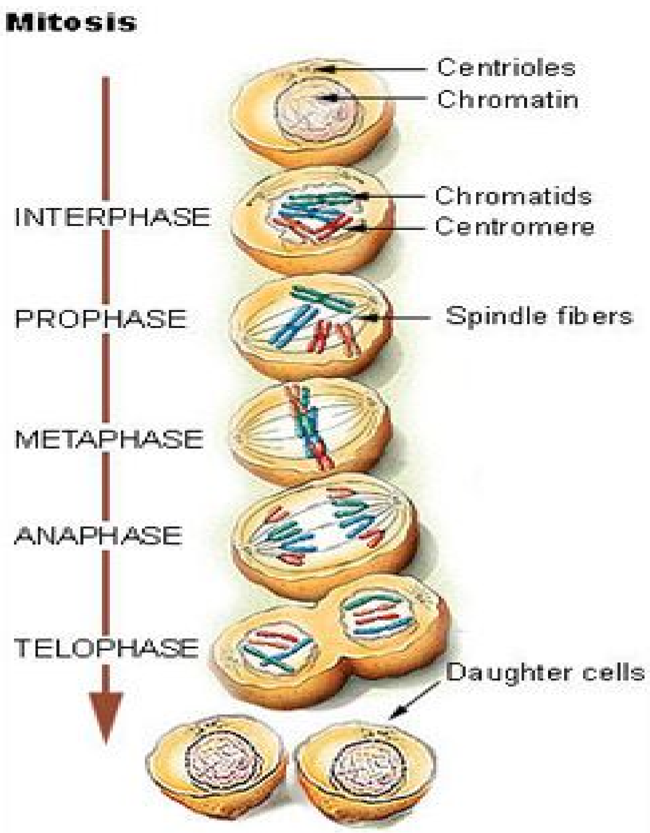
The structural and functional characteristics of different types of cells are determined by the nature of the proteins present. Cells of various types have different functions because cell structure and function are closely related. It is apparent that a cell that is very thin is not well suited for a protective function. Bone cells do not have an appropriate structure for nerve impulse conduction. Just as there are many cell types, there are varied cell functions. The generalized cell functions include movement of substances across the cell membrane, cell division to make new cells, and protein synthesis.

Movement of substances across the cell membrane

The survival of the cell depends on maintaining the difference between extracellular and intracellular material. Mechanisms of movement across the cell membrane include simple diffusion, osmosis, filtration, active transport, endocytosis, and exocytosis.

Simple diffusion is the movement of particles (solutes) from a region of higher solute concentration to a region of lower solute concentration. Osmosis is the diffusion of solvent or water molecules through a selectively permeable membrane. Filtration utilizes pressure to push substances through a membrane. Active transport moves substances against a concentration gradient from a region of lower concentration to a region of higher concentration. It requires a carrier molecule and uses energy. Endocytosis refers to the formation of vesicles to transfer particles and droplets from outside to inside the cell. Secretory vesicles are moved from the inside to the outside of the cell by exocytosis.

Cell division



Cell division is the process by which new cells are formed for growth, repair, and replacement in the body. This process includes division of the nuclear material and division of the cytoplasm. All cells in the body (somatic cells), except those that give rise to the eggs and sperm (gametes), reproduce by mitosis. Egg and sperm cells are produced by a special type of nuclear division called meiosis in which the number of chromosomes is halved. Division of the cytoplasm is called cytokinesis.

Somatic cells reproduce by mitosis, which results in two cells identical to the one parent cell. Interphase is the period between successive cell divisions. It is the longest part of the cell cycle. The successive stages of mitosis are prophase, metaphase, anaphase, and telophase. Cytokinesis, division of the cytoplasm, occurs during telophase. Meiosis is a special type of cell division that occurs in the production of the gametes, or eggs and sperm. These cells have only 23 chromosomes, one-half the number found in somatic cells, so that when fertilization takes place the resulting cell will again have 46 chromosomes, 23 from the egg and 23 from the sperm.

DNA replication and protein synthesis

Proteins that are synthesized in the cytoplasm function as structural materials, enzymes that regulate chemical reactions, hormones, and other vital substances. DNA in the nucleus directs protein synthesis in the cytoplasm. A gene is the portion of a DNA molecule that controls the synthesis of one specific protein molecule. Messenger RNA carries the genetic information from the DNA in the nucleus to the sites of protein synthesis in the cytoplasm.

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.

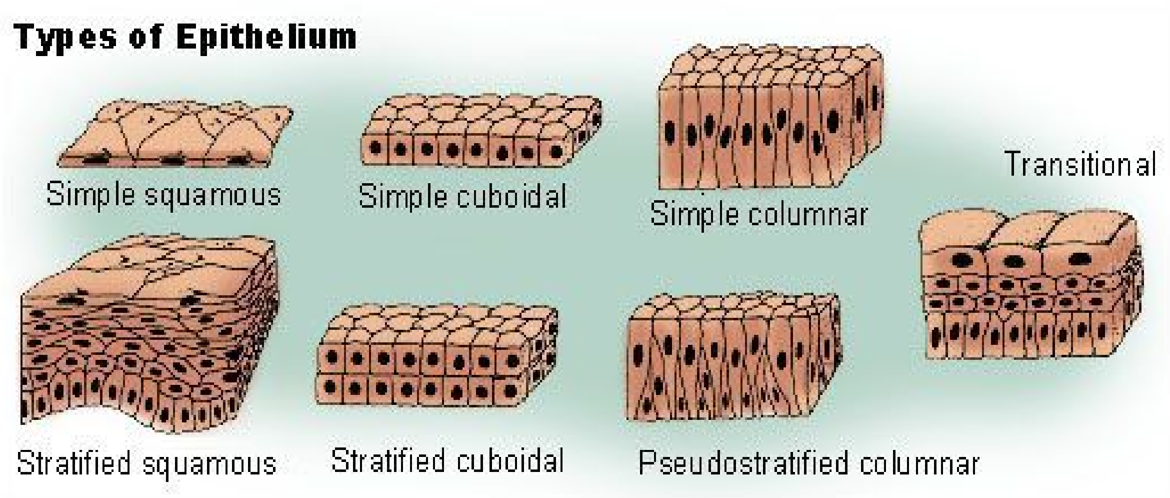
Body tissues

Tissue is a group of cells that have similar structure and that function together as a unit. A nonliving material, called the intercellular matrix, fills the spaces between the cells. This may be abundant in some tissues and minimal in others. The intercellular matrix may contain special substances such as salts and fibers that are unique to a specific tissue and gives that tissue distinctive characteristics. There are four main tissue types in the body: epithelial, connective, muscle, and nervous. Each is designed for specific functions.

Epithelial tissue

Epithelial tissues are widespread throughout the body. They form the covering of all body surfaces, line body cavities and hollow organs, and are the major tissue in glands. They perform a variety of functions that include protection, secretion, absorption, excretion, filtration, diffusion, and sensory reception.

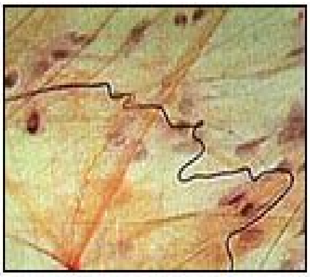
The cells in epithelial tissue are tightly packed together with very little intercellular matrix. Because the tissues form coverings and linings, the cells have one free surface that is not in contact with other cells. Opposite the free surface, the cells are attached to underlying connective tissue by a non-cellular basement membrane. This membrane is a mixture of carbohydrates and proteins secreted by the epithelial and connective tissue cells. Epithelial cells may be squamous, cuboidal, or columnar in shape and may be arranged in single or multiple layers.

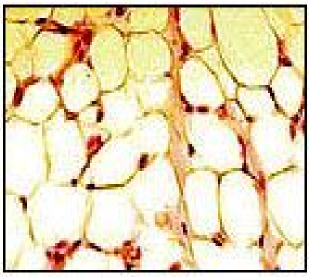


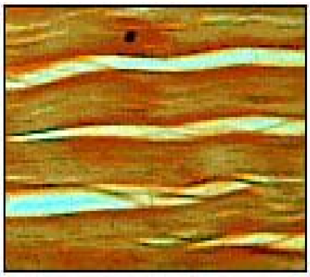
Simple cuboidal epithelium is found in glandular tissue and in the kidney tubules. Simple columnar epithelium lines the stomach and intestines. Pseudostratified columnar epithelium lines portions of the respiratory tract and some of the tubes of the male reproductive tract. Transitional epithelium can be distended or stretched. Glandular epithelium is specialized to produce and secrete substances.

Connective tissue

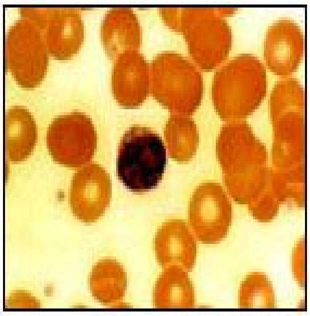
Connective tissues bind structures together, form a framework and support for organs and the body as a whole, store fat, transport substances, protect against disease, and help repair tissue damage. They occur throughout the body. Connective tissues are characterized by an abundance of intercellular matrix with relatively few cells. Connective tissue cells are able to reproduce but not as rapidly as epithelial cells. Most connective tissues have a good blood supply but some do not.

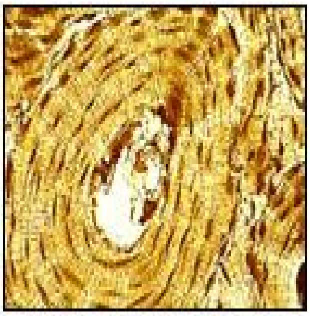

Areolar connective tissue


Adipose tissue


Fibrous connective tissue

Numerous cell types are found in connective tissue. Three of the most common are the fibroblast, macrophage, and mast cell. The types of connective tissue include loose connective tissue, adipose tissue, dense fibrous connective tissue, elastic connective tissue, cartilage, osseous tissue (bone), and blood.


Blood

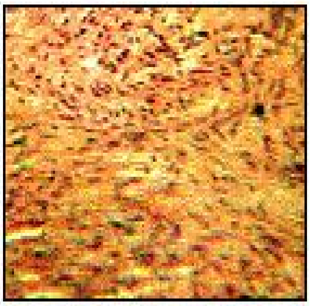

Osseous tissue

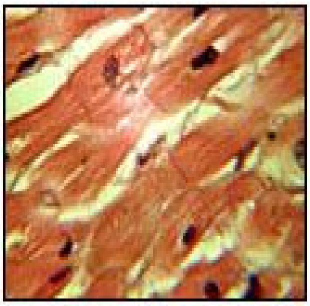

Hyaline cartilage

Muscle tissue

Muscle tissue is composed of cells that have the special ability to shorten or contract in order to produce movement of the body parts. The tissue is highly cellular and is well supplied with blood vessels. The cells are long and slender so they are sometimes called muscle fibers, and these are usually arranged in bundles or layers that are surrounded by connective tissue. Actin and myosin are contractile proteins in muscle tissue. Muscle tissue can be categorised into skeletal muscle tissue, smooth muscle tissue, and cardiac muscle tissue.


Skeletal muscle


Smooth muscle


Cardiac muscle

Skeletal muscle fibers are cylindrical, multinucleated, striated, and under voluntary control. Smooth muscle cells are spindle shaped, have a single, centrally located nucleus, and lack striations. They are called involuntary muscles. Cardiac muscle has branching fibers, one nucleus per cell, striations, and intercalated disks. Its contraction is not under voluntary control.

Nervous tissue

Nervous tissue is found in the brain, spinal cord, and nerves. It is responsible for coordinating and controlling many body activities. It stimulates muscle contraction, creates an awareness of the environment, and plays a major role in emotions, memory, and reasoning. To do all these things, cells in nervous tissue need to be able to communicate with each other by way of electrical nerve impulses. The cells in nervous tissue that generate and conduct impulses are called neurons or nerve cells. These cells have three principal parts: the dendrites, the cell body, and one axon. The main part of the cell, the part that carries on the general functions, is the cell body.

Dendrites are extensions, or processes, of the cytoplasm that carry impulses to the cell body. An extension or process called an axon carries impulses away from the cell body. Nervous tissue also includes cells that do not transmit impulses, but instead support the activities of the neurons. These are the glial cells (neuroglial cells), together termed the neuroglia. Supporting, or glia, cells bind neurons together and insulate the neurons. Some are phagocytic and protect against bacterial invasion, while others provide nutrients by binding blood vessels to the neurons.

Membranes

Body membranes are thin sheets of tissue that cover the body, line body cavities, and cover organs within the cavities in hollow organs. They can be categorised into epithelial and connective tissue membrane.

Epithelial membranes

1. **Epithelial membranes**: consist of epithelial tissue and the connective tissue to which it is attached. The two main types of epithelial membranes are the mucous membranes and serous membranes.
2. **Mucous membranes:** Mucous membranes are epithelial membranes that consist of epithelial tissue that is attached to an underlying loose connective tissue. These membranes, sometimes called mucosae, line the body cavities that open to the outside. The entire digestive tract is lined with mucous membranes. Other examples include the respiratory, excretory, and reproductive tracts.
3. **Serous membranes:** Serous membranes line body cavities that do not open directly to the outside, and they cover the organs located in those cavities. Serous membranes are covered by a thin layer of serous fluid that is secreted by the epithelium. Serous fluid lubricates the membrane and reduces friction and abrasion when organs in the thoracic or abdominopelvic cavity move against each other or the cavity wall. Serous membranes have special names given according to their location. For example, the serous membrane that lines the thoracic cavity and covers the lungs is called pleura.

Connective tissue membranes

Connective tissue membranes contain only connective tissue. Synovial membranes and meninges belong to this category.

Synovial membranes: Synovial membranes are connective tissue membranes that line the cavities of the freely movable joints such as the shoulder, elbow, and knee. Like serous membranes, they line cavities that do not open to the outside. Unlike serous membranes, they do not have a layer of epithelium. Synovial membranes secrete synovial fluid into the joint cavity, and this lubricates the cartilage on the ends of the bones so that they can move freely and without friction.

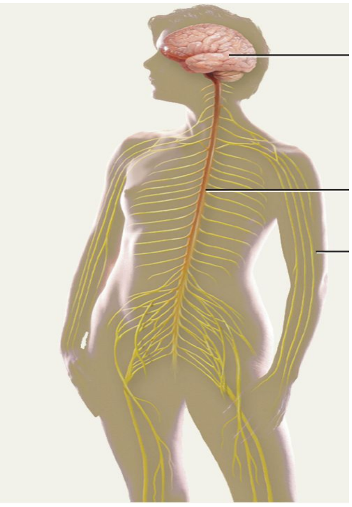
Meninges: The connective tissue covering on the brain and spinal cord, within the dorsal cavity, are called meninges. They provide protection for these vital structures.

Major Body Systems

Systems are the most complex of the component units of the human body. A system is an organisation of varying numbers and kinds of organs so arranged that together they can perform complex functions for the body. Eleven major systems compose 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 major controlling, regulatory, and communicating system in the body. It is the centre of all mental activity including thought, learning, and memory. Together with the endocrine system, the nervous system is responsible for regulating and maintaining homeostasis. Through its receptors, the nervous system keeps us in touch with our environment, both external and internal. Like other systems in the body, the nervous system is composed of organs, principally the brain, spinal cord, nerves, and ganglia. These, in turn, consist of various tissues, including nerve, blood, and connective tissue. Together these carry out the complex activities of the nervous system.

The various activities of the nervous system can be grouped together as three general, overlapping functions:

1. Sensory.
2. Integrative.
3. Motor.

Millions of sensory receptors detect changes, called stimuli, which occur inside and outside the body. They monitor such things as temperature, light, and sound from the external environment. Inside the body, the internal environment, receptors detect variations in pressure, pH, carbon dioxide concentration, and the levels of various electrolytes. All of this gathered information is called sensory input. Sensory input is converted into electrical signals called nerve impulses that are transmitted to the brain. There the signals are brought together to create sensations, to produce thoughts, or to add to memory; Decisions are made each moment based on the sensory input. This is integration.

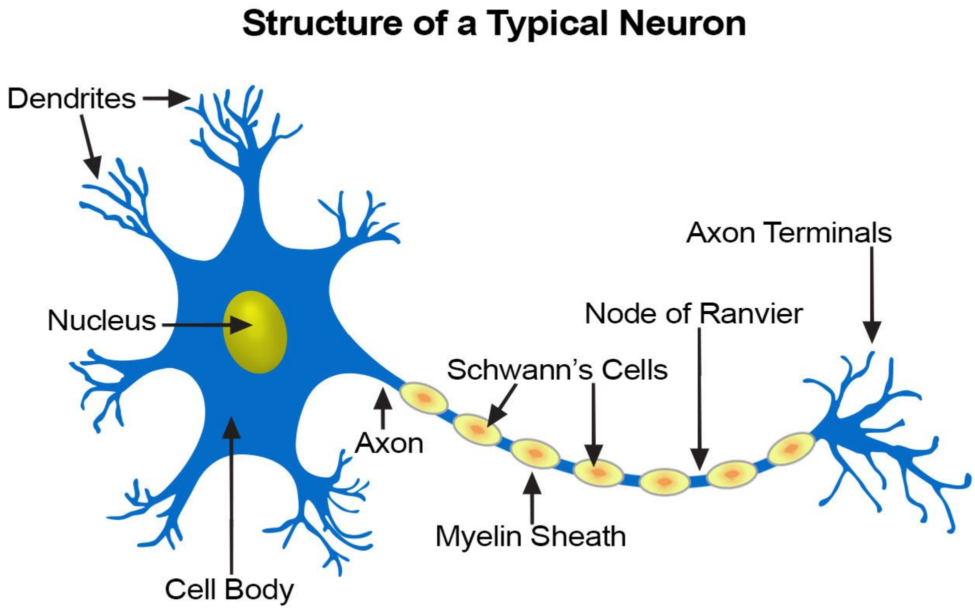
Based on the sensory input and integration, the nervous system responds by sending signals to muscles, causing them to contract, or to glands, causing them to produce secretions. Muscles and glands are called effectors because they cause an effect in response to directions from the nervous system. This is the motor output or motor function.

Nerve tissue

Although the nervous system is very complex, there are only two main types of cells in nerve tissue. The actual nerve cell is the neuron. It is the "conducting" cell that transmits impulses and the structural unit of the nervous system. The other type of cell is neuroglia, or glial, cell. The word "neuroglia" means "nerve glue." These cells are nonconductive and provide a support system for the neurons. They are a special type of "connective tissue" for the nervous system.

Neurons

Neurons, or nerve cells, carry out the functions of the nervous system by conducting nerve impulses. They are highly specialised and amitotic. This means that if a neuron is destroyed, it cannot be replaced because neurons do not go through mitosis. The image below illustrates the structure of a typical neuron.



Each neuron has **<u>three basic parts</u>**: cell body (soma), one or more dendrites, and a single axon.

1. Cell Body

In many ways, the cell body is similar to other types of cells. It has a nucleus with at least one nucleolus and contains many of the typical cytoplasmic organelles. It lacks centrioles, however. Because centrioles function in cell division, the fact that neurons lack these organelles is consistent with the amitotic nature of the cell.

2. Dendrites

Dendrites and axons are cytoplasmic extensions, or processes, that project from the cell body. They are sometimes referred to as fibers. Dendrites are usually, but not always, short and branching, which increases their surface area to receive signals from other neurons. The number of dendrites on a neuron varies. They are called afferent processes because they transmit impulses to the neuron cell body. There is only one axon that projects from each cell body. It is usually elongated and because it carries impulses away from the cell body, it is called an efferent process.

3. Axon

An axon may have infrequent branches called axon collaterals. Axons and axon collaterals terminate in many short branches or telodendria. The distal ends of the telodendria are slightly enlarged to form synaptic bulbs. Many axons are surrounded by a segmented, white, fatty substance called myelin or the myelin sheath. Myelinated fibers make up the white matter in the CNS, while cell bodies and unmyelinated fibers make the gray matter. The unmyelinated regions between the myelin segments are called the nodes of Ranvier.

In the peripheral nervous system, the myelin is produced by Schwann cells. The cytoplasm, nucleus, and outer cell membrane of the Schwann cell form a tight covering around the myelin and around the axon itself at the nodes of Ranvier. This covering is the neurilemma, which plays an important role in the regeneration of nerve fibers. In the CNS, oligodendrocytes produce myelin, but there is no neurilemma, which is why fibers within the CNS do not regenerate.

Functionally, neurons are classified as afferent, efferent, or interneurons (association neurons) according to the direction in which they transmit impulses relative to the central nervous system. Afferent, or sensory, neurons carry impulses from peripheral sense receptors to the CNS. They usually have long dendrites and relatively short axons. Efferent, or motor, neurons transmit impulses from the CNS to effector organs such as muscles and glands. Efferent neurons usually have short dendrites and long axons. Interneurons, or association neurons, are located entirely within the CNS in which they form the connecting link between the afferent and efferent neurons. They have short dendrites and may have either a short or long axon.

Neuroglia

Neuroglia cells do not conduct nerve impulses, but instead, they support, nourish, and protect the neurons. They are far more numerous than neurons and, unlike neurons, are capable of mitosis.

Tumours

Schwannomas are benign tumours of the peripheral nervous system which commonly occur in their sporadic, solitary form in otherwise normal individuals. Rarely, individuals develop multiple schwannomas arising from one or many elements of the peripheral nervous system. Commonly called a Morton's Neuroma, this problem is a fairly common benign nerve growth and begins when the outer coating of a nerve in your foot thickens. This thickening is caused by irritation of branches of the medial and lateral plantar nerves that results when two bones repeatedly rub together.

Organisation of the Nervous System

Although terminology seems to indicate otherwise, there is really only one nervous system in the body. Although each subdivision of the system is also called a "nervous system," all of these smaller systems belong to the single, highly integrated nervous system. Each subdivision has structural and functional characteristics that distinguish it from the others. The nervous system as a whole is divided into two subdivisions: the central nervous system (CNS) and the peripheral nervous system (PNS).

The Central Nervous System

The brain and spinal cord are the organs of the central nervous system. Because they are so vitally important, the brain and spinal cord, located in the dorsal body cavity, are encased in bone for protection. The brain is in the cranial vault, and the spinal cord is in the vertebral canal of the vertebral column. Although considered to be two separate organs, the brain and spinal cord are continuous at the foramen magnum.

The Peripheral Nervous System

The organs of the peripheral nervous system are the nerves and ganglia. Nerves are bundles of nerve fibers, much like muscles are bundles of muscle fibers. Cranial nerves and spinal nerves extend from the CNS to peripheral organs such as muscles and glands. Ganglia are collections, or small knots, of nerve cell bodies outside the CNS.

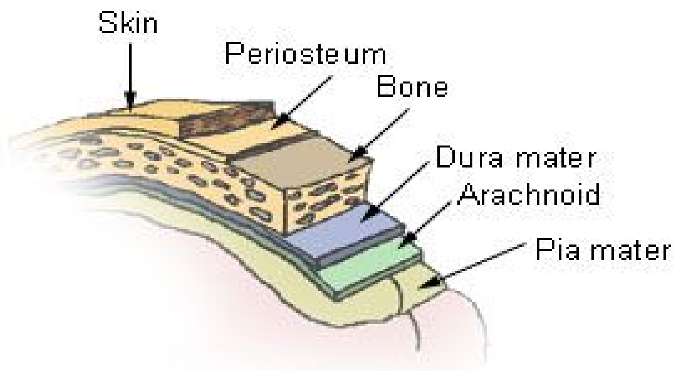
The peripheral nervous system is further subdivided into an afferent (sensory) division and an efferent (motor) division. The afferent or sensory division transmits impulses from peripheral organs to the CNS. The efferent or motor division transmits impulses from the CNS out to the peripheral organs to cause an effect or action.

Finally, the efferent or motor division is again subdivided into the somatic nervous system and the autonomic nervous system. The somatic nervous system, also called the somatomotor or somatic efferent nervous system, supplies motor impulses to the skeletal muscles. Because these nerves permit conscious control of the skeletal muscles, it is sometimes called the voluntary nervous system. The autonomic nervous system, also called the visceral efferent nervous system, supplies motor impulses to cardiac muscle, to smooth muscle, and to glandular epithelium. It is further subdivided into sympathetic and parasympathetic divisions. Because the autonomic nervous system regulates involuntary or automatic functions, it is called the involuntary nervous system.

The Central Nervous System

The CNS consists of the brain and spinal cord, which are located in the dorsal body cavity. The brain is surrounded by the cranium, and the spinal cord is protected by the vertebrae. The brain is continuous with the spinal cord at the foramen magnum. In addition to bone, the CNS is surrounded by connective tissue membranes, called meninges, and by cerebrospinal fluid.

Meninges

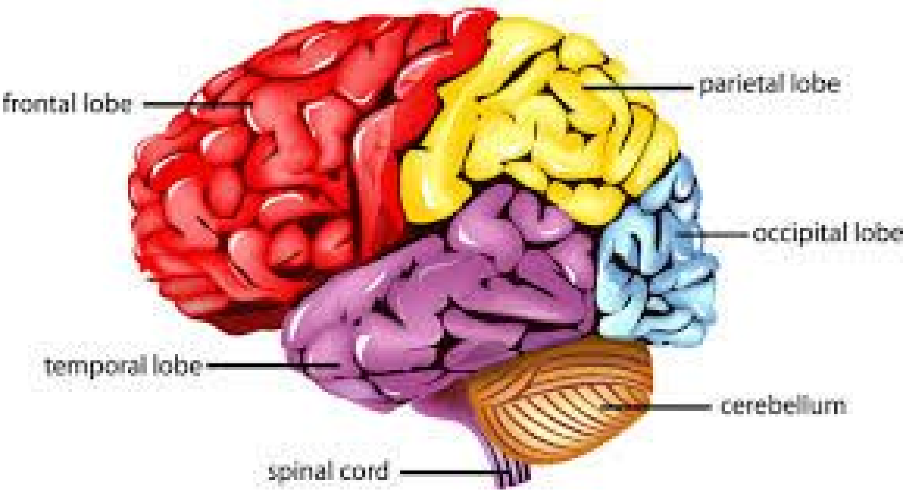


Meninges of the CNS

There are three layers of meninges around the brain and spinal cord. The outer layer, the dura mater, is tough white fibrous connective tissue. The middle layer of meninges is arachnoid, which resembles a cobweb in appearance, is a thin layer with numerous threadlike strands that attach it to the innermost layer. The space under the arachnoid, the subarachnoid space, is filled with cerebrospinal fluid and contains blood vessels. The pia mater is the innermost layer of meninges. This thin, delicate membrane is tightly bound to the surface of the brain and spinal cord and cannot be dissected away without damaging the surface. Meningiomas are tumors of the nerve tissue covering the brain and spinal cord. Although meningiomas are usually not likely to spread, physicians often treat them as though they were malignant to treat symptoms that may develop when a tumor applies pressure to the brain.

Brain

Parts of the Human Brain



The brain is divided into the cerebrum, diencephalons, brain stem, and cerebellum.

Cerebrum: The largest and most obvious portion of the brain is the cerebrum, which is divided by a deep longitudinal fissure into two cerebral hemispheres. The two hemispheres are two separate entities but are connected by an arching band of white fibers, called the corpus callosum that provides a communication pathway between the two halves. Each cerebral hemisphere is divided into five lobes, four of which have the same name as the bone over them: the fontal lobe, the parietal lobe, the occipital lobe, and the temporal lobe. A fifth lobe, the insula or Island of Reil, lies deep within the lateral sulcus.

Diencephalon: The diencephalons is centrally located and is nearly surrounded by the cerebral hemispheres. It includes the thalamus, hypothalamus, and epithalamus. The thalamus, about 80 percent of the diencephalons, consists of two oval masses of gray matter that serve as relay stations for sensory impulses, except for the sense of smell, going to the cerebral cortex. The hypothalamus is a small region below the thalamus, which plays a key role in maintaining homeostasis because it regulates many visceral activities. The epithalamus is the most dorsal portion of the diencephalons. This small gland is involved with the onset of puberty and rhythmic cycles in the body. It is like a biological clock.

Brain stem: The brain stem is the region between the diencephalons and the spinal cord. It consists of three parts: midbrain, pons, and medulla oblongata. The midbrain is the most superior portion of the brain stem. The pons is the bulging middle portion of the brain stem. This region primarily consists of nerve fibers that form conduction tracts between the higher brain centers and spinal cord. The medulla oblongata, or simply medulla, extends inferiorly from the pons. It is continuous with the spinal cord at the foramen magnum. All the ascending (sensory) and descending (motor) nerve fibers connecting the brain and spinal cord pass through the medulla.

Cerebellum: The cerebellum, the second largest portion of the brain, is located below the occipital lobes of the cerebrum. Three paired bundles of myelinated nerve fibers, called cerebellar peduncles, form communication pathways between the cerebellum and other parts of the central nervous system.

Ventricles and Cerebrospinal Fluid: A series of interconnected, fluid-filled cavities are found within the brain. These cavities are the ventricles of the brain, and the fluid is cerebrospinal fluid (CSF).

Spinal cord

The spinal cord extends from the foramen magnum at the base of the skull to the level of the first lumbar vertebra. The cord is continuous with the medulla oblongata at the foramen magnum. Like the brain, the spinal cord is surrounded by bone, meninges, and cerebrospinal fluid. The spinal cord is divided into 31 segments with each segment giving rise to a pair of spinal nerves. At the distal end of the cord, many spinal nerves extend beyond the conus medullaris to form a collection that resembles a horse's tail. This is the cauda equina. In cross section, the spinal cord appears oval in shape.

The spinal cord has two main functions:

1. Serving as a conduction pathway for impulses going to and from the brain. Sensory impulses travel to the brain on ascending tracts in the cord. Motor impulses travel on descending tracts.
2. Serving as a reflex centre. The reflex arc is the functional unit of the nervous system. Reflexes are responses to stimuli that do not require conscious thought and consequently, they occur more quickly than reactions that require thought processes. For example, with the withdrawal reflex, the reflex action withdraws the affected part before you are aware of the pain. Many reflexes are mediated in the spinal cord without going to the higher brain centres.

Brain Tumour

Glioma refers to tumors that arise from the support cells of the brain. These cells are called glial cells. These tumors include the astrocytomas, ependymomas and oligodendrogliomas. These tumors are the most common primary brain tumors.

The Peripheral Nervous System

The peripheral nervous system consists of the nerves that branch out from the brain and spinal cord. These nerves form the communication network between the CNS and the body parts. The peripheral nervous system is further subdivided into the somatic nervous system and the autonomic nervous system. The somatic nervous system consists of nerves that go to the skin and muscles and is involved in conscious activities. The autonomic nervous system consists of nerves that connect the CNS to the visceral organs such as the heart, stomach, and intestines. It mediates unconscious activities.

Structure of a nerve

A nerve contains bundles of nerve fibers, either axons or dendrites, surrounded by connective tissue. Sensory nerves contain only afferent fibers, long dendrites of sensory neurons. Motor nerves have only efferent fibers, long axons of motor neurons. Mixed nerves contain both types of fibers.

A connective tissue sheath called the epineurium surrounds each nerve. Each bundle of nerve fibers is called a fasciculus and is surrounded by a layer of connective tissue called the perineurium. Within the fasciculus, each individual nerve fiber, with its myelin and neurilemma, is surrounded by connective tissue called the endoneurium. A nerve may also have blood vessels enclosed in its connective tissue wrappings.

Cranial nerves

Twelve pairs of cranial nerves emerge from the inferior surface of the brain. All of these nerves, except the vagus nerve, pass through foramina of the skull to innervate structures in the head, neck, and facial region.

The cranial nerves are designated both by name and by Roman numerals, according to the order in which they appear on the inferior surface of the brain. Most of the nerves have both sensory and motor components. Three of the nerves are associated with the special senses of smell, vision, hearing, and equilibrium and have only sensory fibers. Five other nerves are primarily motor in function but do have some sensory fibers for proprioception. The remaining four nerves consist of significant amounts of both sensory and motor fibers.

Acoustic neuromas are benign fibrous growths that arise from the balance nerve, also called the eighth cranial nerve or vestibulocochlear nerve. These tumors are non-malignant, meaning that they do not spread or metastasize to other parts of the body. The location of these tumors is deep inside the skull, adjacent to vital brain centers in the brain stem. As the tumors enlarge, they involve surrounding structures which have to do with vital functions. In the majority of cases, these tumors grow slowly over a period of years. In other cases, the growth rate is more rapid and patients develop symptoms at a faster pace. Usually, the symptoms are mild and many patients are not diagnosed until some time after their tumor has developed. Many patients also exhibit no tumor growth over a number of years when followed by yearly MRI scans.

Spinal nerves

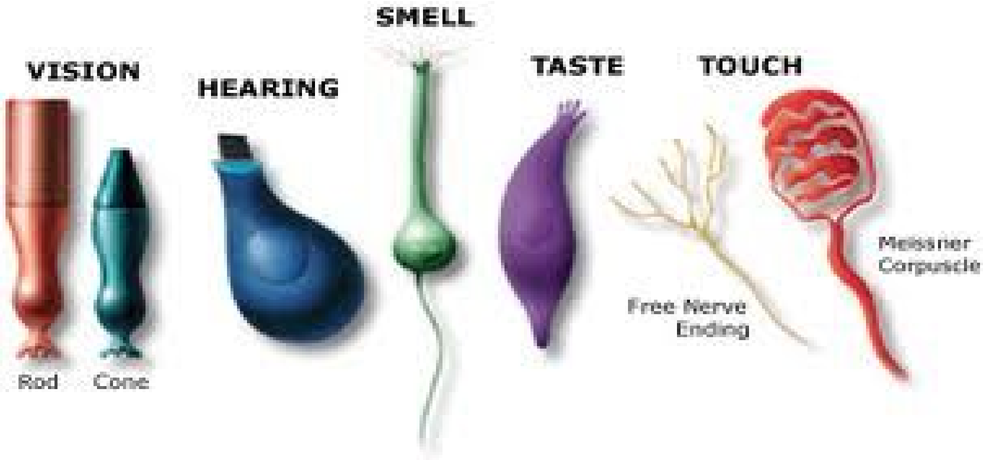
Thirty-one pairs of spinal nerves emerge laterally from the spinal cord. Each pair of nerves corresponds to a segment of the cord and they are named accordingly. This means there are 8 cervical nerves, 12 thoracic nerves, 5 lumbar nerves, 5 sacral nerves, and 1 coccygeal nerve.

Each spinal nerve is connected to the spinal cord by a dorsal root and a ventral root. The cell bodies of the sensory neurons are in the dorsal root ganglion, but the motor neuron cell bodies are in the gray matter. The two roots join to form the spinal nerve just before the nerve leaves the vertebral column. Because all spinal nerves have both sensory and motor components, they are all mixed nerves.

Autonomic Nervous System

The autonomic nervous system is a visceral efferent system, which means it sends motor impulses to the visceral organs. It functions automatically and continuously, without conscious effort, to innervate smooth muscle, cardiac muscle, and glands. It is concerned with heart rate, breathing rate, blood pressure, body temperature, and other visceral activities that work together to maintain homeostasis. The autonomic nervous system has two parts, the sympathetic division and the parasympathetic division. Many visceral organs are supplied with fibers from both divisions. In this case, one stimulates and the other inhibits. This antagonistic functional relationship serves as a balance to help maintain homeostasis.

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 i.e. 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.

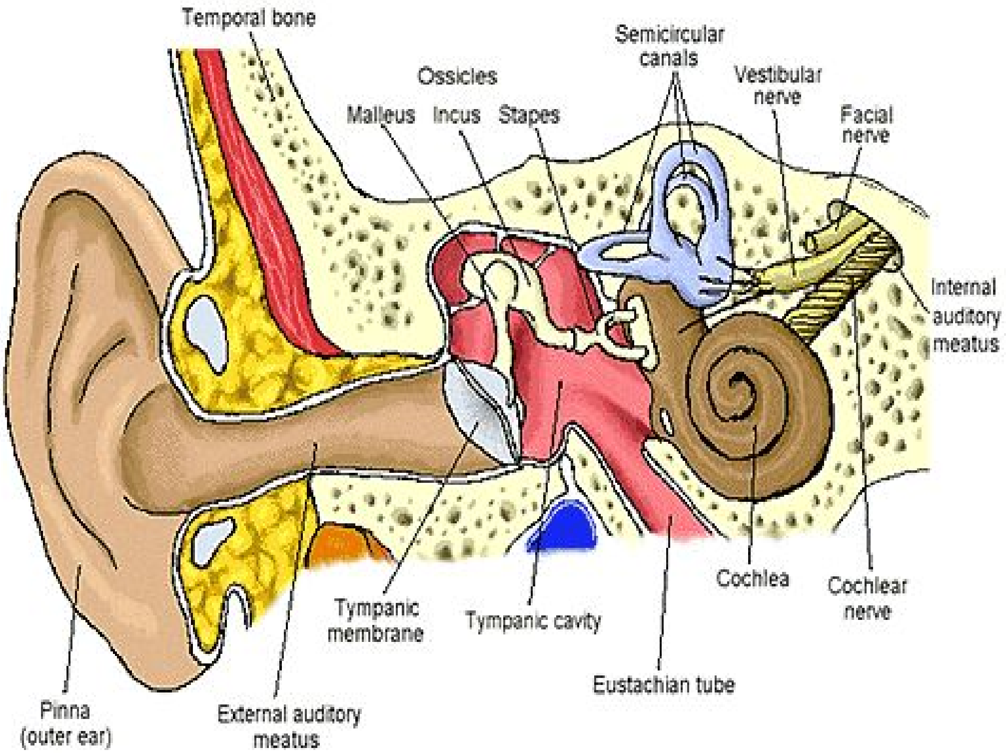
Each receptor has a gustatory hair that extends to the surface through the taste pore which picks up the taste stimuli. The taste impulse is transmitted along cranial nerves V11 (facial), 1X (glossopharyngeal) and X (vagus) to the thalamus via the medulla oblongata and finally to the gustatory area in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

Anatomy 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.

