Introduction

Terms & Definitions

Terms of Reference

The Human Body

Introduction

Anatomy and Physiology for First Aiders is intended as an introduction to human anatomy and physiology, and to the mechanisms of disease and injury. This knowledge will, it is hoped, prove useful as a foundation for an increased understanding of injuries, illnesses, and the appropriate treatments.

The average first aid training syllabus contains very little teaching of anatomy and physiology, mainly because knowledge of the subject above an extremely elementary level is not necessary for the successful rendering of first aid.

However, those who have already mastered the basics of first aid, and who wish to improve their skills and knowledge, will almost certainly find a need to increase their knowledge and understanding of anatomy and physiology.

This book is not aimed at medical professionals, for whom a deeper level of knowledge of anatomy and physiology is almost certainly required, but at volunteer first aiders, and those of similar training levels, particularly those involved in the more advanced levels of first aid practice and training.

As this book is aimed at the first aider, certain parts of the body (eg. the heart and circulation) are described in more detail than other parts (eg. the endocrine system) as they are more likely to be affected by medical conditions and injuries which a first aider may encounter, and are thus likely to be of more direct use and interest to the reader.

Although great care has been taken to aim the text at those who have not received formal medical training, it is impossible to describe and explain all topics without reference to scientific terms and concepts. It has therefore been assumed that the reader will have some knowledge of science, particularly of basic chemistry.

Terms and Definitions

The field of medicine uses a vast number of special terms and definitions. There is a tendency not to use such medical words in modern first aid training. However, in many cases, the use of a 'medical' term may be more precise and exact than using 'everyday' language.

The list below has been compiled to assist the reader.

Abduction Movement of a limb away from the midline of the body.

Acid A substance which releases Hydrogen ions (H^+) when dissolved in water.

Acute (of a disease) Occurring and developing rapidly, and of short duration.
Also used to mean severe.

Adduction Movement of a limb towards the midline of the body.

Afferent Carrying towards.

Alkali A substance which releases Hydroxyl ions (OH^-) when dissolved in water; a substance which will accept Hydrogen ions (H^+).

Amino acid The structural unit of proteins; a chemical compound containing an Amino radical $-NH_2$.

Anatomy The study of the structures of the body.

Anterior Towards the front, or in front of.

Antibody A substance produced by white blood cells in order to destroy an antigen.

Antigen A foreign substance (against which an antibody is produced).

Articulate (of bones) To meet in a joint. (usually moveable).

Axial Pertaining to the axis of the body - the head, neck, thorax, abdomen, and pelvic area.

Bilateral Pertaining to both sides of the body.

Carbohydrate A substance which forms the main source of body energy; a substance composed of Carbon (25%), Oxygen (25%), and Hydrogen (50%).

Cardiac Pertaining to the heart.

Cellular A biochemical process in which **Respiration** energy from foods is released for use by cells and tissues.

Cephalic Pertaining to the head.

Cervical Pertaining to the neck.

Chronic (of a disease) Of long duration, and usually of gradual onset.

Deep Far, or further, from the surface of the body.

Diffusion A chemical movement whereby a substance moves from an area of high concentration to an area of lower concentration - towards an even concentration.

Disease A disorder of body systems, not directly caused by injury, usually with a distinct set of signs and symptoms, and a specific cause.

Distal Away from the centre of the body.

Efferent Carrying away from.

Elevation A movement which raises a body part.

Enzyme A natural catalyst; a substance which increases the rate of a specific biochemical reaction.

Excitation Stimulation of a nerve or muscle cell.

Extension A straightening movement of a limb.

Facet A small flat surface (on a bone).

Filtration A chemical movement whereby small molecules or particles are forced through a partially permeable membrane.

Flexion A bending movement of a limb.

Foramen An opening or hole.

Foreign (of an object or substance) Originating external to the body, and incompatible with or hostile to one, or more, of the body's systems.

Frontal (of a sectional view) A vertical section of the body cut from left to right.

Gastric Pertaining to the stomach.

Gland An organ which produces a fluid secretion.
Note that the common term "lymph gland" is more properly designated as "lymph node".

Haematoma A collection of blood in tissues (following an injury).

Health A condition of normality across all systems of the body.

Hepatic Pertaining to the liver.

