HUMAN BIOLOGY - MODULE
ANATOMY & PHYSIOLOGY
Student Manual

HLT42015  CERTIFICATE IV IN MASSAGE THERAPY
HLT52015  DIPLOMA OF REMEDIAL MASSAGE
HLTAAP002  Confirm physical health status
HLTMSG002  Assess client massage needs
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Assessment

Welcome to your Human Biology Module: Anatomy & Physiology Theory Manual. In this manual you will find details of the theory components of your subject which relate to assessments you will then be required to complete or answer.

Assessments play an important role. At Evolve College they are not pressured or designed to create stress. We implement assessments to support you in your learning. The assessments are a demonstration to you, and to us, that you have learned what is needed to ensure you complete your course with the readiness to work as a valued member of the industry. We structure the assessments in a way that supports you.

Depending on the subject, the type and number of assessments will vary, and may include theory assessments such as Multiple Choice, Short Answer, True/False questions; Matching Exercises; Assignments, Project Reports and practical assessments such as Role plays and Demonstrations.

Access your assessments via the Student Portal - Student Login on the bottom of the Homepage. Answers will only be accepted and recorded through the Student Portal.

Practical Assessment

This subject requires you to undertake several practical assessments. These will be in the form of role plays, demonstrations and clinical massage treatments and client assessments at Massage Practice 1.
1. Introduction to Human Biology

1.1 Definitions

**Anatomy & Physiology**

**ANATOMY** is the study of the structure of the body and the relationship between its various parts. Anatomy has a certain appeal because it is concrete and the body structures can be seen, felt and examined closely - it is purely a descriptive approach.

**PHYSIOLOGY** is the study of the function of the body and how the parts of the body work. Physiology is concerned with the functioning of normal vital processes in animal and plant organisms, including their biochemical composition and how drugs and disease affect them.

*Physiology reveals the dynamic nature of the workings of the living body and Anatomy provides the static image.*

**Complementarity of Structure and Function**

Although it is possible to study Anatomy and Physiology in isolation from one another, they are truly inseparable sciences because the function always reflects the structure. This is called the principle of complementarity. In studying Anatomy and Physiology, a description of the anatomy of a structure is often accompanied by an explanation of its function - what a structure can do depends on its specific form.

*The intimate relationship between anatomy and physiology is stressed throughout any textbook to make learning more meaningful. In all cases, a description of the anatomy of a structure is accompanied by an explanation of its function, emphasising the structural characteristics contributing to that function.*

For example:

Bones: A function (i.e. Physiology) of bones is that they are able to provide support and protection to body organs because their structure (i.e. Anatomy) contains hard mineral deposits.

Heart: A heart functions (i.e. Physiology) by pumping blood flow in one direction because its structure (i.e. Anatomy) contains valves that prevent the backflow of blood.

Lungs: The lungs function (i.e. Physiology) as a site for gas exchange because the structure (i.e. Anatomy) of the walls of their air sacs is extremely thin.
1.2 Fields of Study of Anatomy and Physiology

Anatomy:

Gross Anatomy

Often regarded as general anatomy, so far as it can be studied without the use of the microscope (i.e. body structures are visible to the naked eye); commonly used to denote the study of anatomy by dissection of a cadaver.

Systemic Anatomy

An approach to anatomical study organised by systems of the body, e.g. the cardiovascular system, emphasising an overview of the system throughout the body.

Regional Anatomy

The study of one particular region, part or division of the body (e.g. the foot or the groin region), emphasising the relationships of various systemic structures (e.g. muscles, nerves and arteries) within that area. Also referred to as topographic anatomy.

Surface Anatomy

The study of the configuration of the surface of the body, especially in its relation to deeper parts.

Microscopic Anatomy

The study of structures too small to be seen with the naked eye. The structure of cells, tissues and organs is studied with a light microscope.

Two categories of Microscopic Anatomy are:

- Histology: The science concerned with the minute structure of cells, tissues and organs in relation to their function.
- Cytology: The study of the anatomy, physiology, pathology and chemistry of the cell. Synonymous with Cellular Biology.

Developmental Anatomy

The study of the structural changes in an individual from conception through to old age; includes embryology, foetology and postnatal development.

Pathological Anatomy

The study of the structural changes in the body caused by disease including both the gross and microscopic analysis and interpretation of diseased organs and tissues removed by biopsy or during post-mortem examination and also the interpretation of the results of such study.

Radiographic Anatomy

The study of internal structures using x-ray images.
Physiology:

Physiology is also subdivided into several specialised areas. Common subdivisions of Physiology consider the operation of specific organ systems.

For example:

- Renal Physiology investigates urine production and kidney function
- Neurophysiology explains the workings of the nervous system
- Cardiac Physiology examines the operation of the heart

1.3 Characteristics of Life

What constitutes life? No single criterion defines it. Instead, characteristics of life consist of the following:

**Maintenance of boundaries:**
Keeping the internal environment distinct from the external environment

**Movement:**
The ability to transport the entire being, as well as internal components, throughout the body.

**Responsiveness:**
The ability to sense, monitor and respond to changes in the external environment.

**Conductivity:**
The movement of energy from one point to another.

**Growth:**
A normal increase in size and/or number of cells.

**Respiration:**
The absorption, transport and use or exchange of respiratory gases (oxygen and carbon dioxide).

**Digestion:**
The process by which food products are broken down into simple substances to be used by individual cells.

**Absorption:**
The transport and use of nutrients.

**Secretion:**
The production and delivery of specialised substances for diverse functions.

**Excretion:**
The removal of waste products.
Circulation:
The movement of fluids, nutrients, secretions and waste products from one area of the body to another.

Reproduction:
The formation of a new being, including the formation of new body cells to permit growth, repair and replacement.

Metabolism:
A chemical reaction that occurs in cells to effect transformation, production, or consumption of energy. Each characteristic of life is related to the sum of all the physical and chemical reactions that occur in the body. Physiology, or function, characterises life.

We can study form (structure) without life, for example through cadaver dissection; however, we can study physiology only in terms of living dynamics. This subject represents the study of life and the dynamic process of living.
1.4 Introduction to the Levels of Organisation in the Body

The human body incorporates many levels of structural complexity starting with the ATOM and continuing through to the ORGANISM itself.

**Level One - Chemical Level**

The simplest level of the structural ladder is the chemical level, which we will study in Lesson 2. At this level, atoms, tiny building blocks of matter, combine to form molecules such as water, sugar and proteins. Molecules, in turn, associate in specific ways to form microscopic cells, the smallest units of all living things.