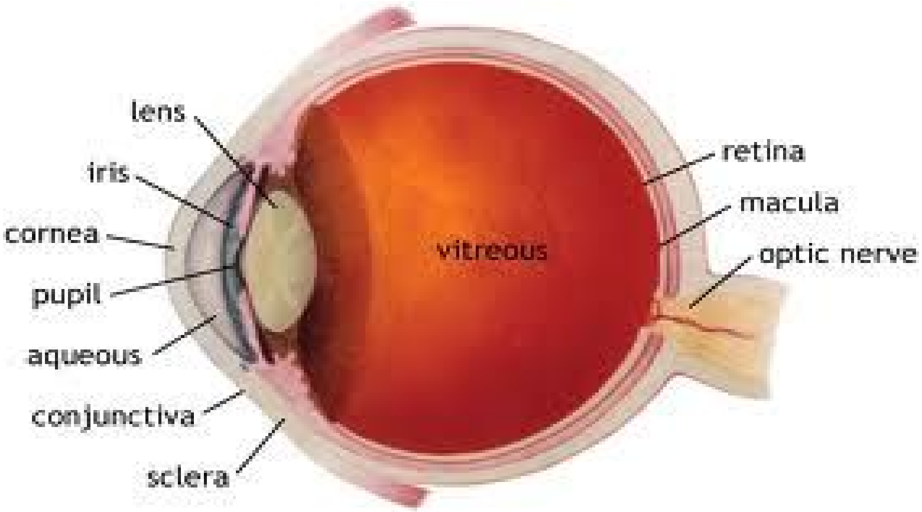
Internal ear

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 semi-circular 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)



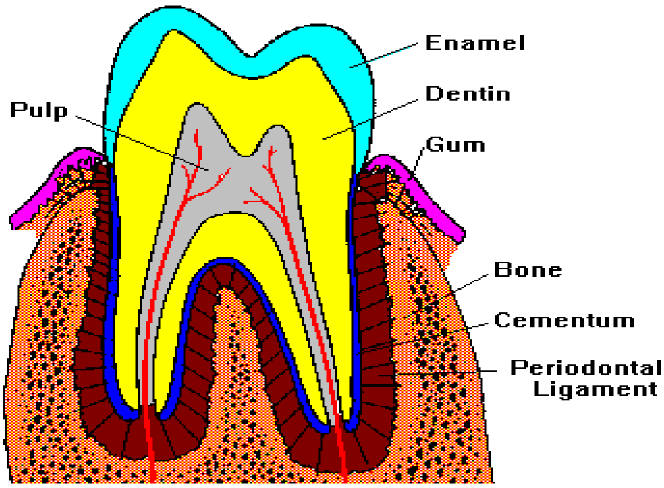
The sense of sight relies on the eye. Measuring about 2.5 cm in diameter, the eye sits in the orbital socket of the skull. The eye is protected by the socket, the eyelids and the eyelashes.

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.
- **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.

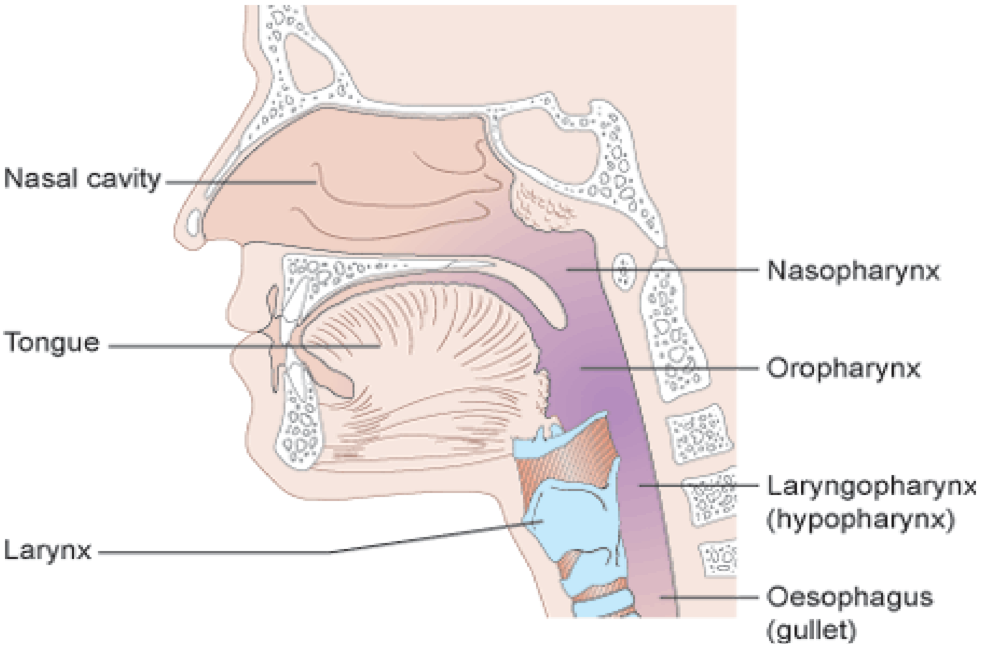
Sense of smell (olfactory) disorders

There are several types of olfactory disorders:

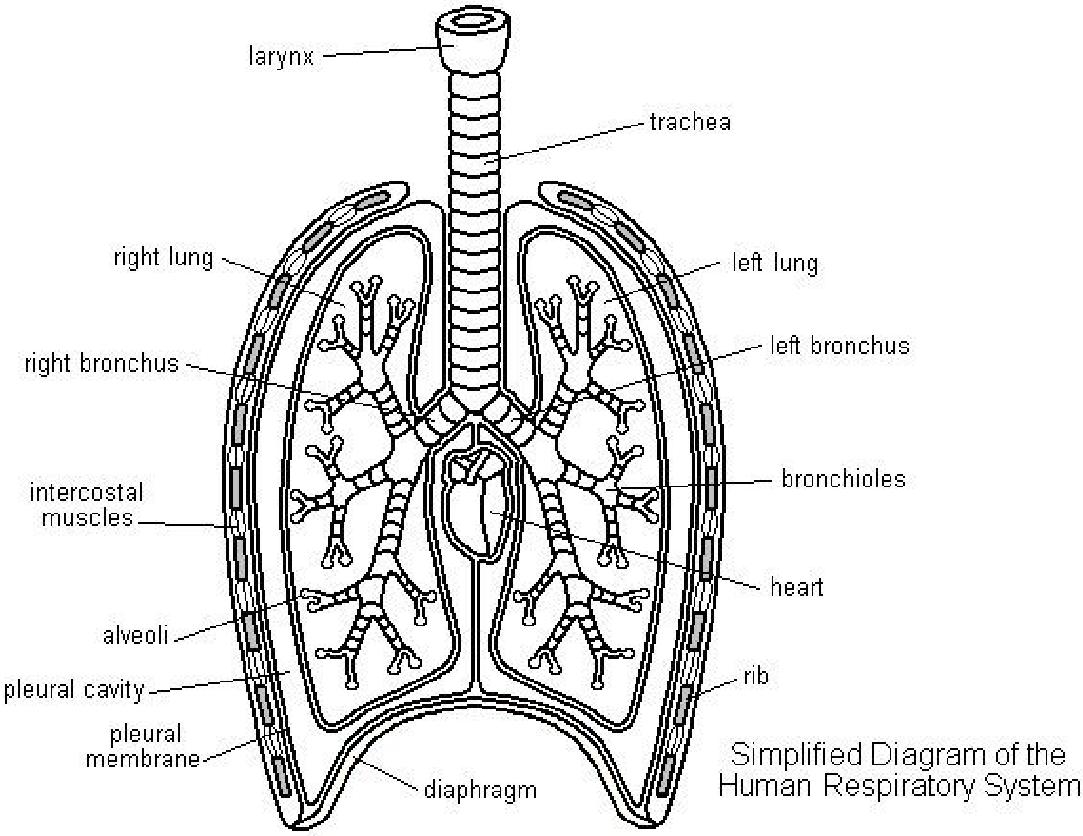
- **Anosmia:** is the absence of the ability to smell
- **Hyposmia:** is the decreased ability to smell
- **Hyperosmia:** is increased sensitivity to an odorant
- **Dysosmia:** is distortion in the perception of an odour
- **Phantosmia:** is perception of an odorant where none is present
- **Agnosia:** 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

Upper respiratory tract



Lower respiratory tract



When the respiratory system is mentioned, people generally think of breathing, but breathing is only one of the activities of the respiratory system. The body cells need a continuous supply of oxygen for the metabolic processes that are necessary to maintain life. The respiratory system works with the circulatory system to provide this oxygen and to remove the waste products of metabolism. It also helps to regulate pH of the blood.

Respiration is the sequence of events that results in the exchange of oxygen and carbon dioxide between the atmosphere and the body cells. Every 3 to 5 seconds, nerve impulses stimulate the breathing process, or ventilation, which moves air through a series of passages into and out of the lungs. After this, there is an exchange of gases between the lungs and the blood. This is called external respiration. The blood transports the gases to and from the tissue cells. The exchange of gases between the blood and tissue cells is internal respiration. Finally, the cells utilize the oxygen for their specific activities: this is called cellular metabolism, or cellular respiration. Together, these activities constitute respiration.

Mechanics of ventilation

Ventilation, or breathing, is the movement of air through the conducting passages between the atmosphere and the lungs. The air moves through the passages because of pressure gradients that are produced by contraction of the diaphragm and thoracic muscles.

Pulmonary ventilation: Pulmonary ventilation is commonly referred to as breathing. It is the process of air flowing into the lungs during inspiration (inhalation) and out of the lungs during expiration (exhalation). Air flows because of pressure differences between the atmosphere and the gases inside the lungs. Air, like other gases, flows from a region with higher pressure to a region with lower pressure. Muscular breathing movements and recoil of elastic tissues create the changes in pressure that result in ventilation.

Pulmonary ventilation involves three different pressures:

1. Atmospheric pressure.
2. Intraalveolar (intrapulmonary) pressure.
3. Intrapleural pressure.

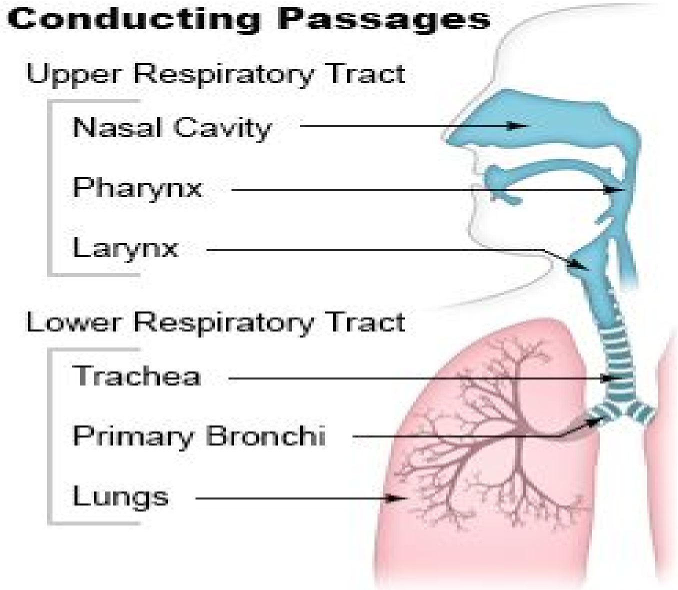
Atmospheric pressure is the pressure of the air outside the body. Intraalveolar pressure is the pressure inside the alveoli of the lungs. Intrapleural pressure is the pressure within the pleural cavity. These three pressures are responsible for pulmonary ventilation.

Inspiration: Inspiration (inhalation) is the process of taking air into the lungs. It is the active phase of ventilation because it is the result of muscle contraction. During inspiration, the diaphragm contracts and the thoracic cavity increases in volume. This decreases the intraalveolar pressure so that air flows into the lungs. Inspiration draws air into the lungs.

Expiration: Expiration (exhalation) is the process of letting air out of the lungs during the breathing cycle. During expiration, the relaxation of the diaphragm and elastic recoil of tissue decreases the thoracic volume and increases the intraalveolar pressure. Expiration pushes air out of the lungs.

Respiratory volumes and capacities

Under normal conditions, the average adult takes 12 to 15 breaths a minute. A breath is one complete respiratory cycle that consists of one inspiration and one expiration. An instrument called a spirometer is used to measure the volume of air that moves into and out of the lungs, and the process of taking the measurements is called spirometry. Respiratory (pulmonary) volumes are an important aspect of pulmonary function testing because they can provide information about the physical condition of the lungs. Respiratory capacity (pulmonary capacity) is the sum of two or more volumes. Factors such as age, sex, body build, and physical conditioning have an influence on lung volumes and capacities. Lungs usually reach their maximumin capacity in early adulthood and decline with age after that.

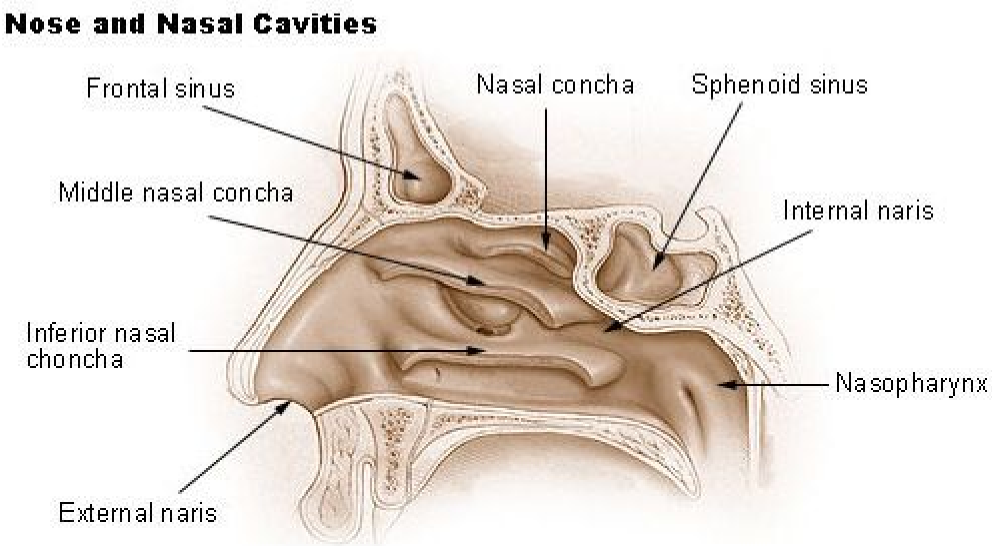


The respiratory conducting passages are divided into the upper respiratory tract and the lower respiratory tract. The upper respiratory tract includes the nose, pharynx, and larynx. The lower respiratory tract consists of the trachea, bronchial tree, and lungs. These tracts open to the outside and are lined with mucous membranes. In some regions, the membrane has hairs that help filter the air. Other regions may have cilia to propel mucus.

Nose, nasal cavities, and Paranasal sinuses

Nose and nasal cavities

The framework of the nose consists of bone and cartilage. Two small nasal bones and extensions of the maxillae form the bridge of the nose, which is the bony portion. The remainder of the framework is cartilage and is the flexible portion. Connective tissue and skin cover the framework.



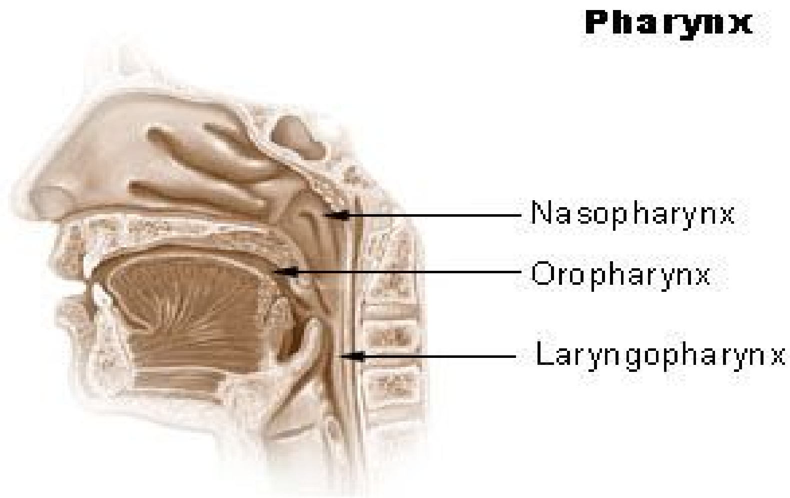
Air enters the nasal cavity from the outside through two openings: the nostrils or external nares. The openings from the nasal cavity into the pharynx are the internal nares. Nose hairs at the entrance to the nose trap large inhaled particles.

Paranasal sinuses

Paranasal sinuses are air-filled cavities in the frontal, maxilae, ethmoid, and sphenoid bones. These sinuses, which have the same names as the bones in which they are located, surround the nasal cavity and open into it. They function to reduce the weight of the skull, to produce mucus, and to influence voice quality by acting as resonating chambers.

Pharynx

The pharynx, commonly called the throat, is a passageway that extends from the base of the skull to the level of the sixth cervical vertebra. It serves both the respiratory and digestive systems by receiving air from the nasal cavity and air, food, and water from the oral cavity. Inferiorly, it opens into the larynx and esophagus. The pharynx is divided into three regions according to location: the nasopharynx, the oropharynx, and the laryngopharynx (hypopharynx).



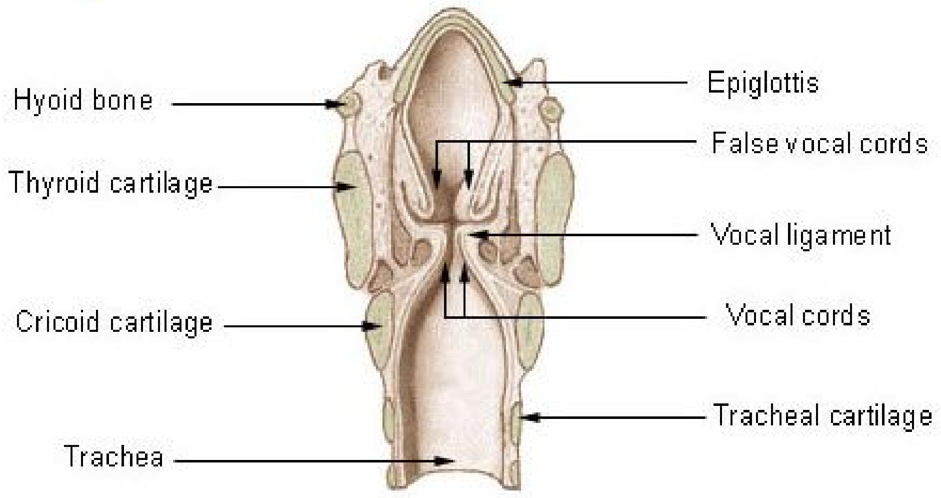
The nasopharynx is the portion of the pharynx that is posterior to the nasal cavity and extends inferiorly to the uvula. The oropharynx is the portion of the pharynx that is posterior to the oral cavity. The most inferior portion of the pharynx is the laryngopharynx that extends from the hyoid bone down to the lower margin of the larynx. The upper part of the pharynx (throat) lets only air pass through. Lower parts permit air, foods, and fluids to pass. The pharyngeal, palatine, and lingual tonsils are located in the pharynx. They are also called Waldereyer's Ring. The retromolar trigone is the small area behind the wisdom teeth.

Larynx and Trachea

Larynx

The larynx, commonly called the voice box or glottis, is the passageway for air between the pharynx above and the trachea below. It extends from the fourth to the sixth vertebral levels. The larynx is often divided into three sections: sublarynx, larynx, and supralarynx. It is formed by nine cartilages that are connected to each other by muscles and ligaments.

Larynx



The larynx plays an essential role in human speech. During sound production, the vocal cords close together and vibrate as air expelled from the lungs passes between them. The false vocal cords have no role in sound production, but help close off the larynx when food is swallowed. The thyroid cartilage is the Adam's apple. The epiglottis acts like a trap door to keep food and other particles from entering the larynx.

Trachea

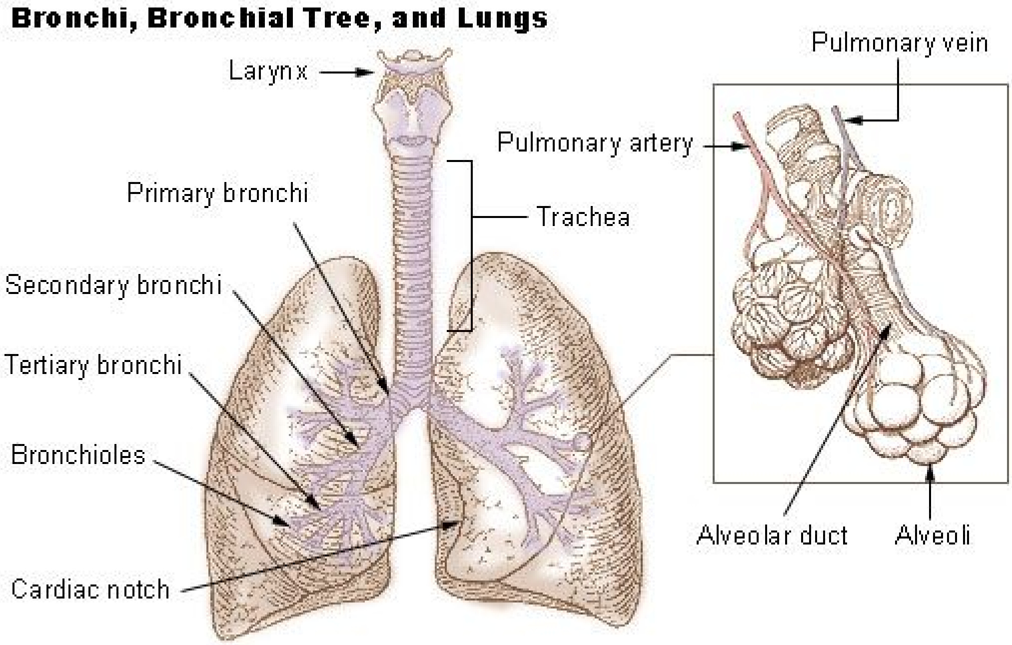
The trachea, commonly called the windpipe, is the main airway to the lungs. It divides into the right and left bronchi at the level of the fifth thoracic vertebra, channeling air to the right or left lung. The hyaline cartilage in the tracheal wall provides support and keeps the trachea from collapsing. The posterior soft tissue allows for expansion of the esophagus, which is immediately posterior to the trachea. The mucous membrane that lines the trachea is ciliated pseudostratified columnar epithelium similar to that in the nasal cavity and nasopharynx. Goblet cells produce mucus that traps airborne particles and microorganisms, and the cilia propel the mucus upward, where it is either swallowed or expelled.

Bronchi, Bronchial Tree, and lungs

Bronchi and Bronchial Tree

In the mediastinum, at the level of the fifth thoracic vertebra, the trachea divides into the right and left primary bronchi. The bronchi branch into smaller and smaller passageways until they terminate in tiny air sacs called alveoli.

The cartilage and mucous membrane of the primary bronchi are similar to that in the trachea. As the branching continues through the bronchial tree, the amount of hyaline cartilage in the walls decreases until it is absent in the smallest bronchioles. As the cartilage decreases, the amount of smooth muscle increases. The mucous membrane also undergoes a transition from ciliated pseudostratified columnar epithelium to simple cuboidal epithelium to simple squamous epithelium. The alveolar ducts and alveoli consist primarily of simple squamous epithelium, which permits rapid diffusion of oxygen and carbon dioxide. Exchange of gases between the air in the lungs and the blood in the capillaries occurs across the walls of the alveolar ducts and alveoli.



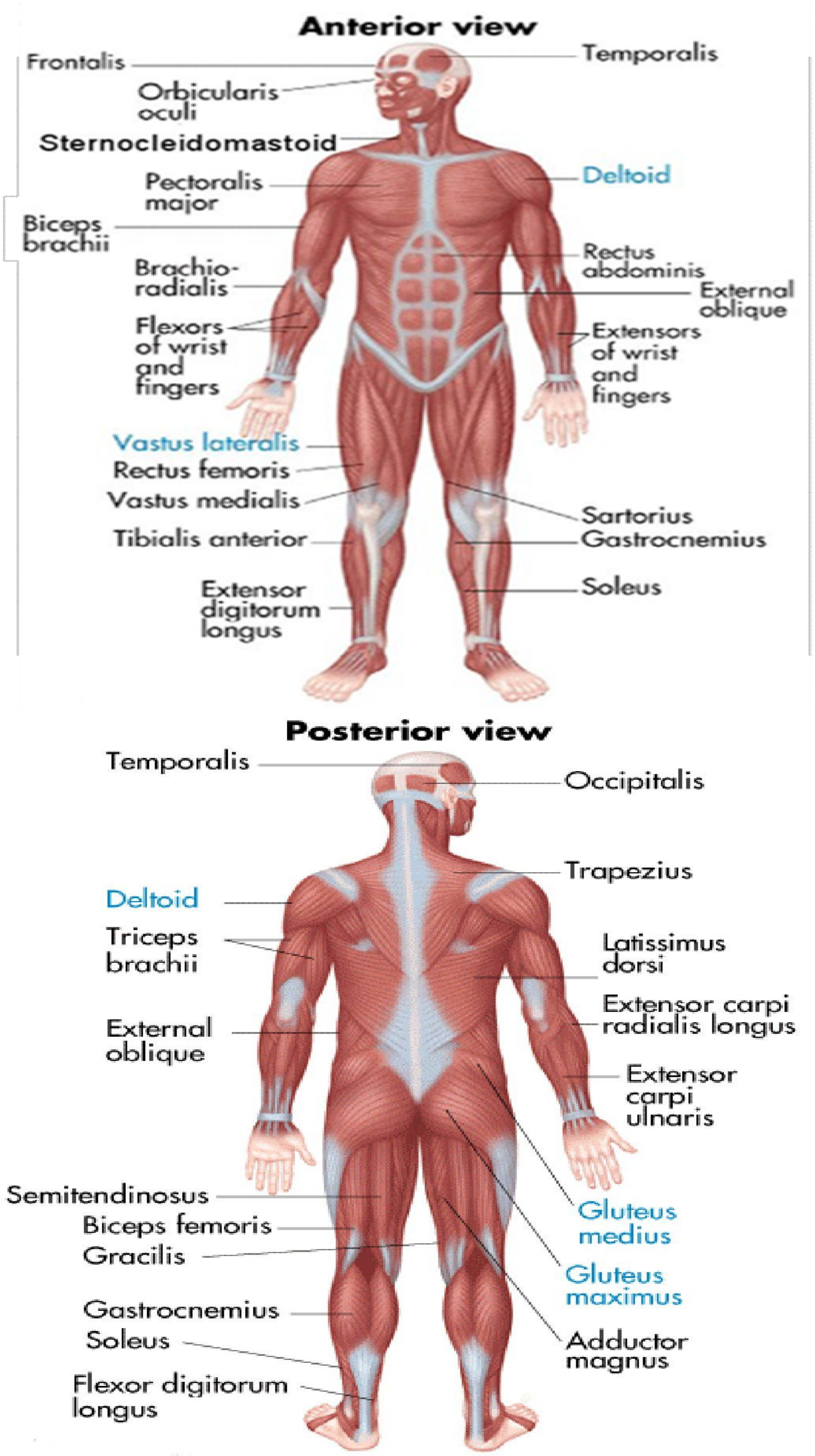
Lungs

The two lungs, which contain all the components of the bronchial tree beyond the primary bronchi, occupy most of the space in the thoracic cavity. The lungs are soft and spongy because they are mostly air spaces surrounded by the alveolar cells and elastic connective tissue. They are separated from each other by the mediastinum, which contains the heart. The only point of attachment for each lung is at the hilum, or root, on the medial side. This is where the bronchi, blood vessels, lymphatics, and nerves enter the lungs.

The right lung is shorter, broader, and has a greater volume than the left lung. It is divided into three lobes and each lobe is supplied by one of the secondary bronchi. The left lung is longer and narrower than the right lung. It has an indentation, called the cardiac notch, on its medial surface for the apex of the heart. The left lung has two lobes.

Each lung is enclosed by a double-layered serous membrane, called the pleura. The visceral pleura is firmly attached to the surface of the lung. At the hilum, the visceral pleura is continuous with the parietal pleura that lines the wall of the thorax. The small space between the visceral and parietal pleurae is the pleural cavity. It contains a thin film of serous fluid that is produced by the pleura. The fluid acts as a lubricant to reduce friction as the two layers slide against each other, and it helps to hold the two layers together as the lungs inflate and deflate.

The Muscular System

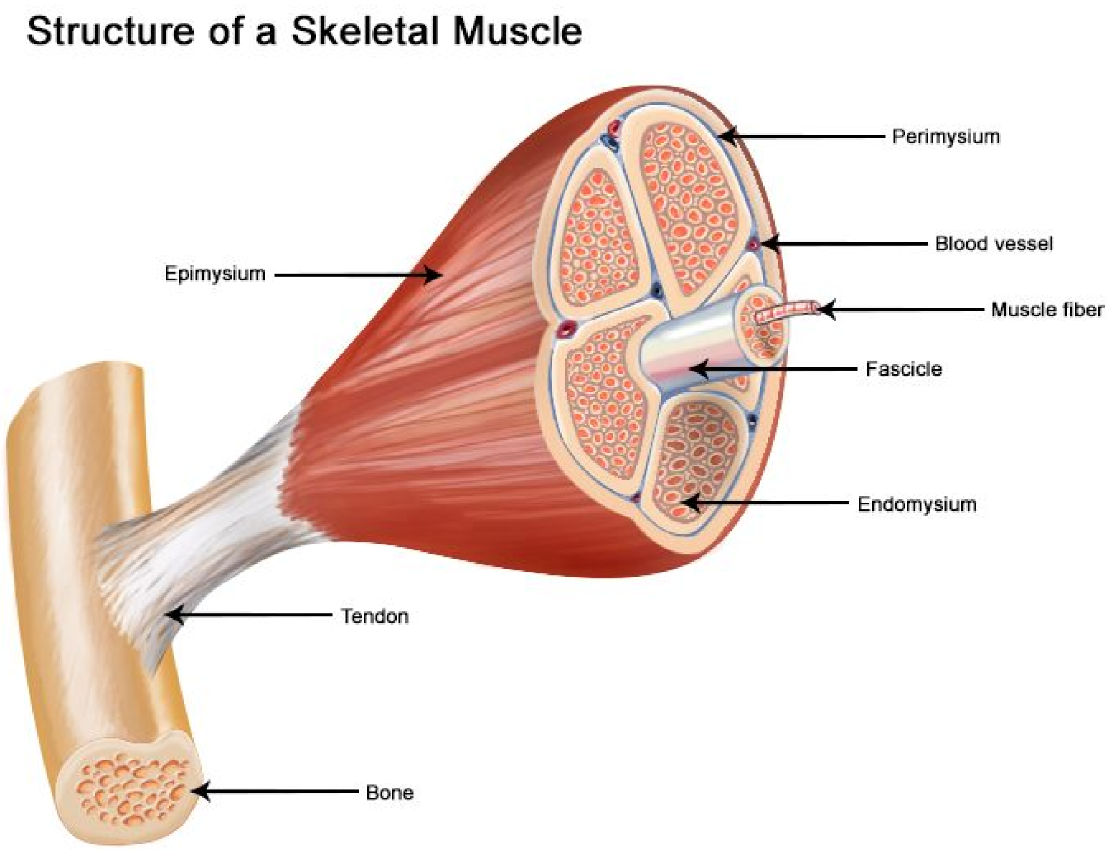


The muscular system is composed of specialized cells called muscle fibers. Their predominant function is contractibility. Muscles, attached to bones or internal organs and blood vessels, are responsible for movement. Nearly all movement in the body is the result of muscle contraction. Exceptions to this are the action of cilia, the flagellum on sperm cells, and amoeboid movement of some white blood cells. The integrated action of joints, bones, and skeletal muscles produces obvious movements such as walking and running. Skeletal muscles also produce more subtle movements that result in various facial expressions, eye movements, and respiration.

In addition to movement, muscle contraction also fulfills some other important functions in the body, such as posture, joint stability, and heat production. Posture, such as sitting and standing, is maintained as a result of muscle contraction. The skeletal muscles are continually making fine adjustments that hold the body in stationary positions. The tendons of many muscles extend over joints and in this way contribute to joint stability. This is particularly evident in the knee and shoulder joints, where muscle tendons are a major factor in stabilizing the joint. Heat production, to maintain body temperature, is an important by-product of muscle metabolism. Nearly 85 percent of the heat produced in the body is the result of muscle contraction.

Structure of skeletal muscle

A whole skeletal muscle is considered an organ of the muscular system. Each organ or muscle consists of skeletal muscle tissue, connective tissue, nerve tissue, and blood or vascular tissue. Skeletal muscles vary considerably in size, shape, and arrangement of fibers. They range from extremely tiny strands such as the stapedium muscle of the middle ear to large masses such as the muscles of the thigh. Some skeletal muscles are broad in shape and some narrow. In some muscles the fibers are parallel to the long axis of the muscle; in some they converge to a narrow attachment; and in some they are oblique.



Each skeletal muscle fiber is a single cylindrical muscle cell. An individual skeletal muscle may be made up of hundreds, or even thousands, of muscle fibers bundled together and wrapped in a connective tissue covering. Each muscle is surrounded by a connective tissue sheath called the epimysium. Fascia, connective tissue outside the epimysium, surrounds and separates the muscles. Portions of the epimysium project inward to divide the muscle into compartments. Each compartment contains a bundle of muscle fibers. Each bundle of muscle fiber is called a fasciculus and is surrounded by a layer of connective tissue called the perimysium. Within the fasciculus, each individual muscle cell, called a muscle fiber, is surrounded by connective tissue called the endomysium.

Skeletal muscle cells (fibers), like other body cells, are soft and fragile. The connective tissue covering furnish support and protection for the delicate cells and allow them to withstand the forces of contraction. The coverings also provide pathways for the passage of blood vessels and nerves.

Commonly, the epimysium, perimysium, and endomysium extend beyond the fleshy part of the muscle, the belly or gaster, to form a thick ropelike tendon or a broad, flat sheet-like aponeurosis. The tendon and aponeurosis form indirect attachments from muscles to the periosteum of bones or to the connective tissue of other muscles. Typically a muscle spans a joint and is attached to bones by tendons at both ends. One of the bones remains relatively fixed or stable while the other end moves as a result of muscle contraction.

Skeletal muscles have an abundant supply of blood vessels and nerves. This is directly related to the primary function of skeletal muscle, contraction. Before a skeletal muscle fiber can contract, it has to receive an impulse from a nerve cell. Generally, an artery and at least one vein accompany each nerve that penetrates the epimysium of a skeletal muscle. Branches of the nerve and blood vessels follow the connective tissue components of the muscle of a nerve cell and with one or more minute blood vessels called capillaries.

Muscle types

In the body, there are three types of muscle: skeletal (striated), smooth, and cardiac.

Skeletal muscle

Skeletal muscle, attached to bones, is responsible for skeletal movements. The peripheral portion of the central nervous system (CNS) controls the skeletal muscles. Thus, these muscles are under conscious, or voluntary, control. The basic unit is the muscle fiber with many nuclei. These muscle fibers are striated (having transverse streaks) and each acts independently of neighboring muscle fibers.

Smooth muscle

Smooth muscle, found in the walls of the hollow internal organs such as blood vessels, the gastrointestinal tract, bladder, and uterus, is under control of the autonomic nervous system. Smooth muscle cannot be controlled consciously and thus acts involuntarily. The non-striated (smooth) muscle cell is spindle-shaped and has one central nucleus. Smooth muscle contracts slowly and rhythmically.

Cardiac Muscle

Cardiac muscle, found in the walls of the heart, is also under control of the autonomic nervous system. The cardiac muscle cell has one central nucleus, like smooth muscle, but it also is striated, like skeletal muscle. The cardiac muscle cell is rectangular in shape. The contraction of cardiac muscle is involuntary, strong, and rhythmical. Smooth and cardiac muscle will be discussed in detail with respect to their appropriate systems. This unit mainly covers the skeletal muscular system.

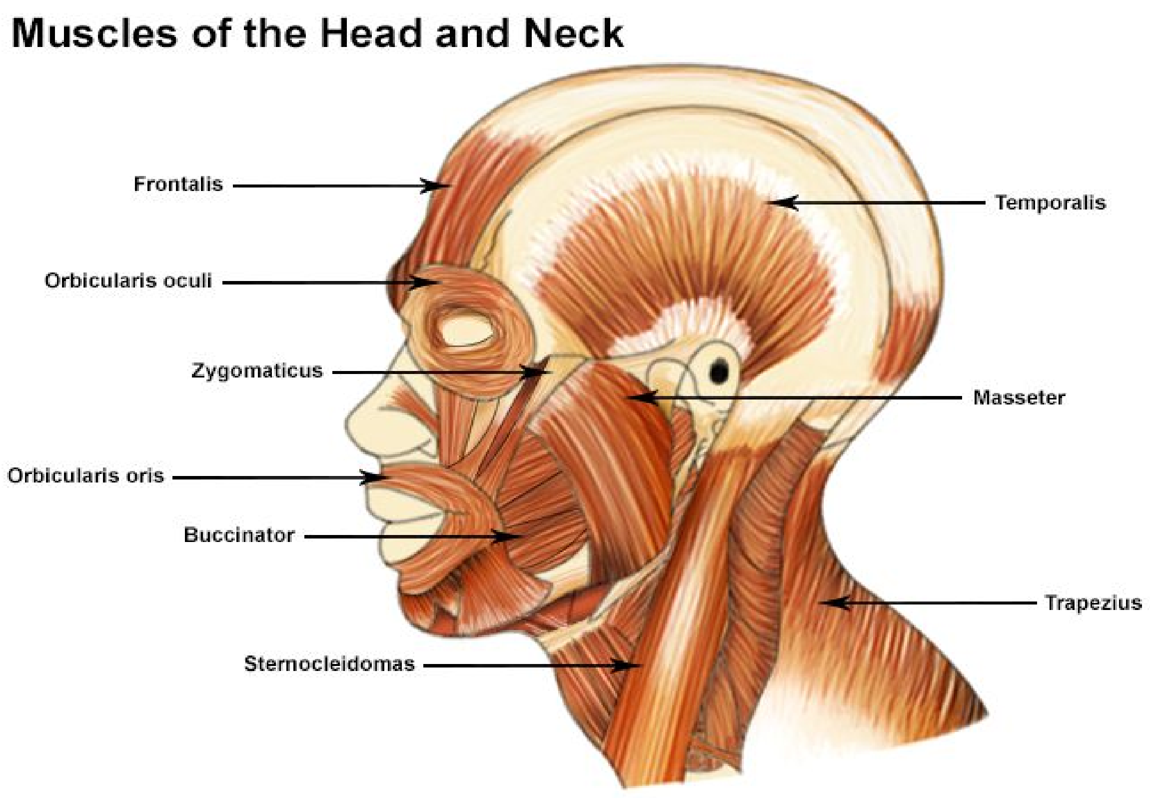
Muscle Groups

There are more than 600 muscles in the body, which together account for about 40 percent of a person's weight. Most skeletal muscles have names that describe some feature of the muscle. Often several criteria are combined into one name. Associating the muscle's characteristics with its name will help you learn and remember them. The following are some terms relating to muscle features that are used in naming muscles.