Hormone A chemical 'messenger' secreted by a gland or by other specialist cells to control the chemical activity of another specific part of the body.

Hyper... Above, raised, large.

Hypo... Below, lowered, small.

Idiopathic (of a disease) Occurring spontaneously, of no identifiable cause.

Inferior Below, or lower.

Injury Physical damage to the body.

Intercostal Between the ribs.

Interstitial Between the tissues.

Lateral Away from the midline of the body.

Lesion An area of tissue which has been damaged and reduced in function by injury or disease.

Ligament Fibrous tissue which connects bones at joints.

Medial Towards the midline of the body.

Median plane A vertical plane from front to back through the left-right midline of the body.

Metabolic rate The rate at which body cells use Oxygen and food substances to produce heat and other forms of energy.

Metabolism Chemical processes within the body.

Mid-sagittal (of a sectional view) A vertical section of the body, cut from front to back along the median plane.

Oedema An excessive accumulation of fluid in tissues, leading to swelling.

Organ An item within the body which performs a specific function.

Osmosis The movement of water through a partially permeable membrane, from a less concentrated solution to a more concentrated solution - towards even concentration.

Oxidation A chemical reaction in which a molecule or atom loses an electron or Hydrogen ion.

Peripheral Towards the extremities of the body.

pH A measure of acidity and alkalinity, by stating the concentration of Hydrogen ions in a substance on an inverse logarithmic scale.
pH1 = very acidic
pH7 = neutral
pH14 = very alkaline

Physiology The study of the normal functions of the body.

Portal Pertaining to the porta hepatis (the 'door of the liver').

Posterior Towards the rear, or behind.

Process An extension or protuberance to a bone (or other organ).

Protein A complex compound based on Amino Acids.

Proximal Towards the centre of the body.

Pulmonary Pertaining to the lungs.

Renal Pertaining to the kidneys.

Rotation A twisting movement of a limb or body part.

Sagittal (of a sectional view) A vertical section of the body, cut from front to back.

Septum A dividing wall.

Sphincter A circular muscle which acts as a valve.

Superficial Near, or towards the surface of the body.

Superior Above, or higher.

System A collection of organs which work together to perform associated functions.

Transverse Running horizontally, or across the body.
(of a sectional view) A section cut horizontally through the body.

Vaso Pertaining to the blood vessels.

Visceral Pertaining to an internal organ, or cavity.

Measurement unit multipliers

These are prefixed to measurement units to denote multiplication of scale:

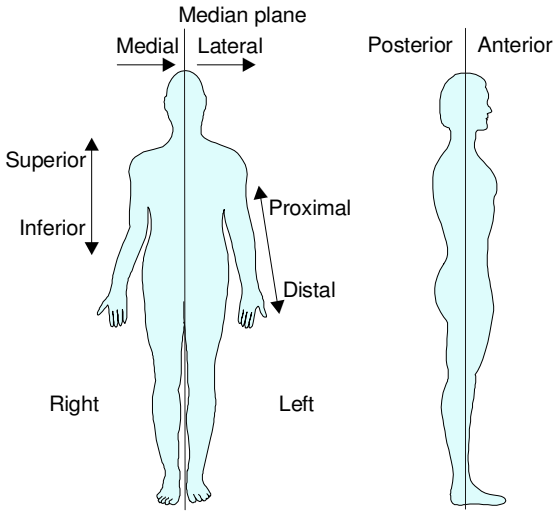
M	=	mega	x1,000,000	million
k	=	kilo	x1,000	thousand
m	=	milli	x0.001	thousandth
µ	=	micro	x0.000001	millionth
n	=	nano	x0.000000001	billionth