**Level Two - Cellular Level**

The cellular level is examined in Lesson 3. Individual cells vary widely in size and shape, reflecting their particular functions in the body.

**Level Three - Tissue Level**

The simplest living creatures are composed of single cells, but in complex organisms like human beings, the structural ladder continues on to the tissue level. Tissues consist of groups of similar cells that have a common function. As we will discuss in Lesson 4, each of the four basic tissue types plays a definite but different role in the body.
Level Four - Organ Level

An organ is a structure, composed of two or more tissue types, that performs a specific function for the body. At the organ level of organisation, discussed in Lesson 5, extremely complex functions become possible. For example, the stomach, which digests and absorbs food, is composed of all four tissue types.

Refer to diagram above showing the stomach and digestive system as the example.

Level Five - Organ System Level

All the body's organs are grouped so that a number of organ systems are formed. An organ system is a group of organs that cooperate to accomplish a common purpose. For example, the digestive system includes the oesophagus, the stomach and the small and large intestines (to name a few of its organs). Each organ has its own job to do and, working together, they keep food moving through the digestive system so that it is properly broken down and absorbed into the blood, providing fuel for all the body’s cells.

Level Six - Organism Level

In all, 12 organ systems make up the living body, or the organism, which represents the highest level of structural organisation, the organism level. This is discussed in Lesson 6.
2. Body Chemicals

Chemical Level (Level One)

Chemicals

Our body needs energy to function, this energy is provided by the food we eat but it has to change form before it can be utilised as an energy force. Chemicals present in food form the basis of this energy. They have to be combined with other chemicals, as well as being broken into smaller chemical structures to allow absorption to take place in the body.

These chemicals must remain in a state of balance or homeostasis.

Homeostasis

Our body cells survive and thrive in a healthy condition only when the temperature, pressure and chemical composition of their fluid environment remains relatively constant. The overall structure of our body does not change noticeably from moment to moment. When you go to bed at night, unless major trauma has occurred, your body looks pretty much the same as it did when you wake up. This consistency is due to the constant balancing activities of our physiology.

Homeostasis is the relatively constant state maintained by the physiology of the body. We have our own regulatory mechanisms that constantly adjust and adapt to keep the temperature and chemical composition in balance in the fluid environment contained inside our skin. When this balance is interrupted, homeostasis is altered and the body is more susceptible to a disease process.

Chemical Elements

We need to digress here for a moment and cover some basic chemistry. In our bodies and in the universe for that matter, all substances have a chemical form whether it is liquid, gaseous or solid. These chemicals are classified into elements. There are roughly 106 of these known at the moment but many more may be discovered in the future. Ninety two of these elements occur naturally and 24 of these are found in the human body. The human body is also capable of synthesising other chemical elements out of the chemicals it absorbs.

These chemical elements are like bricks in a house, they are the units that build our body. Each element can be broken down into a smaller unit called an atom.

Each element is made up of atoms. When atoms combine we have a molecule (a larger structure). Chemical compounds are made up of molecules that have two different atoms – e.g. sodium chloride.

To create energy in our body atoms combine or separate and in this sense a chemical reaction is said to have occurred. It is this chemical reaction that is the actual beginning of all the life processes as vital energy is released or stored. Two important energy forms in our body are adenosine triphosphate (ATP) and adenosine di-phosphate (ADP), they enable the cell to carry on its activities – e.g. the resident "battery" in the cell. ATP provides us with an immediate source of energy to run our body machinery.

The body is really a thriving mass of energy. It's either breaking apart chemical compounds to give us instant energy or, its digesting and absorbing food for stored energy. Whichever one is occurring it is an energy reaction. If this energy reaction fails we become ill.
In Chinese medicine and the study of acupuncture, attention is paid to this energy force, as acupuncture points occur on the meridian/energy pathway.

Medical physicists in the western world are at last starting to pay more attention to these concepts. Discrediting anything that can’t be seen, heard, felt or touched has been a major tenant of conventional (allopathic) medicine for the past 200 years. It may be that the scientific reductionism of medicine is beginning to lose power.

**Chemical elements in the Human Body**

The major chemical elements in the human body are carbon, oxygen, hydrogen and nitrogen with the most abundant being oxygen. These four elements make up 96% of body weight. The food we eat finishes up as these chemicals. Interesting thought isn’t it? 3% of the body is occupied by the chemical elements phosphorus and calcium and they are found mainly in the bones. 1% of chemical elements in the body are made up of trace elements, such as sodium, copper, magnesium etc. Our body is made up largely of water and these dissolved chemical elements vital to our survival.

**Water**

Water itself is an important chemical in the body. It is the most abundant chemical and found in all cells, with the smallest amount being in the teeth and bones.

Take for example the cell and the cell membrane that separates the watery substance inside the cell from the watery substances outside the cell. 60% of red blood cells are made of water, 92% of plasma is made of water, 75% of muscle tissue is made up of water.

Water is a great solvent. It dissolves chemicals allowing the breaking apart of the molecules with new chemical combinations then occurring. It assists in the transportation of oxygen and carbon dioxide in the blood. Water carries out wastes in urine, faeces and in perspiration. Water is used in the synthesis or storage of energy and in the decomposition process which liberates energy for our use. Water also serves as lubrication.

It is easy to see how vital water is to our body and how dangerous dehydration can be. Dehydration results in an inability to dissolve chemicals adequately, an inability to get rid of waste products; store energy or make energy available for use in the body. Water is an extremely important part of our daily intake for our health’s sake.

The most important property of water is that it forms a medium in which chemical reactions occur. Chemical reactions cause changes, thereby creating a charge which produces energy.

**Chemical Reactions (Changes = Charge)**

**Anabolism**

This is the combination of atoms or molecules to form new or larger molecules from the food we take into our bodies. This synthesis or changing reaction provides energy which is stored in the body for future use. For example, when we drink juice, the glucose molecules, may be converted by the body
into a new substance called glycogen. Glycogen is stored in the liver and the muscle for future energy requirements. The process of anabolism is going on all the time and is vital to our life processes.

**Catabolism**

This is the reverse of anabolism. Catabolism occurs when we break down the larger substances into smaller parts, e.g. a bowl of pasta consists of complex carbohydrate molecules that can be broken down into smaller molecules called monosaccharides. These monosaccharides are the molecules that can be utilised by the body. Digestion is a catabolic process and so is burning up of stored food molecules for energy use.

**Anabolism + Catabolism = Metabolism**

**Metabolism**

The physiologic process that converts food and air into energy is called metabolism.