- **Size:** vastus (huge); maximus (large); longus (long); minimus (small); brevis (short).
- **Shape:** deltoid (triangular); rhomboid (like a rhombus with equal and parallel sides); latissimus (wide); teres (round); trapezius (like a trapezoid, a four-sided figure with two sides parallel).
- **Direction of fibers:** rectus (straight); transverse (across); oblique (diagonally); orbicularis (circular).
- **Location:** pectoralis (chest); gluteus (buttock or rump); brachii (arm); supra- (above); infra- (below); sub- (under or beneath); lateralis (lateral).
- **Number of origins:** biceps (two heads); triceps (three heads); quadriceps (four heads).
- **Origin and insertion:** sternocleidomastoideus (origin on the sternum and clavicle, insertion on the mastoid process); brachioradialis (origin on the brachium or arm, insertion on the radius).
- **Action:** abductor (to abduct a structure); adductor (to adduct a structure); flexor (to flex a structure); extensor (to extend a structure); levator (to lift or elevate a structure); masseter (a chewer).

Muscles of the head and neck

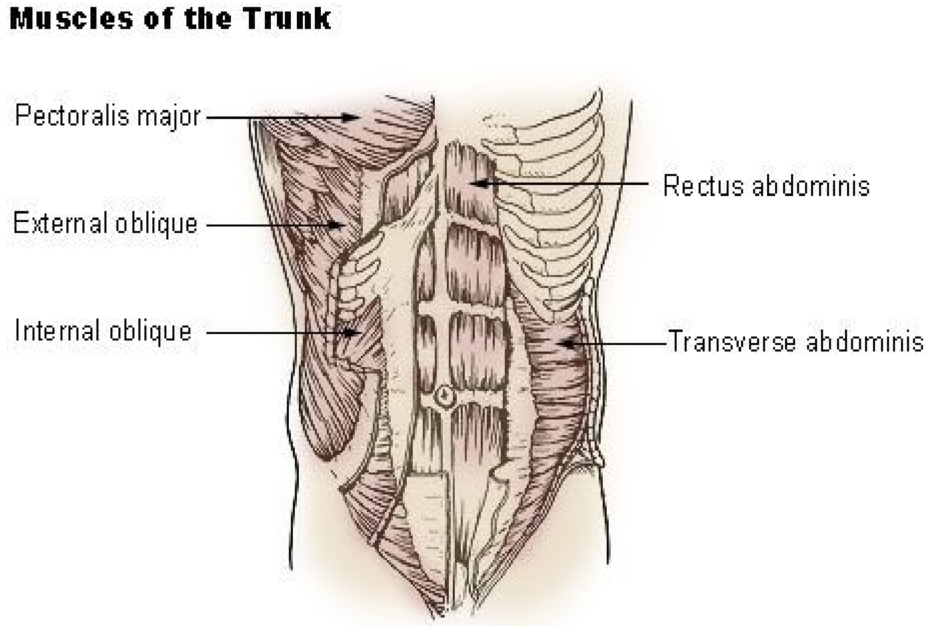
Humans have well-developed muscles in the face that permit a large variety of facial expressions. Because the muscles are used to show surprise, disgust, anger, fear, and other emotions, they are an important means of nonverbal communication. Muscles of facial expression include frontalis, orbicularis oris, laris oculi, buccinator, and zygomaticus.These muscles of facial expressions are identified in the illustration below.



There are four pairs of muscles that are responsible for chewing movements or mastication. All of these muscles connect to the mandible and they are some of the strongest muscles in the body. Two of the muscles, temporalis and masseter, are identified in the illustration above. There are numerous muscles associated with the throat, the hyoid bone and the vertebral column; only two of the more obvious and superficial neck muscles are identified in the illustration: sternocleidomastoid and trapezius.

Muscles of the Trunk

The muscles of the trunk include those that move the vertebral column, the muscles that form the thoracic and abdominal walls, and those that cover the pelvic outlet.

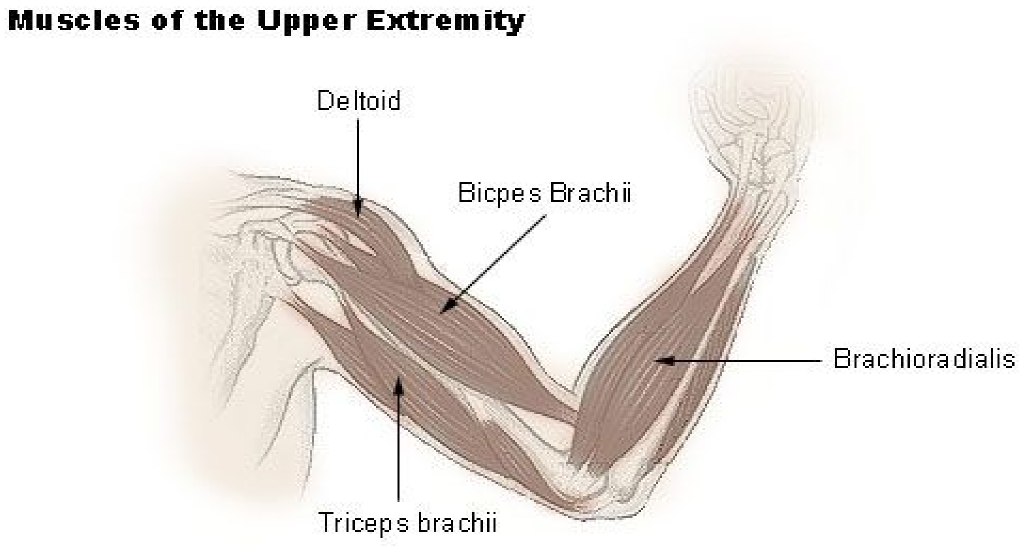


The erector spinae group of muscles on each side of the vertebral column is a large muscle mass that extends from the sacrum to the skull. These muscles are primarily responsible for extending the vertebral column to maintain erect posture. The deep back muscles occupy the space between the spinous and transverse processes of adjacent vertebrae.

The muscles of the thoracic wall are involved primarily in the process of breathing. The intercostal muscles are located in spaces between the ribs. They contract during forced expiration. External intercostal muscles contract to elevate the ribs during the inspiration phase of breathing. The diaphragm is a dome-shaped muscle that forms a partition between the thorax and the abdomen. It has three openings in it for structures that have to pass from the thorax to the abdomen. The abdomen, unlike the thorax and pelvis, has no bony reinforcements or protection. The wall consists entirely of four muscle pairs, arranged in layers, and the fascia that envelops them. The abdominal wall muscles are identified in the illustration below. The pelvic outlet is formed by two muscular sheets and their associated fascia.

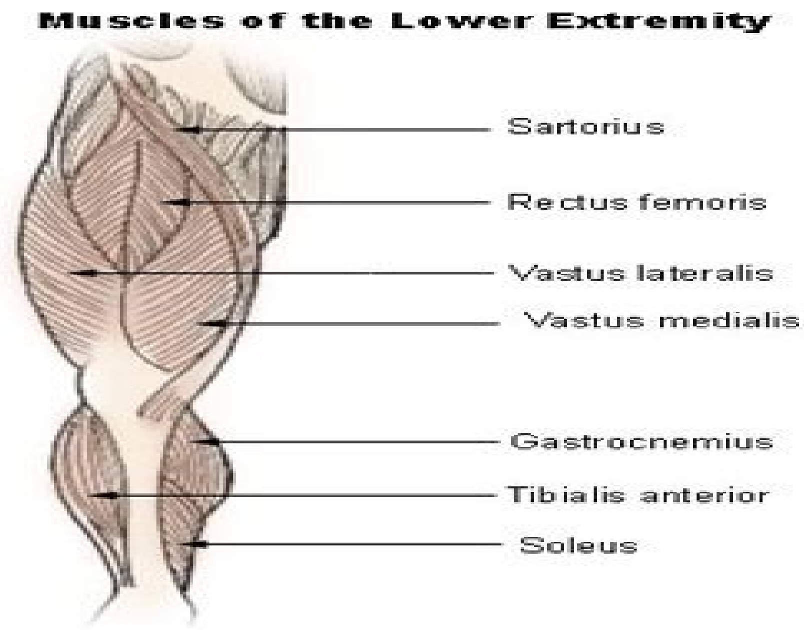
Muscles of the upper extremity

The muscles of the upper extremity include those that attach the scapula to the thorax and generally move the scapula, those that attach the humerus to the scapula and generally move the arm, and those that are located in the arm or forearm that move the forearm, wrist, and hand. The illustration below shows some of the muscles of the upper extremity.



Muscles that move the shoulder and arm include the trapezius and serratus anterior. The pectoralis major, latissimus dorsi, deltoid, and rotator cuff muscles connect to the humerus and move the arm. The muscles that move the forearm are located along the humerus, which include the triceps brachii, biceps brachii, brachialis, and brachioradialis. The 20 or more muscles that cause most wrist, hand, and finger movements are located along the forearm.

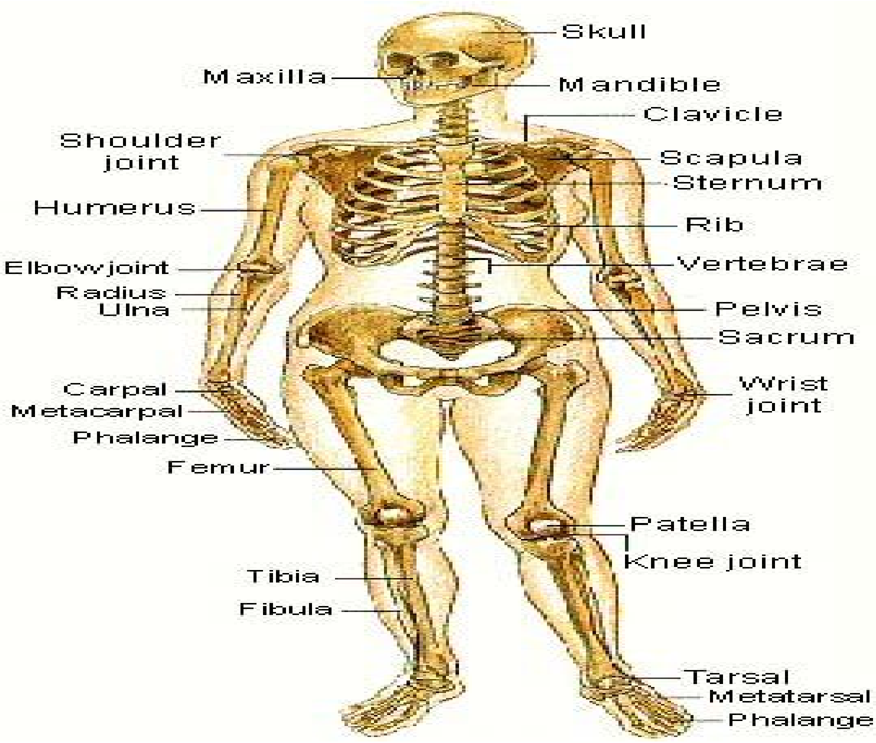
Muscles of the lower extremity



The muscles that move the thigh have their origins on some part of the pelvic girdle and their insertions on the femur. The largest muscle mass belongs to the posterior group, the gluteal muscles, which, as a group, adduct the thigh. The iliopsoas, an anterior muscle, flexes the thigh. The muscles in the medial compartment adduct the thigh. The illustration below shows some of the muscles of the lower extremity.

Muscles that move the leg are located in the thigh region. The quadriceps femoris muscle group straightens the leg at the knee. The hamstrings are antagonists to the quadriceps femoris muscle group, which are used to flex the leg at the knee. The muscles located in the leg that move the ankle and foot are divided into anterior, posterior, and lateral compartments. The tibialis anterior, which dorsiflexes the foot, is antagonistic to the gastrocnemius and soleus muscles, which plantar flex the foot.

The Skeletal System



Humans are vertebrates, animals having a vertebral column or backbone. They rely on a sturdy internal frame that is centered on a prominent spine. The human skeletal system consists of bones, cartilage, ligaments and tendons and accounts for about 20 percent of the body weight. The living bones in our bodies use oxygen and give off waste products in metabolism. They contain active tissues that consume nutrients, require a blood supply and change shape or remodel in response to variations in mechanical stress.

Bones provide a rigid framework, known as the skeleton that support and protect the soft organs of the body. The skeleton supports the body against the pull of gravity. The large bones of the lower limbs support the trunk when standing.

The skeleton also protects the soft body parts. The fused bones of the cranium surround the brain to make it less vulnerable to injury. Vertebrae surround and protect the spinal cord and bones of the rib cage help protect the heart and lungs of the thorax. Bones work together with muscles as simple mechanical lever systems to produce body movement. Bones contain more calcium than any other organ. The intercellular matrix of bone contains large amounts of calcium salts, the most important being calcium phosphate.

When blood calcium levels decrease below normal, calcium is released from the bones so that there will be an adequate supply for metabolic needs. When blood calcium levels are increased, the excess calcium is stored in the bone matrix. The dynamic process of releasing and storing calcium goes on almost continuously. Hematopoiesis, the formation of blood cells, mostly takes place in the red marrow of the bones.

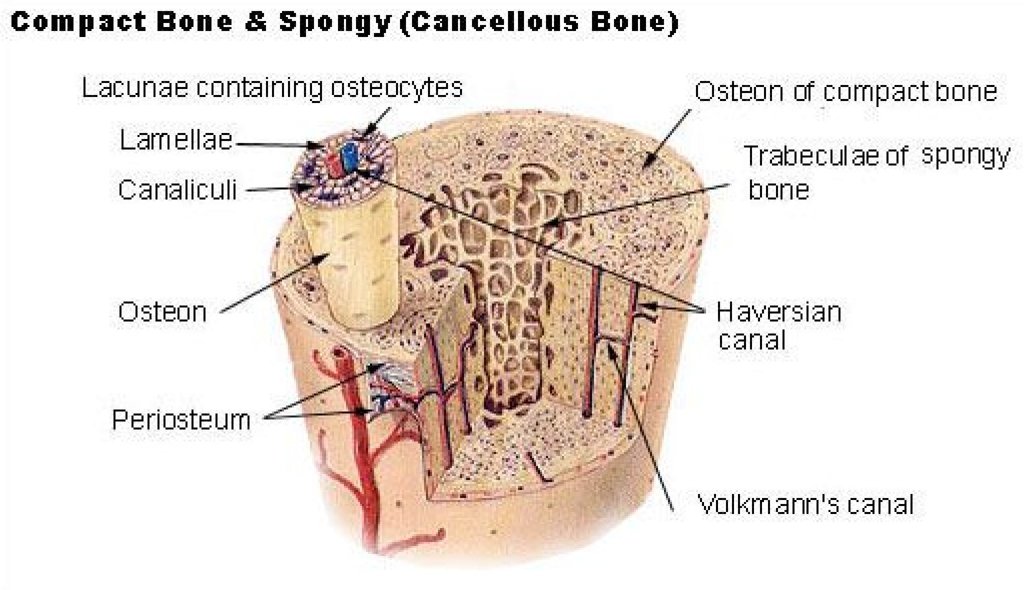
In infants, red marrow is found in the bone cavities. With age, it is largely replaced by yellow marrow for fat storage. In adults, red marrow is limited to the spongy bone in the skull, ribs, sternum, clavicles, vertebrae and pelvis. Red marrow functions in the formation of red blood cells, white blood cells and blood platelets.

Structure of bone tissue

There are two types of bone tissue: compact and spongy. The names imply that the two types differ in density, or how tightly the tissue is packed together. There are three types of cells that contribute to bone homeostasis. Osteoblasts are bone-forming cell, osteoclasts resorb or break down bone, and osteocytes are mature bone cells. An equilibrium between osteoblasts and osteoclasts maintains bone tissue.

Compact bone

Compact bone consists of closely packed osteons or haversian systems. The osteon consists of a central canal called the osteonic (haversian) canal, which is surrounded by concentric rings (lamellae) of matrix. Between the rings of matrix, the bone cells (osteocytes) are located in spaces called lacunae. Small channels (canaliculi) radiate from the lacunae to the osteonic (haversian) canal to provide passageways through the hard matrix. In compact bone, the haversian systems are packed tightly together to form what appears to be a solid mass. The osteonic canals contain blood vessels that are parallel to the long axis of the bone. These blood vessels interconnect, by way of perforating canals, with vessels on the surface of the bone.



Spongy (Cancellous) bone

Spongy (cancellous) bone is lighter and less dense than compact bone. Spongy bone consists of plates (trabeculae) and bars of bone adjacent to small, irregular cavities that contain red bone marrow. The canaliculi connect to the adjacent cavities, instead of a central haversian canal, to receive their blood supply. It may appear that the trabeculae are arranged in a haphazard manner, but they are organized to provide maximum strength similar to braces that are used to support a building. The trabeculae of spongy bone follow the lines of stress and can realign if the direction of stress changes.

Bone development and growth

The terms osteogenesis and ossification are often used synonymously to indicate the process of bone formation. Parts of the skeleton form during the first few weeks after conception. By the end of the eighth week after conception, the skeletal pattern is formed in cartilage and connective tissue membranes and ossification begins. Bone development continues throughout adulthood. Even after adult stature is attained, bone development continues for repair of fractures and for remodeling to meet changing lifestyles. Osteoblasts, osteocytes and osteoclasts are the three cell types involved in the development, growth and remodeling of bones. Osteoblasts are bone-forming cells, osteocytes are mature bone cells and osteoclasts break down and reabsorb bone.

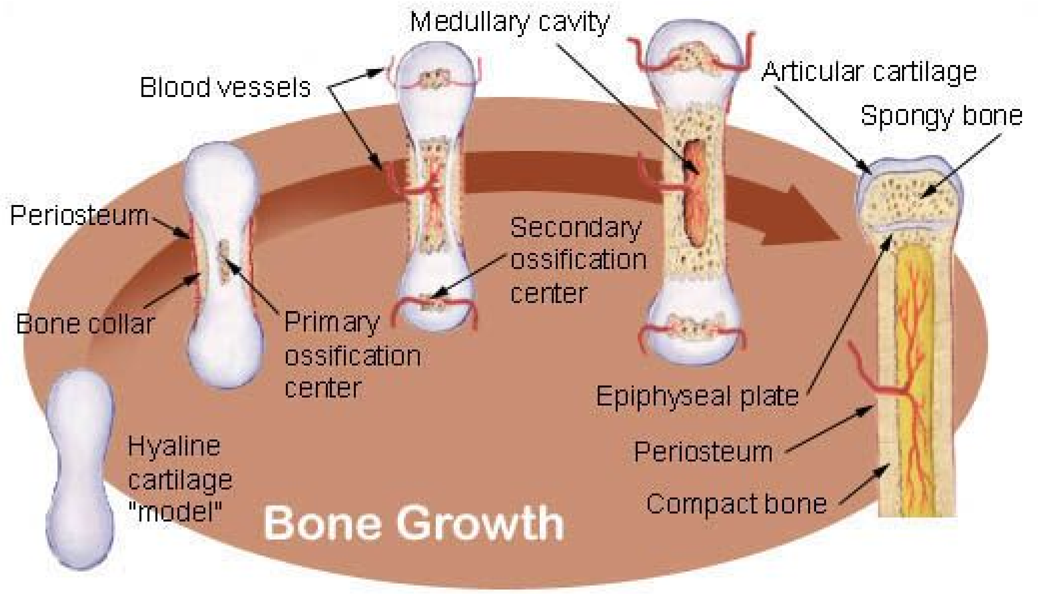
There are two types of ossification: intramembranous and endochondral.

1. **Intramembranous:** Intramembranous ossification involves the replacement of sheet-like connective tissue membranes with bony tissue. Bones formed in this manner are called intramembranous bones. They include certain flat bones of the skull and some of the irregular bones. The future bones are first formed as connective tissue membranes. Osteoblasts migrate to the membranes and deposit bony matrix around themselves. When the osteoblasts are surrounded by matrix they are called osteocytes.
2. **Endochondral Ossification:** Endochondral ossification involves the replacement of hyaline cartilage with bony tissue. Most of the bones of the skeleton are formed in this manner. These bones are called endochondral bones. In this process, the future bones are first formed as hyaline cartilage models. During the third month after conception, the perichondrium that surrounds the hyaline cartilage "models" becomes infiltrated with blood vessels and osteoblasts and changes into a periosteum. The osteoblasts form a collar of compact bone around the diaphysis. At the same time, the cartilage in the center of the diaphysis begins to disintegrate. Osteoblasts penetrate the disintegrating cartilage and replace it with spongy bone. This forms a primary ossification center. Ossification continues from this center toward the ends of the bones. After spongy bone is formed in the diaphysis, osteoclasts break down the newly formed bone to open up the medullary cavity.

The cartilage in the epiphyses continues to grow so the developing bone increases in length. Later, usually after birth, secondary ossification centers form in the epiphyses. Ossification in the epiphyses is similar to that in the diaphysis except that the spongy bone is retained instead of being broken down to form a medullary cavity. When secondary ossification is complete, the hyaline cartilage is totally replaced by bone except in two areas. A region of hyaline cartilage remains over the surface of the epiphysis as the articular cartilage and another area of cartilage remains between the epiphysis and diaphysis. This is the epiphyseal plate or growth region.

Bone growth

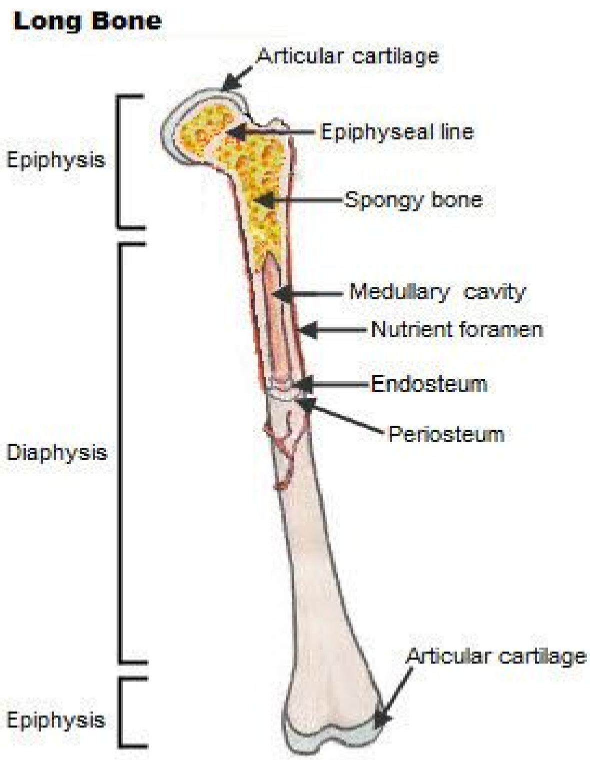
Bones grow in length at the epiphyseal plate by a process that is similar to endochondral ossification. The cartilage in the region of the epiphyseal plate next to the epiphysis continues to grow by mitosis. The chondrocytes, in the region next to the diaphysis, age and degenerate. Osteoblasts move in and ossify the matrix to form bone. This process continues throughout childhood and the adolescent years until the cartilage growth slows and finally stops. When cartilage growth ceases, usually in the early twenties, the epiphyseal plate completely ossifies so that only a thin epiphyseal line remains and the bones can no longer grow in length. Bone growth is under the influence of growth hormone from the anterior pituitary gland and sex hormones from the ovaries and testes.



Even though bones stop growing in length in early adulthood, they can continue to increase in thickness or diameter throughout life in response to stress from increased muscle activity or to weight. The increase in diameter is called appositional growth. Osteoblasts in the periosteum form compact bone around the external bone surface. At the same time, osteoclasts in the endosteum break down bone on the internal bone surface, around the medullary cavity. These two processes together increase the diameter of the bone and, at the same time, keep the bone from becoming excessively heavy and bulky.

Classification of bones

Long Bones



The bones of the body come in a variety of sizes and shapes. The four principal types of bones are long, short, flat and irregular. Bones that are longer than they are wide are called long bones. They consist of a long shaft with two bulky ends or extremities. They are primarily compact bone but may have a large amount of spongy bone at the ends or extremities. Long bones include bones of the thigh, leg, arm, and forearm.

Short bones: Short bones are roughly cube shaped with vertical and horizontal dimensions approximately equal. They consist primarily of spongy bone, which is covered by a thin layer of compact bone. Short bones include the bones of the wrist and ankle.

Flat bones: Flat bones are thin, flattened, and usually curved. Most of the bones of the cranium are flat bones.

Irregular bones: Bones that are not in any of the above three categories are classified as irregular bones. They are primarily spongy bone that is covered with a thin layer of compact bone. The vertebrae and some of the bones in the skull are irregular bones.

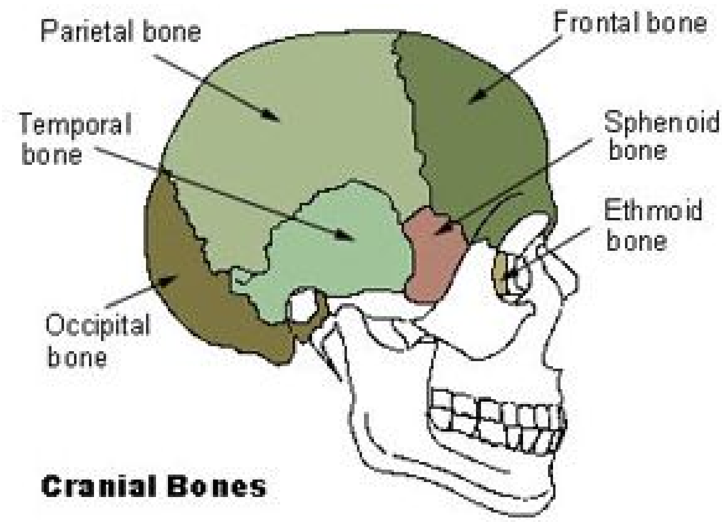
All bones have surface markings and characteristics that make a specific bone unique. There are holes, depressions, smooth facets, lines, projections and other markings. These usually represent passageways for vessels and nerves, points of articulation with other bones or points of attachment for tendons and ligaments.

Divisions of the skeleton

The adult human skeleton usually consists of 206 named bones. These bones can be grouped in two divisions: axial skeleton and appendicular skeleton. The 80 bones of the axial skeleton form the vertical axis of the body. They include the bones of the head, vertebral column, ribs and breastbone or sternum. The appendicular skeleton consists of 126 bones and includes the free appendages and their attachments to the axial skeleton. The free appendages are the upper and lower extremities, or limbs, and their attachments which are called girdles. The named bones of the body are listed below by category.

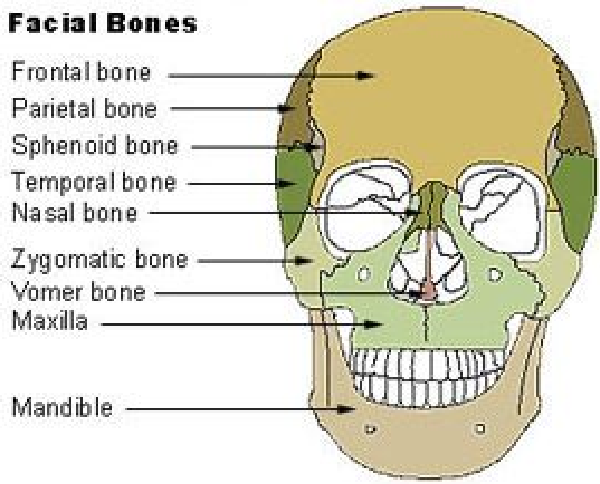
Axial Skeleton (80 bones)

Skull (28)



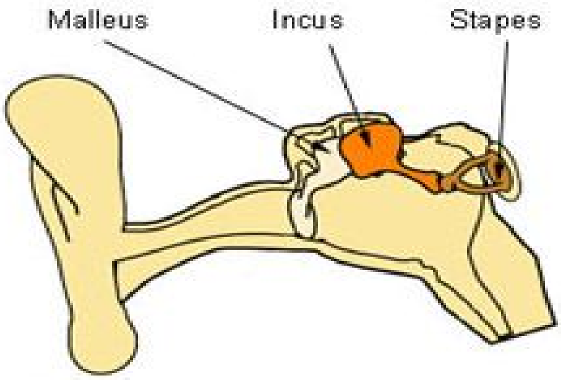
Cranial bones

- Parietal
- Temporal
- Frontal
- Occipital
- Ethmoid
- Sphenoid.



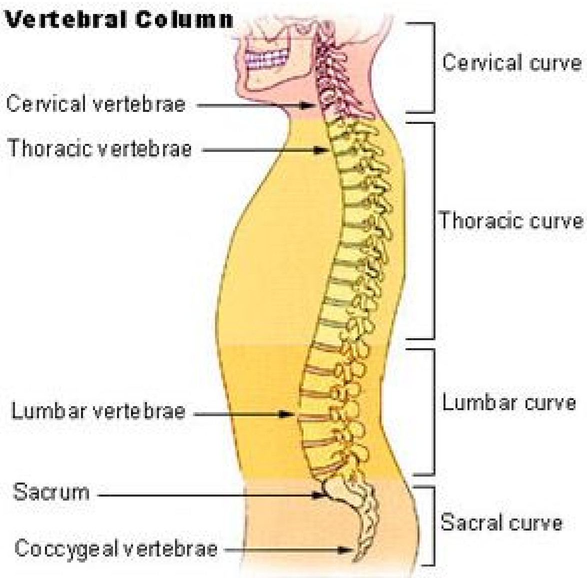
Facial bones

- Maxilla
- Zygomatic
- Mandible
- Nasal
- Platine
- Inferior nasal concha
- Lacrimal
- Vomer.



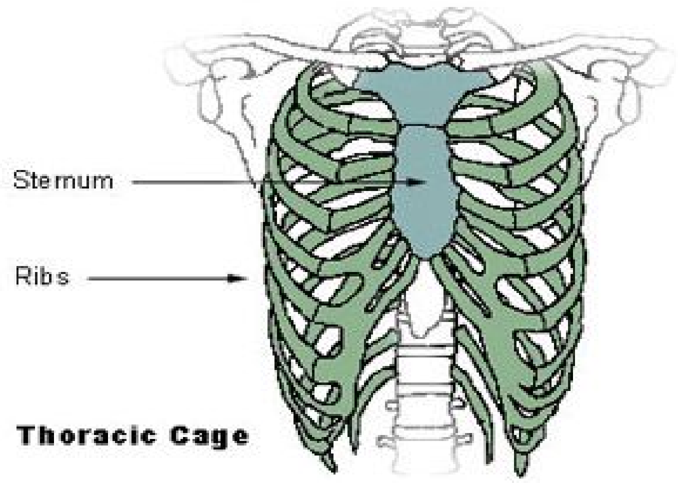
Cranial Bones

- Auditory Ossicles
- Malleus
- Incus
- Stapes
- Hyoid.



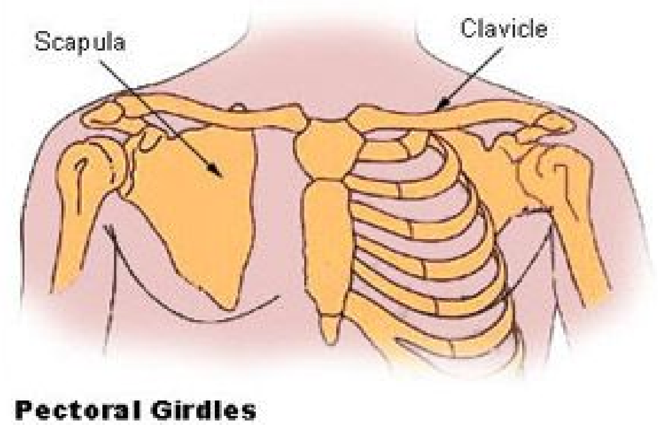
Vertebral column

- Cervical vertebrae
- Thoracic vertebrae
- Lumbar vertebrae
- Sacrum
- Coccyx.



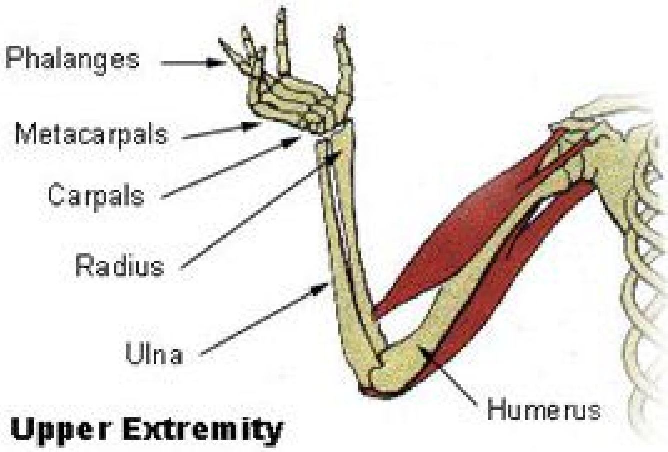
- Thoracic Cage
- Sternum
- Ribs.

Appendicular Skeleton (126 bones)



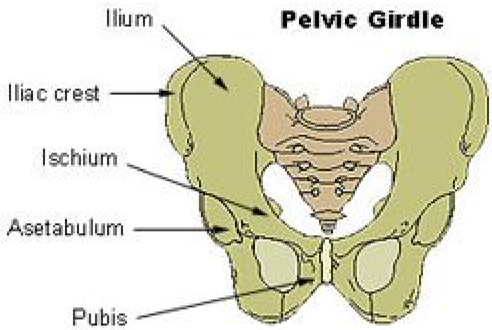
Pectoral girdles

- Clavicle
- Scapula.



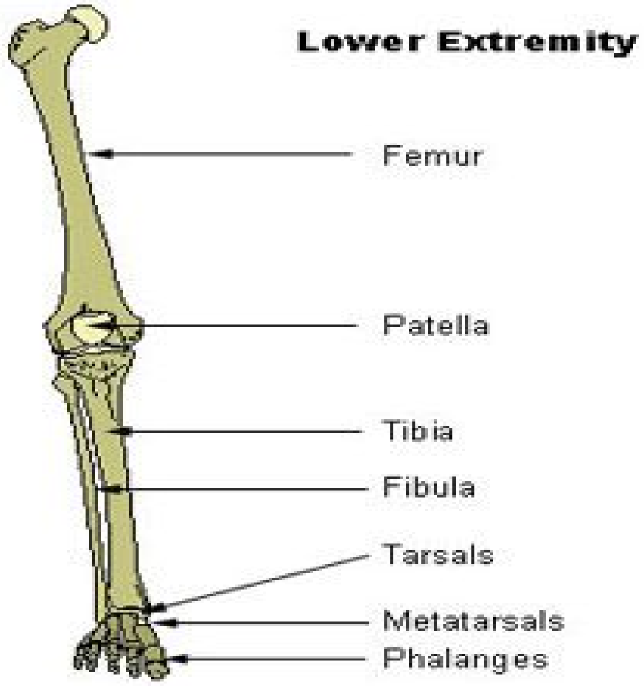
Upper extremity

- Humerus
- Radius
- Ulna
- Carpals
- Metacarpals
- Phalanges.



Pelvic Girdle

- Coxal, innominate, or hip bones



Lower extremity

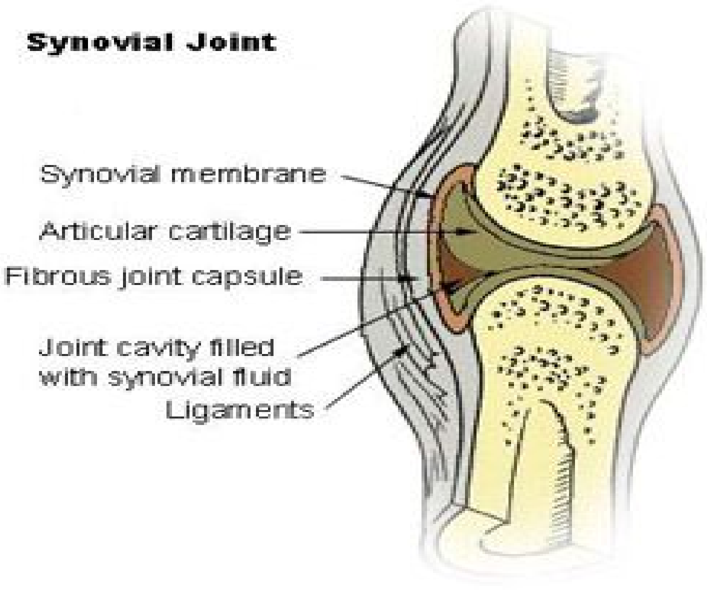
- Femur
- Tibia
- Fibula)
- Patella)
- Tarsals
- Metatarsals
- Phalanges

Articulations

An articulation, or joint, is where two bones come together. In terms of the amount of movement they allow, there are three types of joints: immovable, slightly movable and freely movable.