mm^2 = square millimetre
mm^3 = cubic millimetre

Terms of Reference

The Anatomical Position

Figure 1 - 1 the anatomical position and terms of reference

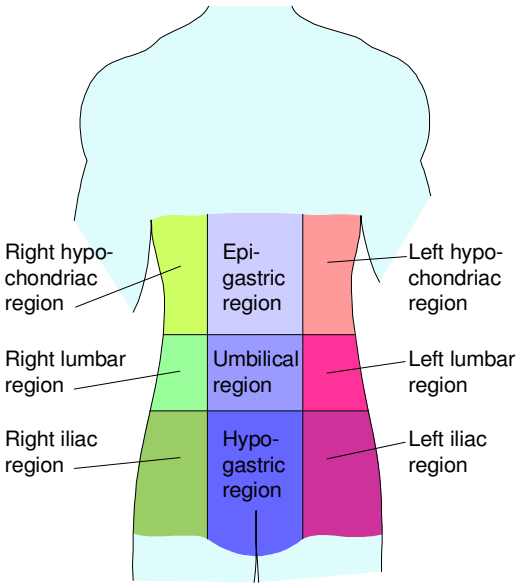


All references to left, right, anterior, superior, etc. are made assuming that the body is in a standing position, facing towards the reader, with palms forwards. [*Figure 1 - 1*]

Abdominal Regions

The abdomen is divided into nine regions for reference purposes. [*Figure 1 - 2*]

Figure 1 - 2 regions of the abdomen



Body Cavities

The body is divided into cavities. These cavities contain the internal organs, sometimes known as the *viscera*. [*Figure 1 - 3*]

There are four main cavities within the body:

Cranial cavity. This is surrounded by the cranium, and contains the brain.

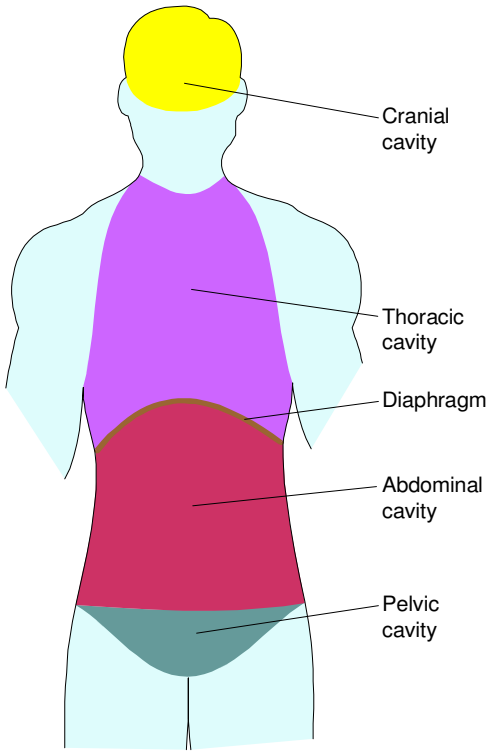
Thoracic cavity. This is the section of the torso above the diaphragm. It contains the lungs, heart, and major vessels.

The area between the lungs is known as the *mediastinum*.

Abdominal cavity. This is the section of the torso below the diaphragm, but above the superior edge of the pelvis. It contains the digestive system, and associated organs.

Pelvic cavity. This is the section of the torso which is surrounded by the pelvis. It is continuous with the abdominal cavity above. It contains the internal reproductive organs, the urinary bladder, and the rectum.

Figure 1 - 3 cavities of the body



The Systems of the Body

The human body contains many different organs, most of which are associated with specific systems. Although these systems are considered as separate, their functions are interlinked, and none can exist without the others, neither can the body survive successfully without all of its systems.

It is, however, well accepted that certain organs have less critical functions than others, and that survival is possible with these organs either malfunctioning, damaged, or removed.

There are twelve main systems within the body:

The Body Covering

The skin, together with the nails and hair cover and protect all the other systems of the body.

The body covering is sometimes known as the *integumentary system*.

The Circulatory System

This comprises the blood, the heart, and the blood vessels. It carries nutrients to the tissues, and carries waste materials towards excretion. It is also fundamental in the body's defence against infection and in the healing of wounds.

The Digestive System

This is based around the alimentary canal. It breaks down ingested foods into simple compounds which body tissues can absorb. It then eliminates waste solids.

The Endocrine System

This comprises a series of glands. These secrete hormones which regulate and control chemical reactions around the body.

The Lymphatic System

This is often considered as part of the circulatory system.

It comprises lymph vessels, and a series of 'nodes'. It returns excess fluid to the blood. It also forms the major proportion of the body's defence against infection.

The Muscular System

This comprises all muscles within the body, although generally only the skeletal muscles are considered.

It provides the motive force for movement of the body, and for the movement of materials throughout the body.