Metabolism is equivalent to the sum of the anabolic and catabolic processes. Differences in metabolic rate occur and if this is the case then symptoms of one process overtaking the other will appear.

For example:

A high metabolic rate, often due to an overactive thyroid gland will create large amounts of energy being used up in the body. This excessive catabolic process results in the symptom of weight loss and a speeding up of all bodily processes including:

- appetite increases despite weight loss
- increased movements of the digestive tract, i.e. diarrhoea
- increased heart and respiratory rates
- high blood pressure
- marked muscular tremor and nervousness
- excitable and apprehensive emotional states
- protrusion of eyeballs

Conversely, if an excess of anabolic processes occurs, governed by a dysfunction of the thyroid gland, the person will have a tendency to be plumper, slower and have less energy. A slowing down of all bodily processes occurs including:

- reduced appetite and weight gain
- sluggish gut movements, i.e. constipation
- reduced heart, respiratory rate and blood pressure
- slow thought processes, e.g. lethargy
- thickening and puffiness of the skin
- dry, brittle and loss of hair

Energy is involved whenever the bonds between the atoms in the molecules are formed or broken down, so anabolism needs energy to take place and catabolism re-releases energy into the body when it takes place. This concept of energy is a constant theme in the body’s vital processes.

Anabolism:  \[ \text{Sodium} + \text{Chloride} + \text{ENERGY} = \text{Sodium Chloride} \]

Catabolism:  \[ \text{Sodium Chloride} = \text{Sodium} + \text{Chloride} + \text{ENERGY} \]
Chemical Compounds

There are two classes of compounds in the body:
1. Organic Compounds
2. Inorganic Compounds

Organic Compounds

Organic compounds contain the element carbon and are derived from the food stuffs we eat. They are divided into the following groups.

1. Carbohydrates

The sugars and starches. They are the most readily available form of energy and they are stored in the liver and skeletal muscles in the form of glycogen which is synthesized from glucose. Glucose is the body’s major quick energy source. Carbohydrates are broken down into monosaccharides then into glucose then glycogen.

2. Fats or Lipids

Are substances derived from the food we eat, they are insoluble in water and are therefore more complex to digest. The molecules of fat are held together by hydrogen bonds that come in three combinations

- saturated fats
- unsaturated fats
- polyunsaturated fats

This classification is based on the number of hydrogen atoms present in the molecule. The polyunsaturated fat molecules have the least number of hydrogen atoms and the saturated fat molecules have the highest number. This is of interest to us because hydrogen is a substance that once broken down in the body leaves acidic waste which the body has to work hard to eliminate. The other concern is that these molecules usually occur in foods that are already high in cholesterol molecules. The combination of these two (the saturated fats and the cholesterol) leads to waste building up on the walls of arteries. This can lead to high blood pressure and the increased potential for a heart attack and/or stroke. There is evidence that both our genetic background and our level of exercise can influence the use of saturated fats and cholesterol in the body.

Fats are a good source of energy but not as efficient in their usage by the body as carbohydrates. If the body runs out of a carbohydrate for energy it will use fats. If a person wants to lose weight they will be eating into their fat storage provided they cut down their carbohydrate intake. But a person relying on stored fats only as a source of energy will show symptoms of high acid build-up in the blood. This can be smelt on the breath and can be detected in the urine as ketone bodies.

The build-up of waste leads to hardening of the arteries known as Atherosclerosis. High blood pressure and tobacco smoking along with high blood cholesterol has created a No.1 killer in Western civilisation.
Ketone bodies are the waste products of fatty acids and glycerol, which are the absorbable substances from our fat intake.

**Diabetes** occurs when carbohydrates are unable to be utilised by the body and fats are then burnt up as a source of energy. This is detrimental to the person’s health and in diabetics can lead to severe symptoms including coma. A coma can occur because the body has high levels of acidic waste from the inappropriate burning of fats and because the brain is unable to function without glucose.

3. **Proteins**

Proteins are the building blocks of the body. Just as the final unit to be absorbed for carbohydrates is glucose, for fats it is fatty acids and glycerol, for proteins it is amino acids. There are 20 amino acids that we know of and they are responsible for maintaining the structure of the body. They maintain the structure of the organs because of their contribution to muscle build up. They also maintain production of hormones and the manufacture of enzymes and anti-bodies.

Proteins are not a source of energy, proteins make up the hormones and enzymes units that keep the body moving and without which we would be at risk of infection and illness.

**Interactive question:**

1. List the final units to be absorbed for each of the organic compounds discussed:

   - Carbohydrates - _____________________________
   - Fats or Lipids - ____________________________
   - Protein - __________________________________

**Inorganic Compounds**

Inorganic compounds contain no carbon; they include the mineral salts, acid and alkaline bases and water. Inorganic compounds are found in our food and they **readily dissolve in water** to form **electrolytes**. This is one of the key characteristics of inorganic compounds. These molecules become ionised and are then capable of carrying an electric charge. This is very similar to a car battery. The ions of the salts are the source of many essential chemical elements. They could not be used by the body if they were not ionised, in fact, they would be fatal if they circulated in the blood in an un-ionised form. Electrolytes are found in all cells and extra-cellular spaces of the body. They can carry a positive or negative charge.

Positively charged ions are cations, negatively charged ions are anions. These charges are significant because different charges are attracted to each other for interaction and combination for special purpose. For example, nerve tissue relies on precise amounts of potassium and sodium for the impulse to be passed along the axon. If the potassium and sodium are not ionised then the nerve impulse would not pass along.

So in a way the electrolytes are the starters of our body, they are the things that keep the energy maintained in our body and then interact with other chemicals to keep all the body processes happening, to keep energy flowing throughout the body, to enable energy to be built up and stored, to enable energy to be released. For example, calcium ions found in muscle tissue combine with ATP from the mitochondria and with amino acids for muscle activity and muscle repair. Our body is like a chemical factory and the importance of keeping the chemicals in absolute balance is vital to our health.

*Like salts, acids and bases are electrolytes. That is, they ionise and then dissolve in water and conduct an electrical charge.*
There are many sports drinks on the market which contain electrolytes which replenish the body's loss of ions due to physical exercise.

Acid/ Base Balance (the concept of pH)

In order to describe the nature of the different types of chemicals and fluids in our body, we use a concept known as pH. This measures the degree of acidity and alkalinity with a measure of the proportion of anions and cations present in a substance. This can be determined by tests; at its most simple is the litmus paper test. Our body is very sensitive to minute changes in the acid/base balance.