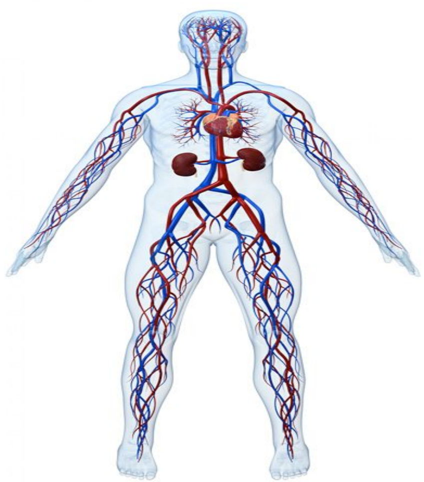
Synarthroses: Synarthroses are immovable joints. The singular form is synarthrosis. In these joints, the bones come in very close contact and are separated only by a thin layer of fibrous connective tissue. The sutures in the skull are examples of immovable joints.

Amphiarthroses: Slightly movable joints are called amphiarthroses. The singular form is amphiarthrosis. In this type of joint, the bones are connected by hyaline cartilage or fibrocartilage. The ribs connected to the sternum by costal cartilages are slightly movable joints connected by hyaline cartilage. The symphysis pubis is a slightly movable joint in which there is a fibrocartilage pad between the two bones. The joints between the vertebrae and the intervertebral disks are also of this type.



Diarthroses: Most joints in the adult body are diarthroses, or freely movable joints. The singular form is diarthrosis. In this type of joint, the ends of the opposing bones are covered with hyaline cartilage, the articular cartilage, and they are separated by a space called the joint cavity. The components of the joints are enclosed in a dense fibrous joint capsule. The outer layer of the capsule consists of the ligaments that hold the bones together. The inner layer is the synovial membrane that secretes synovial fluid into the joint cavity for lubrication. Because all of these joints have a synovial membrane, they are sometimes called synovial joints.

The cardiovascular system



The cardiovascular system is sometimes called the blood-vascular, or simply the circulatory, system. It consists of the heart, which is a muscular pumping device, and a closed system of vessels called arteries, veins, and capillaries. As the name implies, blood contained in the circulatory system is pumped by the heart around a closed circle or circuit of vessels as it passes again and again through the various "circulations" of the body.

As in the adult, survival of the developing embryo depends on the circulation of blood to maintain homeostasis and a favorable cellular environment. In response to this need, the cardiovascular system makes its appearance early in development and reaches a functional state long before any other major organ system. Incredible as it seems, the primitive heart begins to beat regularly early in the fourth week following fertilisation.

The vital role of the cardiovascular system in maintaining homeostasis depends on the continuous and controlled movement of blood through the thousands of miles of capillaries that permeate every tissue and reach every cell in the body. It is in the microscopic capillaries that blood performs its ultimate transport function. Nutrients and other essential materials pass from capillary blood into fluids surrounding the cells as waste products are removed.

Numerous control mechanisms help to regulate and integrate the diverse functions and component parts of the cardiovascular system in order to supply blood to specific body areas according to need. These mechanisms ensure a constant internal environment surrounding each body cell regardless of differing demands for nutrients or production of waste products.

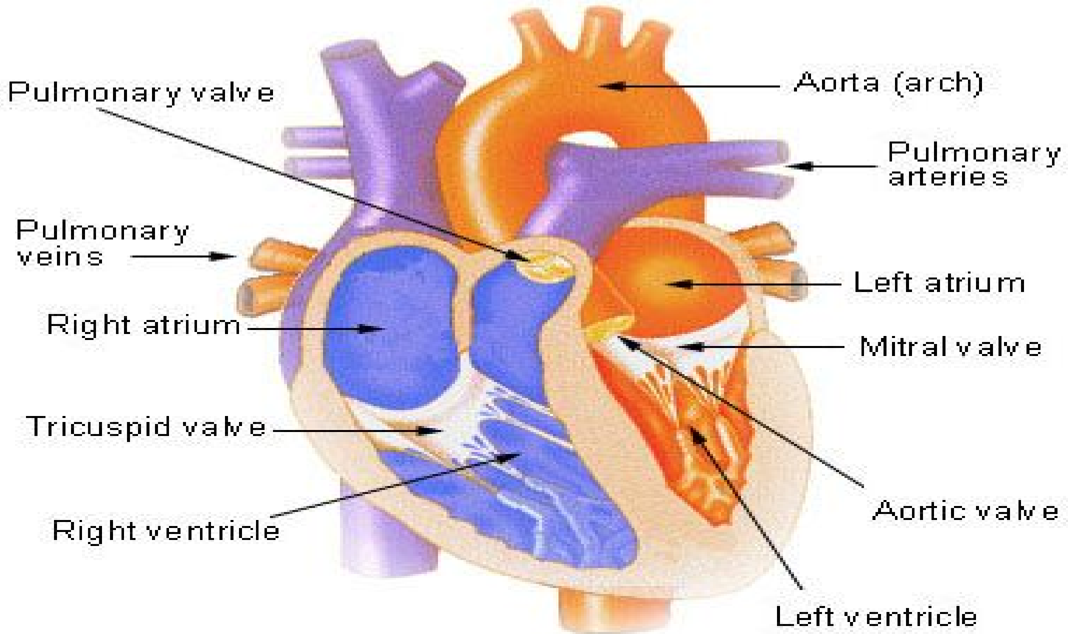
Heart

The heart is a muscular pump that provides the force necessary to circulate the blood to all the tissues in the body. Its function is vital because, to survive, the tissues need a continuous supply of oxygen and nutrients, and metabolic waste products have to be removed. Deprived of these necessities, cells soon undergo irreversible changes that lead to death. While blood is the transport medium, the heart is the organ that keeps the blood moving through the vessels. The normal adult heart pumps about 5 liters of blood every minute throughout life. If it loses its pumping effectiveness for even a few minutes, the individual's life is jeopardised.

Structure of the Heart

The human heart is a four-chambered muscular organ, shaped and sized roughly like a man's closed fist with two-thirds of the mass to the left of midline. The heart is enclosed in a pericardial sac that is lined with the parietal layers of a serous membrane. The visceral layer of the serous membrane forms the epicardium.

Internal View of the Heart



Layers of the Heart Wall

Three layers of tissue form the heart wall. The outer layer of the heart wall is the epicardium, the middle layer is the myocardium, and the inner layer is the endocardium.

Chambers of the heart

The internal cavity of the heart is divided into four chambers:

1. Right atrium.
2. Right ventricle.
3. Left atrium.
4. Left ventricle.

The two atria are thin-walled chambers that receive blood from the veins. The two ventricles are thick-walled chambers that forcefully pump blood out of the heart. Differences in thickness of the heart chamber walls are due to variations in the amount of myocardium present, which reflects the amount of force each chamber is required to generate.

The right atrium receives deoxygenated blood from systemic veins; the left atrium receives oxygenated blood from the pulmonary veins.

Valves of the Heart

Pumps need a set of valves to keep the fluid flowing in one direction and the heart is no exception. The heart has two types of valves that keep the blood flowing in the correct direction. The valves between the atria and ventricles are called atrioventricular valves (also called cuspid valves), while those at the bases of the large vessels leaving the ventricles are called semilunar valves.

The right atrioventricular valve is the tricuspid valve. The left atrioventricular valve is the bicuspid, or mitral, valve. The valve between the right ventricle and pulmonary trunk is the pulmonary semilunar valve. The valve between the left ventricle and the aorta is the aortic semilunar valve.

When the ventricles contract, atrioventricular valves close to prevent blood from flowing back into the atria. When the ventricles relax, semilunar valves close to prevent blood from flowing back into the ventricles.

Pathway of blood through the heart

While it is convenient to describe the flow of blood through the right side of the heart and then through the left side, it is important to realise that both atria and ventricles contract at the same time. The heart works as two pumps, one on the right and one on the left, working simultaneously. Blood flows from the right atrium to the right ventricle, and then is pumped to the lungs to receive oxygen. From the lungs, the blood flows to the left atrium, then to the left ventricle. From there it is pumped to the systemic circulation.

Blood supply to the Myocardium

The myocardium of the heart wall is a working muscle that needs a continuous supply of oxygen and nutrients to function efficiently. For this reason, cardiac muscle has an extensive network of blood vessels to bring oxygen to the contracting cells and to remove waste products. The right and left coronary arteries, branches of the ascending aorta, supply blood to the walls of the myocardium. After blood passes through the capillaries in the myocardium, it enters a system of cardiac (coronary) veins. Most of the cardiac veins drain into the coronary sinus, which opens into the right atrium.

Physiology of the heart

The conduction system includes several components. The first part of the conduction system is the sinoatrial node . Without any neural stimulation, the sinoatrial node rhythmically initiates impulses 70 to 80 times per minute. Because it establishes the basic rhythm of the heartbeat, it is called the pacemaker of the heart. Other parts of the conduction system include the atrioventricular node, atrioventricular bundle, bundle branches, and conduction myofibers. All of these components coordinate the contraction and relaxation of the heart chambers.

Cardiac cycle

The cardiac cycle refers to the alternating contraction and relaxation of the myocardium in the walls of the heart chambers, coordinated by the conduction system, during one heartbeat. Systole is the contraction phase of the cardiac cycle, and diastole is the relaxation phase. At a normal heart rate, one cardiac cycle lasts for 0.8 second.

Heart sounds

The sounds associated with the heartbeat are due to vibrations in the tissues and blood caused by closure of the valves. Abnormal heart sounds are called murmurs.

Heart rate

The sinoatrial node, acting alone, produces a constant rhythmic heart rate. Regulating factors are reliant on the atrioventricular node to increase or decrease the heart rate to adjust cardiac output to meet the changing needs of the body. Most changes in the heart rate are mediated through the cardiac center in the medulla oblongata of the brain. The center has both sympathetic and parasympathetic components that adjust the heart rate to meet the changing needs of the body. Peripheral factors such as emotions, ion concentrations, and body temperature may affect heart rate. These are usually mediated through the cardiac center.

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.

Blood

Blood is the fluid of life, transporting oxygen from the lungs to body tissue and carbon dioxide from body tissue to the lungs. Blood is the fluid of growth, transporting nourishment from digestion and hormones from glands throughout the body. Blood is the fluid of health, transporting disease-fighting substances to the tissue and waste to the kidneys. Because it contains living cells, blood is alive. Red blood cells and white blood cells are responsible for nourishing and cleansing the body.

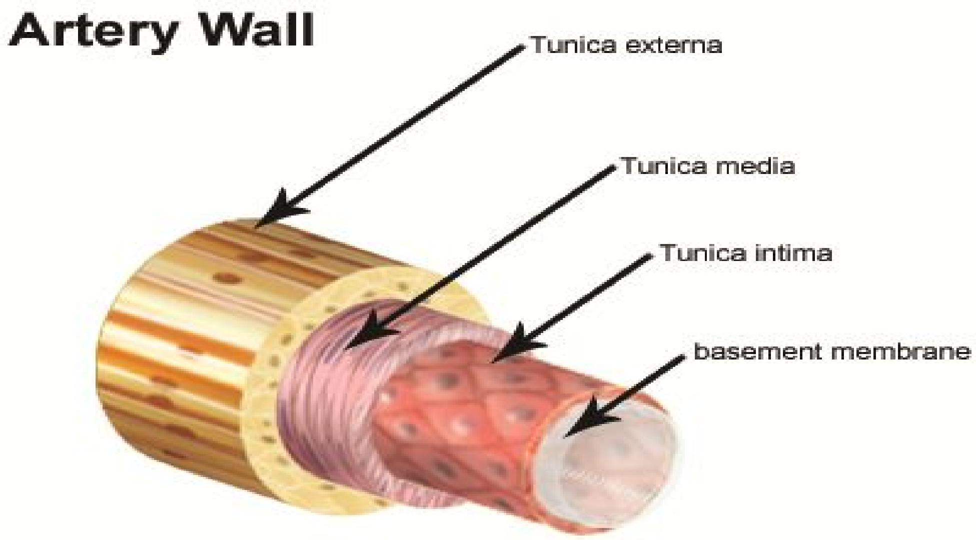
Without blood, the human body would stop working.

Classification and structure of blood vessels

Blood vessels are the channels or conduits through which blood is distributed to body tissues. The vessels make up two closed systems of tubes that begin and end at the heart. One system, the pulmonary vessels, transports blood from the right ventricle to the lungs and back to the left atrium. The other system, the systemic vessels, carries blood from the left ventricle to the tissues in all parts of the body and then returns the blood to the right atrium. Based on their structure and function, blood vessels are classified as either arteries, capillaries, or veins.

Arteries

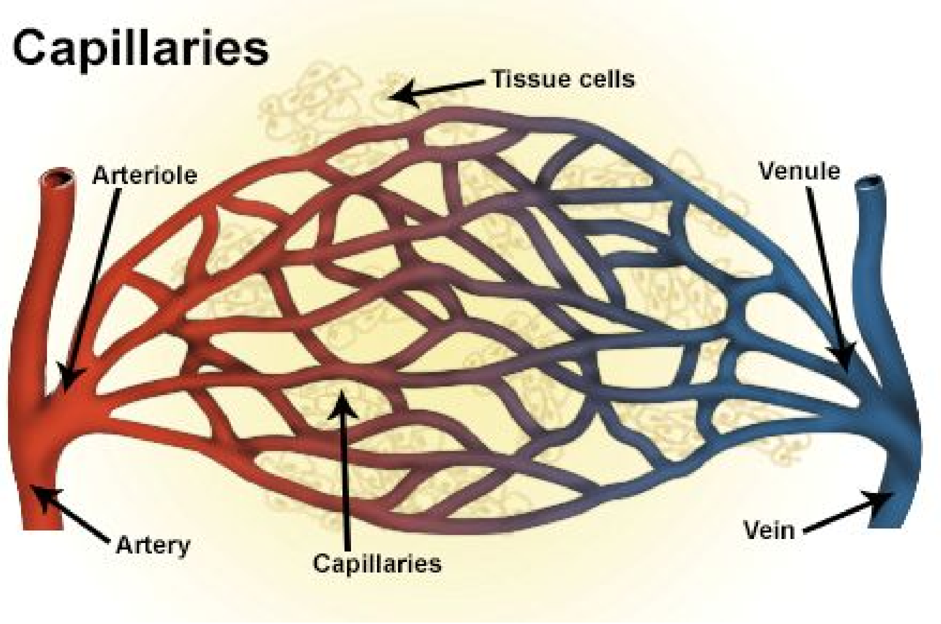
Arteries carry blood away from the heart. Pulmonary arteries transport blood that has a low oxygen content from the right ventricle to the lungs. Systemic arteries transport oxygenated blood from the left ventricle to the body tissues. Blood is pumped from the ventricles into large elastic arteries that branch repeatedly into smaller and smaller arteries until the branching results in microscopic arteries called arterioles. The arterioles play a key role in regulating blood flow into the tissue capillaries. About 10 percent of the total blood volume is in the systemic arterial system at any given time.



The wall of an artery consists of three layers. The innermost layer, the tunica intima (also called tunica interna), is simple squamous epithelium surrounded by a connective tissue basement membrane with elastic fibers. The middle layer, the tunica media, is primarily smooth muscle and is usually the thickest layer. It not only provides support for the vessel but also changes vessel diameter to regulate blood flow and blood pressure. The outermost layer, which attaches the vessel to the surrounding tissue, is the tunica externa or tunica adventitia. This layer is connective tissue with varying amounts of elastic and collagenous fibers. The connective tissue in this layer is quite dense where it is adjacent to the tunic media, but it changes to loose connective tissue near the periphery of the vessel.

Capillaries

Capillaries, the smallest and most numerous of the blood vessels, form the connection between the vessels that carry blood away from the heart (arteries) and the vessels that return blood to the heart (veins). The primary function of capillaries is the exchange of materials between the blood and tissue cells.

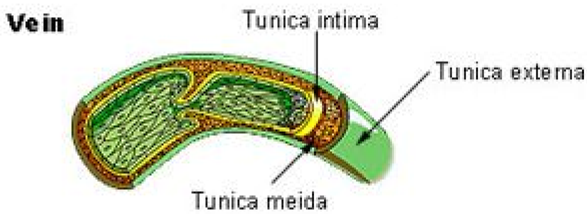


Capillary distribution varies with the metabolic activity of body tissues. Tissues such as skeletal muscle, liver, and kidney have extensive capillary networks because they are metabolically active and require an abundant supply of oxygen and nutrients. Other tissues, such as connective tissue, have a less abundant supply of capillaries. The epidermis of the skin and the lens and cornea of the eye completely lack a capillary network. About 5 percent of the total blood volume is in the systemic capillaries at any given time. Another 10 percent is in the lungs.

Smooth muscle cells in the arterioles where they branch to form capillaries regulate blood flow from the arterioles into the capillaries.

Veins

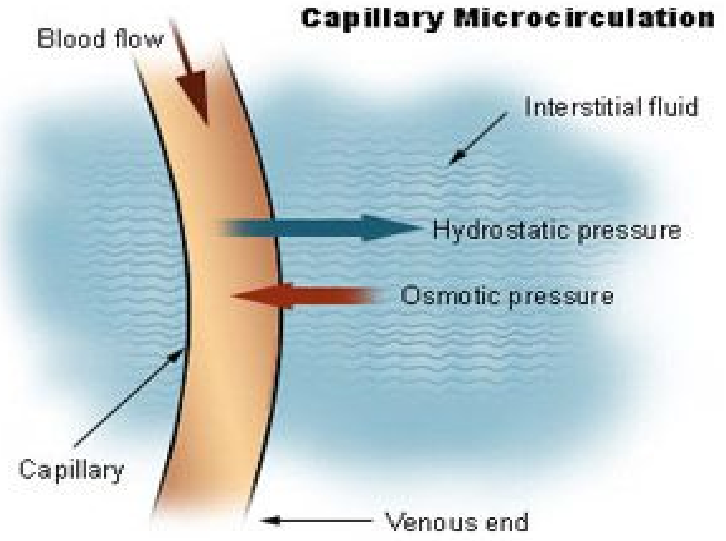
Veins carry blood toward the heart. After blood passes through the capillaries, it enters the smallest veins, called venules. From the venules, it flows into progressively larger and larger veins until it reaches the heart. In the pulmonary circuit, the pulmonary veins transport blood from the lungs to the left atrium of the heart. This blood has a high oxygen content because it has just been oxygenated in the lungs. Systemic veins transport blood from the body tissue to the right atrium of the heart. This blood has a reduced oxygen content because the oxygen has been used for metabolic activities in the tissue cells.



The walls of veins have the same three layers as the arteries. Although all the layers are present, there is less smooth muscle and connective tissue. This makes the walls of veins thinner than those of arteries, which is related to the fact that blood in the veins has less pressure than in the arteries. Because the walls of the veins are thinner and less rigid than arteries, veins can hold more blood. Almost 70 percent of the total blood volume is in the veins at any given time. Medium and large veins have venous valves, similar to the semilunar valves associated with the heart, that help keep the blood flowing toward the heart. Venous valves are especially important in the arms and legs, where they prevent the backflow of blood in response to the pull of gravity.

Physiology of circulation

Roles of capillaries



In addition to forming the connection between the arteries and veins, capillaries have a vital role in the exchange of gases, nutrients, and metabolic waste products between the blood and the tissue cells. Substances pass through the capillary wall by diffusion, filtration, and osmosis. Oxygen and carbon dioxide move across the capillary wall by diffusion. Fluid movement across a capillary wall is determined by a combination of hydrostatic and osmotic pressure. The net result of the capillary microcirculation created by hydrostatic and osmotic pressure is that substances leave the blood at one end of the capillary and return at the other end.

Blood flow

Blood flow refers to the movement of blood through the vessels from arteries to the capillaries and then into the veins. Pressure is a measure of the force that the blood exerts against the vessel walls as it moves the blood through the vessels. Like all fluids, blood flows from a high pressure area to a region with lower pressure. Blood flows in the same direction as the decreasing pressure gradient: arteries to capillaries to veins.

The rate, or velocity, of blood flow varies inversely with the total cross-sectional area of the blood vessels. As the total cross-sectional area of the vessels increases, the velocity of flow decreases. Blood flow is slowest in the capillaries, which allows time for exchange of gases and nutrients.

Resistance is a force that opposes the flow of a fluid. In blood vessels, most of the resistance is due to vessel diameter. As vessel diameter decreases, the resistance increases and blood flow decreases.

Very little pressure remains by the time blood leaves the capillaries and enters the venules. Blood flow through the veins is not the direct result of ventricular contraction. Instead, venous return depends on skeletal muscle action, respiratory movements, and constriction of smooth muscle in venous walls.

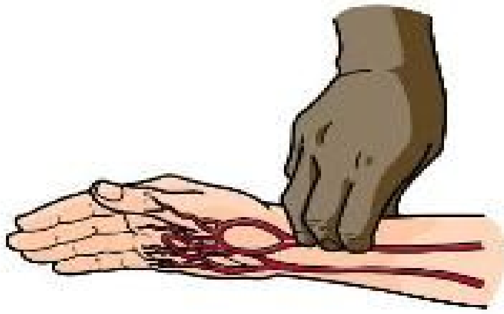
Pulse and Blood Pressure

Pulse refers to the rhythmic expansion of an artery that is caused by ejection of blood from the ventricle. It can be felt where an artery is close to the surface and rests on something firm.

In common usage, the term blood pressure refers to arterial blood pressure, the pressure in the aorta and its branches. Systolic pressure is due to ventricular contraction. Diastolic pressure occurs during cardiac relaxation. Pulse pressure is the difference between systolic pressure and diastolic pressure. Blood pressure is measured with a sphygmomanometer and is recorded as the systolic pressure over the diastolic pressure. Four major factors interact to affect blood pressure: cardiac output, blood volume, peripheral resistance, and viscosity. When these factors increase, blood pressure also increases.

Arterial blood pressure is maintained within normal ranges by changes in cardiac output and peripheral resistance. Pressure receptors (barareceptors), located in the walls of the large arteries in the thorax and neck, are important for short-term blood pressure regulation.

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**

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

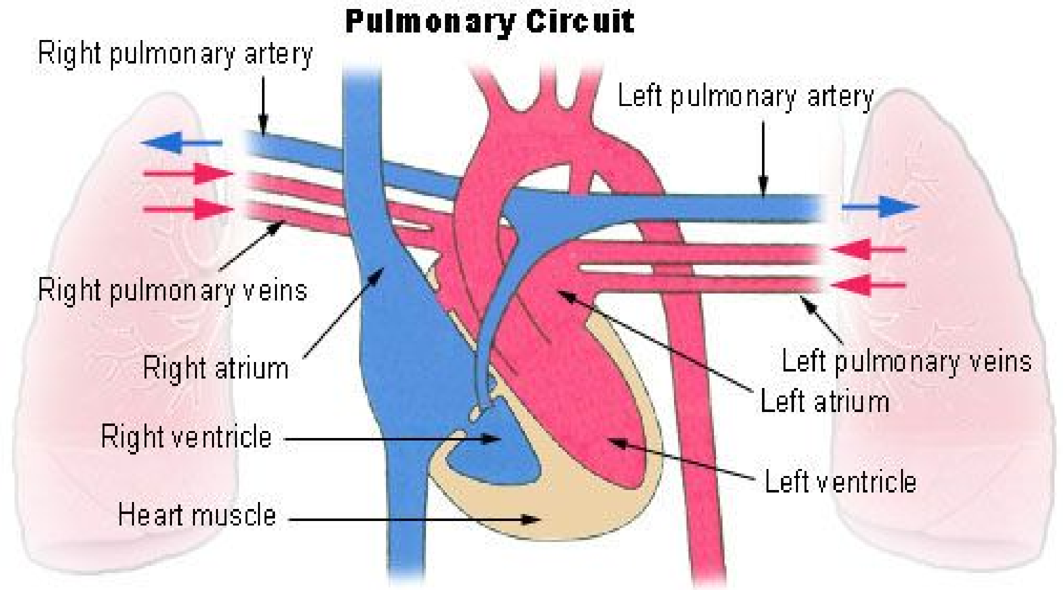
1. Ensure the cuff is completely deflated.
2. Put the centre of the cuff around the upper arm (with the tubes lying over the cubital fossa) and wrap the cuff evenly and snugly.
3. Place the stethoscope in your ears.
4. Locate the brachial pulse in the anterior cubital fossa and place the diaphragm of 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.

Circulatory pathways

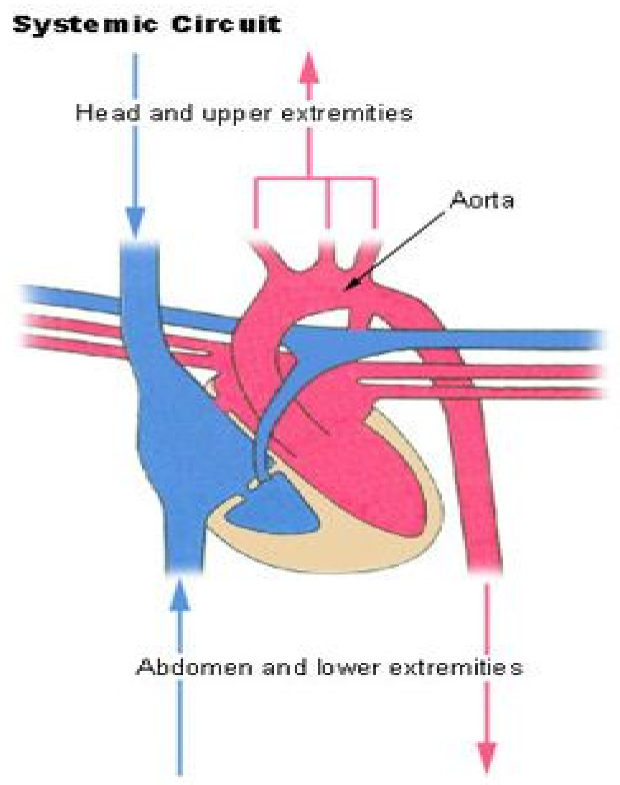
The blood vessels of the body are functionally divided into two distinctive circuits: pulmonary circuit and systemic circuit. The pump for the pulmonary circuit, which circulates blood through the lungs, is the right ventricle. The left ventricle is the pump for the systemic circuit, which provides the blood supply for the tissue cells of the body.

Pulmonary circuit

Pulmonary circulation transports oxygen-poor blood from the right ventricle to the lungs, where blood picks up a new blood supply. Then it returns the oxygen-rich blood to the left atrium.



Systemic circuit



The systemic circulation provides the functional blood supply to all body tissue. It carries oxygen and nutrients to the cells and picks up carbon dioxide and waste products. Systemic circulation carries oxygenated blood from the left ventricle, through the arteries, to the capillaries in the tissues of the body. From the tissue capillaries, the deoxygenated blood returns through a system of veins to the right atrium of the heart.

The coronary arteries are the only vessels that branch from the ascending aorta. The brachiocephalic, left common carotid, and left subclavian arteries branch from the aortic arch. Blood supply for the brain is provided by the internal carotid and vertebral arteries. The subclavian arteries provide the blood supply for the upper extremity. The celiac, superior mesenteric, suprarenal, renal, gonadal, and inferior mesenteric arteries branch from the abdominal aorta to supply the abdominal viscera. Lumbar arteries provide blood for the muscles and spinal cord. Branches of the external iliac artery provide the blood supply for the lower extremity. The internal iliac artery supplies the pelvic viscera.

Major systemic arteries: All systemic arteries are branches, either directly or indirectly, from the aorta. The aorta ascends from the left ventricle, curves posteriorly and to the left, then descends through the thorax and abdomen. This geography divides the aorta into three portions: ascending aorta, arotic arch, and descending aorta. The descending aorta is further subdivided into the thoracic arota and abdominal aorta.

Major systemic veins: After blood delivers oxygen to the tissues and picks up carbon dioxide, it returns to the heart through a system of veins. The capillaries, where the gaseous exchange occurs, merge into venules and these converge to form larger and larger veins until the blood reaches either the superior vena cava or inferior vena cava, which drain into the right atrium.

Fetal circulation

Most circulatory pathways in a fetus are like those in the adult but there are some notable differences because the lungs, the gastrointestinal tract, and the kidneys are not functioning before birth. The fetus obtains its oxygen and nutrients from the mother and also depends on maternal circulation to carry away the carbon dioxide and waste products.

The umbilical cord contains two umbilical arteries to carry fetal blood to the placenta and one umbilical vein to carry oxygen-and-nutrient-rich blood from the placenta to the fetus. The ductus venosus allows blood to bypass the immature liver in fetal circulation. The foramen ovale and ductus arteriosus are modifications that permit blood to bypass the lungs in fetal circulation.

The Endocrine system

The endocrine system, along with the nervous system, functions in the regulation of body activities. The nervous system acts through electrical impulses and neurotransmitters to cause muscle contraction and glandular secretion. The effect is of short duration, measured in seconds, and localized. The endocrine system acts through chemical messengers called hormones that influence growth, development, and metabolic activities. The action of the endocrine system is measured in minutes, hours, or weeks and is more generalized than the action of the nervous system.

There are two major categories of glands in the body - exocrine and endocrine.

Exocrine Glands

Exocrine glands have ducts that carry their secretory product to a surface. These glands include the sweat, sebaceous, and mammary glands and, the glands that secrete digestive enzymes.

Endocrine glands

The endocrine glands do not have ducts to carry their product to a surface. They are called ductless glands. The word endocrine is derived from the Greek terms "endo," meaning within, and "krine," meaning to separate or secrete. The secretory products of endocrine glands are called hormones and are secreted directly into the blood and then carried throughout the body where they influence only those cells that have receptor sites for that hormone.

Characteristics of hormones

Chemical nature of hormones

Chemically, hormones may be classified as either proteins or steroids. All of the hormones in the human body, except the sex hormones and those from the adrenal cortex, are proteins or protein derivatives.

Mechanism of hormone

Action Hormones are carried by the blood throughout the entire body, yet they affect only certain cells. The specific cells that respond to a given hormone have receptor sites for that hormone. This is sort of a lock-and-key mechanism. If the key fits the lock, then the door will open. If a hormone fits the receptor site, then there will be an effect. If a hormone and a receptor site do not match, then there is no reaction.

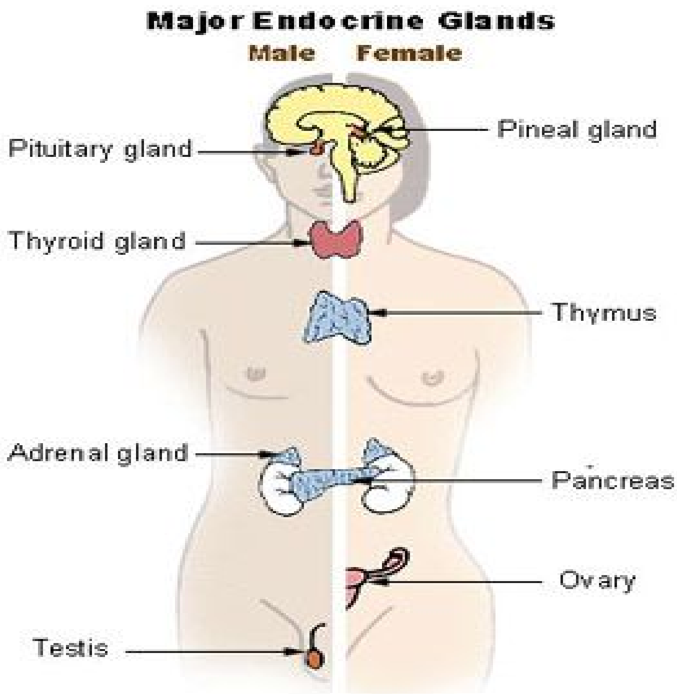
All the cells that have receptor sites for a given hormone make up the target tissue for that hormone. In some cases, the target tissue is localized in a single gland or organ. In other cases, the target tissue is diffuse and scattered throughout the body so that many areas are affected. Hormones bring about their characteristic effects on target cells by modifying cellular activity. Protein hormones react with receptors on the surface of the cell, and the sequence of events that results in hormone action is relatively rapid. Steroid hormones typically react with receptor sites inside a cell. Because this method of action actually involves synthesis of proteins, it is relatively slow.

Control of hormone action

Hormones are very potent substances, which means that very small amounts of a hormone may have profound effects on metabolic processes. Because of their potency, hormone secretion must be regulated within very narrow limits in order to maintain homeostasis in the body.

Many hormones are controlled by some form of a negative feedback mechanism. In this type of system, a gland is sensitive to the concentration of a substance that it regulates. A negative feedback system causes a reversal of increases and decreases in body conditions in order to maintain a state of stability or homeostasis. Some endocrine glands secrete hormones in response to other hormones. The hormones that cause secretion of other hormones are called tropic hormones. A hormone from gland A causes gland B to secrete its hormone. A third method of regulating hormone secretion is by direct nervous stimulation. A nerve stimulus causes gland A to secrete its hormone.

Endocrine glands and their hormones



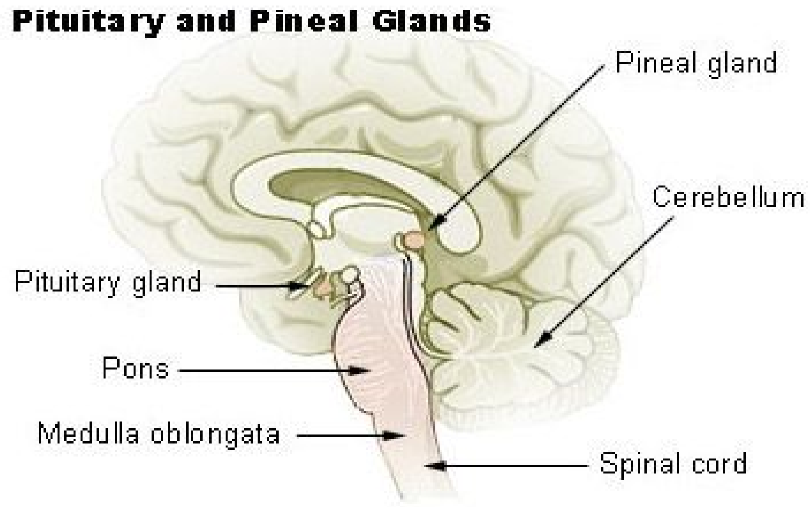
The endocrine system is made up of the endocrine glands that secrete hormones. Although there are eight major endocrine glands scattered throughout the body, they are still considered to be one system because they have similar functions, similar mechanisms of influence, and many important interrelationships.

Some glands also have non-endocrine regions that have functions other than hormone secretion. For example, the pancreas has a major exocrine portion that secretes digestive enzymes and an endocrine portion that secretes hormones. The ovaries and testes secrete hormones and also produce the ova and sperm. Some organs, such as the stomach, intestines, and heart, produce hormones, but their primary function is not hormone secretion.

Pituitary and Pineal glands

Pituitary gland

The pituitary gland or hypophysis is a small gland about 1 centimeter in diameter or the size of a pea. It is nearly surrounded by bone as it rests in the sella turcica, a depression in the sphenoid bone. The gland is connected to the hypothalamus of the brain by a slender stalk called the infundibulum.



There are two distinct regions in the gland: the anterior lobe (adenohypophysis) and the posterior lobe (neurohypophysis). The activity of the adenohypophysis is controlled by releasing hormones from the hypothalamus. The neurohypophysis is controlled by nerve stimulation.

Hormones of the Anterior Lobe (Adenohypophysis)

Growth hormone is a protein that stimulates the growth of bones, muscles, and other organs by promoting protein synthesis. This hormone drastically affects the appearance of an individual because it influences height. If there is too little growth hormone in a child, that person may become a pituitary dwarf of normal proportions but small stature. An excess of the hormone in a child results in an exaggerated bone growth, and the individual becomes exceptionally tall or a giant.

Thyroid-stimulating hormone, or thyrotropin, causes the glandular cells of the thyroid to secrete thyroid hormone. When there is a hypersecretion of thyroid-stimulating hormone, the thyroid gland enlarges and secretes too much thyroid hormone.

Adrenocorticotropic hormone reacts with receptor sites in the cortex of the adrenal gland to stimulate the secretion of cortical hormones, particularly cortisol. Gonadotropic hormones react with receptor sites in the gonads, or ovaries and testes, to regulate the development, growth, and function of these organs. Prolactin hormone promotes the development of glandular tissue in the female breast during pregnancy and stimulates milk production after the birth of the infant.

Hormones of the Posterior Lobe (Neurohypophysis)

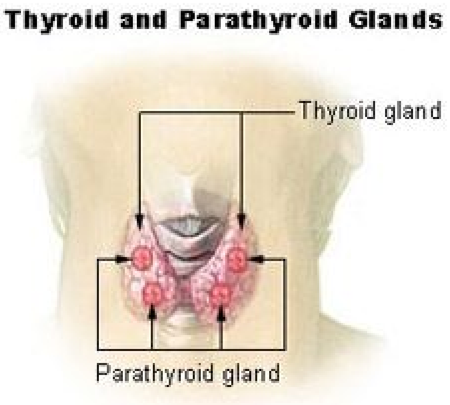
Antidiuretic hormone promotes the reabsorption of water by the kidney tubules, with the result that less water is lost as urine. This mechanism conserves water for the body. Insufficient amounts of antidiuretic hormone cause excessive water loss in the urine. Oxytocin causes contraction of the smooth muscle in the wall of the uterus. It also stimulates the ejection of milk from the lactating breast.

Pineal gland

The pineal gland, also called pineal body or epiphysis cerebri, is a small cone-shaped structure that extends posteriorly from the third ventricle of the brain. The pineal gland consists of portions of neurons, neuroglial cells, and specialized secretory cells called pinealocytes. The pinealocytes synthesize the hormone melatonin and secrete it directly into the cerebrospinal fluid, which takes it into the blood. Melatonin affects reproductive development and daily physiologic cycles.

Thyroid and Parathyroid glands

Thyroid Gland



The thyroid gland is a very vascular organ that is located in the neck. It consists of two lobes, one on each side of the trachea, just below the larynx or voice box. The two lobes are connected by a narrow band of tissue called the isthmus. Internally, the gland consists of follicles, which produce thyroxine and triiodothyronine hormones. These hormones contain iodine.