The Nervous System

This comprises the brain, the spinal cord, and other nerves.

It regulates and controls body functions, and allows reaction to external influences.

The Reproductive System

This includes the sexual reproductive organs.

It provides mechanisms for the reproduction and continuation of the species.

The Respiratory System

This comprises the air passages and lungs.

It provides the mechanism for drawing Oxygen into the body, and for removing the waste gas Carbon Dioxide.

The Skeletal System

This comprises the bones.

It provides support and protection for the body. It also houses the production materials for blood cells, and provides attachments for muscles, thus facilitating movement.

The joints are included as part of the skeletal system.

The Senses

The senses provide information upon which the nervous system may act.

They include the special senses of sight, hearing, smell, and taste, as well as the general senses of touch, pain, balance, and movement.

The Urinary System

This includes the kidneys, bladder, and connecting vessels.

It removes waste fluid and soluble matter from the body.

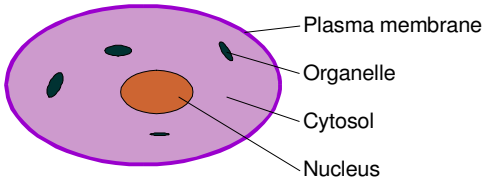
Cells and Tissues

Cells

The basic building block for the entire body is the *cell*. [*Figure 1 - 4*]

Figure 1 - 4 a typical cell

Simplified view of a typical cell, showing basic structure



The centre of the cell is formed by a *nucleus*, in which is found the genetic 'signature' of the body in the form of DNA (Deoxyribo Nucleic Acid). Surrounding the nucleus is a fluid known as *cytosol*, which together with discrete subcells (*organelles*), forms the *cytoplasm*, contained in an outer *plasma membrane*.

All cells have a similar structure, with the exception of red blood cells and platelets, which do not have nuclei.

Some cells, particularly certain types of white blood cells have the ability to surround and ingest foreign matter and dead cells, in a process termed *phagocytosis*.

Stem cells are unlike many other cell types in that they retain the ability to divide throughout their life and create cells of different and specialised types, taking the place of cells that die or are lost.

Stem cells are a fundamental part of the body's ability to repair and renew its tissues.

Stem cells in bone marrow are particularly important as they provide the basis for blood cells.

Tissues

Tissues are formed by cells bound together. They form the structure of the body. Tissues fall into five main categories:

Epithelium,
Connective tissue,
Muscle tissue,
Nerve tissue,
Bone tissue.

Epithelium

Epithelium is formed from closely packed layers of cells, with little other tissue involved. It covers the body, and lines cavities and tubes

There are four main varieties of epithelium:

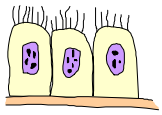
Squamous epithelium. (also termed *endothelium*)

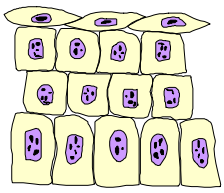
This is formed from a single layer of cells resulting in a very smooth, semi-permeable membrane.

Columnar epithelium and **Cuboidal epithelium**.

These are formed from aligned cells, usually attached to an inert basement membrane.

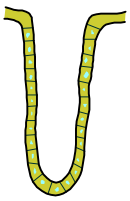
Ciliated epithelium. This is columnar epithelium to which fine hairs called *cilia* are attached.





Stratified epithelium. This is formed from layers of different epithelial tissues, usually without basement membranes. Together with the protein keratin, this forms the outer skin covering for the body.

Glands



Glands are groups of epithelial cells which produce specialised secretions.

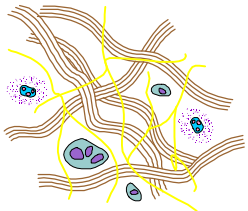
Glands which secrete onto the surface of an organ - either directly or via a duct - are known as *exocrine glands*; glands which secrete into the blood are known as *endocrine glands*.

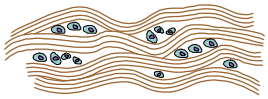
Connective Tissue

As the name suggests, *connective tissue* links other tissues. Its cells tend to be separated by other substances, often including elastic fibres or fibres formed from the protein collagen.