A scale from zero to fourteen is used to measure pH - the level of acidity and alkalinity. Values below 7 are considered acidic while values above 7 are considered alkaline. For example, gastric juice, is very acidic, usually between 1.2 to 3 compared to lime water which is very alkaline, at around 12.3. Blood which is slightly alkaline is 7.35 to 7.45, with pure distilled water being 7.0.

This balance of acids and alkaline must be maintained in our bodies so the blood can remain exactly within this range of 7.35 to 7.45. If the blood becomes too alkaline or too acid, then symptoms of illness will appear.

Our body is very sensitive to subtle changes in pH. The body has a complex buffer system which acts like a big sponge using counter chemicals to soak up the chemical imbalances and correct the problem. Weak acids or weak alkalines soak up the oversupply to strong alkalines or strong acids.

The most important of these is the carbonic acid found in the interstitial fluid (the spaces outside the cells). Little is known about the exact origin of these buffer systems. But we know from other buffer systems that they send out chemicals that soak up excessive acidity or alkalinity.

If acid levels rise, we talk about a state of acidosis. Diabetic coma is a good example of this. In this condition, fats are being burnt up inappropriately for energy and eventually the acid level in the blood rises. The excess acids in the form of ketones circulating in the bloodstream combined with the lack of carbohydrates for nourishment in the brain, can lead to a coma.

On the other hand, alkalosis is a state where there is a predominance of alkaline substances in the blood. A good example is hyper-ventilation where the person has actually breathed off more carbon dioxide than is necessary and a state of alkalosis exists. Breathing into a paper bag is a well-known remedy for alkalosis.

An acid could be defined as a substance that has more hydrogen ions than its counterpart. An alkaline has more hydroxyl ions, which are more alkaline. The ions of the salts are found throughout the body and these are the source of many essential chemical compounds that keep our body going but they must remain in balance.

Heat Production

Our body always has some degree of muscle activity occurring; even when we are sitting still muscle activity occurs to keep our posture. The outcome of this muscle activity is heat and this heat plays a vital role in keeping the body’s temperature stable. So a vital role in homeostasis is played by heat production from muscle activity. It is necessary for us to understand how this heat is produced by muscle activity.

Following is an example:
If we do some exercise we need fuel, the cell will release glycogen, turn it into glucose and it will be used by the muscles to give energy. This will then give a waste product from the oxidation of the glucose called pyruvic acid, this combines with other cellular chemicals and we have heat produced. Chemicals combine to give us energy; heat is produced as a result of this activity.
3. Cellular Level (Level Two)

Cellular Level (Level Two)

Molecules, in turn, associate in very specific ways to form cells, the living structural and functional units of an organism.

Cells

This lesson is one of the more abstract in the course. But it is important you understand the microscopic structures in our bodies. Without this understanding you will not be able to conceive of activities like metabolism and absorption and conservation of energy for future use. It is very exciting to study cells, the information that has been collected together about their function is quite considerable.

Scientists originally assumed the basic organisation of an organism were the visible structures such as the legs, heart, lungs, etc. The cell is now known to be the basic subunit of any living organism. It is the simplest unit that can exist as an independent living system.

There are billions and billions of cells in our body that are all working intricately in a programmed manner every day for our well being. Cells are like little protein factories that determine the growth and direction of our bodies.

A cell is the basic structural unit of an organism and is also the primary functional unit with properties that reflect the characteristics of life. Cells reproduce by cell division. They are surrounded by a dilute saltwater solution called interstitial fluid. Cells are self-regulating, which allows them to adjust to constant changes and to interact with their surroundings. The specific activities of any organism depend on the individual and collective activities of the cells.

Cells change size in response to hormones, nutrient availability and changes in their function. Atrophy is a decrease in the size of a cell; hypertrophy is an increase in the size of a cell. Muscle cells in particular can adapt their size to their function. Hypertrophy most often occurs when a person is continually using muscle cells, such as in weight training; atrophy occurs in underused muscle cells, such as when a muscle is immobilised so that a broken bone can heal.

Cell Theory

The cell theory states that:

- all living organisms are composed of cells
- the life of a new organism begins with a single cell
- organisms develop by creating new cells

There are four concepts to consider regarding cells:

1. A cell is the basic structural and functional unit of living organisms.
2. The activity of an organism is dependent on both INDIVIDUAL and COLLECTIVE activity of its cells.
3. Structure of a cell determines its function.
4. Continuity of life has a cellular basis.
Basic Model of a Cell

Shown is a basic model of a cell consisting of:
1. Cell Membrane
2. Cytoplasm
3. Nucleus

Every cell is not exactly like this but this cell combines the three basic features of all cells and it is the cell that is the basis of this lesson.

Cell Membrane (also called Plasma Membrane)

This is a membrane that separates cells from each other and from the fluid that surrounds cells. The most plentiful substance composing most cell membranes is protein. The cell membrane allows substances to pass through it by processes of osmosis, diffusion and filtration. Cells are actually bathed in fluid (Interstitial Fluid) and the plasma membrane is also made up of cells. So everything is made up of cells. You can imagine how small the cells are in the plasma membrane when you think the plasma membrane itself is part of a microscopic structure.

Cytoplasm

Cytoplasm is the liquid inside the cells. It is like a soup with all sorts of ingredients floating around in it. It is within the ‘soup’ that all the chemical activity of the body takes place, the movement of nutrients and wastes and the exchange of gases (carbon dioxide and oxygen). Cytoplasm is 75 % to 90% water. In the cytoplasm we find proteins, carbohydrates, fats and mineral salts.

Nucleus

This is generally spherical or oval shaped and contains the structures that control the body's activities and is referred to as the ‘brains’ of the cell. The DNA (Deoxyribonucleic Acid) and the RNA (Ribonucleic Acid) structures are composed of protein. Genes are found in the DNA molecules and within this substance there is specific genetic material that is used to program cells around reproduction and repair.

- It is the DNA that carries our inherited genetic material.
- Chromosome strands are a part of DNA protein, within these are located the genes.
- The RNA structure assumes a role in protein manufacture. This is necessary because proteins are used in our body in many forms and must be synthesised to meet the needs of the body such as hormones, enzymes and muscle tissue.

Cells need to be replaced and this process is going on all the time. Each cell has a special program so that it will divide and reproduce itself exactly so that the next cell will carry on in the same manner as the parent cell. If this were not the case we would not continue to maintain our uniqueness. We all have programming within our genes to reproduce our particular eyes, nose, cheek shape, the skin colour, the amount of hair on our face etc. All these programmes are in the genes and they keep repeating themselves over and over again. If this were not the case we would change the way we look
all the time. I could finish up with a nose that looks like yours or you might finish up with hair the same colour as me or your next door neighbour.