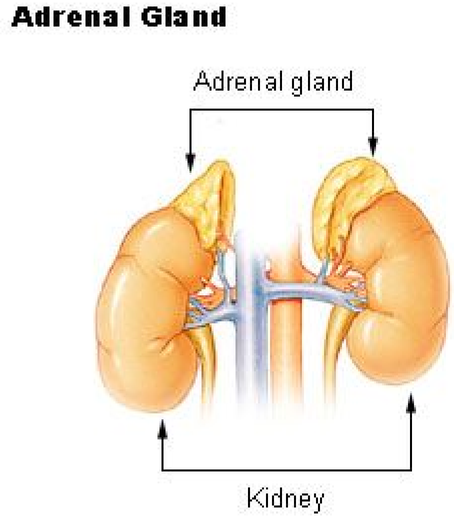
About 95 percent of the active thyroid hormone is thyroxine, and most of the remaining 5 percent is triiodothyronine. Both of these require iodine for their synthesis. Thyroid hormone secretion is regulated by a negative feedback mechanism that involves the amount of circulating hormone, hypothalamus, and adenohypophysis.

If there is an iodine deficiency, the thyroid cannot make sufficient hormone. This stimulates the anterior pituitary to secrete thyroid-stimulating hormone, which causes the thyroid gland to increase in size in a vain attempt to produce more hormones. But it cannot produce more hormones because it does not have the necessary raw material, iodine. This type of thyroid enlargement is called simple goiter or iodine deficiency goiter. Calcitonin is secreted by the parafollicular cells of the thyroid gland. This hormone opposes the action of the parathyroid glands by reducing the calcium level in the blood. If blood calcium becomes too high, calcitonin is secreted until calcium ion levels decrease to normal.

Parathyroid gland

Four small masses of epithelial tissue are embedded in the connective tissue capsule on the posterior surface of the thyroid glands. These are parathyroid glands, and they secrete parathyroid hormone or parathormone. Parathyroid hormone is the most important regulator of blood calcium levels. The hormone is secreted in response to low blood calcium levels, and its effect is to increase those levels. Hypoparathyroidism, or insufficient secretion of parathyroid hormone, leads to increased nerve excitability. The low blood calcium levels trigger spontaneous and continuous nerve impulses, which then stimulate muscle contraction

Adrenal gland



The adrenal, or suprarenal, gland is paired with one gland located near the upper portion of each kidney. Each gland is divided into an outer cortex and an inner medulla. The cortex and medulla of the adrenal gland, like the anterior and posterior lobes of the pituitary, develop from different embryonic tissues and secrete different hormones. The adrenal cortex is essential to life, but the medulla may be removed with no life-threatening effects.

The hypothalamus of the brain influences both portions of the adrenal gland but by different mechanisms. The adrenal cortex is regulated by negative feedback involving the hypothalamus and adrenocorticotropic hormone; the medulla is regulated by nerve impulses from the hypothalamus.

Hormones of the Adrenal Cortex

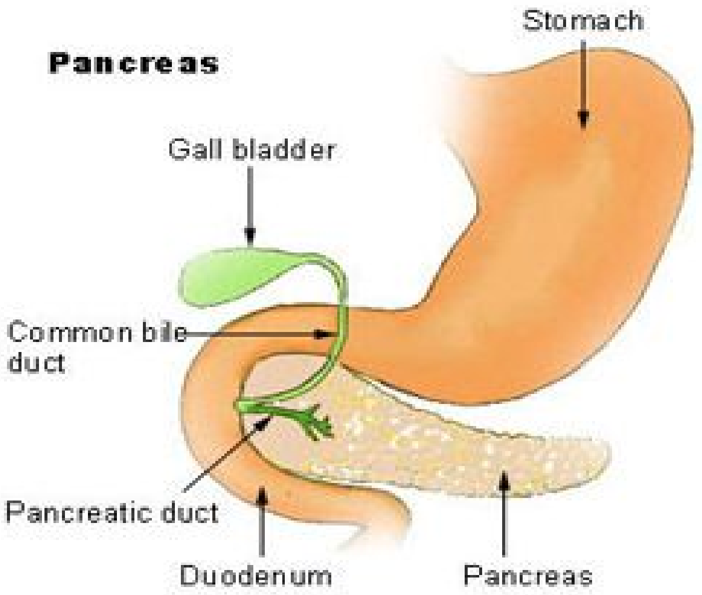
The adrenal cortex consists of three different regions, with each region producing a different group or type of hormones. Chemically, all the cortical hormones are steroid. Mineralocorticoids are secreted by the outermost region of the adrenal cortex. The principal mineralocorticoid is aldosterone, which acts to conserve sodium ions and water in the body. Glucocorticoids are secreted by the middle region of the adrenal cortex. The principal glucocorticoid is cortisol, which increases blood glucose levels.

The third group of steroids secreted by the adrenal cortex is the gonadocorticoids, or sex hormones. These are secreted by the innermost region. Male hormones, androgens, and female hormones, estrogens, are secreted in minimal amounts in both sexes by the adrenal cortex, but their effect is usually masked by the hormones from the testes and ovaries. In females, the masculinization effect of androgen secretion may become evident after menopause, when estrogen levels from the ovaries decrease.

Hormones of the Adrenal Medulla

The adrenal medulla develops from neural tissue and secretes two hormones, epinephrine and norepinephrine. These two hormones are secreted in response to stimulation by sympathetic nerve, particularly during stressful situations. A lack of hormones from the adrenal medulla produces no significant effects. Hypersecretion, usually from a tumor, causes prolonged or continual sympathetic responses.

Pancreas—Islets of Langerhans

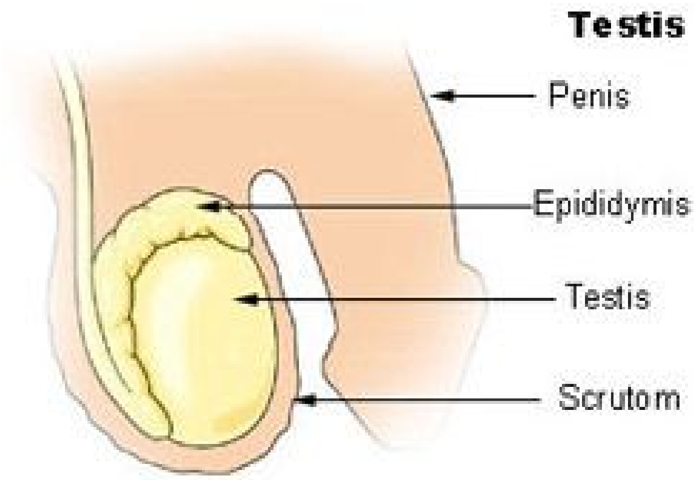


The pancreas is a long, soft organ that lies transversely along the posterior abdominal wall, posterior to the stomach, and extends from the region of the duodenum to the spleen. This gland has an exocrine portion that secretes digestive enzymes that are carried through a duct to the duodenum. The endocrine portion consists of the pancreatic islets, which secrete glucagons and insulin. Alpha cells in the pancreatic islets secrete the hormone glucagons in response to a low concentration of glucose in the blood. Beta cells in the pancreatic islets secrete the hormone insulin in response to a high concentration of glucose in the blood.

Gonads

The gonads, the primary reproductive organs, are the testes in the male and the ovaries in the female. These organs are responsible for producing the sperm and ova, but they also secrete hormones and are considered to be endocrine glands.

Testes



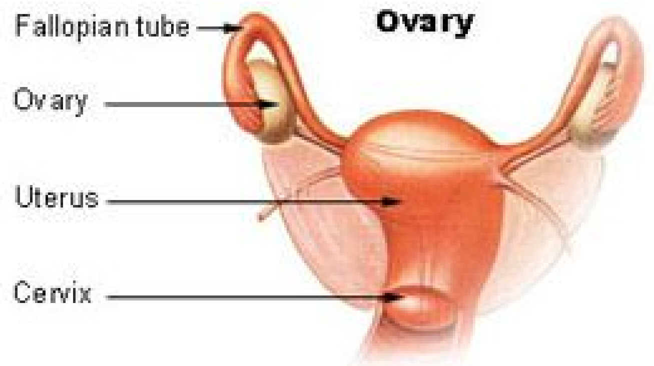
Male sex hormones, as a group, are called androgens. The principal androgen is testosterone, which is secreted by the testes. A small amount is also produced by the adrenal cortex. Production of testosterone begins during fetal development, continues for a short time after birth, nearly ceases during childhood, and then resumes at puberty.

This steroid hormone is responsible for:

- The growth and development of the male reproductive structures
- Increased skeletal and muscular growth
- Enlargement of the larynx accompanied by voice changes
- Growth and distribution of body hair
- Increased male sexual drive.

Testosterone secretion is regulated by a negative feedback system that involves releasing hormones from the hypothalamus and gonadotropins from the anterior pituitary.

Ovaries



Two groups of female sex hormones are produced in the ovaries, the estrogens and progesterone. These steroid hormones contribute to the development and function of the female reproductive organs and sex characteristics. At the onset of puberty, estrogens promotes:

- The development of the breasts
- Distribution of fat evidenced in the hips, legs, and breast
- Maturation of reproductive organs such as the uterus and vagina.

Progesterone causes the uterine lining to thicken in preparation for pregnancy. Together, progesterone and estrogens are responsible for the changes that occur in the uterus during the female menstrual cycle.

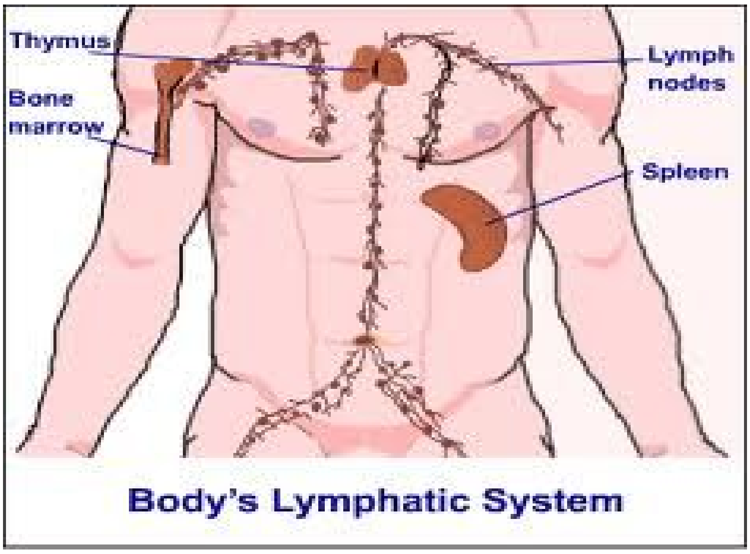
Other Endocrine glands

In addition to the major endocrine glands, other organs have some hormonal activity as part of their function. These include the thymus, stomach, small intestines, heart, and placenta. Thymosin, produced by the thymus gland, plays an important role in the development of the body's immune system. The lining of the stomach, the gastric mucosa, produces a hormone, called gastrin, in response to the presence of food in the stomach. This hormone stimulates the production of hydrochloric acid and the enzyme pepsin, which are used in the digestion of food.

The mucosa of the small intestine secretes the hormones secretin and cholecystokinin. Secreting stimulates the pancreas to produce a bicarbonate-rich fluid that neutralizes the stomach acid. Cholecystokinin stimulates contraction of the gallbladder, which releases bile. It also stimulates the pancreas to secrete digestive enzyme. The heart also acts as an endocrine organ in addition to its major role of pumping blood. Special cells in the wall of the upper chambers of the heart, called atria, produce a hormone called atrial natriiuretic hormone, or atriopeptin.

The placenta develops in the pregnant female as a source of nourishment and gas exchange for the developing fetus. It also serves as a temporary endocrine gland. One of the hormones it secretes is human chorionic gonadotropin, which signals the mother's ovaries to secrete hormones to maintain the uterine lining so that it does not degenerate and slough off in menstruation.

The Lymphatic System



The lymphatic system has three primary functions. First of all, it returns excess interstitial fluid to the blood. Of the fluid that leaves the capillary, about 90 percent is returned. The 10 percent that does not return becomes part of the interstitial fluid that surrounds the tissue cells. Small protein molecules may "leak" through the capillary wall and increase the osmotic pressure of the interstitial fluid. This further inhibits the return of fluid into the capillaries, and fluid tends to accumulate in the tissue spaces. If this continues, blood volume and blood pressure decrease significantly and the volume of tissue fluid increases, which results in edema (swelling). Lymph capillaries pick up the excess interstitial fluid and proteins and return them to the venous blood. After the fluid enters the lymph capillaries, it is called lymph.

The second function of the lymphatic system is the absorption of fats and fat-soluble vitamins from the digestive system and the subsequent transport of these substances to the venous circulation. The mucosa that lines the small intestine is covered with fingerlike projections called villi. There are blood capillaries and special lymph capillaries, called lacteals, in the centre of each villus. The blood capillaries absorb most nutrients, but the fats and fat-soluble vitamins are absorbed by the lacteals. The lymph in the lacteals has a milky appearance due to its high fat content and is called chyle. The third and probably most well known function of the lymphatic system is defense against invading microorganisms and disease. Lymph nodes and other lymphatic organs filter the lymph to remove microorganisms and other foreign particles. Lymphatic organs contain lymphocytes that destroy invading organisms.

Components of the Lymphatic System

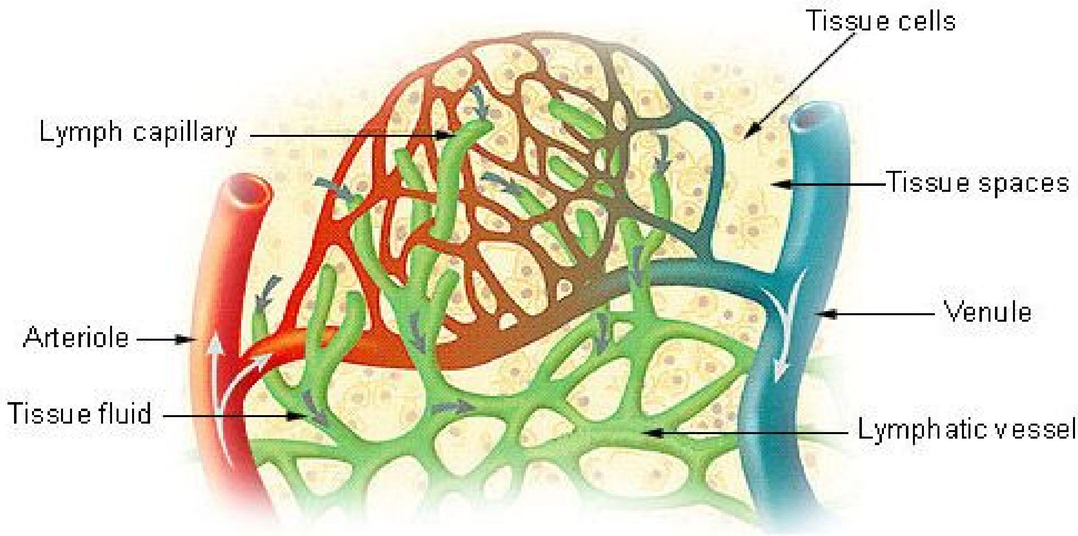
The lymphatic system consists of a fluid (lymph), vessels that transport the lymph, and organs that contain lymphoid tissue.

Lymph: Lymph is a fluid similar in composition to blood plasma. It is derived from blood plasma as fluids pass through capillary walls at the arterial end. As the interstitial fluid begins to accumulate, it is picked up and removed by tiny lymphatic vessels and returned to the blood. As soon as the interstitial fluid enters the lymph capillaries, it is called lymph. Returning the fluid to the blood prevents edema and helps to maintain normal blood volume and pressure.

Lymphatic vessels

Lymphatic vessels, unlike blood vessels, only carry fluid away from the tissues. The smallest lymphatic vessels are the lymph capillaries, which begin in the tissue spaces as blind-ended sacs. Lymph capillaries are found in all regions of the body except the bone marrow, central nervous system, and tissues, such as the epidermis, that lack blood vessels. The wall of the lymph capillary is composed of endothelium in which the simple squamous cells overlap to form a simple one-way valve. This arrangement permits fluid to enter the capillary but prevents lymph from leaving the vessel.

Lymph Capillaries in the Tissue Spaces



The microscopic lymph capillaries merge to form lymphatic vessels. Small lymphatic vessels join to form larger tributaries, called lymphatic trunks, which drain large regions. Lymphatic trunks merge until the lymph enters the two lymphatic ducts. The right lymphatic duct drains lymph from the upper right quadrant of the body. The thoracic duct drains all the rest. Like veins, the lymphatic tributaries have thin walls and have valves to prevent backflow of blood. There is no pump in the lymphatic system like the heart in the cardiovascular system. The pressure gradients to move lymph through the vessels come from the skeletal muscle action, respiratory movement, and contraction of smooth muscle in vessel walls.

Lymphatic organs

Lymphatic organs are characterized by clusters of lymphocytes and other cells, such as macrophages, enmeshed in a framework of short, branching connective tissue fibers. The lymphocytes originate in the red bone marrow with other types of blood cells and are carried in the blood from the bone marrow to the lymphatic organs. When the body is exposed to microorganisms and other foreign substances, the lymphocytes proliferate within the lymphatic organs and are sent in the blood to the site of the invasion. This is part of the immune response that attempts to destroy the invading agent.

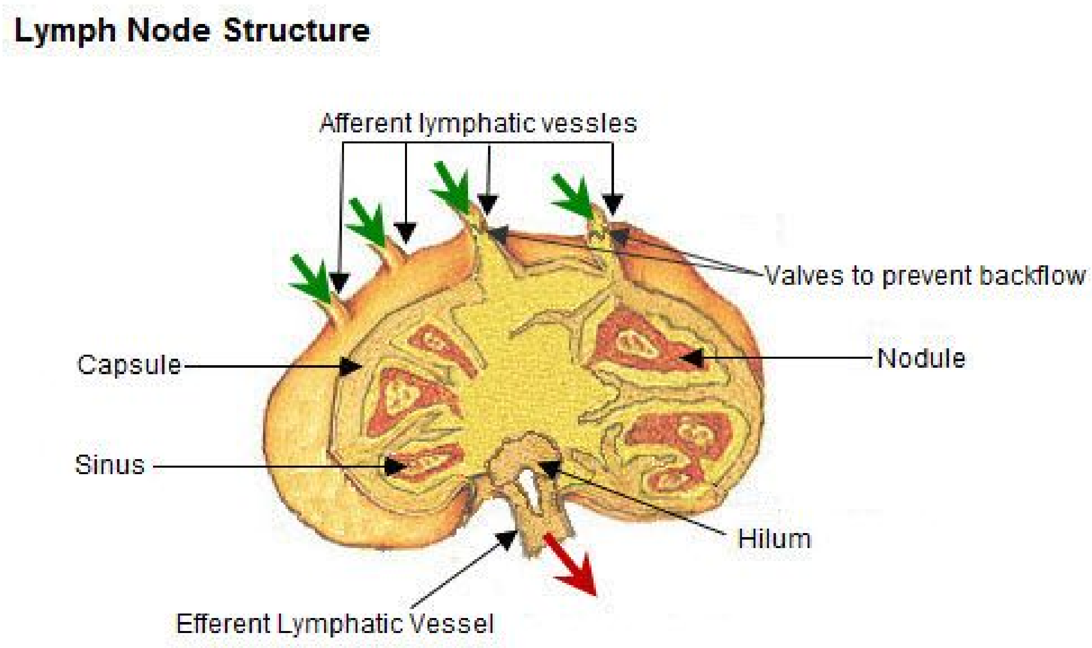
The lymphatic organs include:

- Lymph nodes
- Tonsils
- Spleen
- Thymus.

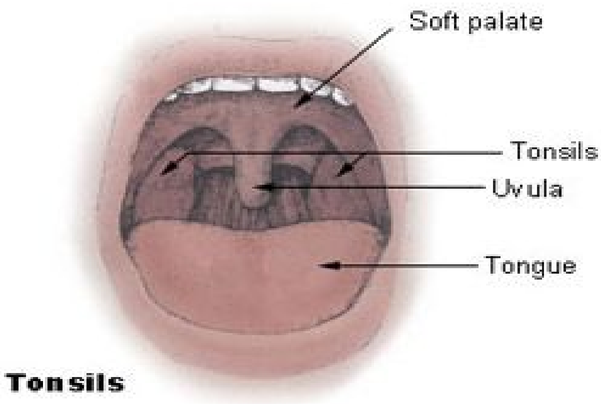
Lymph nodes

Lymph nodes are small bean-shaped structures that are usually less than 2.5 cm in length. They are widely distributed throughout the body along the lymphatic pathways where they filter the lymph before it is returned to the blood. Lymph nodes are not present in the central nervous system. There are three superficial regions on each side of the body where lymph nodes tend to cluster. These areas are the inguinal nodes in the groin, the axillary nodes in the armpit, and the cervical nodes in the neck.

The typical lymph node is surrounded by a connective tissue capsule and divided into compartments called lymph nodules. The lymph nodules are dense masses of lymphocytes and macrophages and are separated by spaces called lymph sinuses. The afferent lymphatics enter the node at different parts of its periphery, which carry lymph into the node; entering the node on the convex side. The lymph moves through the lymph sinuses and enters an efferent lymphatic vessel, which, located at an indented region called the hilum, carries the lymph away from the node.

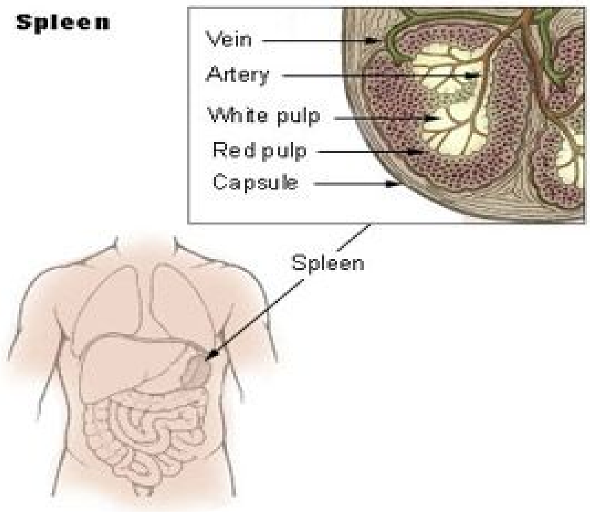


Tonsils



Tonsils are clusters of lymphatic tissue just under the mucous membranes that line the nose, mouth, and throat (pharynx). There are three groups of tonsils. The pharyngeal tonsils are located near the opening of the nasal cavity into the pharynx. When these tonsils become enlarged they may interfere with breathing and are called adenoids. The palatine tonsils are the ones that are located near the opening of the oral cavity into the pharynx. Lingual tonsils are located on the posterior surface of the tongue, which also places them near the opening of the oral cavity into the pharynx. Lymphocytes and macrophages in the tonsils provide protection against harmful substances and pathogens that may enter the body through the nose or mouth.

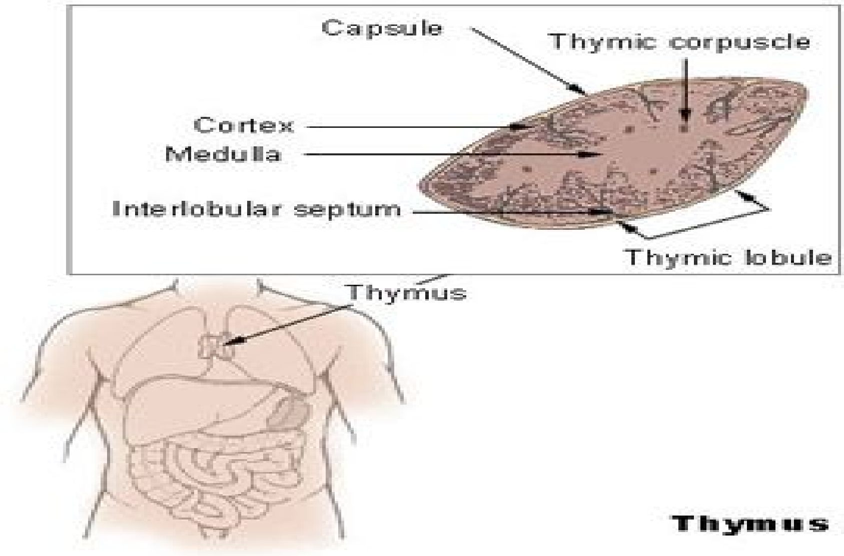
Spleen



The spleen is located in the upper left abdominal cavity, just beneath the diaphragm, and posterior to the stomach. It is similar to a lymph node in shape and structure but it is much larger. The spleen is the largest lymphatic organ in the body. Surrounded by a connective tissue capsule, which extends inward to divide the organ into lobules, the spleen consists of two types of tissue called white pulp and red pulp. The white pulp is lymphatic tissue consisting mainly of lymphocytes around arteries. The red pulp consists of venous sinuses filled with blood and cords of lymphatic cells, such as lymphocytes and macrophages. Blood enters the spleen through the splenic artery, moves through the sinuses where it is filtered, then leaves through the splenic vein.

The spleen filters blood in much the way that the lymph nodes filter lymph. Lymphocytes in the spleen react to pathogens in the blood and attempt to destroy them. Macrophages then engulf the resulting debris, the damaged cells, and the other large particles. The spleen, along with the liver, removes old and damaged erythrocytes from the circulating blood. Like other lymphatic tissue, it produces lymphocytes, especially in response to invading pathogens. The sinuses in the spleen are a reservoir for blood. In emergencies such as hemorrhage, smooth muscle in the vessel walls and in the capsule of the spleen contracts. This squeezes the blood out of the spleen into the general circulation.

Thymus



The thymus is a soft organ with two lobes that is located anterior to the ascending aorta and posterior to the sternum. It is relatively large in infants and children but after puberty it begins to decrease in size so that in older adults it is quite small. The primary function of the thymus is the processing and maturation of special lymphocytes called T-lymphocytes or T-cells. While in the thymus, the lymphocytes do not respond to pathogens and foreign agents. After the lymphocytes have matured, they enter the blood and go to other lymphatic organs where they help provide defense against disease. The thymus also produces a hormone, thymosin, which stimulates the maturation of lymphocytes in other lymphatic organs.

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.

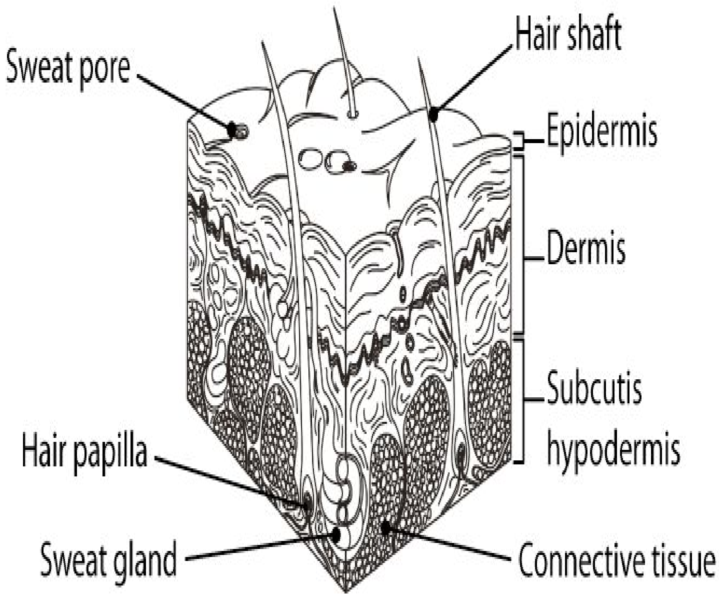
The skin

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.

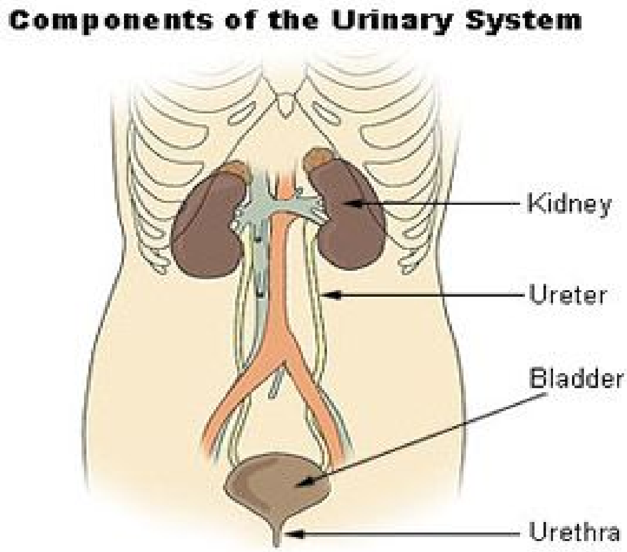
The Urinary System

The principal function of the urinary system is to maintain the volume and composition of body fluids within normal limits. One aspect of this function is to rid the body of waste products that accumulate as a result of cellular metabolism and, because of this, it is sometimes referred to as the excretory system.

Although the urinary system has a major role in excretion, other organs contribute to the excretory function. The lungs in the respiratory system excrete some waste products, such as carbon dioxide and water. The skin is another excretory organ that rids the body of wastes through the sweat glands. The liver and intestines excrete bile pigments that result from the destruction of haemoglobin. The major task of excretion still belongs to the urinary system. If it fails the other organs cannot take over and compensate adequately.

The urinary system maintains an appropriate fluid volume by regulating the amount of water that is excreted in the urine. Other aspects of its function include regulating the concentrations of various electrolytes in the body fluids and maintaining normal pH of the blood. In addition to maintaining fluid homeostasis in the body, the urinary system controls red blood cell production by secreting the hormone erythropoietin. The urinary system also plays a role in maintaining normal blood pressure by secreting the enzyme renin.

Components of the Urinary System



The urinary system consists of the kidneys, ureters, urinary bladder, and urethra. The kidneys form the urine and account for the other functions attributed to the urinary system. The ureters carry the urine away from kidneys to the urinary bladder, which is a temporary reservoir for the urine. The urethra is a tubular structure that carries the urine from the urinary bladder to the outside.

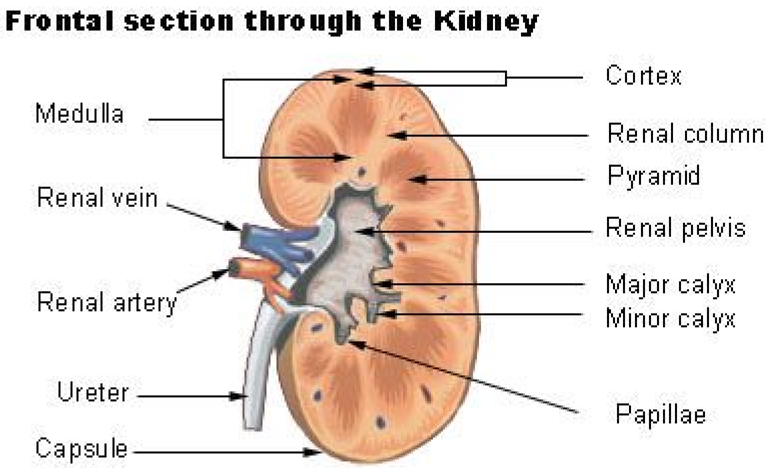
- Kidneys
- Ureters
- Urinary Bladder
- Urethra

Kidneys

The kidneys are the primary organs of the urinary system. The kidneys are the organs that filter the blood, remove the wastes, and excrete the wastes in the urine. They are the organs that perform the functions of the urinary system. The other components are accessory structures to eliminate the urine from the body.

The paired kidneys are located between the twelfth thoracic and third lumbar vertebrae, one on each side of the vertebral column. The right kidney usually is slightly lower than the left because the liver displaces it downward. The kidneys, protected by the lower ribs, lie in shallow depressions against the posterior abdominal wall and behind the parietal peritoneum. This means they are retroperitoneal. Each kidney is held in place by connective tissue, called renal fascia, and is surrounded by a thick layer of adipose tissue, called perirenal fat, which helps to protect it. A tough, fibrous, connective tissue renal capsule closely envelopes each kidney and provides support for the soft tissue that is inside.

In the adult, each kidney is approximately 3 cm thick, 6 cm wide, and 12 cm long. It is roughly bean-shaped with an indentation, called the hilum, on the medial side. The hilum leads to a large cavity, called the renal sinus, within the kidney. The ureter and renal vein leave the kidney, and the renal artery enters the kidney at the hilum.



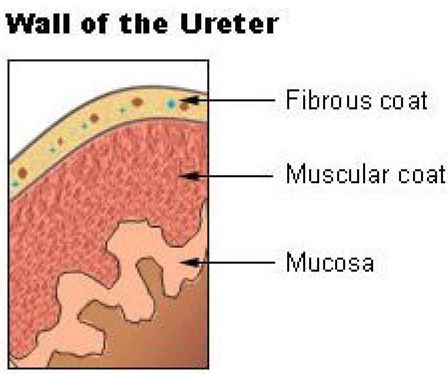
The outer, reddish region, next to the capsule, is the renal cortex. This surrounds a darker reddish-brown region called the renal medulla. The renal medulla consists of a series of renal pyramids, which appear striated because they contain straight tubular structures and blood vessels. The wide bases of the pyramids are adjacent to the cortex and the pointed ends, called renal papillae, are directed toward the center of the kidney. Portions of the renal cortex extend into the spaces between adjacent pyramids to form renal columns. The cortex and medulla make up the parenchyma, or functional tissue, of the kidney.

The central region of the kidney contains the renal pelvis, which is located in the renal sinus, and is continuous with the ureter. The renal pelvis is a large cavity that collects the urine as it is produced. The periphery of the renal pelvis is interrupted by cuplike projections called calyces. A minor calyx surrounds the renal papillae of each pyramid and collects urine from that pyramid. Several minor calyces converge to form a major calyx. From the major calyces, the urine flows into the renal pelvis; and from there, it flows into the ureter.

Each kidney contains over a million functional units, called nephrons, in the parenchyma (cortex and medulla). A nephron has two parts: a renal corpuscle and a renal tubule.The renal corpuscle consists of a cluster of capillaries, called the glomerulus, surrounded by a double-layered epithelial cup, called the glomerular capsule. An afferent arteriole leads into the renal corpuscle and an efferent arteriole leaves the renal corpuscle. Urine passes from the nephrons into collecting ducts then into the minor calyces.

The juxtaglomerular apparatus, which monitors blood pressure and secretes renin, is formed from modified cells in the afferent arteriole and the ascending limb of the nephron loop.

Ureters



Each ureter is a small tube, about 25 cm long, that carries urine from the renal pelvis to the urinary bladder. It descends from the renal pelvis, along the posterior abdominal wall, which is behind the parietal peritoneum, and enters the urinary bladder on the posterior inferior surface.

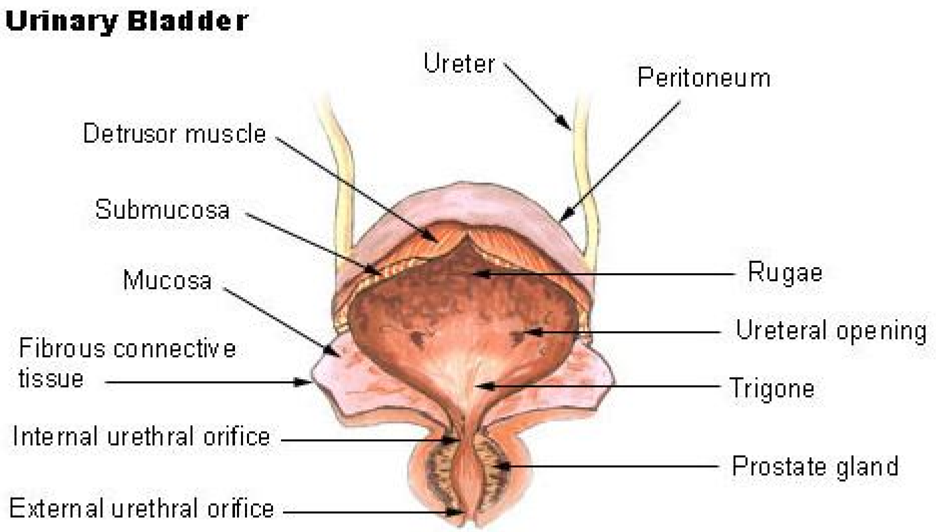
The wall of the ureter consists of three layers. The outer layer, the fibrous coat, is a supporting layer of fibrous connective tissue. The middle layer, the muscular coat, consists of the inner circular and outer longitudinal smooth muscle. The main function of this layer is peristalsis: to propel the urine. The inner layer, the mucosa, is transitional epithelium that is continuous with the lining of the renal pelvis and the urinary bladder. This layer secretes mucus, which coats and protects the surface of the cells.

Urinary Bladder

The urinary bladder is a temporary storage reservoir for urine. It is located in the pelvic cavity, posterior to the symphysis pubis, and below the parietal peritoneum. The size and shape of the urinary bladder varies with the amount of urine it contains and with the pressure it receives from surrounding organs.

The inner lining of the urinary bladder is a mucous membrane of transitional epithelium that is continuous with that in the ureters. When the bladder is empty, the mucosa has numerous folds called rugae. The rugae and transitional epithelium allow the bladder to expand as it fills. The second layer in the walls is the submucosa, which supports the mucous membrane. It is composed of connective tissue with elastic fibers.

The next layer is the muscularis, which is composed of smooth muscle. The smooth muscle fibers are interwoven in all directions and, collectively, these are called the detrusor muscle. Contraction of this muscle expels urine from the bladder. On the superior surface, the outer layer of the bladder wall is parietal peritoneum. In all other regions, the outer layer is fibrous connective tissue.



There is a triangular area, called the trigone, formed by three openings in the floor of the urinary bladder. Two of the openings are from the ureters and form the base of the trigone. Small flaps of mucosa cover these openings and act as valves that allow urine to enter the bladder but prevent it from backing up from the bladder into the ureters. The third opening, at the apex of the trigone, is the opening into the urethra. A band of the detrusor muscle encircles this opening to form the internal urethral sphincter.