There are six main varieties of connective tissue:

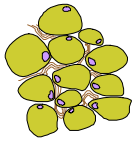
Areolar tissue. This is the most common connective tissue, linking almost all other tissues and organs. It is semi-solid and formed from cells held in a mesh of collagen and elastic fibres.





Fibrous tissue. This is found in ligaments, or as a protective layer around organs.

It has few cells, being mainly composed of tightly packed bundles of collagen fibres.

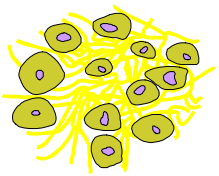


Adipose tissue. This is tissue composed of fat cells held in a matrix of areolar tissue. It provides heat insulation and energy storage.

Elastic tissue. This is found in blood vessels, and is formed from elastic fibres, with very few cells involved.

Lymphoid tissue. This is found in lymph nodes, and other organs of the lymphatic system. It is also found in the intestines. It is a semi-solid tissue, with specialised cells held in fine fibres known as *reticular fibres*.

Cartilage. This is a firm, but slightly flexible tissue found at joints and in the trachea and bronchi. It is formed from cells held in a reinforced matrix of collagen and elastic fibres.



Cartilage is of three types:

Fibrocartilage, which is tough and slightly flexible, and found in intervertebral discs, other joints, and in ligaments.

Hyaline cartilage, which is smooth and solid, and found in the air passages, and at joints.

Elastic cartilage, which has elastic fibres, and is found in blood vessels.

Blood. This carries the body's nutrients, and waste products; it is considered as a connective tissue.

Connective tissue is host to a series of specialist cell types:

Fibroblasts. These produce collagen and elastic fibres. They also assist in the repair of wounded tissue by binding severed surfaces together through the creation of fibres.

Macrophages. These form part of the body's defence mechanisms by ingesting invading matter.

Mast cells. These produce the local hormones histamine and serotonin as part of the body's immune response.

Plasma cells. These produce specific antibodies to combat invading organisms.

Nerve Tissue

Nerve tissue is formed from complex cells called *neurones*, which have the property of being able to transmit nerve impulses - electro-chemical messages - in response to stimulation.

Muscle Tissue

This has the ability to contract when given a nervous stimulus.

There are three varieties of muscle tissue:

Striated muscle. This forms muscles under voluntary control.

Smooth muscle. This forms muscles under autonomic control.

Cardiac muscle. This forms the muscle of the heart.

Bone Tissue

This provides the rigid structure of the skeleton.

There are two varieties of bone tissue:

Compact bone. This forms the hard outer shell of bones.

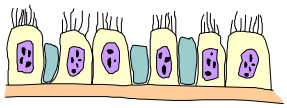
Cancellous bone. This forms the inner structure of bones.

Membranes

Membranes are thin, flexible layers of epithelium and/or connective tissue.

There are three types of membrane:

Mucous membrane. This lines body cavities which open outside the body. It is made up from connective tissue covered with epithelium.



Goblet cells within the membrane secrete *mucus*, a watery fluid, made sticky by the protein mucin.

Serous membrane. This occurs in double layers, and covers and lines internal organs. It is formed by connective tissue covered with squamous epithelium.

Serous fluid is secreted between the two layers of membrane as a protective lubricant.

Synovial membrane. This lines the cavities of moveable joints. It is composed from connective and adipose tissues.

Synovial membranes secrete *synovial fluid*, a clear, viscous, oily fluid which acts as a lubricant for joints.

Synovial membranes have very smooth inner surfaces, which together with synovial fluid, provide a capability for movement which is almost frictionless.

Cancer

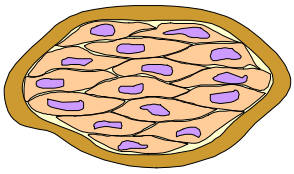
Normally, cells divide at a rate to balance losses as other cells die. In a *cancer*, cells divide and grow out of control, spreading as they multiply.

Tumour

An abnormal growth of tissue resulting from uncontrolled cell division is termed a *tumour* or *neoplasm*.

Tumours may be either benign or malignant.

Benign tumours



In a *benign tumour*, cell structure is close to normal even though growth is abnormal.