Cells are repairing all the time. The skin or any tissue in our body does not remain static, it is reproduced constantly so we always have fresh tissue occurring in our body from the constant activity of the cells dividing and replacing themselves. This is an extraordinary activity when you think about it; it happens all the time right throughout our life. If it did not happen we would wear out. It is something that goes on without us even thinking about it.

**Specialisation of Function**

No matter what a cell does or where it is located in the body, its basic maintenance functions are the same. These are nutrition, metabolism, respiration, excretion, organisation and irritability.

When a cell needs to adapt to perform specialised duties, the structure of the cell and in turn some of the specialised functions are modified; this form of specialisation is referred to as cell differentiation. For example, fat cells are modified to store energy, but they have lost the functions of contraction and secretion. Muscle cells have well-developed functions of contractility but diminished functions of secretion and reproduction. Cells that specialise in certain functions form tissues. As mentioned earlier, disease usually appears when cellular homeostasis (internal balance) has been lost.

*Even at a cellular level, complementarity of structure and function exists, i.e. the structure and form of a cell is closely related to its function.*

Let’s look at some examples:

**Secretory Cell**

Nucleus is displaced to the base by the formed and stored secretion. As a result, it has highly developed powers of secretion, e.g. Enzymes for chemical breakdown of foodstuffs. However, it has diminished powers of contraction and reproduction.

**Fat Cell**

Cytoplasm is displaced by the stored fat. As a result, it has the specialised function of storage of fat. However, it has loss of powers of contraction and secretion.

**Muscle Cell**

Has an elongated cell body. As a result, it has highly developed powers of contractility. However, it has diminished powers of secretion and reproduction.

**Nerve Cell**

Cytoplasm is drawn out into long branching processes. As a result, it has highly developed powers of irritability.
However, there is loss of powers of reproduction, i.e. if a nerve cell is destroyed limited regeneration is possible.

As can be seen from the above examples, cells vary in:

1. Size
2. Shape
3. Length
4. Function

**Cell Structure**

Let’s now look at the structure of a cell in more detail.

**Organelles**

Organelles, detailed shortly, are special bodies floating around in the cytoplasm, like peas floating around in soup. Typically, the cytoplasm contains about nine types of organelles including the nucleus. Each type of organelle is “engineered” to carry out a specific function for the cell as a whole; some synthesise proteins, others package those proteins and so on.

Inclusions, discussed later, are not a functioning unit, but instead are chemical substances that may or may not be present, depending on the specific cell type.

1. **The Nucleus**

The nucleus is rich in RNA. Refer to above for further details.

2. **The Golgi Complex/Apparatus**

This is a small structure that sits near the nucleus. Its function is to dispense proteins as they are required by other cells, packaging them and releasing them from the Cytoplasm, so they move through the cell membrane and into the bloodstream and on to areas of the body.

An example of this is a protein required for hormone manufacture by the Thyroid gland. A chemical message is sent out around the body that a protein is needed for this acidity, the Cell releases the protein after it has been synthesised by the RNA molecule. The Golgi complex packages it and sends it off into the bloodstream to its destination. This is quite a remarkable activity for such a small structure. The Golgi complex is also involved in fat and carbohydrate metabolism.

3. **The Mitochondria**

The mitochondria are the powerhouses of the cell. They are extremely important and contain a chemical called Adenosine Tri Phosphate, or A.T.P, which is a form of stored energy and will be used for later activity by the cell. There are many Mitochondria in muscle cells and in the liver cells because these are areas of high activity.
4. **Lysosomes**

Lysosomes are enzyme substances that live in the cells and they have the charter of cleaning up the cell. They enclose any debris in the cell, package it up and push it out through the plasma membrane for waste product disposal. They also help break down cells following cell reproduction and cell death.

5. **Centrioles**

These are structures involved in reproduction. They also have a role in propelling substances across a cell's surface through projections called cilia.

6. **Ribosomes**

These are small, dark-staining granules surrounded by a membrane and containing ribosomes (RNA = ribonucleic acid). The assembly of amino acids occur on the ribosomes thus making ribosomes the sites of protein synthesis.

7. **Endoplasmic Reticulum**

Endoplasmic Reticulum is an extensive system of fluid-filled tubes that coil and twist through the cytoplasm. It accounts for about half of a cell's membranes. It serves as a mini-circulatory system for the cell because it provides a network of channels for carrying substances or material (primarily proteins) from one part of the cell to another.

8. **Peroxisomes**

Peroxisomes are membranous sacs containing powerful enzymes that use oxygen to detoxify a number of harmful or poisonous substances, including alcohol and formaldehyde. However, their most important function is to "disarm" dangerous **free radicals**.

   *Free radicals are highly reactive chemicals that scramble the structure of proteins and nucleic acids. Although free radicals are normal by-products of cellular metabolism, if allowed to accumulate, they can have devastating effects on cells and therefore the body.*

Peroxisomes convert free radicals to hydrogen peroxide, a function indicated in their naming (peroxisomes = peroxide bodies). The enzyme catalase then converts excess hydrogen peroxide to water. Peroxisomes are especially numerous in the liver and kidney cells, which are very active in detoxification.

9. **Cytoskeleton**

Cytoskeleton is an elaborate network of protein structures which extends throughout the cytoplasm. This acts as the cell's "bones and muscles" by creating an internal framework that determines cell shape, supports other organelles and provides the machinery needed for intracellular transport and various types of movements.

It is clear that the Organelles are important in the cell. They direct the nature for the particular cell and thus direct the structure of the organ. It is on the Organelles, particularly the Nucleus that much scientific focus has been directed.

We are able to see the DNA molecule microscopically.

Shown is an interpretation of the DNA molecule with the Helix strands, its engineering, meaning they are able to lift off unwanted genes from the DNA Molecule and replace them with other more desirable genes.
Inclusions

These are bodies found in the cell, the identity of which would depend on the particular activity of the cell. Most inclusions are stored nutrients or cell products.

Examples are:

- **Calcium** and **phosphorus** will be found in large quantities in bone cells but not so in nerve cells.
- **Glycogen** will be found in muscle and liver cells but Glycogen will not be found in skin cells.
- **Fat** droplets are common in fat cells of the subcutaneous tissue below the skin, but would not be found in liver cells.
- **Melanin** is seen in the skin and hair cells, but not so in stomach cells.

Inclusions will change at certain stages in life for example puberty and menopause. Dietary changes will also affect inclusions. If a person has an inadequate diet then the number of specialised inclusions will be below the required level and a symptom of this will occur, e.g. Osteoporosis from low levels of calcium.