Urethra

The final passageway for the flow of urine is the urethra, a thin-walled tube that conveys urine from the floor of the urinary bladder to the outside. The opening to the outside is the external urethral orifice. The mucosal lining of the urethra is transitional epithelium. The wall also contains smooth muscle fibers and is supported by connective tissue.

The internal urethral sphincter surrounds the beginning of the urethra, where it leaves the urinary bladder. This sphincter is smooth (involuntary) muscle. Another sphincter, the external urethral sphincter, is skeletal (voluntary) muscle and encircles the urethra where it goes through the pelvic floor. These two sphincters control the flow of urine through the urethra.

In females, the urethra is short, only 3 to 4 cm (about 1.5 inches) long. The external urethral orifice opens to the outside just anterior to the opening for the vagina.

In males, the urethra is much longer, about 20 cm (7 to 8 inches) in length, and transports both urine and semen. The first part, next to the urinary bladder, passes through the prostate gland and is called the prostatic urethra. The second part, a short region that penetrates the pelvic floor and enters the penis, is called the membranous urethra. The third part, the spongy urethra, is the longest region. This portion of the urethra extends the entire length of the penis, and the external urethral orifice opens to the outside at the tip of the penis.

The Reproductive System

The major function of the reproductive system is to ensure survival of the species. Other systems in the body, such as the endocrine and urinary systems, work continuously to maintain homeostasis for survival of the individual. An individual may live a long, healthy, and happy life without producing offspring, but if the species is to continue, at least some individuals must produce offspring.

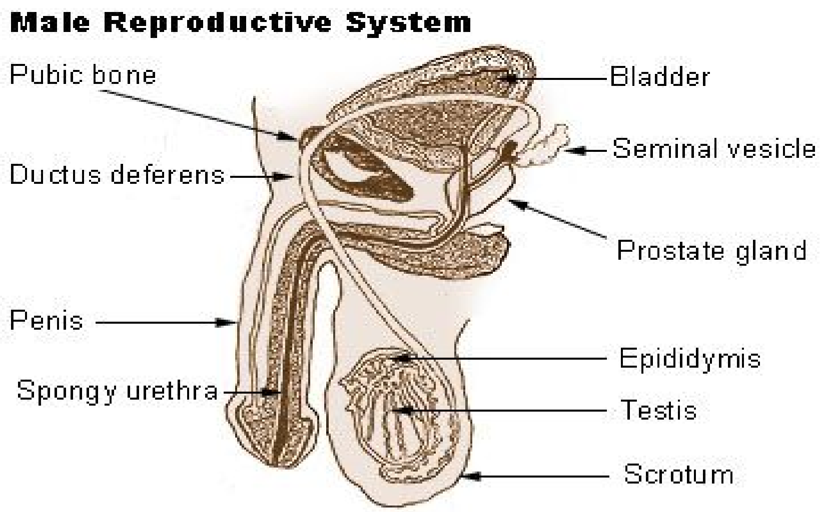
Within the context of producing offspring, the reproductive system has four functions:

1. To produce egg and sperm cells.
2. To transport and sustain these cells.
3. To nurture the developing offspring.
4. To produce hormones.

These functions are divided between the primary and secondary, or accessory, reproductive organs. The primary reproductive organs, or gonads, consist of the ovaries and testes. These organs are responsible for producing the egg and sperm cells gametes), and hormones. These hormones function in the maturation of the reproductive system, the development of sexual characteristics, and regulation of the normal physiology of the reproductive system. All other organs, ducts, and glands in the reproductive system are considered secondary, or accessory, reproductive organs. These structures transport and sustain the gametes and nurture the developing offspring.

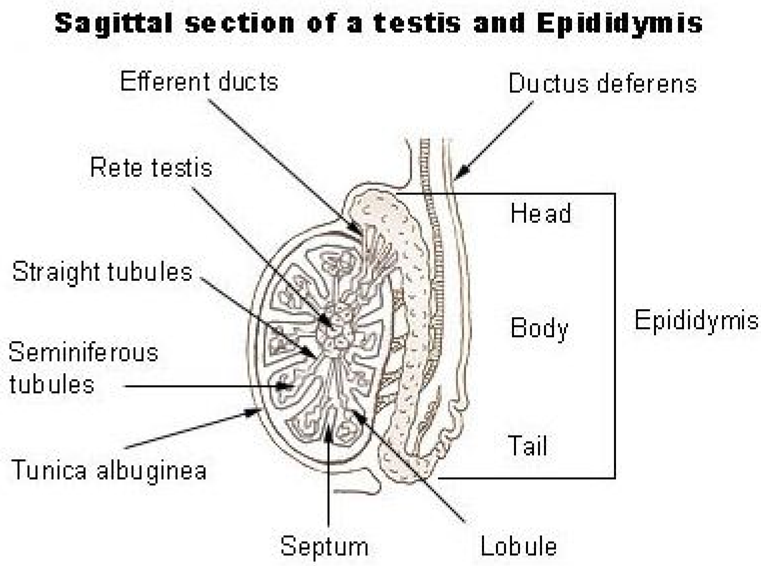
Male Reproductive System

The male reproductive system, like that of the female, consists of those organs whose function is to produce a new individual, i.e., to accomplish reproduction. This system consists of a pair of testes and a network of excretory ducts (epididymis, ductus deferens (vas deferens), and ejaculatory ducts), seminal vesicles, the prostate, the bulbourethral glands, and the penis.



Testes

The male gonads, testes or testicles, begin their development high in the abdominal cavity, near the kidneys. During the last two months before birth, or shortly after birth, they descend through the inguinal canal into the scrotum, a pouch that extends below the abdomen, posterior to the penis. Although this location of the testes, outside the abdominal cavity, may seem to make them vulnerable to injury, it provides a temperature about 3° C below normal body temperature. This lower temperature is necessary for the production of viable sperm.



The scrotum consists of skin and subcutaneous tissue. A vertical septum, or partition, of subcutaneous tissue in the center divides it into two parts, each containing one testis. Smooth muscle fibers, called the dartos muscle, in the subcutaneous tissue contract to give the scrotum its wrinkled appearance. When these fibers are relaxed, the scrotum is smooth. Another muscle, the cremaster muscle, consists of skeletal muscle fibers and controls the position of the scrotum and testes. When it is cold or a man is sexually aroused, this muscle contracts to pull the testes closer to the body for warmth.

Structure

Each testis is an oval structure about 5 cm long and 3 cm in diameter. A tough, white fibrous connective tissue capsule, the tunica albuginea, surrounds each testis and extends inward to form septa that partition the organ into lobules. There are about 250 lobules in each testis. Each lobule contains 1 to 4 highly coiled seminiferous tubules that converge to form a single straight tubule, which leads into the rete testis. Short efferent ducts exit the testes. Interstitial cells (cells of Leydig), which produce male sex hormones, are located between the seminiferous tubules within a lobule.

Spermatogenesis

Sperm are produced by spermatogenesis within the seminiferous tubules. A transverse section of a seminiferous tubule shows that it is packed with cells in various stages of development. Interspersed with these cells, there are large cells that extend from the periphery of the tubule to the lumen. These large cells are the supporting, or sustentacular cells (Sertoli's cells), which support and nourish the other cells.

Early in embryonic development, primordial germ cells enter the testes and differentiate into spermatogonia, immature cells that remain dormant until puberty. Spermatogonia are diploid cells, each with 46 chromosomes (23 pairs) located around the periphery of the seminiferous tubules. At puberty, hormones stimulate these cells to begin dividing by mitosis. Some of the daughter cells produced by mitosis remain at the periphery as spermatogonia. Others are pushed toward the lumen, undergo some changes, and become primary spermatocytes. Because they are produced by mitosis, primary spermatocytes, like spermatogonia, are diploid and have 46 chromosomes.

Spermatogenesis (and oogenesis in the female) differs from mitosis because the resulting cells have only half the number of chromosomes as the original cell. When the sperm cell nucleus unites with an egg cell nucleus, the full number of chromosomes is restored. If sperm and egg cells were produced by mitosis, then each successive generation would have twice the number of chromosomes as the preceding one.

The final step in the development of sperm is called spermiogenesis. In this process, the spermatids formed from spermatogenesis become mature spermatozoa, or sperm. The mature sperm cell has a head, midpiece, and tail. The head, also called the nuclear region, contains the 23 chromosomes surrounded by a nuclear membrane. The tip of the head is covered by an acrosome, which contains enzymes that help the sperm penetrate the female gamete. The midpiece, metabolic region, contains mitochondria that provide adenosine triphosphate (ATP). The tail or locomotor region, uses a typical flagellum for locomotion. The sperm are released into the lumen of the seminiferous tubule and leave the testes. They then enter the epididymis where they undergo their final maturation and become capable of fertilizing a female gamete.

Sperm production begins at puberty and continues throughout the life of a male. The entire process, beginning with a primary spermatocyte, takes about 74 days. After ejaculation, the sperm can live for about 48 hours in the female reproductive tract.

Duct system: Sperm cells pass through a series of ducts to reach the outside of the body. After they leave the testes, the sperm passes through the epididymis, ductus deferens, ejaculatory duct, and urethra.

Epididymis: Sperm leave the testes through a series of efferent ducts that enter the epididymis. Each epididymis is a long (about 6 meters) tube that is tightly coiled to form a comma-shaped organ located along the superior and posterior margins of the testes. When the sperm leave the testes, they are immature and incapable of fertilizing ova. They complete their maturation process and become fertile as they move through the epididymis. Mature sperm are stored in the lower portion, or tail, of the epididymis.

Ductus Deferens: The ductus deferens, also called vas deferens, is a fibromuscular tube that is continuous (or contiguous) with the epididymis. It begins at the bottom (tail) of the epididymis then turns sharply upward along the posterior margin of the testes. The ductus deferens enters the abdominopelvic cavity through the inguinal canal and passes along the lateral pelvic wall. It crosses over the ureter and posterior portion of the urinary bladder, and then descends along the posterior wall of the bladder toward the prostate gland. Just before it reaches the prostate gland, each ductus deferens enlarges to form an ampulla. Sperm are stored in the proximal portion of the ductus deferens, near the epididymis, and peristaltic movements propel the sperm through the tube.

Ejaculatory duct: Each ductus deferens, at the ampulla, joins the duct from the adjacent seminal vesicle (one of the accessory glands) to form a short ejaculatory duct. Each ejaculatory duct passes through the prostate gland and empties into the urethra.

Urethra

The urethra extends from the urinary bladder to the external urethral orifice at the tip of the penis. It is a passageway for sperm and fluids from the reproductive system and urine from the urinary system. While reproductive fluids are passing through the urethra, sphincters contract tightly to keep urine from entering the urethra.

The male urethra is divided into three regions. The prostatic urethra is the proximal portion that passes through the prostate gland. It receives the ejaculatory duct, which contains sperm and secretions from the seminal vesicles, and numerous ducts from the prostate glands. The next portion, the membranous urethra, is a short region that passes through the pelvic floor. The longest portion is the penile urethra (also called spongy urethra or cavernous urethra), which extends the length of the penis and opens to the outside at the external urethral orifice. The ducts from the bulbourethral glands open into the penile urethra.

Accessory glands

The accessory glands of the male reproductive system are the seminal vesicles, prostate gland, and the bulbourethral glands. These glands secrete fluids that enter the urethra.

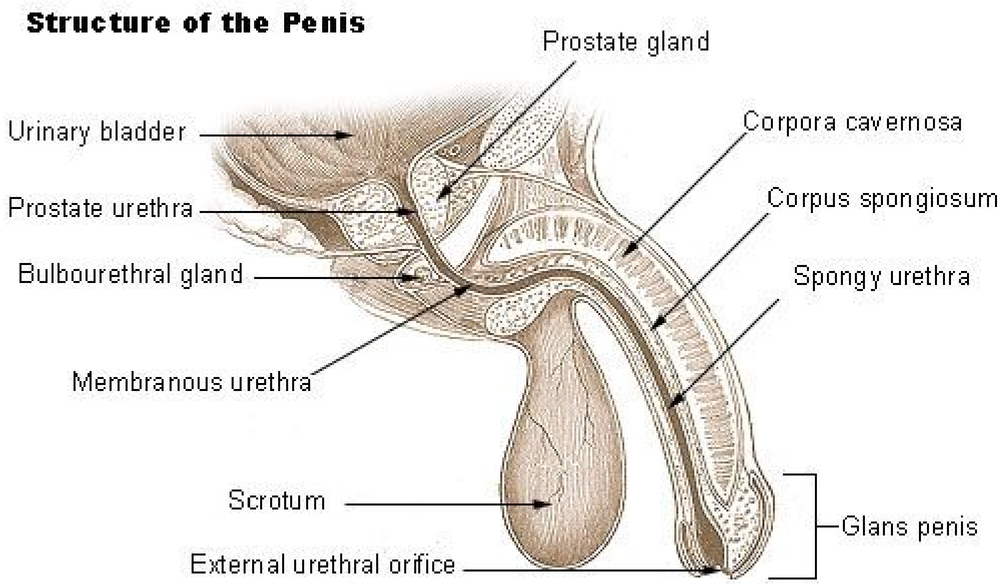
Seminal Vesicles: The paired seminal vesicles are saccular glands posterior to the urinary bladder. Each gland has a short duct that joins with the ductus deferens at the ampulla to form an ejaculatory duct, which then empties into the urethra. The fluid from the seminal vesicles is viscous and contains fructose, which provides an energy source for the sperm; prostaglandins, which contribute to the mobility and viability of the sperm; and proteins that cause slight coagulation reactions in the semen after ejaculation.

Prostate: The prostate gland is a firm, dense structure that is located just inferior to the urinary bladder. It is about the size of a walnut and encircles the urethra as it leaves the urinary bladder. Numerous short ducts from the substance of the prostate gland empty into the prostatic urethra. The secretions of the prostate are thin, milky colored, and alkaline. They function to enhance the motility of the sperm.

Bulbourethral glands: The paired bulbourethral (Cowper's) glands are small, about the size of a pea, and located near the base of the penis. A short duct from each gland enters the proximal end of the penile urethra. In response to sexual stimulation, the bulbourethral glands secrete an alkaline mucus-like fluid. This fluid neutralizes the acidity of the urine residue in the urethra, helps to neutralise the acidity of the vagina, and provides some lubrication for the tip of the penis during intercourse.

Seminal fluid: Seminal fluid, or semen, is a slightly alkaline mixture of sperm cells and secretions from the accessory glands. Secretions from the seminal vesicles make up about 60 percent of the volume of the semen, with most of the remainder coming from the prostate gland. The sperm and secretions from the bulbourethral gland contribute only a small volume. The volume of semen in a single ejaculation may vary from 1.5 to 6.0 ml. There are usually between 50 to 150 million sperm per milliliter of semen. Sperm counts below 10 to 20 million per milliliter usually present fertility problems. Although only one sperm actually penetrates and fertilises the ovum, it takes several million sperm in an ejaculation to ensure that fertilisation will take place.

Penis: The penis, the male copulatory organ, is a cylindrical pendant organ located anterior to the scrotum and functions to transfer sperm to the vagina. The penis consists of three columns of erectile tissue that are wrapped in connective tissue and covered with skin. The two dorsal columns are the corpora cavernosa. The single, midline ventral column surrounds the urethra and is called the corpus spongiosum.

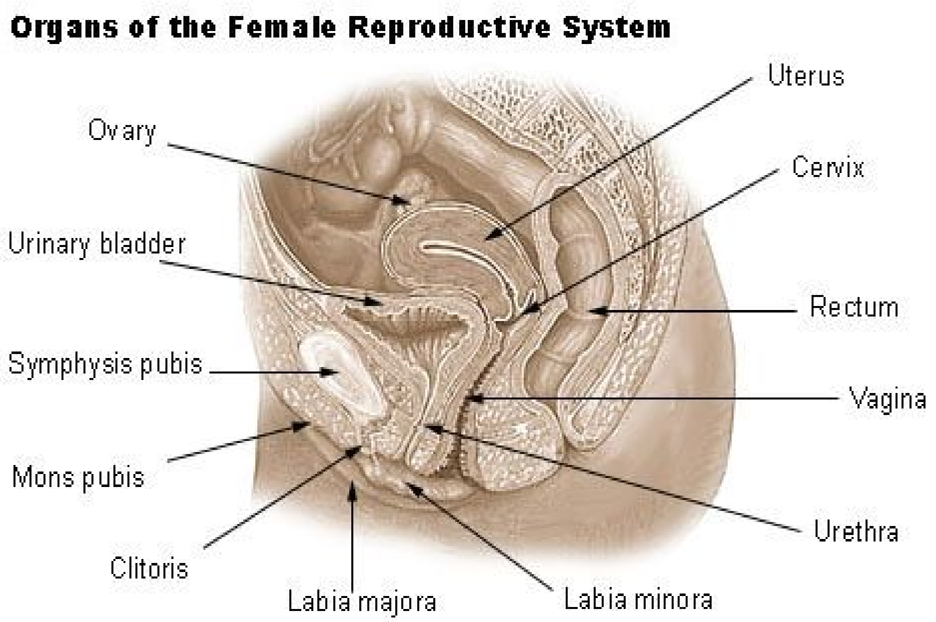


The penis has a root, body (shaft), and glans penis. The root of the penis attaches it to the pubic arch, and the body is the visible, pendant portion. The corpus spongiosum expands at the distal end to form the glans penis. The urethra, which extends throughout the length of the corpus spongiosum, opens through the external urethral orifice at the tip of the glans penis. A loose fold of skin, called the prepuce, or foreskin, covers the glans penis.

Male sexual response and hormonal control

The male sexual response includes erection and orgasm accompanied by ejaculation of semen. Orgasm is followed by a variable time period during which it is not possible to achieve another erection. Three hormones are the principle regulators of the male reproductive system: follicle-stimulating hormone (FSH) stimulates spermatogenesis; luteinizing hormone (LH) stimulates the production of testosterone; and testosterone stimulates the development of male secondary sex characteristics and spermatogenesis

Female Reproductive System



The organs of the female reproductive system produce and sustain the female sex cells (egg cells or ova), transport these cells to a site where they may be fertilized by sperm, provide a favorable environment for the developing fetus, move the fetus to the outside at the end of the development period, and produce the female sex hormones. The female reproductive system includes the ovaries, Fallopian tubes, uterus, vagina, accessory glands, and external genital organs.

- Ovaries
- Genital Tract
- External Genitalia
- Female Sexual Response and Hormonal Control
- Mammary Glands.

Ovaries: The primary female reproductive organs, or gonads, are the two ovaries. Each ovary is a solid, ovoid structure about the size and shape of an almond, about 3.5 cm in length, 2 cm wide, and 1 cm thick. The ovaries are located in shallow depressions, called ovarian fossae, one on each side of the uterus, in the lateral walls of the pelvic cavity. They are held loosely in place by peritoneal ligaments.

Structure: The ovaries are covered on the outside by a layer of simple cuboidal epithelium called germinal (ovarian) epithelium. This is actually the visceral peritoneum that envelops the ovaries. Underneath this layer is a dense connective tissue capsule, the tunica albuginea. The substance of the ovaries is distinctly divided into an outer cortex and an inner medulla. The cortex appears more dense and granular due to the presence of numerous ovarian follicles in various stages of development. Each of the follicles contains an oocyte, a female germ cell. The medulla is a loose connective tissue with abundant blood vessels, lymphatic vessels, and nerve fibers.

Oogenesis: Female sex cells, or gametes, develop in the ovaries by a form of meiosis called oogenesis. The sequence of events in oogenesis is similar to the sequence in spermatogenesis, but the timing and final result are different. Early in fetal development, primitive germ cells in the ovaries differentiate into oogonia. These divide rapidly to form thousands of cells, still called oogonia, which have a full complement of 46 (23 pairs) chromosomes. Oogonia then enter a growth phase, enlarge, and become primary oocytes.

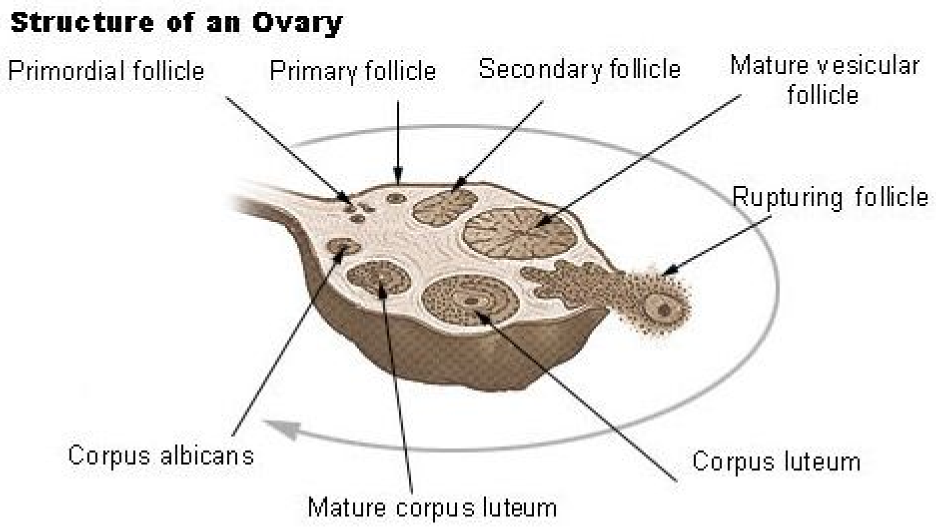
The diploid (46 chromosomes) primary oocytes replicate their DNA and begin the first meiotic division, but the process stops in prophase and the cells remain in this suspended state until puberty. Many of the primary oocytes degenerate before birth, but even with this decline, the two ovaries together contain approximately 700,000 oocytes at birth. This is the lifetime supply, and no more will develop. This is quite different than the male in which spermatogonia and primary spermatocytes continue to be produced throughout the reproductive lifetime. By puberty the number of primary oocytes has further declined to about 400,000.

Beginning at puberty, under the influence of follicle-stimulating hormone, several primary oocytes start to grow again each month. One of the primary oocytes seems to outgrow the others and it resumes meiosis I. The other cells degenerate. The large cell undergoes an unequal division so that nearly all the cytoplasm, organelles, and half the chromosomes go to one cell, which becomes a secondary oocyte. The remaining half of the chromosomes go to a smaller cell called the first polar body. The secondary oocyte begins the second meiotic division, but the process stops in metaphase. At this point ovulation occurs. If fertilization occurs, meiosis II continues. Again this is an unequal division with all of the cytoplasm going to the ovum, which has 23 single-stranded chromosome. The smaller cell from this division is a second polar body.

The first polar body also usually divides in meiosis I , to produce two even smaller, polar bodies. If fertilization does not occur, the second meiotic division is never completed and the secondary oocyte degenerates. Here again there are obvious differences between the male and female. In spermatogenesis, four functional sperm develop from each primary spermatocyte. In oogenesis, only one functional fertilizable cell develops from a primary oocyte. The other three cells are polar bodies and they degenerate.

Ovarian follicle development

An ovarian follicle consists of a developing oocyte surrounded by one or more layers of cells called follicular cells. At the same time that the oocyte is progressing through meiosis, corresponding changes are taking place in the follicular cells. Primordial follicles, which consist of a primary oocyte surrounded by a single layer of flattened cells, develop in the fetus and are the stage that is present in the ovaries at birth and throughout childhood.



Beginning at puberty, follicle-stimulating hormone stimulates changes in the primordial follicles. The follicular cells become cuboidal, the primary oocyte enlarges, and it is now a primary follicle. The follicles continue to grow under the influence of follicle-stimulating hormone, and the follicular cells proliferate to form several layers of granulose cells around the primary oocyte.

Most of these primary follicles degenerate along with the primary oocytes within them, but usually one continues to develop each month. The granulosa cells start secreting estrogen and a cavity, or antrum, forms within the follicle. When the antrum starts to develop, the follicle becomes a secondary follicle. The granulose cells also secrete a glycoprotein substance that forms a clear membrane, the zona pellucida, around the oocyte. After about 10 days of growth the follicle is a mature vesicular (graafian) follicle, which forms a "blister" on the surface of the ovary and contains a secondary oocyte ready for ovulation.

Ovulation

Ovulation, prompted by luteinizing hormone from the anterior pituitary, occurs when the mature follicle at the surface of the ovary ruptures and releases the secondary oocyte into the peritoneal cavity. The ovulated secondary oocyte, ready for fertilization is still surrounded by the zona pellucida and a few layers of cells called the corona radiata. If it is not fertilized, the secondary oocyte degenerates in a couple of days. If a sperm passes through the corona radiata and zona pellucida and enters the cytoplasm of the secondary oocyte, the second meiotic division resumes to form a polar body and a mature ovum

After ovulation and in response to luteinising hormone, the portion of the follicle that remains in the ovary enlarges and is transformed into a corpus luteum. The corpus luteum is a glandular structure that secretes progesterone and some estrogen. Its fate depends on whether fertilization occurs. If fertilization does not take place, the corpus luteum remains functional for about 10 days; then it begins to degenerate into a corpus albicans, which is primarily scar tissue, and its hormone output ceases. If fertilizstion occurs, the corpus luteum persists and continues its hormone functions until the placenta develops sufficiently to secrete the necessary hormones. Again, the corpus luteum ultimately degenerates into corpus albicans, but it remains functional for a longer period of time.

Genital tract

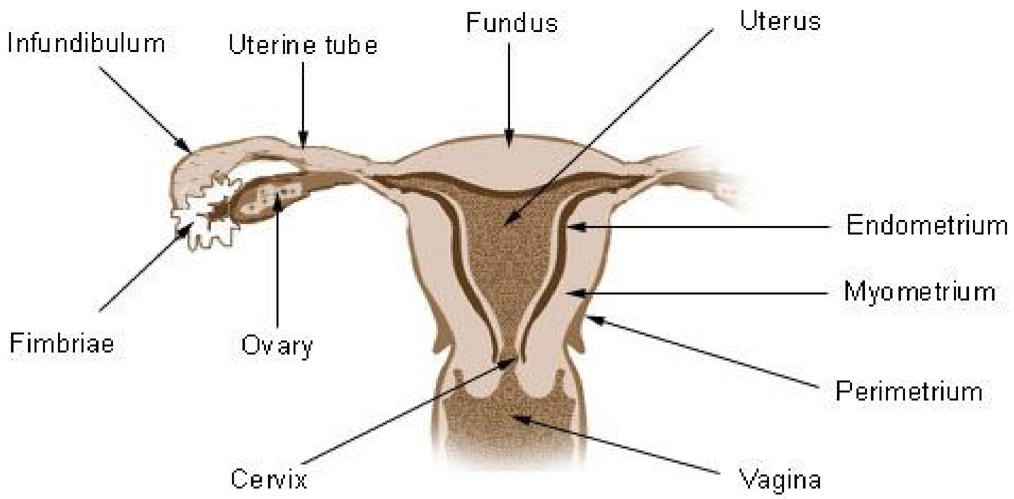
Fallopian tubes

There are two uterine tubes, also called Fallopian tubes or oviducts. There is one tube associated with each ovary. The end of the tube near the ovary expands to form a funnel-shaped infundibulum, which is surrounded by fingerlike extensions called fimbriae. Because there is no direct connection between the infundibulum and the ovary, the oocyte enters the peritoneal cavity before it enters the Fallopian tube. At the time of ovulation, the fimbriae increase their activity and create currents in the peritoneal fluid that help propel the oocyte into the Fallopian tube. Once inside the Fallopian tube, the oocyte is moved along by the rhythmic beating of cilia on the epithelial lining and by peristaltic action of the smooth muscle in the wall of the tube. The journey through the Fallopian tube takes about 7 days. Because the oocyte is fertile for only 24 to 48 hours, fertilization usually occurs in the Fallopian tube.

Uterus

The uterus is a muscular organ that receives the fertilized oocyte and provides an appropriate environment for the developing fetus. Before the first pregnancy, the uterus is about the size and shape of a pear, with the narrow portion directed inferiorly. After childbirth, the uterus is usually larger, then regresses after menopause.

Uterus and Uterine tubes



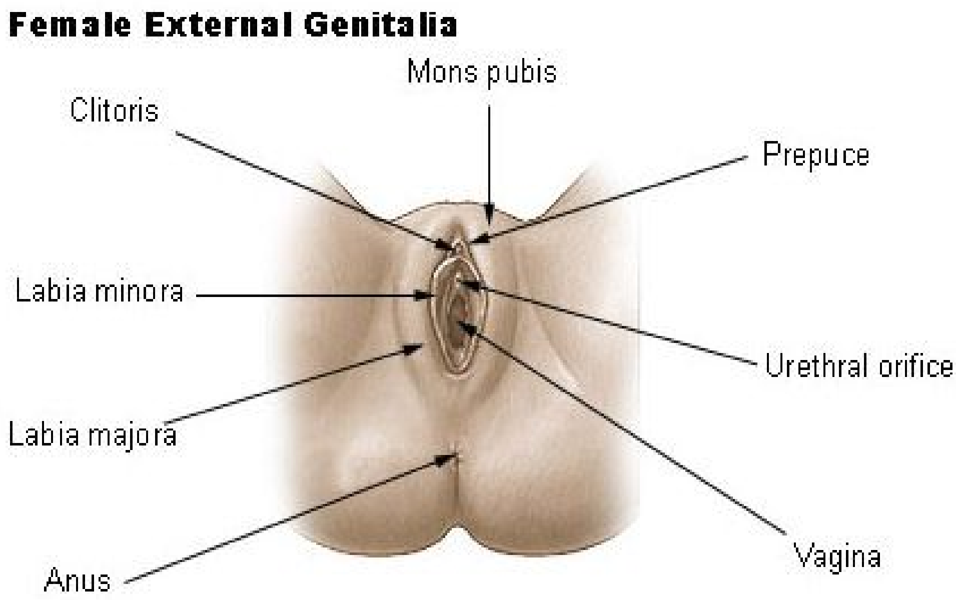
The uterus is lined with the endometrium. The stratum functionale of the endometrium sloughs off during menstruation. The deeper stratum basale provides the foundation for rebuilding the stratum functionale.

Vagina

The vagina is a fibromuscular tube, about 10 cm long, that extends from the cervix of the uterus to the outside. It is located between the rectum and the urinary bladder. Because the vagina is tilted posteriorly as it ascends and the cervix is tilted anteriorly, the cervix projects into the vagina at nearly a right angle. The vagina serves as a passageway for menstrual flow, receives the erect penis during intercourse, and is the birth canal during childbirth.

External genitalia

The external genitalia are the accessory structures of the female reproductive system that are external to the vagina. They are also referred to as the vulva or pudendum. The external genitalia include the labia majora, mons pubis, labia minora, clitoris, and glands within the vestibule. The clitoris is an erectile organ, similar to the male penis, that responds to sexual stimulation. Posterior to the clitoris, the urethra, vagina, paraurethral glands and greater vestibular glands open into the vestibule.



Female sexual response and hormone control

The female sexual response includes arousal and orgasm, but there is no ejaculation. A woman may become pregnant without having an orgasm. Follicle-stimulating hormone, luteinising hormone, estrogen, and progesterone have major roles in regulating the functions of the female reproductive system.

At puberty, when the ovaries and uterus are mature enough to respond to hormonal stimulation, certain stimuli cause the hypothalamus to start secreting gonadotropin-releasing hormone. This hormone enters the blood and goes to the anterior pituitary gland where it stimulates the secretion of follicle-stimulating hormone and luteinising hormone. These hormones, in turn, affect the ovaries and uterus and the monthly cycles begin. A woman's reproductive cycles last from menarche to menopause.

The monthly ovarian cycle begins with the follicle development during the follicular phase, continues with ovulation during the ovulatory phase, and concludes with the development and regression of the corpus luteum during the luteal phase. The uterine cycle takes place simultaneously with the ovarian cycle. The uterine cycle begins with menstruation during the menstrual phase, continues with repair of the endometrium during the proliferative phase, and ends with the growth of glands and blood vessels during the secretory phase.

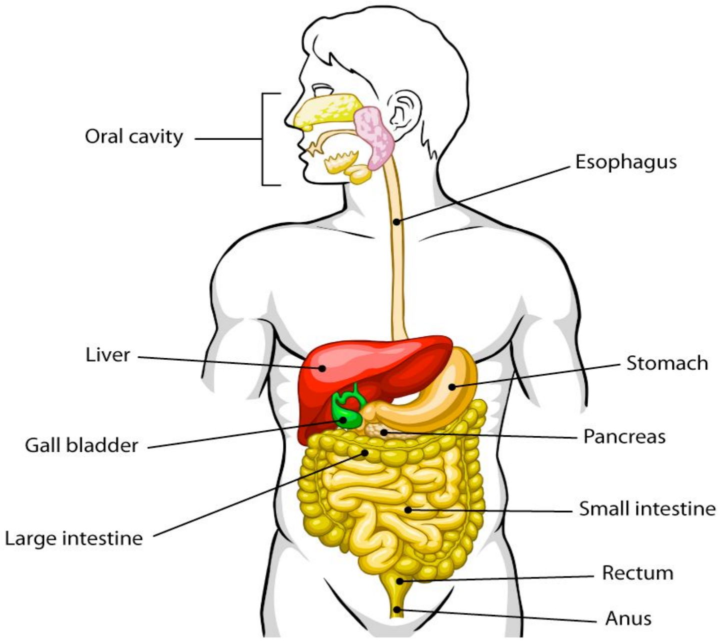
Menopause occurs when a woman's reproductive cycles stop. This period is marked by decreased levels of ovarian hormones and increased levels of pituitary follicle-stimulating hormone and luteinizing hormone. The changing hormone levels are responsible for the symptoms associated with menopause.

Mammary Glands

Functionally, the mammary glands produce milk; structurally, they are modified sweat glands. Mammary glands, which are located in the breast overlying the pectoralis major muscles, are present in both sexes, but usually are functional only in the female.

Mammary gland function is regulated by hormones. At puberty, increasing levels of estrogen stimulate the development of glandular tissue in the female breast. Estrogen also causes the breast to increase in size through the accumulation of adipose tissue. Progesterone stimulates the development of the duct system. During pregnancy, these hormones enhance further development of the mammary glands. Prolactin from the anterior pituitary stimulates the production of milk within the glandular tissue, and oxytocin causes the ejection of milk from the glands.

The Digestive System



The digestive system includes the digestive tract and its accessory organs, which process food into molecules that can be absorbed and utilised by the cells of the body. Food is broken down, bit by bit, until the molecules are small enough to be absorbed and the waste products are eliminated. The digestive tract, also called the alimentary canal or gastrointestinal (GI) tract, consists of a long continuous tube that extends from the mouth to the anus. It includes the mouth, pharynx, esophagus, stomach, small intestine, and large intestine. The tongue and teeth are accessory structures located in the mouth. The salivary glands, liver, gallbladder, and pancreas are major accessory organs that have a role in digestion. These organs secrete fluids into the digestive tract.

Food undergoes three types of processes in the body:

1. Digestion.
2. Absorption.
3. Elimination.

Digestion and absorption occur in the digestive tract. After the nutrients are absorbed, they are available to all cells in the body and are utilised by the body cells in metabolism. The digestive system prepares nutrients for utilisation by body cells through six activities, or functions.

1. **Ingestion:** The first activity of the digestive system is to take in food through the mouth. This process, called ingestion, has to take place before anything else can happen.
2. **Mechanical digestion:** The large pieces of food that are ingested have to be broken into smaller particles that can be acted upon by various enzymes. This is mechanical digestion, which begins in the mouth with chewing or mastication and continues with churning and mixing actions in the stomach.
3. **Chemical digestion:** The complex molecules of carbohydrates, proteins, and fats are transformed by chemical digestion into smaller molecules that can be absorbed and utilized by the cells. Chemical digestion, through a process called hydrolysis, uses water and digestive enzymes to break down the complex molecules. Digestive enzymes speed up the hydrolysis process, which is otherwise very slow.

4. **Movements :** After ingestion and mastication, the food particles move from the mouth into the pharynx, then into the esophagus. This movement is deglutition, or swallowing. Mixing movements occur in the stomach as a result of smooth muscle contraction. These repetitive contractions usually occur in small segments of the digestive tract and mix the food particles with enzymes and other fluids. The movements that propel the food particles through the digestive tract are called peristalsis. These are rhythmic waves of contractions that move the food particles through the various regions in which mechanical and chemical digestion takes place.
5. **Absorption:** The simple molecules that result from chemical digestion pass through cell membranes of the lining in the small intestine into the blood or lymph capillaries. This process is called absorption.
6. **Elimination:** The food molecules that cannot be digested or absorbed need to be eliminated from the body. The removal of indigestible wastes through the anus, in the form of feces, is defecation or elimination.

General structure of the Digestive System

The long continuous tube that is the digestive tract is about 9 meters in length. It opens to the outside at both ends, through the mouth at one end and through the anus at the other. Although there are variations in each region, the basic structure of the wall is the same throughout the entire length of the tube.

The wall of the digestive tract has four layers or tunics:

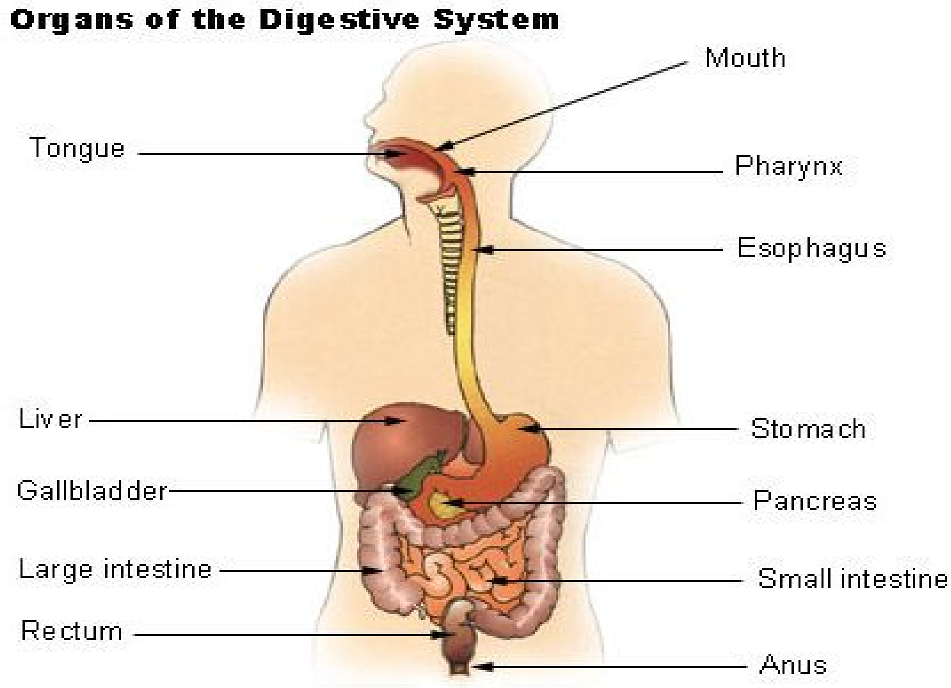
1. Mucosa.
2. Submucosa.
3. Muscular layer.
4. Serous layer or serosa.