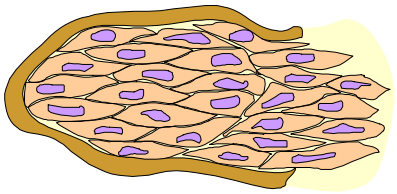
The cells tend to remain inside a capsule of connective tissue and do not spread outside their original site.

Whilst usually having few initial adverse effects, and being relatively easy to treat, benign tumours may cause problems simply by their physical presence as they continue to grow. There is also the risk that they may turn malignant.

Malignant tumours

A *malignant tumour* is characterised by rapid growth of abnormal cells.

These cells will eventually break out of their protective capsule causing structural changes in surrounding tissue.



As the tumour spreads these tissue changes may well affect the operation of the organ of which the tissue is part.

Once the tumour has broken free from its original capsule, it will almost certainly spread to other parts of the body.

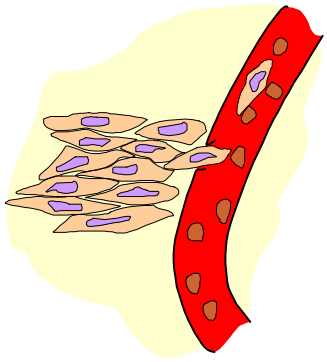
Malignant tumours may be classified according to the tissue type in which they originate:

Sarcoma. This may form in connective tissue or muscle, anywhere in the body.

Carcinoma. This forms in epithelial tissue, most commonly in the lungs, digestive tract, uterus, breasts, or on the skin.

Other forms of cancer include those which form in tissues of mixed cell type, in the cells of the nervous system, and *leukaemias*, which result in abnormal blood cells.

The spread of cancer



Once cancer cells have broken away from their original site, they may spread into a body cavity, or enter the bloodstream or the lymphatic system by breaking through the walls of capillaries or smaller lymph vessels.

The cancer cells thus spread, or *metastasize*, throughout the body.

The bodies defence systems will attempt to destroy the cancer cells, and may succeed, but if not the cancer cells may then attach themselves to other tissues and organs, forming *secondary tumours*. Each secondary tumour then becomes a source of further cancerous cells.

Causes of cancer

The base cause for cancerous growth is not known, although extended exposure to certain factors, known as *carcinogens*, is known to promote abnormal cell division.

There are several types of carcinogens, including X-rays and other electromagnetic radiation, substances such as benzenes, and some viruses.

Electric Shock

Electric shock is the reaction of the human body to an unnatural passage of electric current through its tissues.

The severity of a shock depends mainly on the magnitude of the current which flows. This is determined by the voltage applied divided by the impedance of the body, as defined by Ohm's law.

Table 1 - 1 electrical terminology

Electrical terms and their definitions

Term	Symbol	Definition	Measurement unit	Symbol
Charge	Q	The 'amount' of electricity at a particular point.	Coulomb	C
Voltage	V	The force or pressure which causes the flow of electric charge	Volt	V
Current	I	The rate of flow of electric charge	Ampère (Amp)	A
Direct current	DC	Electric current which flows in one direction only, from a source such as a battery		
Alternating current	AC	Electric current which alternates in the direction of its flow, from a source such as a generator		
Frequency	f	The rate of alternation of an alternating current.	Hertz	Hz
Resistance	R	The property of a substance to restrict the flow of electric current	Ohm	Ω
Impedance	Z	The property of a substance to restrict the flow of an alternating current (AC)	Ohm	Ω

The impedance of the body

Body tissue contains a significant proportion of water, with dissolved salts, and is therefore a relatively good electrical conductor. Conversely, skin has a fairly high resistance - especially when dry.

The *internal body impedance* varies greatly, depending on the types of tissue involved. Muscles and blood vessels are good conductors, whereas bone and fat tissue are not.

The wrists and ankles consist of multiple bones with little other tissue and therefore have relatively high impedances.

The *impedance of the skin* also varies greatly and is inversely proportional to the contact area. Dry skin has a high DC resistance - over 10MΩ per square millimetre. However it has considerable capacitance and thus conducts AC with a decreasing impedance as the frequency increases.

The skin's impedance falls dramatically if it is wetted, especially with a conductive solution. Breaking or abrading the skin further lowers its impedance.

Finally the skin's impedance falls with increasing voltage, reaching almost zero at around 200V, when the skin's structure begins to break down.