Below are the common structural and functional features of a generalized cell as discussed above.
Cell Activities

The spaces outside the cell that are filled with water are called the extra cellular spaces; these spaces contain interstitial fluid substances related to the cells activities. There will be substances outside the cell that are in transport either into the cell or they have just come out of the cell, e.g. nutrients, wastes etc. Anything that the cell produces will be transported to its destination by the Blood or the Lymph. Lymph itself is originally blood and as it changes to Lymph the Red blood cells come out of it. So Lymph is really a Plasma type substance.

Cell Division

The worn out cells must be reproduced. Cells normally have a life of 4 months. The nucleus knows this and it starts to divide, this is called Mitosis. Each cell divides so that it has the same type and number of chromosomes to enable it to carry on exactly the same function in the future. Each cell reproduces itself exactly otherwise we would finish up changing appearances all the time.

- The longitudinal halving of chromosomes and genes ensures that each new cell receives the same hereditary factors as the original cell.
- The number of chromosomes is constant for any one species.
- The cells of the human body carry 23 pairs, i.e. 46 chromosomes.

Cell Damage

Cells are also repaired by the DNA Molecule. If we cut or bruise ourselves, the DNA Molecule knows exactly how to repair this cell because it has the genetic blueprint. The cell will never change in character unless it becomes ill and mutation occurs. One form of mutation is excess growth of the cell – a tumor.

Target Cells

These have special receptors that will attract and absorb a particular hormone or enzyme. Once absorbed the cell will perform a certain way.

A good example of this is insulin, not every cell has a special receptor for this. Once insulin is manufactured it circulates throughout the body and is taken up by only the cells that need it, e.g. the bone cells don’t want to store glucose, liver cells do. The liver cells will have a particular receptor that will be tuned into insulin, so once the blood gets to the site the receptors are activated and the glucose is drawn in through the plasma membrane.

Exchange of Gases

Within the cytoplasm many chemical reactions occur and one in particular is that the cell will take up oxygen. This enables chemical changes to occur in the cell, as a result waste products occur, namely carbon dioxide. It is then taken out into the blood for transport out of the body. This is called exchange of gases. Oxygen is a gas and carbon dioxide is a gas. Every cell in the body must utilise oxygen or it dies. Oxygen undergoes chemical changes in the cell to give the cell energy. The waste product of this process is carbon dioxide.
Viruses

We will mention viruses here because they are in the news a lot. A virus will enter the cell and actually change the way it functions. The cell can't deal with the virus and it becomes weakened in its function. Symptoms often result - people who have weakened immune systems often have a virus in their cells. Many viruses are thought to be carcinogenic. In some cases viruses affect Lysosome production (the cleaners of the cell).

Basic Constituents of a Cell

Let's now look at the basic constituents of a cell. It will help if we can include some of the information covered in the previous lesson on Chemicals.

Firstly, all cells are composed entirely of chemical substances called Protoplasm.

Protoplasm is made up of certain ELEMENTS in CHEMICAL COMBINATION.

As discussed earlier, the four major chemical elements in the human body (making up 96% of body weight) are:

- Hydrogen (H)
- Oxygen (O)
- Carbon (C)
- Nitrogen (N)

Hydrogen + Oxygen = Water (H2O)

- Combining one oxygen atom with two hydrogen atoms gives you water (H2O).

Carbon + Hydrogen + Oxygen = Carbohydrates & Fats (CHO)

- C, H and O combine chemically to form carbohydrates and fats.
- These are the chief sources of energy in the living cell.

Carbohydrates (CHO)

- The simpler ones are SUGARS.
- The more complex ones are STARCH, made up of hundreds of units of sugar tied chemically together.

Fats (CHO)

- The fat molecule is made up of smaller molecules of FATTY ACIDS linked chemically with a molecule of GLYCEROL.

Carbon + Hydrogen + Oxygen + Nitrogen = Protein (CHON)

- C, H, O and N combine to form proteins
- protein is the chief organic constituent and the main building constituent of all cells
- the molecule is made up of smaller units called AMINO ACIDS
- as well as C, H, O and N, they sometimes contain S (sulphur) and P (phosphorus)
- There are thousands of different kinds of Protein but only about 20 different amino acids.
- The differences between proteins depend on the amino acids present and on their number and arrangement.

The following eight elements make up much of the remaining body weight (over 3%):
Calcium (Ca) and Phosphorus (P)
Important constituents of blood and of hard tissues, e.g. Bones and teeth

Chlorine (Cl) and Sodium (Na)
Important constituents of body fluids.

Sulphur (S)

Magnesium (Mg)
Important for activity of the brain, nerves and muscles.

Iron (Fe)
Trace elements, such as Manganese, Copper, Iodine, Zinc, Cobalt, Fluorine and Strontium make up the remaining body weight (less than 1%).

Please Note:
Apart from WATER, the chief constituents in both plant and animal cells, are present as compounds of CARBON, i.e. they are ORGANIC SUBSTANCES.
4. Tissue Level (Level Three)

As can be seen from the examples of different cells in the previous lesson, cells of one tissue will differ from those of other tissues, depending on the specialised function they perform (in accordance with their modified structure).

As a result, different cell types are not mixed haphazardly in the body. Groups of similar cells that have a common function (i.e. cells which are alike) combine to create tissues.

Tissues are the basis of the organs in our body. There are four main types of tissue classifications:

1. **Epithelial** think of the word *Covering*
2. **Connective Tissue** think of the word *Support*
3. **Muscular Tissue** think of the word *Movement*
4. **Nervous Tissue** think of the word *Control*

1. **Epithelial Tissue**

   - Consists of a sheet of cells that covers the body surface (and therefore forms part of the skin).
   - It lines body cavities, such as the gastro-intestinal system including the mouth, anus and vagina.
   - Epithelium forms the boundaries between different environments, e.g. epidermis of the skin lies between the inside and outside of the body, epithelium lining of the bladder separates the bladder wall from urine.
   - Nearly all substances received or given off by the body must pass through an epithelium.
   - It also forms glands such as the thyroid gland and the adrenal glands.

Epithelial tissue can be single or multilayered. The thickness depends on the amount of wear and tear on that part of the body, so the epithelial tissue of the skin will have many more layers of cells than the epithelial tissue in the small intestine.

Epithelial Tissue has the capacity to **absorb, secrete, filter** and **protect**. Thus our skin is able to absorb many substances. The secretory ability of the epithelial tissue is important for glands like the thyroid gland that is able to secrete thyroxine straight into the bloodstream.