The mucosa, or mucous membrane layer, is the innermost tunic of the wall. It lines the lumen of the digestive tract. The mucosa consists of epithelium, an underlying loose connective tissue layer called lamina propria, and a thin layer of smooth muscle called the muscularis mucosa. In certain regions, the mucosa develops folds that increase the surface area. Certain cells in the mucosa secrete mucus, digestive enzymes, and hormones. Ducts from other glands pass through the mucosa to the lumen. In the mouth and anus, where thickness for protection against abrasion is needed, the epithelium is stratified squamous tissue. The stomach and intestines have a thin simple columnar epithelial layer for secretion and absorption.

The submucosa is a thick layer of loose connective tissue that surrounds the mucosa. This layer also contains blood vessels, lymphatic vessels, and nerves. Glands may be embedded in this layer. The smooth muscle responsible for movements of the digestive tract is arranged in two layers, an inner circular layer and an outer longitudinal layer. The myenteric plexus is between the two muscle layers. Above the diaphragm, the outermost layer of the digestive tract is a connective tissue called adventitia. Below the diaphragm, it is called serosa.

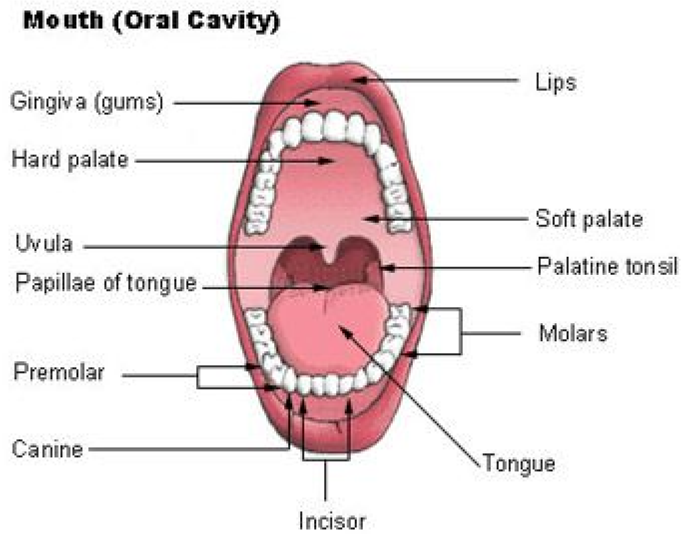
Regions of the Digestive System

At its simplest, the digestive system is a tube running from mouth to anus. Its chief goal is to break down huge macromolecules (proteins, fats and starch), which cannot be absorbed intact, into smaller molecules (amino acids, fatty acids and glucose) that can be absorbed across the wall of the tube, and into the circulatory system for dissemination throughout the body.



Regions of the digestive system can be divided into two main parts: the alimentary tract and accessory organs. The alimentary tract of the digestive system is composed of the mouth, pharynx, esophagus, stomach, small and large intestines, rectum and anus. Associated with the alimentary tract are the following accessory organs: salivary glands, liver, gallbladder, and pancreas.

Mouth



The mouth, or oral cavity, is the first part of the digestive tract. It is adapted to receive food by ingestion, break it into small particles by mastication, and mix it with saliva. The lips, cheeks, and palate form the boundaries. The oral cavity contains the teeth and tongue and receives the secretions from the salivary glands.

Lips and cheeks: The lips and cheeks help hold food in the mouth and keep it in place for chewing. They are also used in the formation of words for speech. The lips contain numerous sensory receptors that are useful for judging the temperature and texture of foods.

Palate: The palate is the roof of the oral cavity. It separates the oral cavity from the nasal cavity. The anterior portion, the hard palate, is supported by bone. The posterior portion, the soft palate, is skeletal muscle and connective tissue. Posteriorly, the soft palate ends in a projection called the uvula. During swallowing, the soft palate and uvula move upward to direct food away from the nasal cavity and into the oropharynx.

Tongue: The tongue manipulates food in the mouth and is used in speech. The surface is covered with papillae that provide friction and contain the taste buds.

Teeth: A complete set of deciduous (primary) teeth contains 20 teeth. There are 32 teeth in a complete permanent (secondary) set. The shape of each tooth type corresponds to the way it handles food.

Pharynx and oesophagus

Pharynx

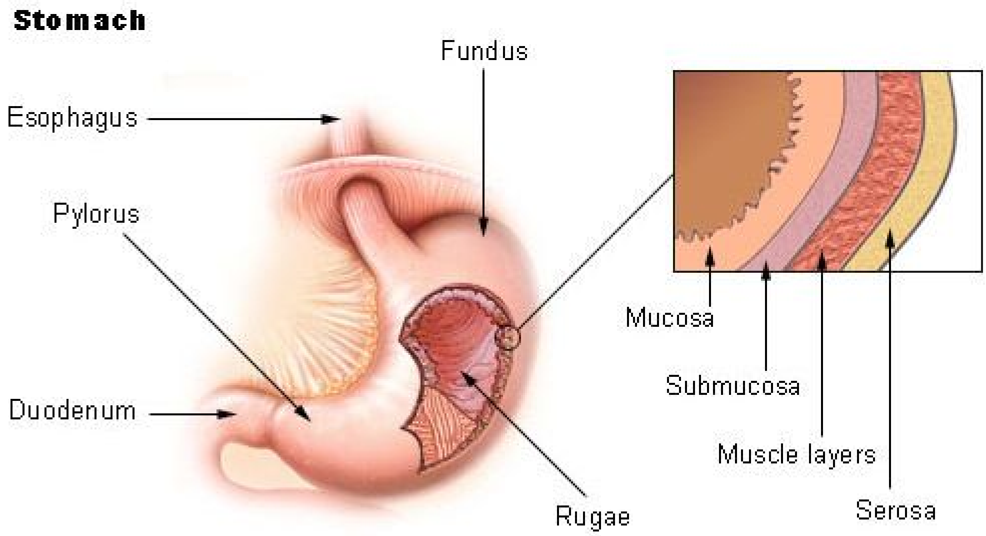
Food is forced into the pharynx by the tongue. When food reaches the opening, sensory receptors around the fauces respond and initiate an involuntary swallowing reflex. This reflex action has several parts. The uvula is elevated to prevent food from entering the nasopharynx. The epiglottis drops downward to prevent food from entering the larynx and trachea in order to direct the food into the esophagus. Peristaltic movements propel the food from the pharynx into the esophagus.

Oesophagus

The esophagus is a collapsible muscular tube that serves as a passageway between the pharynx and stomach. As it descends, it is posterior to the trachea and anterior to the vertebral column. It passes through an opening in the diaphragm, called the esophageal hiatus, and then empties into the stomach. The mucosa has glands that secrete mucus to keep the lining moist and well lubricated to ease the passage of food. Upper and lower esophageal sphincters control the movement of food into and out of the esophagus. The lower esophageal sphincter is sometimes called the cardiac sphincter and resides at the esophagogastric junction.

Stomach

The stomach, which receives food from the esophagus, is located in the upper left quadrant of the abdomen. The stomach is divided into the fundic, cardiac, body, and pyloric regions. The lesser and greater curvatures are on the right and left sides, respectively, of the stomach.



Gastric secretions

The mucosal lining of the stomach is simple columnar epithelium with numerous tubular gastric glands. The gastric glands open to the surface of the mucosa through tiny holes called gastric pits.

Four different types of cells make up the gastric glands:

1. Mucous cells.
2. Parietal cells.
3. Chief cells.
4. Endocrine cells.

The secretions of the exocrine gastric glands - composed of the mucous, parietal, and chief cells - make up the gastric juice. The products of the endocrine cells are secreted directly into the bloodstream and are not a part of the gastric juice. The endocrine cells secrete the hormone gastrin, which functions in the regulation of gastric activity.

Regulation of gastric secretions: The regulation of gastric secretion is accomplished through neural and hormonal mechanisms. Gastric juice is produced all the time but the amount varies subject to the regulatory factors. Regulation of gastric secretions may be divided into cephalic, gastric, and intestinal phases. Thoughts and smells of food start the cephalic phase of gastric secretion; the presence of food in the stomach initiates the gastric phase; and the presence of acid chyme in the small intestine begins the intestinal phase.

Stomach emptying: Relaxation of the pyloric sphincter allows chyme to pass from the stomach into the small intestine. The rate of which this occurs depends on the nature of the chyme and the receptivity of the small intestine.

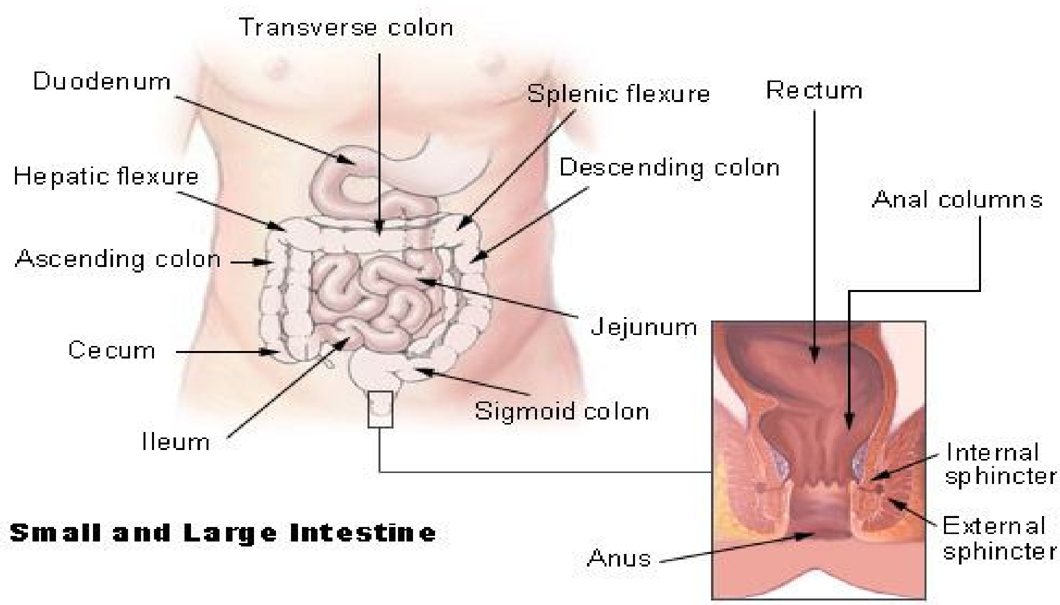
Small and large intestine

Small Intestine

The small intestine extends from the pyloric sphincter to the ileocecal valve, where it empties into the large intestine. The small intestine finishes the process of digestion, absorbs the nutrients, and passes the residue on to the large intestine. The liver, gallbladder, and pancreas are accessory organs of the digestive system that are closely associated with the small intestine.

The small intestine is divided into the duodenum, jejunum, and ileum. The small intestine follows the general structure of the digestive tract in that the wall has a mucosa with simple columnar epithelium, submucosa, smooth muscle with inner circular and outer longitudinal layers, and serosa. The absorptive surface area of the small intestine is increased by plicae circulares, villi, and microvilli.

Exocrine cells in the mucosa of the small intestine secrete mucus, peptidase, sucrase, maltase, lactase, lipase, and enterokinase. Endocrine cells secrete cholecystokinin and secretin. The most important factor for regulating secretions in the small intestine is the presence of chyme. This is largely a local reflex action in response to chemical and mechanical irritation from the chyme and in response to distention of the intestinal wall. This is a direct reflex action, thus the greater the amount of chyme, the greater the secretion.



Large Intestine

The large intestine is larger in diameter than the small intestine. It begins at the ileocecal junction, where the ileum enters the large intestine, and ends at the anus. The large intestine consists of the colon, rectum, and anal canal.

The wall of the large intestine has the same types of tissue that are found in other parts of the digestive tract but there are some distinguishing characteristics. The mucosa has a large number of goblet cells but does not have any villi. The longitudinal muscle layer, although present, is incomplete. The longitudinal muscle is limited to three distinct bands, called teniae coli, that run the entire length of the colon. Contraction of the teniae coli exerts pressure on the wall and creates a series of pouches, called haustra, along the colon. Epiploic appendages, pieces of fat-filled connective tissue, are attached to the outer surface of the colon. Unlike the small intestine, the large intestine produces no digestive enzymes. Chemical digestion is completed in the small intestine before the chyme reaches the large intestine. Functions of the large intestine include the absorption of water and electrolytes and the elimination of feces.

Rectum and Anus

The rectum continues from the sigmoid colon to the anal canal and has a thick muscular layer. It follows the curvature of the sacrum and is firmly attached to it by connective tissue. The rectum ends about 5 cm below the tip of the coccyx, at the beginning of the anal canal.

The last 2 to 3 cm of the digestive tract is the anal canal, which continues from the rectum and opens to the outside at the anus. The mucosa of the rectum is folded to form longitudinal anal columns. The smooth muscle layer is thick and forms the internal anal sphincter at the superior end of the anal canal. This sphincter is under involuntary control. There is an external anal sphincter at the inferior end of the anal canal. This sphincter is composed of skeletal muscle and is under voluntary control.

Accessory organs

The salivary glands, liver, gallbladder, and pancreas are not part of the digestive tract, but they have a role in digestive activities and are considered accessory organs.

Salivary glands

Three pairs of major salivary glands (parotid, submandibular, and sublingual glands) and numerous smaller ones secrete saliva into the oral cavity, where it is mixed with food during mastication. Saliva contains water, mucus, and enzyme amylase.

Functions of saliva include the following:

- It has a cleansing action on the teeth
- It moistens and lubricates food during mastication and swallowing
- It dissolves certain molecules so that food can be tasted
- It begins the chemical digestion of starches through the action of amylase, which breaks down polysaccharides into disaccharides.

Liver

The liver is located primarily in the right hypochondriac and epigastric regions of the abdomen, just beneath the diaphragm. It is the largest gland in the body. On the surface, the liver is divided into two major lobes and two smaller lobes. The functional units of the liver are lobules with sinusoids that carry blood from the periphery to the central vein of the lobule.

The liver receives blood from two sources. Freshly oxygenated blood is brought to the liver by the common hepatic artery, a branch of the celiac trunk from the abdominal aorta. Blood that is rich in nutrients from the digestive tract is carried to the liver by the hepatic portal vein. The liver has a wide variety of functions and many of these are vital to life. Hepatocytes perform most of the functions attributed to the liver, but the phagocytic Kupffer cells that line the sinusoids are responsible for cleansing the blood.

Liver functions include the following:

- Secretion
- Synthesis of bile salts
- Synthesis of plasma protein
- Storage
- Detoxification
- Excretion
- Carbohydrate metabolism
- Lipid metabolism
- Protein metabolism
- Filtering.

Gallbladder

The gallbladder is a pear-shaped sac that is attached to the visceral surface of the liver by the cystic duct. The principal function of the gallbladder is to serve as a storage reservoir for bile. Bile is a yellowish-green fluid produced by liver cells. The main components of bile are water, bile salts, bile pigments, and cholesterol. Bile salts act as emulsifying agents in the digestion and absorption of fats. Cholesterol and bile pigments from the breakdown of hemoglobin are excreted from the body in the bile.

Pancreas

The pancreas has both endocrine and exocrine functions. The endocrine portion consists of the scattered islets of Langerhans, which secrete the hormones insulin and glucagon into the blood. The exocrine portion is the major part of the gland. It consists of pancreatic acinar cells that secrete digestive enzymes into tiny ducts interwoven between the cells. Pancreatic enzymes include anylase, trypsin, peptidase, and lipase. Pancreatic secretions are controlled by the hormones secretin and cholecystokinin.

Two

Interpreting information based on understanding of the structure and functioning of body systems

Carry out research on cells and respond to the following:

1. Describe the structure and function of a basic cell.

2. Identify how substances are moved in and out of the cell.

3. Carry out research to identify four types of tissues and their function. Record these below.

4. Choose one of the following body systems and identify its functions and two of its major organs.

   1. Digestive system
   2. Urinary system
   3. Reproductive system
   4. Integumentary system
   5. Lymphatic system
   6. Nervous system
   7. The special senses
   8. The immune system
   9. Endocrine system
   10. Musculoskeletal
   11. Respiratory system.

Use information to identify any actual or potential problems regarding health status

Information gathering

Sources of information regarding a person physical health status might include:

- Documented information
- Information obtained through direct consultation and observation of the client
- Information obtained through consultation with others.

Documented information

Documented information about a person's health status can provide you with valuable information regarding:

- What their specific health issues are
- How these issues have been addressed in the past
- How effective past intervention has been
- Any ongoing treatments
- What organisations are or have been involved with the client.

On the basis of this information you may then be in a position to ascertain:

- The information you still need to obtain, either directly or indirectly from the client
- What form of information gathering has been most effective previously
- Which issues need an ongoing focus
- Previous difficulties or incidents which might assist you in determining how to interact most effectively with the client
- Whether what you can offer is appropriate, or whether referral to other services might better suit the client's needs
- Any potential problems with regards to the client accessing services
- Ways of dealing with these potential problems.

Documented information which may help you to gather information about a person's physical health status might include:

- Professional reports, including assessment reports and reviews
- Results of previous formal testing, eg: by health professionals such as psychologists, speech pathologists, etc.
- Medical reports
- Reports of previous interviews from within your own organisation or from other organisations
- Case notes.

These sources will all provide information specific to your client. You may also seek general information regarding services offered by other organisations which might be of benefit to your client and the specific nature of your client's health issues, eg: from texts, online sources, organisational guidelines, etc. Be aware that not all documented information will be available for you to access. Familiarise yourself with confidentiality policies within your organisation and if in doubt about your right to access information, consult with your supervisor/manager.

Three

Using information to identify any actual or potential problems regarding health status

Think about three recent interactions with clients which necessitated information gathering to identify any actual or potential problems regarding health status. Make some notes in response to the following questions:

1. How effective were your questioning skills in these situations with regards to obtaining information?

2. How effective were they in terms of directing the course of the interaction?

3. How did your clients respond to your questions?

4. What were you aware of doing with regards to considering the client's feelings/ emotional state/situation?

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5. What else might you have done?

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6. How aware were you of framing your questions to fit each client's physical health status?

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7. What else might you have done with regards to shaping your questions to meet their needs?

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Taking into account factors that may have impacted on an identified physical condition

Lifestyle issues which impact on health

Lifestyle -- or a typical way of life, as health specialists often define it -- could affect an individual's health and life expectancy. An imbalanced diet or bad eating habits might cause a person to develop chronic diseases, such as diabetes and hypertension, down the road. A sedentary lifestyle -- or one with little exercise -- also might not foster good health and physical fitness. Other habits that could adversely affect a person's metabolism include consuming too much saturated fat and starch, abusing alcohol and using illicit drugs, such as cocaine and heroin. Obesity also causes an individual to experience health problems and could lead to diseases and risky conditions including high cholesterol, diabetes and heart disease.

Natural habitat

An individual's natural habitat -- the house or apartment where the person lives -- also can affect an individual's health. People who live close to manufacturing facilities or industrial settings are more likely to be exposed to chemicals and other hazardous substances -- such as nuclear residue, asbestos and radioactive materials -- that companies use in the production of goods.

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).*

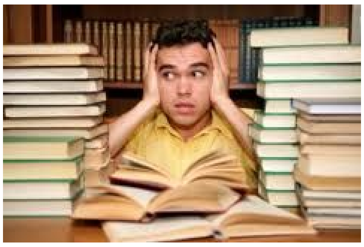
Lack of physical activity and exercise

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.

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.

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.

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:

Degenerative diseases 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.

Internal factors affecting health

Various factors affect a person's health, and medical professionals classify them as internal and external. Internal factors -- also known as hereditary factors or acquired elements -- include smoking and personal diet or eating habits. External factors pertain to the direct outer environment, the geographical location and micro-organisms that could affect an individual's health.

Emotional responses

Emotions are an important part of a person's being. They can give important information, change relationships, and keep life from feeling mundane or boring. Powerful emotions can also sometimes spring forth and leave the feeling of being overwhelmed and drained.

Many events and situations in life provoke emotional reactivity, some of which feels great and others not so much. How can we recognise and deal with what has provoked emotional reactivity? Emotional response is a feeling that is felt and then either acted upon or not, depending on what you choose.

Patterns of thinking

Negative thinking is the cornerstone of an anxiety disorder. Many people with anxiety have severe problems with anxious and irrational thinking - thoughts that many know are irrational, and yet they struggle to convince themselves of the more logical and reasoned response. In many ways, anxiety is specifically a problem with irrational thoughts. Anxiety is, in many ways, a fear of irrational things. At its heart, those that deal with anxiety are often trying to control and contain severe negative thoughts that can have a drastic impact on their overall quality of life.

Reactions to disease

Sudden, unexpected, or life-threatening chronic illness or disability engenders a variety of reactions. How individuals view their condition, its causes, and its consequences greatly affects what they do in the face of it. They may view their condition as a challenge, an enemy to be fought, a punishment, and a sign of weakness, a relief, a strategy for gaining attention, an irreparable loss, or an uplifting spiritual experience. Although the emotional reactions of individuals experiencing chronic illness or disability vary both in type and in intensity, the following reactions are common. Although each emotional reaction is discussed individually, it is important to note that reactions are often experienced simultaneously.

Genetics

Genetics is the passing on of traits from biological parents to children. Genetic factors or traits that are passed on through heredity include skin, eye, and hair colour; body type and size; growth patterns; and the likelihood of getting certain diseases.

Ageing

The aging process happens during an individual's lifespan. We are all involved in this process and none can escape it. When one is young, aging is associated with growth, maturation, and discovery. Many human abilities peak before age 30, while other abilities continue to grow through life. The great majority of those over age 65 today are healthy, happy and fully independent. In spite of this, some individuals begin to experience changes that are perceived as signs of deterioration or decline.

Normal Aging

The changes aging individuals experience are not necessarily harmful. With age, hair thins and turns gray. Skin thins, becomes less elastic, and sags. There is a slowing down of functions which goes forward throughout adulthood – loss of function of bodily organs. In the gastrointestinal system, for example, production of digestive enzymes diminishes, reducing the body's ability to break down and absorb the nutrition from food. Some of these losses may not be noticeable until later life.

Adaptation

The ability of human beings to adapt to change is one of the most positive aspects of the aging process. It transcends all areas of human functioning, from living independently, despite overwhelming physical problems, to being able to compete with younger employees in the work force. Changes and adaptation foster diversity, and our older population is no exception. While generalistions about older people are dangerous, the following observations reveal how much like *us*, *they* really are:

- Older people are extremely sensitive to the fact that their personal resources are diminishing.
- They resent condescension in all of its forms and do not want to be patronized.
- They want to remain independent as long as possible.
- Most of all, they want to retain their dignity and self respect.

Cellular adaption

In cell biology and pathophysiology, cellular adaptation refers to changes made by a cell in response to adverse environmental changes. The adaptation may be physiologic(al) (normal) or pathologic(al) (abnormal). Five minor types of adaptation include atrophy, hypertrophy, hyperplasia, dysplasia, and metaplasia.

1. Adaptation number one is **atrophy**. Atrophy is when the cell decreases its functional part. The cell is basically reducing its size by decreasing its functional parts. That's number one.
2. Number two is **hypertrophy**. That is when the individual cells increase in size, and that of course, is going to cause the tissue to increase in size.
3. Then, there's **hyperplasia**. Hyperplasia is when we have more cells being formed. So, the cells are replicating, and as a result of that, the tissue is increasing in size.
4. With hypertrophy, we have the tissue increasing in size because the individual cells are increasing in size. In hyperplasia, we have the tissue increasing in size because we're getting more cells, which make sense.
5. Then, the last type of adaptation will be **metaplasia**. And, that is when one tissue type that's replaced by another tissue type.

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.

Four

Taking into account factors that may have impacted on an identified physical condition

1. Describe what a person's diet may have on the functioning of the person's body?

2. What are pathogens? Give some examples.

3. Name three internal factors that may affect health status.

4. Name three external factors that may affect health status.

Element 2: Check physical health status

Make checks of client health status prior to delivery of health intervention using knowledge of body systems

It is important to know the health history of a person with care needs before a service or intervention takes place. Familiarise yourself with their documentation and/or care plan and clarify your scope of practice so you know the interventions you can and can't perform. Understand the implications for the limits of your authority and capabilities.

Checking health status requires you to clarify any variation from health that you identify, and think about the actions you may need to take before beginning your health intervention or delivery of a health service. You need knowledge of the body systems and to be able to identify the health problems associated with each of them.

If you suspect a health problem after checking physical health status, or that the person's physical health status is not as it should be, find out who you should consult to clarify the problem. Any variation from normal functioning should be accurately reported as soon as possible. In an emergency situation, you must know what to do. Refer to your scope of practice, job description and organisational protocol. Your workplace policies and procedures can also guide you in these situations, and in undertaking your day-to-day duties.

Checking health information

In order to make decisions regarding a person's health status you need to have collected and reviewed all relevant information, including observations, questions and documents completed previously, such as health and , medical history and or/care plans. These documents can be updated with current information gained from the appointment. Once this is done you need to be able to apply these findings to your knowledge of the human body. For every body system disorder or problem you identify, you need to check if any action needs to be taken prior to your health intervention or delivery of service. .

Body system problems

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.

(Source: http://www.virtualmedicalcentre.com/diseases.asp?did=823)

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, i.e.: 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.

(Source: http://www.hearing.com.au/types-of-hearing-loss)

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 let's 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.

Five

Making checks of client health status prior to delivery of health intervention using knowledge of body systems

1. Susan has been using her MP3 player constantly. Her doctor tests her and tells her she has suffered extensive hearing loss. What may have caused her deafness? What actions should you take?

2. Simon is 14 years old, admitted with severe abdominal pain and fever, diagnosed with severe appendicitis. What actions should you take?

3. What actions should you take where the person has constipation?

Clarify significance of physical health status in relation to a particular intervention in line with job role and organisation requirements

If, after collecting and clarifying a person's health status, it is revealed that their health status is not what it should be, then actions need to be taken. Any action taken should be within your job role and scope of practice. This may or may not involve using first-aid skills. You should immediately report any serious health concerns and, if necessary, take emergency actions if it is life threatening. You should consult with a supervisor to clarify the health problem and determine if this will impact on the delivery of health services or interventions. As soon as is possible, an accurate report should be made and provided to supervisors and others, in accordance with the organisations policies and procedures.

Emergency procedures

It is important that you understand organisational protocols and procedures for what to do in an emergency and you should receive training for these situations during your job induction. Your supervisor should show you the location of equipment and numbers as a part of your WHS training. If you are unclear about any aspect of emergency procedures, be sure to clarify it with your supervisor.

Having a current first aid certification or similar training is often a prerequisite of a job in the health sector. Do not rely on others to be available in time of emergency, as it is your duty of care to be able to respond as necessary. A defibrillator is a first-aid device that sends an electric shock to start the heart pumping in the event of cardiac arrest. A person has the best chance of survival when they receive a shock from the defibrillator within the first five minutes of collapse. An ambulance may not reach the person in time to provide life-saving treatment, which is why death frequently occurs. A defibrillator can be used by anyone with basic first-aid training, and is safe to use as it scans the patient for a shock response and will only administer a shock if needed.

Minimise risk of an emergency situation

In your role, there may be precautions you can take to avoid or minimise risk in an emergency intervention. You cannot anticipate or avoid all emergencies or health concerns, but the following steps may help minimise risk. These will vary according to the specific role you play in providing care needs.

STEPS TO HELP MINIMISE RISK IN AN EMERGENCY INTERVENTION

1	Refer to care plan Refer to the person's care plan and your supervisor before undertaking activities to ensure they are appropriate for the person's needs and abilities.
2	Report changes Report any changes or variations from normal health status immediately to your supervisor or a relevant health professional.
3	Ensure access to medication If a person requires medication, such as ventilation for asthma or insulin for diabetes, ensure the person (or relevant professional) has easy access to the medication.
4	Check accessibility Ensure destinations for outings are suitable for peoples' needs; for example, a person in a wheelchair requires ramp access and suitable transport.
5	Check for hazards Ensure destinations for outings are safe and hazard free; for example, protect a person with osteoporosis from falling by ensuring walkways are flat and not slippery.
6	Check suitability of food Ensure food provided is suitable for the people you support; for example, a person who has difficulty swallowing should have puréed food; a person with allergies may have special requirements. Health notes should contain notes on allergies, particularly in relation to medications.
7	Locate first aid equipment Ensure you can locate first-aid equipment; for example, know if there is a defibrillator at the destination of the activity.

Non-emergency situations

You may often observe variations from normal functioning when working with people with care needs. These may not be emergency situations, but you must still take timely action to address any variations to ensure the person receives the appropriate treatment and that their condition does not deteriorate or become life threatening. These variations may still impact on the health service you are going to deliver, and may require adjustments for the person with care needs.

Non-emergency situations are described here, along with suggestions about the significance of the observation. For each case, it is advised that you speak to your supervisor or an appropriate health professional, as the person may need to see a doctor immediately.

Six

Clarifying the significance of physical health status in relation to a particular intervention in line with job role and organisation requirements

1. What might be the significance of changes in health status such as a person being confused or disorientated?

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2. What important emergency training should be provided when you first start work in a new organisation?

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Clarify implications and significance of physical health status with appropriate people in the case of uncertainty or limits on own capability or authority

Working within the scope of your job role

While an understanding of the body systems and the range of diseases or disorders which might impact on the homeostasis of the body system is necessary, especially when your role incorporates the care of an individual. However it is also important that you only work within the scope and limitations of your job role. Your training, together with any in-service training undertaken at your workplace, equips you to a certain level or role. This is also reflected within your position description or duty statement.

It is important that you work to your job role for several reasons. If you work outside your level of knowledge, you are placing yourself, the organisation and the client at risk. Working within your job role also supports the team environment. Your coordinator or direct up-line staff member will need to know they can rely on you to complete specific tasks.

As you are involved in everyday contact with clients, you may notice changes in their health status. Whilst your level of understanding or interactions will be limited to your own scope of practice, the information you gather is important in the holistic appreciation and assessment of the individual. Therefore, you must know where to report the changes you see, or where to source advice in relation to physical health status.

It is also important that you know the information which you need to transfer to other health professionals, as this will support them in their diagnostic or assessment processes. Generally, you would seek input from your coordinator; however you might also need to source advice from other heads of departments, depending on your employing organisational structure.

Example:

In aged care you might clarify health status with your team leader, Registered Nurse, Allied Health professionals, Clinical Nurse or Director of Nursing. In other community services disciplines, you would seek out the appropriately skilled person to clarify the implications and significance of physical health status or changes within the health of a client.

Role and boundaries of each staff members

Health care workers must always work within their role boundaries and organisation's policies and procedures. You must also always work within a human rights perspective, meaning that you must respect the rights and freedoms of your clients. This includes their right to good food, to participate in their culture, pursue education and work.

Your employing organisation will have a set of policies and procedures that will set out your duties and responsibilities. While it is important that all members of the health care team support each other and the client, it is also important that people do not work outside their delegated area of responsibility. Many areas of health care are legislated to ensure that only those people with appropriate knowledge and skills are permitted to perform certain clinical skills, an example of this is the provision of Schedule 8 drugs. Only a medical practitioner with the required qualifications and experience is legally able to prescribe the provision and use of such medicines.

Legislation can be discipline specific. Registration of health professionals at time of publication are state based and some areas of health care are not covered by legislation and difficulties may arise when the Community service and health care worker is confronted by issues that are not clear in the policies and procedures. When this occurs it is recommended you consult with your supervisor about appropriate actions.

Another area where uncertainty may occur is when a client asks you for guidance or for your opinion. Clients are sometimes quite vulnerable when they are newly diagnosed with a chronic condition and may ask many questions and may take comments out of context. Many people find the use of strategic questioning useful in helping the client to uncover their deeper concerns and make a decision based on their own perspective rather than that provided by a third party.

Gathering information through consultation with others

There are many instances in which a client will not be in a position to provide you with information themselves regarding their physical or developmental status, or will need support to do so.

This may be due to:

- Age, eg: young children or very elderly clients may have difficulty communicating
- Their needs without support
- Communication difficulties related to cognitive or physical developmental disabilities
- Health issues
- Mental health issues
- Emotional trauma
- Second language issues.

In such instances, we rely on others involved in the client's ongoing support to provide the necessary information. These might include family members, carers, significant others and other services. It is important to remember that whilst you are gathering information from others, your duty of care is to your client.

Ensure that:

- Your consultations are as inclusive of your client as practicable
- The client is aware that information is being sought from others and of the nature of that information
- Your client is involved in any decision-making processes, to the extent that this is possible
- You advocate for your client if you feel that their needs are not being understood or met by those with whom you are consulting
- You abide by organisational confidentiality protocols and procedures in your consultation with others.

Observation and questioning within the framework of organisational procedure

We identify possible developmental issues through our observation and questioning and through our investigation of documented information regarding the client's background. Depending on organisational procedure and policy, we may use a range of standard methods and protocols (assessment and interview forms, checklists, etc) within this process of assessment, to form a comprehensive picture of the client's developmental status. Be sure that you follow organisational procedure in your investigations and evaluation of a client's developmental status. Use the resources that are available to you.

Providing appropriate services

The service you provide needs to take into consideration the client's developmental needs. There is huge scope for variation with regard to this, depending on each client's specific issues and the sector you are working in. You will need to consider each individual case and evaluate how best to provide a service with a view to specific variations from normal developmental status.

Some general considerations:

Use the information you have obtained through your assessment and consultation with others to develop a plan which adequately considers the client's specific developmental needs. If you are unsure of the implications of developmental issues, ensure that you seek advice from your supervisor, or another appropriate source. You may wish to further research ways to manage specific cases through written and online sources and through seeking consultation with appropriate health professionals. Ensure that your service is not duplicating other services.

Monitor outcomes on a regular basis to ensure your service remains effective. Document ongoing service for your own evaluation and for the benefit of others (in line with confidentiality protocols) who may be working with the client.

You are likely to encounter cases which are extremely complex. You are likely to encounter clients who are still highly vulnerable or at risk of further harm. Be aware of the limits of your own role and capabilities. Seek support if you are unsure in any situation. Do not work outside of the boundaries of your job specifications. Seek specialist support to clarify the implications and significance of client's developmental status in the case of uncertainty or if a case is beyond the limits of your own capability or authority.

The importance of documentation

Documentation is an essential tool in investigating, assessing and responding to a client's needs with regards to developmental issues. Often patterns emerge over time which may easily be forgotten or overlooked. Adequate documentation ensures any concerns are recorded and that information is shared between all involved parties. An incident may be overlooked if looked at in isolation, but may appear more significant when placed within the perspective of a number of documented incidents.

Written records are particularly important if the client is involved with multiple services. These records can provide useful information for other service providers should referral be made. It can also help to minimise repetition of assessment procedures when a number of service providers are involved with a client. Your organisation will have procedures, policies and standard formats for documentation – it is your responsibility as a service provider to comply with these.

Seven

Clarify implications and significance of physical health status with appropriate people in the case of uncertainty or limits on own capability or authority

1. What do you need to understand in order to deal with uncertainty or limits on your own capability and authority?

Element 3: Identify variations from normal physical health status

Identify variations from normal health status using standard methods and protocols

The purpose of health assessment is to establish baseline data identifying the client's normal abilities, any risk factors which may lead to variations in health status and any current changes in health status. This information is used to plan appropriate strategies, encourage healthy options, prevent potential health problems and assist in the alleviation or management of existing health problems. Assessment involves the systematic and continuous collection of data and the validation and communication of that client data. Clients care depends on this information being complete, accurate and relevant.

Health assessment types

Initial assessment

An initial assessment, also called an admission assessment, is performed when the client enters a health care from a health care agency. The purposes are to evaluate the client's health status, to identify functional health patterns that are problematic, and to provide an in-depth, comprehensive database, which is critical for evaluating changes in the client's health status in subsequent assessments.

Problem-focused assessment

A problem focus assessment collects data about a problem that has already been identified. This type of assessment has a narrower scope and a shorter time frame than the initial assessment. In focus assessments, nurse determine whether the problems still exists and whether the status of the problem has changed (i.e. improved, worsened, or resolved). This assessment also includes the appraisal of any new, overlooked, or misdiagnosed problems. In intensive care units, may perform focus assessment every few minute.

Emergency assessment

Emergency assessment takes place in life-threatening situations in which the preservation of life is the top priority. Time is of the essence rapid identification of and intervention for the client's health problems. Often the client's difficulties involve airway, breathing and circulatory problems (the ABCs). Abrupt changes in self-concept (suicidal thoughts) or roles or relationships (social conflict leading to violent acts) can also initiate an emergency. Emergency assessment focuses on few essential health patterns and is not comprehensive.

Time lapsed reassessment

Time lapsed reassessment, another type of assessment, takes place after the initial assessment to evaluate any changes in the client's functional health. Health professionals perform time-lapsed reassessment when substantial periods of time have elapsed between assessments (e.g., periodic output patient clinic visits, home health visits, and health and development screenings.