The effects of electric shock

The main effects of electric shock are sensation, muscular action, cardiac arrhythmias, tissue cell damage, and burning. [*Table 1 - 2*]

The consequences of the shock will be determined by the shock's severity, its duration, and the path taken through the body by the current.

A shock which passes through the torso is likely to cause more harm than one which is restricted to a limb or a small area of the body's surface.

Sensation

Electric current stimulates sensory nerves. The effects of AC increase as the current increases.

Only the making or breaking of a DC current causes actual pain. An increasing sensation of warmth is felt for any steady current above 2mA.

Muscular action

Electric current stimulates motor nerves and muscle tissue, including the muscles of respiration and the heart, as well as skeletal muscles. This gives the risk of respiratory and cardiac disturbances, or even arrest, at all but the lowest current levels.

The effects of AC increase as the current increases.

DC causes significant muscular contraction only when the current is made or broken.

The violent muscular action caused by an electric shock can damage the muscles themselves, tendons, ligaments, or even bones. Also, sudden muscular action may cause accidents and further trauma.

Currents above 10mA AC and 300mA DC tend to inhibit normal muscular action and prevent 'let go' of an electrical contact held in the hand.

Cardiac arrhythmias

An electric current flowing through the heart may disturb or overwhelm the heart's normal electrical impulses.

Table 1 - 2 the effects of electric shock

The potential effects of an AC electric shock on different systems

Current	Sensation	Motor	Cardiac
0.5mA	Mild tingling	None detectable	None detectable
1mA	Tingling	Mild twitching	
2mA	Discomfort	Increasing twitching as current increases	
3mA	Pain		
10mA	Pain increases with increasing current	Spasms and the limit of 'let go'	Likelihood of arrhythmias, increasing as current and shock duration increase. Permanent damage is unlikely
15mA		Uncontrolled contractions	
35mA		Likelihood of total muscular tetanus and respiratory arrest increases with increasing current	
50mA			Likelihood of ventricular fibrillation for shock duration of over 1s.
above 50mA			Shock duration likely to cause ventricular fibrillation decreases as current increases
several A			Total contraction of myocardium, cardiac arrest

The effects of AC increase as the current increases, with a greater likelihood of disruption as shock duration increases.

With shock durations below 100ms, the probability of disruption is increased if the shock occurs during ventricular repolarisation (the T-wave of the ECG) - known as the *vulnerable period* of the cardiac cycle.

The effects of shocks from steady DC of less than 500mA are considerably less than those of an equivalent AC.

Currents of several Amps (AC or DC) for longer than 1 cardiac cycle tend to cause total contraction of the myocardium, and cardiac arrest. If significant tissue damage has not occurred, normal cardiac function may return following removal of the current. This phenomenon is known as *defibrillation*.

Cell damage

Tissue cell plasma membranes are electrical insulators (except to high frequency AC). Low levels of current - DC or low frequency AC - pass around the cells without harming them.

At currents above 100mA, the electric field developed around a cell draws water into the cell. This causes the cell's pores to expand. Continued drawing in of water will rupture the plasma membrane, damaging or destroying the cell. This effect is known as *electroporation*.

Electroporation is reversible for currents up to 200mA applied for less than 5s; above these levels, it may cause permanent damage.

Burning

Heat is produced when electric current flows through tissue.

Heating tissue to over 45°C for any length of time is likely to cause damage.

200mA passing for 5s can heat body tissue to 45°C. 500mA passing for 5s can heat body tissue to 70°C, causing severe damage.

Electrical burns are mainly caused by heat, but electroporation contributes to the damage at higher current levels. The majority of damage tends to occur in deep tissues, thus the full extent of an electrical burn may not become apparent until some time after the injury.

High voltage, high energy sources are capable of passing currents of many Amps through the body. The high voltage forces the current through all types of tissue, generating intense heat, evaporating water from the tissues, and resulting in almost total destruction of tissue along the current path.

Contact burns

The points of contact with an electrical source are common sites for skin tissue damage.

Effects vary from reddening at current densities of 10 - 20 mA/mm^2, through discoloration and blistering at 20 - 50 mA/mm^2, to actual tissue destruction at current densities above 50mA/mm^2.