Because they endure a considerable amount of wear and tear, epithelial cells reproduce actively. If a person is suffering from stress overload or any homeostatic imbalance, the condition often is first seen in the epithelial tissues because of the fast turnover of cells.

Typically, little matrix material is found in epithelial tissues. The matrix present tends to form continuous sheets of cells, with the cells held closely together. The surface of most epithelial tissue is not in contact with other tissues but rather is exposed to the external or internal environment. This surface is the **apical surface**. The other surface faces the inside of the body and is known as the **basal surface**. A permeable, thin **basement membrane** attaches epithelial tissues to the underlying **connective tissues**. Because epithelial tissues contain no blood vessels, they must obtain oxygen and other nutrients by diffusion from capillaries in the connective tissue.

The epithelial tissues make up three types of membranes, each formed with epithelial tissue on the surface and a specialised connective tissue layer underneath. A membrane is a thin, sheet-like layer of tissue that covers a cell, an organ, or a structure; that lines tubes or cavities; or that divides and separates one part from another. The three types of membranes are as follows:
Cutaneous membranes cover the surface of the body, which is exposed to the external environment. The largest cutaneous membrane, more commonly known as our skin, accounts for about 16% of our body weight.

Serous membranes line body cavities not open to the external environment and cover many of the organs. These membranes secrete a thin, watery fluid that lubricates organs to reduce friction as they rub against one another and against the walls of the cavities. Serous membranes line the peritoneal, pleural and pericardial cavities.

Mucous membranes are found on the surface of tubes that open directly to the exterior, such as those lining the respiratory, digestive, urinary and reproductive tracts. The film of mucus secreted by these membranes coats and protects the underlying cells.

2. Connective Tissue

Connective tissue is the most abundant tissue in the body and is the most widely distributed of the four primary types of tissue. Connective tissue is specialised to support and hold together the body and its parts, transport substances through the body and protect the body from foreign substances.

All forms of connective tissue are made of matrix, fibres and cells. The properties of the connective tissue cells and the composition and arrangement of the matrix elements account for the amazing diversity of connective tissues.

Connective tissue cells often are spaced far apart and the space between cells is filled with large amounts of nonliving matrix. Within the matrix of connective tissue is a shapeless ground substance containing molecules that expand when combined with electrolytes and water molecules. The matrix of connective tissue may be 90% ground substance. The remainder is made up mainly of one or more of the following fibres:

Collagen fibres

Collagen fibres are tough and strong and have minimal stretch capability. They have a high degree of tensile strength, which allows them to withstand longitudinal stress. These fibres occur in bundles. Because of their colour, they are referred to as white fibres. Collagen makes up more than one quarter of the protein in the body. As we age, the molecular structure of collagen changes, which accounts for the appearance of changes in our tissues. Scar tissue has a high concentration of collagen fibres.

Reticular fibres

Reticular fibres are delicate fibres found in networks that support small structures such as capillaries, nerve fibres and the basement membrane. These fibres are made of a form of collagen called reticulin.

Elastic fibres

Elastic fibres are extensible and elastic. Found in the stretchy tissues, they are made from a protein called elastin, which has the ability to return to its original length, much like an elastic band does after being stretched. Because of their colour, these fibres are called yellow fibres.
Connective Tissue Cell Types

Each major type of connective tissue has a fundamental cell type that secretes the matrix and fibres:

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Matrix and Fibres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibroblast</td>
<td>Connective Tissue</td>
</tr>
<tr>
<td>Chondroblast</td>
<td>Cartilage</td>
</tr>
<tr>
<td>Osteoblast</td>
<td>Bone</td>
</tr>
<tr>
<td>Hemocytoblast (Haematopoietic stem cell)</td>
<td>Blood</td>
</tr>
</tbody>
</table>

A watery ground substance creates a fluid connective tissue such as blood. By changing the proportion of collagen and elastic and reticular fibres, the tissue can be made as tough as tendons or as flexible as the tissue that covers muscles. Calcium salts added to the ground substance make the tissue become rigid, such as bone.

Connective tissue can be manipulated by application of heat, cold, stretch and activity. Connective tissue is thixotropic, which makes substances solidify when cold or left undisturbed and become more fluid when warmed or stirred. Gelatine is an example. If not stretched and warmed by muscular activity, connective tissue tends to stiffen and become less flexible.

Therapeutic massage stretches, strokes and moves tissue and generates heat to make connective tissue more fluid, allowing greater mobility and encouraging blood flow.

The collagen fibres of connective tissue tend to bind together by hydrogen bonding with disuse and chronic pressure. Inflammation is a factor in the bonding process called adhesions. Nerves and blood vessels may get caught in adhesions and range of motion often is reduced or pain results. Massage applications help slow down formation of adhesions and also aids the alignment of the collagen fibres, reducing friction and allowing more optimal movement.

Although connective tissue is found in all areas of the body, some areas contain more than others. The brain has little connective tissue, whereas ligaments, tendons and skin have high concentrations. The number of blood vessels in connective tissue varies. Cartilage has none, but other types of connective tissue have a large number of blood vessels. Connective tissue contains cells that help with repair, healing and storage as well as other cells that help with defence. Three other types of cells also are found commonly in connective tissue:

In order from the most rigid to the softest, the major connective tissue classes are:

a) Bone
b) Cartilage
c) Dense Fibrous
d) Loose Fibrous
e) Blood

a) Bone

Also referred to as osseous tissue. Because of its hardness it is able to protect and support other body organs.
Bone Tissue

Bones share four features that allow them to work together as parts of the skeleton despite their different shape.

1. Hard cells and a rigid matrix give bones strength and shape to sustain weight and movement.
2. Bones usually articulate with other bones.
3. A connective tissue structure called the periosteum covers every bone and provides vessels for nutrition, bone cells for growth and attachments for tendons and ligaments and finally
4. Oppositional growth of new bone matrix and remodelling of the existing bone matrix is responsible for shaping bones.

Ossification or bone development is a two part process in the embryo, first a cartilage model is created and then osteoblasts or bone building cells develop the bone tissue from the cartilage model. Shortly after birth calcification takes place.

In a long bone the transformation of cartilage to bone begins in the centre of the shaft. The long bone continues to grow in length at secondary bone forming centres through childhood and into the late teens. As we grow, our bones widen and lengthen as osteocytes (bone cells) are added in some areas of bone and resorbed in others. In children their bodies contain more cartilage making them more flexible as complete calcification has not yet taken place. In older adults this is reversed where bone cells outnumber cartilage cells, and the bone is more brittle because it contains more minerals and fewer blood vessels. This makes bones more prone to fracture or breaks and slower to heal.