Body System approach

- **General presentation of symptoms:** Fever, chills, malaise, pain, sleep patterns, fatigability
- **Diet:** Appetite, likes and dislikes, restrictions, written dairy of food intake
- **Skin, hair, and nails:** rash or eruption, itching, color or texture change, excessive sweating, abnormal nail or hair growth
- **Musculoskeletal:** Joint stiffness, pain, restricted motion, swelling, redness, heat, deformity
- **Head and neck: Eyes:** visual acuity, blurring, diplopia, photophobia, pain, recent change in vision. **Ears:** Hearing loss, pain, discharge, tinnitus, vertigo
- **Nose:** Sense of smell, frequency of colds, obstruction, epistaxis, sinus pain, or postnasal discharge
- **Throat and mouth**: Hoarseness or change in voice, frequent sore throat, bleeding o swelling, of gums, recent tooth abscesses or extractions, soreness of tongue or mucosa.
- **Endocrine and genital reproductive**: Thyroid enlargement or tenderness, heat or cold intolerance, unexplained weight change, polyuria, polydipsia, changes in distribution of facial hair; Males: Puberty onset, difficulty with erections, testicular pain, libido, infertility; Females: Menses (onset, regularity, duration and amount), Dysmenorrhea, last menstrual period, frequency of intercourse, age at menopause, pregnancies (number, miscarriage, abortions) type of delivery, complications, use of contraceptives; breasts (pain, tenderness, discharge, lumps)
- **Chest and lungs:** Pain related to respiration, dyspnea, cyanosis, wheezing, cough, sputum (character, and quantity), exposure to tuberculosis (TB), last chest X-ray
- **Heart and blood vessels:** Chest pain or distress, precipitating causes, timing and duration, relieving factors, dyspnea, orthopnea, edema, hypertension, exercise tolerance
- **Gastrointestinal:** Appetite, digestion, food intolerance, dysphagia, heartburn, nausea or vomiting, bowel regularity, change in stool color, or contents, constipation or diarrhea, flatulence or hemorrhoids
- **Genitourinary:** Dysuria, flank or suprapubic pain, urgency, frequency, nocturia, hematuria, polyuria, hesitancy, loss in force of stream, edema, sexually transmitted disease
- **Neurological:** Syncope, seizures, weakness or paralysis, abnormalities of sensation or coordination, tremors, loss of memory
- **Psychiatric:** Depression, mood changes, difficulty concentrating nervousness, tension, suicidal thoughts, irritability.
- **Pediatrics**: along with systemic approach in case of pediatrics, measure anthropometric measurement and neuromuscular assessment.

Components of a health assessment

- **Biographic data**: name, address, age, sex, marital status, occupation, religion.
- **Reason for visit/chief complaint**: primary reason why client seek consultation or hospitalisation.
- **History of present Illness: includes**: usual health status, chronological story, family history, disability assessment.
- **Past health history:** includes all previous immunizations, experiences with illness.
- **Family history:** reveals risk factors for certain disease diseases (Diabetes, hypertension, cancer, mental illness).
- **Review of systems :**review of all health problems by body systems
- **Lifestyle:** include personal habits, diets, sleep or rest patterns, activities of daily living, recreation or hobbies.
- **Social data: include** family relationships, ethnic and educational background, economic status, home and neighborhood conditions.
- **Psychological data: information** about the client's emotional state.
- **Pattern of health care:** includes all health care resources: hospitals, clinics, health centers, family doctors.
- **Client's perception:** (why they think they have been referred/are being assessed; what they hope to gain from the meeting)
- **Emotional health :(**mental health state, coping styles etc)
- **Social health :** (accommodation, finances, relationships, genogram, employment status, ethnic back ground, support networks etc)
- **Physical health:** (general health, illnesses, previous history, appetite, weight, sleep pattern, urinal variations, alcohol, tobacco, street drugs; list any prescribed medication with comments on effectiveness)
- **Spiritual health:** (is religion important? If so, in what way? What/who provides a sense of purpose?)
- **Intellectual health:** (cognitive functioning, hallucinations, delusions, concentration, interests, hobbies etc

Physical examination

A health assessment includes a physical examination: the observation or measurement of signs, which can be observed or measured, or symptoms such as nausea or vertigo, which can be felt by the patient. The techniques used may include Inspection, Palpation, Auscultation and Percussion in addition to the "vital signs" of temperature, blood pressure, pulse and respiratory rate, and further examination of the body systems such as the cardiovascular or musculoskeletal systems.

Documentation of the assessment

The assessment is documented in the patient's medical or nursing records, which may be on paper or as part of the electronic medical record which can be accessed by all members of the healthcare team.

Using correct medical and anatomical terminology

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.

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, i.e.: '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.

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

Following the strategies identified in the client's support plan

Various members of the multidisciplinary team and client are involved in developing a holistic, agreed client-focused care plan. An initial assessment will be undertaken by appropriate health professionals such as Medical Practitioners, Registered Nurses, and Allied Health Assistants etc. They will also provide a diagnosis and suggest treatment options. Usually the multidisciplinary team, including Enrolled Nurses, will begin to action the agreed care plan along with the rest of the team. These are plans that are based on assessment, diagnosis and an agreed plan of care.

They have several aspects:

- Are holistic in their approach, and should include the:
- Physical
- Mental
- Social
- Emotional and,
- Spiritual aspects of client care.

They can be broad covering all aspects of care or limited to just one issue that the client is dealing with. The care you give to your clients will differ. This is because the needs of individual clients and types of services you will work for are different.

You are likely to work with clients in a variety of different situations. You may work with clients who:

- Live in their own home or a residential care environment
- Live in a place that is suited to people with high-care needs
- Live in a place that is suited to people with lower support needs
- Are veterans
- Have disabilities
- Are using services through a community program.

There are some things, however, that should be the same in most workplaces. There should be a personal care support plan for each client. The support plan is a written document that explains the personal care a client needs. The plan is written with the help of the client and may also include information provided by the client's carer. The name of these plans may vary from workplace to workplace. The plans are updated regularly. This may be because the needs of the client have changed. They may need more care in certain areas. They might not be able to do some tasks on their own or they might need workers to give them more prompts during tasks.

Making adjustments to the care plan

Reviewing client's progress should reveal the following information:

- Difficulties associated with fulfilling the program
- Strengths of the program or areas the client was able to follow with ease
- The strengths and needs of the individual client
- Any opportunities and constraints the client may have in relation to fulfilling the program
- What areas of the program have worked for the client
- Client's current situation in relation to future progress
- Any changes in client attitude or behaviour since the last progress review
- The extent to which these needs are being addressed
- Indications for alternative action.

Should any of these situations be revealed during the review process, a change in client service delivery will need to take place? The agreed range, type and method of services provided to clients will be initially established in relation to organisational guidelines and procedures. It is essential that any review that takes place occurs within the guidelines established by the organisation. In addition, any changes to service delivery based on the information revealed during review processes should also occur in accordance with organisational policies and procedures. If for any reason you are unsure about your organisation's guidelines in relation to evaluating client service delivery, it is essential that you discuss this with your supervisor.

The areas in which a client program may need to be revised include:

- Client goals
- Action plan
- Level of support required / Nature of support provided

Basic pharmacology in relation to cautions and contraindications for relevant health procedures

Basics of pharmacology

All medicines are chemicals that change, in some way, how the body works. In order to better understand how medication works or how they affect the functions of the body you need to have some idea of the fundamental principles of pharmacology, which include:

- **Pharmacokinetics:** the absorption, distribution, metabolism, and excretion of a drug
- **Pharmacodynamics:** the biochemical and physical effects of drugs and the mechanisms of drug actions
- **Pharmacotherapeutics: the** use of drugs to prevent and treat disease.

The route of administration will influence the quantity of a medication given and the rate at which the medication is absorbed and distributed. These variables will affect the medication's action and the individual's response. Why is this important? Pharmacokinetics explains why this is so.

Pharmacokinetics

Kinetics refers to movement. Pharmacokinetics describes the physiological processes that act on a drug as it moves through the body, or in other words, how the body handles the drug.

Therefore, pharmacokinetics includes how a drug is:

- **Absorbed:** taken into the body
- **Distributed:** moved into various tissue
- **Metabolised:** changed into a form that can be excreted
- **Excreted:** removed from the body.

Absorption: Drug absorption covers a drug's progress from the time it is administered, through the passage to the tissues, until it reaches systemic circulation. On a cellular level, drugs are absorbed by several means – primarily through active or passive transport.

Active transport: requires cellular energy to move the drug from an area of lower concentration to one of higher concentration. Active transport is used to absorb electrolytes, such as sodium and potassium.

Passive transport: requires no cellular energy because diffusion allows the drug to move from an area of higher concentration to one of lower concentration.

Contraindications

A contraindication is a factor that makes a procedure or administration of a drug dangerous or undesirable. There are a number of situations where a particular medication should not be used, for example, in the presence of other medical conditions, particularly those affecting the kidney, liver or gastrointestinal tract. In many cases, an alternate medication will be found for treatment or the medication may need to be taken under strict medical supervision.

Toxicity

These are predictable adverse reactions to a drug and usually relate to its pharmacological properties. Toxicity may occur after prolonged usage of the drug or when it accumulates in the blood because of impaired metabolism or excretion. Blood serum levels are measured frequently in clients taking drugs with known toxic effects. This way, the levels can be monitored and dosages changed as required to maintain a therapeutic level only.

Allergic reactions

Usually these are unpredictable responses to a medication and the symptoms experienced may range from mild to severe. The symptoms will vary according to the individual and could include rashes, fever, pruritus, skin wheals, and oedema of the tissues. An anaphylactic reaction is a severe allergic reaction characterised by sudden narrowing of the bronchiolar muscles, oedema of the pharynx and larynx, severe wheezing and shortness of breath. It frequently requires emergency resuscitation measures.

It must be remembered that a person could be allergic to both the active and the inactive ingredients in the medication. The inactive ingredients include the preservatives, colourings and fillers. Sometimes a person will favour a certain brand of medication, claiming that another brand of the same medication does not agree with them. This is usually the inactive ingredients causing the problem.

Eight

Identify variations from normal health status using standard methods and protocols

1. What is the difference between a sign and a symptom in relation to health problem?

2. Name the digestive disorder that has the following list of signs and symptoms; difficulty swallowing, coughing when swallowing, choking, gagging and regurgitating food.

Identify potential factors responsible for significant variations from normal health status

The factors that may be responsible for a significant variation in a client's normal health status may be internal or external. When you note a change in a client's health status, consider the internal and external factors that may be at play. Again, if you know the client's history and current health status, this will help you determine the factors responsible, which should then be considered in your response.

External factors

External factors that may be responsible for significant variations from normal health status include:

- Diet and nutritional factors
- Use of alcohol, tobacco and other substances
- Environmental factors impacting health
- Level and type of physical activity.

Internal factors

- Interrelationships between body systems
- Emotional responses
- Patterns of thinking
- Disease processes
- Pathogens
- Emotional factors, i.e.: grief.

It is important to be aware of how a person responds emotionally to their physical health status. The person may be understating the experience or experiencing denial. Make sure you factor in this possibility when you are speaking to the relevant health professional about a variation in a person's health status. If a person has been diagnosed with a disease or illness monitor the disease progress. If the disease worsens notify the relevant health professional and superior immediately.

Factors responsible for abnormal readings

Health disorders or diseases are often recognised and managed through a series of assessments. Part of the assessment process may include testing or taking readings. The readings provide health professionals with an understanding of the impact of the disorder or disease over a period of time. There are a range of factors however, which may impact on the collection of information (readings). Because of this, measurements or readings are usually taken on several occasions under restful conditions, and an average is calculated. This will tend to be much more accurate than a single reading.

Within your working role, it is important that you understand any readings need to form part of a holistic assessment process and should be considered in connection with other information. You may also need to pass on information to other staff in relation to activities the individual has been involved in. If your client has just been on a long walk, for example, this might impact on health readings, and workers should be aware of this.

Depending on your working role, you may not normally be expected to undertake health readings; however it is important you are aware of the range of factors which might impact on the accuracy of those readings.

Temperature readings

While an oral temperature of 37°C is generally thought to be a 'normal' body temperature, this is an average of normal body temperatures. A temperature may actually be 0.6°C or more above or below 37°C. Temperature measurements can vary throughout the day, depending on how active you are and the time of day. Body temperature is very sensitive to hormone levels and may vary according to the source of the temperature reading. A rectal or ear temperature reading is slightly higher than an oral temperature reading. A temperature taken in the armpit is slightly lower than an oral temperature reading.

Cold drinks or food reduce oral temperatures, while hot drinks, hot food, chewing, and smoking raise oral temperatures. Increased physical fitness increases the amount of daily variation in temperature. Exercise raises body temperature. Psychological factors, such as excitement, may also influence body temperature.

Pulse rate and blood pressure

The pulse is the rate at which your heart beats. As the heart pumps blood through your body, you can feel a pulsing in some of the blood vessels close to the skin's surface, such as in your wrist, neck, or upper arm. Changes in the pulse rate may indicate heart disease or another problem.

Blood pressure readings reflect your arterial pressure when your heart pushes blood through your system, and also when your heart rests between beats. Blood pressure readings may change throughout the day, depending on your position, your anxiety level, and your activity level.

Blood pressure also rises and falls in response to physical exertion, stress, emotional changes and anxiety. Something as simple as moving your arm while your blood pressure is being taken can affect the reading. If the sleeves of your shirt fit too tightly over the cuff (part of the measuring device) or if the cuff size is wrong, readings could be inaccurate.

Other factors

Faulty equipment or improper use of equipment can contribute to readings which are not accurate. It is part of health and safety better practice for each organisation to ensure that manufacturing guidelines are followed for each piece of equipment. Staff members need to be trained in the correct use of equipment to ensure accuracy of readings. Environmental factors, such as dust or other irritants, may affect the accuracy of readings in some equipment, as may sound or electrical interference, eg: mobile phones or remote handsets. Failure to correctly calibrate or maintain equipment has the capacity to impact on the accuracy of readings collected.

Working within your job role

As you can see, an understanding of the body systems and the range of diseases or disorders which might impact on the homeostasis of the body system is necessary, especially when your role incorporates the care of an individual. However it is also important that you only work within the scope and limitations of your job role. Your training, together with any in-service training undertaken at your workplace, equips you to a certain level or role. This is also reflected within your position description or duty statement.

It is important that you work to your job role for several reasons. If you work outside your level of knowledge, you are placing yourself, the organisation and the client at risk. Working within your job role also supports the team environment. Your coordinator or direct up-line staff member will need to know they can rely on you to complete specific tasks.

As you are involved in everyday contact with clients, you may notice changes in their health status. Whilst your level of understanding or interactions will be limited to your own scope of practice, the information you gather is important in the holistic appreciation and assessment of the individual. Therefore, you must know where to report the changes you see, or where to source advice in relation to physical health status.

It is also important that you know the information which you need to transfer to other health professionals, as this will support them in their diagnostic or assessment processes. Generally, you would seek input from your coordinator, however you might also need to source advice from other heads of departments, depending on your employing organisational structure.

Example:

In aged care you might clarify health status with your team leader, Registered Nurse, Allied Health professionals, Clinical Nurse or Director of Nursing. In other community services disciplines, you would seek out the appropriately skilled person to clarify the implications and significance of physical health status or changes within the health of a client.

Activity Nine

Identify potential factors responsible for significant variations from normal health status

1. Outline three potential factors responsible for variations from normal physical health functioning.

2. What are two external factors that could result in abnormal temperature reading?

Identify potential risk factors associated with variations from normal health status

A person's health and wellbeing are influenced by a number of intrinsically related biological, lifestyle, societal and environmental factors, many of which can be modified to some extent. Individual biological factors can be as fundamental as genetic make-up, while lifestyle factors can encompass a range of matters, for example, diet, activity levels, and substance use. Societal and environmental influences can include where you live, and the affordability and availability of health-care services. Things that increase our risk of ill health are known as risk factors. There are some population groups and certain life stages where risky behaviours and other risks to health are more common—for example, risky behaviours are particularly prevalent in youth.

Factors that increase the likelihood of Endocrine system problems

Everyone's body undergoes changes, some natural and some not, that can affect the way the endocrine system works. Some of the factors that affect endocrine organs include aging, certain diseases and conditions, stress, the environment, and genetics.

Aging

Despite age-related changes, the endocrine system functions well in most older people. However, some changes occur because of damage to cells during the aging process and genetically programmed cellular changes.

These changes may alter the following:

- Hormone production and secretion
- Hormone metabolism (how quickly hormones are broken down and leave the body)
- Hormone levels circulating in blood
- Target cell or target tissue response to hormones
- Rhythms in the body, such as the menstrual cycle

For example, increasing age is thought to be related to the development of type 2 diabetes, especially in people who might be at risk for this disorder. The aging process affects nearly every gland. With increasing age, the pituitary gland can become smaller and may not work as well. For example, production of growth hormone might decrease. Decreased growth hormone levels in older people might lead to problems such as decreased lean muscle, decreased heart function, and osteoporosis. Aging affects a woman's ovaries and results in menopause, usually between 50 and 55 years of age. In menopause, the ovaries stop making estrogen and progesterone and no longer have a store of eggs. When this happens, menstrual periods stop.

Diseases and Conditions

Chronic diseases and other conditions may affect endocrine system function in several ways. After hormones produce their effects at their target organs, they are broken down (metabolized) into inactive molecules. The liver and kidneys are the main organs that break down hormones. The ability of the body to break down hormones may be decreased in people who have chronic heart, liver, or kidney disease.

Abnormal endocrine function can result from:

- Congenital (birth) or genetic defects (see section on Genetics below)
- Surgery, radiation, or some cancer treatments
- Traumatic injuries
- Cancerous and non-cancerous tumours
- Infection
- Autoimmune destruction (when the immune system turns against the body's own organs and causes damage)

In general, abnormal endocrine function creates a hormone imbalance typified by too much or too little of a hormone. The underlying problem might be due to and endocrine gland making too much or too little of the hormone, or to a problem breaking down the hormone.

Stress

Physical or mental stressors can trigger a stress response. The stress response is complex and can influence heart, kidney, liver, and endocrine system function. Many factors can start the stress response, but physical stressors are most important. In order for the body to respond to, and cope with, physical stress, the adrenal glands make more cortisol. If the adrenal glands do not respond, this can be a life-threatening problem.

Some medically important factors causing a stress response are:

- Trauma (severe injury) of any type
- Severe illness or infection
- Intense heat or cold
- Surgical procedures
- Serious diseases
- Allergic reactions.

Other types of stress include emotional, social, or economic, but these usually do not require the body to produce high levels of cortisol in order to survive the stress.

Factors that increase the likelihood of cardiovascular disease

Risk factors for developing heart disease include:

- **Age.** Aging increases your risk of damaged and narrowed arteries and weakened or thickened heart muscle
- **Sex.** Men are generally at greater risk of heart disease. However, women's risk increases after menopause
- **Family history.** A family history of heart disease increases your risk of coronary artery disease, especially if a parent developed it at an early age (before age 55 for a male relative, such as your brother or father, and 65 for a female relative, such as your mother or sister)
- **Smoking.** Nicotine constricts your blood vessels, and carbon monoxide can damage their inner lining, making them more susceptible to atherosclerosis. Heart attacks are more common in smokers than in non-smokers
- **Poor diet.** A diet that's high in fat, salt, sugar and cholesterol can contribute to the development of heart disease
- **High blood pressure.** Uncontrolled high blood pressure can result in hardening and thickening of your arteries, narrowing the vessels through which blood flows
- **High blood cholesterol levels.** High levels of cholesterol in your blood can increase the risk of formation of plaques and atherosclerosis.
- **Diabetes.** Diabetes increases your risk of heart disease. Both conditions share similar risk factors, such as obesity and high blood pressure
- **Obesity.** Excess weight typically worsens other risk factors
- **Physical inactivity.** Lack of exercise also is associated with many forms of heart disease and some of its other risk factors, as well
- **Stress.** Unrelieved stress may damage your arteries and worsen other risk factors for heart disease
- **Poor hygiene.** Not regularly washing your hands and not establishing other habits that can help prevent viral or bacterial infections can put you at risk of heart infections, especially if you

already have an underlying heart condition. Poor dental health also may contribute to heart disease.

Factors that increase the likelihood of respiratory system problems

Many risk factors for chronic respiratory diseases have been identified and can be prevented.

Major risk factors include:

- Tobacco smoke
- Second hand tobacco smoke
- Other indoor air pollutants
- Outdoor air pollutants
- Allergens
- Occupational agents.

Possible risk factors include:

- Diet and nutrition
- Post infectious chronic respiratory diseases.

Factors that increase the likelihood of muscoskeletal system problems

Osteoporosis

The bones of the skeleton become thinner and weaker as a normal part of the aging process. The bone-building activity of the body begins to slow down between the ages of 30 and 40. Women lose roughly 8 percent of their skeletal mass every decade. Men lose about 3 percent per decade. Not all parts of the skeleton are equally affected. The vertebrae, jaws, and the area near the ends of bones (at the "growth plate") lose more bone tissue than other bones, resulting in a loss of height, loss of teeth, and limbs prone to fracture.

Age

The older you are, the greater your risk. Bones become weaker and less dense as you age.

Gender

The risk of osteoporosis is greater if you are a woman. Women have less bone tissue and lose bone more rapidly than do men because of the changes involved in menopause.

Race

Caucasian and Asian women are more likely to develop osteoporosis. However, African American and Hispanic women are at a significant risk for developing the disease.

Bone structure and body weight

Small-boned and thin women are at greater risk.

Menopause/menstrual history

Normal or early menopause (brought about naturally or because of surgery) increases your risk of developing osteoporosis. During pre-imenopause/menopause, a decline in circulating oestrogen contributes to bone loss. In addition, women who stop menstruating before menopause because of conditions such as anorexia or bulimia, or because of excessive physical exercise, also might lose bone tissue and develop osteoporosis.

Lifestyle

Smoking, drinking too much alcohol, consuming an inadequate amount of calcium, or getting little or no weight-bearing exercise increases your chances of developing osteoporosis.

Risks that increase the likelihood of Nervous System problems

The symptoms of a nervous system problem depend on which area of the nervous system is involved and what is causing the problem. Nervous system problems may occur slowly and cause a gradual loss of function (degenerative). Or they may occur suddenly and cause life-threatening problems (acute). Symptoms may be mild or severe.

Some serious conditions, diseases, and injuries that can cause nervous system problems include:

- Blood supply problems (vascular disorders)
- Injuries (trauma), especially injuries to the head and spinal cord
- Problems that are present at birth (congenital)
- Mental health problems, such as anxiety disorders, depression, or psychosis
- Exposure to toxins, such as carbon monoxide, arsenic, or lead
- Problems that cause a gradual loss of function (degenerative).

Examples include:

- Parkinson's disease
- Multiple sclerosis (MS)
- Amyotrophic lateral sclerosis (ALS)
- Alzheimer's disease
- Huntington's disease
- Peripheral neuropathies.

Infections. These may occur in the:

- Brain (encephalitis or abscesses)
- Membrane surrounding the brain and spinal cord (meningitis)
- Overuse of or withdrawal from prescription and non-prescription medicines, illegal drugs, or alcohol
- A brain tumour.

Organ system failure. Examples include:

- Respiratory failure
- Heart failure
- Liver failure (hepatic encephalopathy)
- Kidney failure (uremia).

Other conditions. Some examples include:

- Thyroid dysfunction (overactive or underactive thyroid)
- High blood sugar (diabetes) or low blood sugar (hypoglycemia)
- Electrolyte problems
- Nutritional deficiencies, such as vitamin B1 (thiamine) or vitamin B12 deficiency
- Guillain-Barré syndrome.

A sudden, (acute) nervous system problem can cause many different symptoms, depending on the area of the nervous system involved. Stroke and transient ischemic attack (TIA) are common examples of acute problems.

A person experiences the sudden onset of one or more symptoms, such as:

- Numbness, tingling, weakness, or inability to move a part or all of one side of the body (paralysis)
- Dimness, blurring, double vision, or loss of vision in one or both eyes
- Loss of speech, trouble talking, or trouble understanding speech
- Sudden, severe headache
- Dizziness, unsteadiness, or the inability to stand or walk, especially if other symptoms are present
- Confusion or a change in level of consciousness or behaviour
- Severe nausea or vomiting.

Risks that increase the likelihood of eye problems

After the age of 40, the risk of eye diseases and vision problems increases threefold every 10 years. People with vision problems can get depression and have an increased risk of falls and hip fractures. People at the highest risk of vision loss are older people and those with diabetes and a family history of vision problems. Eye diseases and vision problems can go unnoticed, because people think that changes in vision are a natural part of ageing. Most vision loss in Australia is caused by eye diseases.

The most common eye diseases include:

- **Cataracts –** a cataract occurs when the lens of the eye becomes cloudy. This prevents light entering the eye and results in poor vision.
- **Macular degeneration** – damage to the macula, the part of the retina responsible for central vision and for seeing fine detail. If both eyes are affected, reading, recognising faces and driving may become very difficult.
- **Diabetic retinopathy** – people with diabetes may develop a condition called 'diabetic retinopathy' which can lead to serious loss of vision. If you have diabetes, you should make sure that you have regular eye tests.
- **Glaucoma – a** condition where the nerve cells that transmit information from the eye to the brain become damaged. It is often associated with a build-up of pressure in the eye.

Risks that increase the likelihood of digestive system problems

Various lifestyle factors can increase the risk for digestive diseases. Smoking cigarettes, drinking too much alcohol, eating too much dietary fat, getting inadequate dietary fibre, or fluids, having stress, and lacking exercise can all contribute to digestive disease. Other risk factors include contaminated food and water, unsafe sex, and having a family incidence of hepatitis B.

Risks that increase the likelihood of urinary system problems

Urinary problems are sure to be distressing and often embarrassing for the adult man and woman. An infection of the bladder and urinary tract often leads to discomfort and the need for frequent, painful urination. In men, enlargement of the prostate can also cause frequent urination, with difficulty in starting, and leakage. In women, escape of urine (incontinence) is a common urinary problem, which possesses a variety of causes.

Urinary Tract Infection (UTI)

Urinary Tract Infections (UTI) usually occur when bacteria enter the urinary tract through the urethra and multiply in the bladder. Infection-fighting assets are found in the urinary system and help inhibit the growth of bacteria. Unfortunately, certain factors boost the chances that bacteria will enter the urinary tract and develop into an infection.

Sexual intercourse may lead to UTI's in women, and due to the fact that the anus is so close to the female urethra, women who aren't sexually active may contract lower urinary tract infections. Most cases of cystitis are caused by E. coli, a type of bacteria usually found in the gastrointestinal tract. When men suffer from a UTI it is not typically acquired from sexual contact. Some sexually transmitted diseases, like herpes or chlamydia, also are possible causes.

Hematuria

There are numerous possible causes of blood in urine. Some are severe, including cancers, trauma, stones, infections, and obstructions of the urinary tract. Others may be less serious and may not even require treatment. Non-serious causes can be viral infections, medications that thin the blood's ability to clot, and benign prostate enlargement.

Urinary Incontinence

This condition may occur due to a variety of different reasons.

Common causes include:

- Loss of pelvic muscle support of the bladder, especially in women who have had multiple vaginal deliveries as they age
- Overactive Bladder
- Neurologic conditions
- History of Prostate surgery or radiation therapy to the prostate or pelvis
- Some medications
- Stool build-up of in the bowels
- Immobility
- Urinary tract infection
- Elevated calcium levels.

Cystitis is an infection of the bladder that almost always follows (is secondary to) bacterial infection in the urine. It is the most common type of urinary tract infection (UTI), particularly in women. The bladder is a muscular bag that stores urine from the kidneys. Urine leaves the body through a tube called the urethra. Cystitis occurs when bacteria travel up the urethra, infect the urine and inflame the bladder lining. Most women will experience cystitis at least once in their lives. While it is painful and annoying, it isn't dangerous or contagious, and the infection can't be passed on to your partner during sex.

If left untreated, the infection can 'backtrack' deeper into the urinary system from the bladder and reach the kidneys. A kidney infection is serious and needs prompt medical attention as it can cause kidney damage or even kidney failure.

Kidney stones

Kidney stones are solid crystals formed from the salts in urine. They are sometimes called renal calculi. Kidney stones can block the flow of urine and cause infection, kidney damage or even kidney failure. They can vary in size and location.

The risk of kidney stones is about one in 10 for men and one in 35 for women. Between four and eight per cent of the Australian population suffer from kidney stones at any time. After having one kidney stone, the chance of getting a second stone is between five and 10 per cent each year. Up to half the people with a first kidney stone will get a second stone within five years. After five years, the risk declines. However, some people keep getting stones their whole lives.

Risks that increase the likelihood of dental health problems

The risks of dental health problems include:

- **Cardiovascular disease:** In a nutshell, this means heart disease. The bacteria from inflammation of the gums and periodontal disease can enter your bloodstream and travel to the arteries in the heart and cause atherosclerosis (hardening of the arteries). Atherosclerosis causes plaque to develop on the inner walls of arteries which thicken and this decreases or may block blood flow through the body. This can cause an increased risk of heart attack or stroke. The inner lining of the heart can also become infected and inflamed condition known as endocarditis
- **Dementia:** The bacteria from gingivitis may enter the brain through either nerve channels in the head or through the bloodstream, that might even lead to the development of Alzheimer's disease
- **Respiratory infections:** The *Journal of Periodontology* warns that gum disease could cause you to get infections in your lungs, including pneumonia. While the connection might not be completely obvious at first, think of what might happen from breathing in bacteria from infected teeth and gums over a long period of time
- **Diabetic complications:** Inflammation of the gum tissue and periodontal disease can make it harder to control your blood sugar and make your diabetes symptoms worse. Diabetes sufferers are also more susceptible to periodontal disease, making proper dental care even more important for those with this disease
- **Gum disease:** Gum disease is an inflammation of the gum line that can progress to affect the bone that surrounds and supports your teeth. The three stages of gum disease — from least to most severe — are gingivitis, periodontitis and advanced periodontitis.

Gum disease can be painless, so it is important to be aware of any of the following symptoms:

- Swollen, red, tender or bleeding gums
- Gums that recede or move away from the tooth
- Persistent bad breath or bad taste in mouth
- Loose teeth
- Visible pus surrounding the teeth and gums.

Risks that increase the likelihood of Reproductive Health problem

In women, there are numerous conditions that can affect the reproductive system, such as cancer, uterine fibroids, endometriosis, ovarian cysts, infertility, and sexually transmitted diseases (STDs) and more.

Symptoms of female reproductive and hormonal health problems include:

- Bleeding or spotting between periods
- Itching, burning, or irritation (including bumps, blisters, or sores) of the vagina or genital area
- Pain or discomfort during sex
- Excessively heavy bleeding or severe pain with periods
- Severe pelvic/abdominal pain
- A change in vaginal discharge (amount, colour or odour)
- Feeling of fullness in the lower abdomen
- Frequent urination or feeling of urgency to urinate
- Lower back pain
- Pelvic Pain
- Known reproductive problems such as infertility, past miscarriages or early labour
- Excessive hair growth on the face, chest, stomach, thumbs, or toes
- Baldness or thinning hair
- Acne, oily skin, or dandruff
- Patches of thickened dark brown or black skin.

Ten

Identify potential risk factors associated with variations from normal health status

1. What are the most common risks that increase the persons chance of contracting or developing a health problem?

2. What risk factors apply to a person who has oral problems?

3. What risk factors apply to a person with digestive problems?

Recognise and refer potentially serious issues in line with organisation requirements

It is important to be aware of how effectively your client's needs are being met through your organisation. Referral to appropriate services is essential if you feel the client's needs cannot be met, or can only partially be met within your organisation. You may be aware of the need for referral after initial evaluation of the client's needs. Alternatively, the need for referral may not become obvious until you have been working with the client for some time. Ongoing monitoring of the client's behaviour and circumstances enables you to gauge this.

Monitoring might involve:

- Formal processes, such as review meetings and ongoing assessments
- Informal processes, such as ongoing observations and questioning regarding the client's behaviour and response to services provided
- Gaining regular feedback from the client and/or family/caregivers regarding the effectiveness of service provision.

Some considerations in making decisions regarding the need for referral:

- Be aware of the boundaries of your organisation's service and also of your own knowledge/skill/role within that organisation
- Be aware of the need for mandatory notification if the observed behaviours indicate risk of harm or abuse
- Be observant and vigilant when working with a client, not only during initial assessment and evaluation, but over the course of any interaction during service provision. You may be the one to recognise what others haven't and identify potentially serious issues.
- Act with appropriate duty of care – investigate, do your research and be aware of what constitutes a serious enough issue to require support beyond what is available in the immediate environment through your organisation. If you are unsure, consult with your supervisor/manager.

Step one of any referral process is to determine the specific need for this action. The 'scope of practice' or range of approved techniques of each health care modality is the benchmark for decision making here. Referral is the method by which a client is sent to a health care professional for diagnosis and treatment of a condition or disease. It is the process that helps a client move on to, or includes the use of another service.

Because of the complex nature of people and society, no one health care centre will be able to serve all the needs of every client. Recognising the need to refer a client/patient, choosing the most appropriate referral service and implementing the referral process to the satisfaction of all involved, are important skills for a practitioner to develop.

Referrals constitute an important aspect of case management. Case management refers to the individual care plans for clients, through which the appropriate services are located and the ongoing treatment of a client is coordinated and monitored. Referral plans form the links in the chain of services that may be offered to a client through the course of their health care history.

Reporting potentially serious problems

Your supervisor is the first person to refer to in a situation where a client's health status has changed. If they are not available, you should contact another supervisor or manager, or call emergency services. You can phone emergency services on 000 at any time of the day or night for medical assistance. You will be asked details such as your name, location, phone number, the situation, how you have responded and how you are able to respond until the paramedics arrive.

Some facilities may have an emergency button available for you to press to summon colleagues in an emergency situation. Be sure to respond immediately in such an event, as the sooner help arrives, the better chance the client will have to recover. If you are not sure if the changes in a client's health status are significant, refer to your supervisor, manager or a professional for clarification. Remember to accurately report all incidents to your supervisor and make a written report, no matter how significant, as soon as possible.

Paramedical authority

Paramedics are emergency health professionals who are trained in critical, acute health care. Working on their own or with an emergency care assistant or ambulance technician, they assess the patient's condition and then give essential treatment. They use high-tech equipment, such as defibrillators (which restore the heart's rhythm), spinal and traction splints and intravenous drips, and as well as administering oxygen and drugs.

Paramedics are often one of the first healthcare professionals on the scene of any accident or medical emergency. They are usually one of a two-person ambulance crew, with an emergency care assistant or ambulance technician to assist them. However, they might work on their own, using a motorbike, emergency response car or even a bicycle to reach their patients.

With extra training, they could also become members of an air ambulance crew. When they arrive at the scene, they will assess the patient's condition and take potentially life-saving decisions about any treatment needed before the patient is transferred to hospital. They then start giving the treatment, with the assistance of the emergency care assistant or ambulance technician.

Record referrals in case notes

As part of your commitment to providing a service for clients, your organisation will require you to keep detailed and up-to-date records or file notes of all client interactions. Different health care clinics and support agencies will have different documentation procedures and policies, dependent on the nature of services provided and on the approach the facility has adopted in working with clients.

In the case of formal documentation, your reports may be done on organisational record charts, through a computerised record system or on particular formats developed by your organisation. Every interaction with a client needs to be documented. This is related to legal requirements, good practice and duty of care. It includes letters, email communications, phone calls and other correspondences

Report incidents

In the same way that hazards are reported in the workplace, ANY incident or injury needs to be reported to your organisation's management. If you witness or are involved in an incident or receive an injury – the correct and accurate recording of the details must be completed. In most workplaces, the form to do this is available in a folder in the first aid box or in the WHS Manual. You can ask a supervisor for access to the form.

Incident / injury report form

Please print clearly and tick the correct box

Status: ☐ Employee ☐ Contractor ☐ Other

Outcome: ☐ Near miss ☐ Injury

1. DETAILS OF INJURED PERSON

Name: ____________________ Phone: (H)____________ (W)__________

Address: ____________________ Sex: ☐ M ☐ F

____________________ Date of birth: ____________

____________________ Position: ____________

Experience in the job: ____________________ (years/months)

Start time: ____________________ ☐ am ☐ pm

Work arrangement: ☐ Casual ☐ Full-time ☐ Part-time ☐ Other

2. DETAILS OF INCIDENT

Date: ____________ Time: ____________

Location: ____________________

Describe what happened and how: ____________________

____

____

3. DETAILS OF WITNESSES

Name: ____ Phone: (H)__________ (W)__________

Address: ____

____

4. DETAILS OF INJURY

Nature of injury (eg burn, cut, sprain) ____

Cause of injury (eg fall, grabbed by person) ____

Location on body (eg back, left forearm) ____

Agency (eg lounge chair, another person, hot water) __________________________________

5. TREATMENT ADMINISTERED

First Aid given ☐ Yes ☐ No

First Aider name: ____

Treatment: ____

Referred to: ____

6. DID THE INJURED PERSON STOP WORK?

☐ Yes ☐ No If yes, state date: ____________________ Time: ______________

Outcome:

☐ Treated by doctor ☐ Hospitalised ☐ Workers compensation claim

☐ Returned to normal work ☐ Alternative duties ☐ Rehabilitation

7. INCIDENT INVESTIGATION (comments to include causal factors):

____

____

____

____

8. RISK ASSESSMENT

Likelihood of recurrence: ____

Severity of outcome: ____

Level of risk: ____

9. ACTIONS TO PREVENT RECURRENCE

Action	By whom	By when	Date completed

10. ACTIONS COMPLETED

Signed (Manager): ____________________________________ Title: __________

Eleven

Recognising and referring potentially serious issues in line with organisation requirements

Who is the most appropriate professional to refer a person to with the following conditions?

1. Deterioration in vision

2. Suspected broken bone

3. A suspected epileptic seizure

4. Slurred speech

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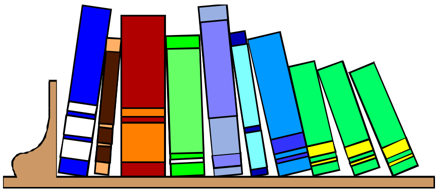

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