Flash burns

An *electric arc* occurs whenever electric current jumps through air. This produces heat; the heat from a large arc will be sufficient to cause instantaneous burning of any nearby body tissue.

The intense light levels produced by large arcs may cause damage to the corneas or retinas of the eyes. Such injuries are known as *arc eye*.

Infectious Diseases

An *infectious disease* is one which may be communicated from one person to another.

Specific conditions are discussed with those systems which they most affect.

Infectious diseases are spread by micro-organisms (usually bacteria or viruses), produced in the body of a sufferer, which when entering the body of another, multiply such that the disease develops.

Modes of infection include:

Droplet. The infecting organism is passed in droplets of fluid, such as saliva or mucus.

Blood borne. The infecting organism is passed by blood transfusion, by direct blood contact, or on contaminated objects.

Contagion. The infecting organism is passed through direct body to body contact.

Dust borne. The infecting organism is carried in dust, or other solid matter.

Sexually transmitted. The infecting organism is passed by sexual contact.

Carrier borne. Another person, food or water, or an animal or insect, carries the infecting organism without actually becoming infected.

Infectious agents

Viruses

A *virus* is a micro-organism, about 100nm in size, consisting of a strand of DNA inside a protein membrane.

Viruses can only live and reproduce inside other living cells.

Bacteria

The term *bacteria* is often used to describe moulds, yeasts, and *Rickettsiae,* which are disease causing micro-organisms sized between viruses and bacteria, as well as true bacteria.

A true bacterium is a minute organism, usually single celled, and generally no more than 1µm across.

Bacteria may be grouped according to their shapes:

cocci are round, *streptococci* are cocci arranged in chains, *bacilli* are long slender rods, *spirilla* are curved or wavy.

Bacteria reproduce by expanding and then splitting in two. Under favourable growth conditions, this splitting may take only about 30 minutes.

Some bacteria produce spores which subsequently produce bacteria on being brought or carried into suitable growth conditions.

It must be noted that many bacteria are benevolent, and are essential for continuing life.

Poisons

A *poison* is any substance which when applied to the body, or introduced into it, can cause damage or even destroy life, by its own inherent qualities without acting mechanically.

The effects of poisoning depend very much on the amount poison absorbed, relative to the body weight. In small, controlled doses, some normally poisonous substances (atropine, for example) have potentially beneficial effects. Likewise, many substances (such as aspirin) which are classed as harmless or beneficial in normal use may have poisonous effects if taken in abnormally high quantities.

The action of many poisons on the body is complex, often affecting more than one organ or system, and may have consequences beyond the initial reactions. Damage may well result to organs such as the liver or kidneys through the toxic chemical action of the poison.

Poisons enter the body by four main routes:
by being swallowed,
by being inhaled,
by being absorbed through the skin,
by being injected.

Classifications of poisons

Poisons may be classified into four main groups:

Corrosives. These poisons react in a chemical manner with body tissue, such that they burn and destroy that with which they come into contact.

Examples include strong or concentrated acids, strong or concentrated alkalis, and other highly reactive substances.

Corrosive poisons tend to cause immediate pain and swelling at the points of contact, leading to burning and tissue destruction.

Irritants. These poisons aggravate the digestive system, particularly the stomach and bowels.

There are many examples, including many vegetable acids and salts, substances such as Arsenic, Lead, Copper Sulphate, Silver Nitrate, and parts or extracts from many plants.

Irritant poisoning usually results in vomiting, diarrhoea, with abdominal discomfort or pain, leading to hypovolaemic shock.

Narcotics. These poisons affect the central or peripheral nervous system, usually causing a reduction in sensation, bodily control, and the level of consciousness.

Examples include substances such as opiates, Potassium Cyanide, alcohols, and Carbon Monoxide (this also affects the ability of red blood cells to carry Oxygen).

Narcotic poisoning does not generally produce pain, but leads to dizziness, a loss of co-ordination, vision disturbances, and a falling level of consciousness.

Narcotico-irritants. These poisons initially have an irritant action upon the digestive system, and then act as narcotics.

Examples include phenol, strychnine, atropine, many plant parts or extracts and various fungi.

Narcotico-irritant poisoning initially causes vomiting, diarrhoea, and abdominal pain. It then leads on to delirium, maybe with convulsions, and eventual unconsciousness.