Stages of Bone Growth
Bone Regeneration and Remodelling

Whilst bones appear to be the most lifeless of body organs they are in fact very dynamic and active tissue in which renewal takes place at the cellular and tissue level. Every week we recycle 5-7% of our bone mass and when bones break they undergo a remarkable process of self-repair. Fractured (broken) bones are first treated by reduction which brings the bone ends back into alignment. From there the area is immobilised by cast or traction to allow the healing to take place. The healing time of a simple fracture is 8-12 weeks but it is much longer for large weight bearing bones.

There are four stages of healing.

1. Haematoma formation

Acute inflammation usually lasts around 4 days. As a result of trauma, to the bone, the periosteum and the surrounding soft tissue, blood gathers at the site of the fracture forming a mass of clot known as a haematoma.

2. Cellular proliferation

The dead bone cells and damaged vessels and structures elicit a typical inflammatory response.

3. Callus formation

The haematoma in a bone fracture gradually forms a fibrous junction between the fractured ends, which becomes a fibrous callus, then cartilage and finally bone.

4. Ossification

This is the final stage of laying down bone tissue. The fracture is bridged and firmly united. Osteoclasts resorb excess callus.

Remodelling

Remodelling occurs after resorption of the callus and the laying down of trabecular bone along the lines of stress. Complete remodelling may take many years. The final structure of the remodelled areas resembles that of the original unbroken bony regions because it responds to the same set of mechanical stimuli.
Abnormal Bone Growth & Healing

Imbalances between bone formation and bone resorption underlie nearly every disease process that affects the skeletal system. Examples include Osteoporosis, Osteomalacia (Rickets) and Pagets Disease.

Bone fractures usually heal without problems in most cases. However, when they occur, problems are almost always a result of a severe initial injury. Examples of complications that can arise during bone fracture healing include:

- **Compartment syndrome**: swelling after a fracture that puts pressure on the blood vessels such that not enough blood can get to the muscles around the fracture. The decreased blood supply can cause the muscles around the fracture to die, which can lead to long-term disability. Compartment syndrome usually occurs only after a severe injury.

- **Neurovascular injury**: Some fractures are so severe that the arteries and nerves around the injury site are damaged.

- **Infection**: Open fractures can become infected when the jagged bone ends are exposed to the air where they have torn through the skin.

- **Post-traumatic arthritis**: Fractures that extend into the joints (intra-articular fractures) or fractures that cause the bones to meet at an abnormal angle in the joint can cause premature arthritis of a joint.

- **Growth abnormalities**: A fracture in the growth plate, in a child, can cause many problems. Two of these problems are premature partial or complete closure of the growth plate. This means that one side of a bone or the whole bone stops growing before it naturally would. If one side of a bone stops growing before the other side, the bone will grow at an abnormal angle. If the whole bone, such as a thigh bone, stops growing prematurely, it will be shorter than the other thigh bone, making one leg shorter than the other.

- **Delayed union**: A fracture that takes longer to heal than expected is a delayed union.

- **Nonunion**: A fracture that fails to heal in a reasonable amount of time is called a nonunion.

- **Malunion**: A fracture that does not heal in a normal alignment is called a malunion.

b) Cartilage

Cartilage is less hard than bone but more flexible due to its rubbery matrix. Cartilage consists of 3 types:

**Hyaline**

The most abundant cartilage and covers the end of bones where they form joints.

**Elastic**

A white cartilage providing great movement due to elastin fibres, e.g. supports the external ear.

**Fibrocartilage**

A yellow cartilage that forms cushion-like discs between the vertebrae of the spine.

c) Dense Fibrous

Consists predominantly of collagen fibres hence creating a dense connective tissue. It forms rope-like structures such as:
Tendons - attach skeletal muscle to bone.
Ligaments - connect bone to bone at joints.

d) Loose Fibrous
Relatively speaking, the loose connective tissues are softer and have more cells and fewer fibres than any other connective tissue type except blood. They consist of:

Areolar
The most widely distributed connective tissue variety in the body. Found under the skin, binding the skin to organs and cushioning and protecting them. You’ll often see it in a leg of lamb under the skin and attached to the muscle. It is thin but quite strong, transparent and is quite wet.

Fascia is a particular type of connective tissue belonging to the areolar group. Fascia will be referred to often throughout the course.

Adipose
Adipose tissue is actually fat. As was shown in the previous lesson, stored fat occupies most of a fat cell's volume and compresses the nucleus, displacing it to the side. Adipose tissue forms the subcutaneous tissue beneath the skin where it insulates and protects the body.

Reticular
Reticular tissue consists of a delicate network of interwoven reticular fibres associated with reticular cells. It forms an internal supporting framework (like a mattress) that can support many free blood cells (mainly lymphocytes) in lymphoid organs such as lymph nodes, the spleen and bone marrow.

e) Blood
Blood or vascular tissue is actually connective tissue because it has a matrix (plasma) and ground substance (blood cells). This is not really evident unless blood clotting occurs, in which case the “fibres” within blood become visible.

3. Muscular Tissue
Muscular tissue is responsible for movement and heat production in the body. Muscle tissue is a highly cellular and well-vascularised tissue

There are three types of muscle tissue:
1. Skeletal
2. Cardiac
3. Smooth

They differ in:
1. structure of cells
2. location in the body
3. function
4. means by which they are activated
1. **Skeletal muscle**

Skeletal muscle fibres are the longest cell types consisting of obvious bands called striations. They are often referred to as voluntary muscles because they are the only type subject to conscious control.

Skeletal muscle can contract rapidly and vigorously, exerting tremendous force.

2. **Cardiac muscle**

Cardiac muscle occurs only in the heart constituting most of the mass of the heart walls. Also striated but is not voluntary. Contraction is usually at a steady rate however it can increase noticeably for brief periods.

3. **Smooth muscle**

Found in the walls of hollow visceral organs (other than the heart). Has no striations and there is no voluntary control. Contraction is slow and sustained due to its role within the body.

**Structural Organisation of Skeletal Muscle**

Refer to the diagrams below which outline the structure of muscles from the gross macroscopic level right down to the cell or myofibril and the microscopic filament or sarcomere level.

A muscle consists of hundreds to thousands of muscle cells plus the connective tissue wrappings, blood vessels and nerve fibres.

At the fascicle level is a discrete bundle of muscle cells bound together by a connective tissue wrapping known as perimysium. Within the Fascicles are Muscle Fibres (cells) which are elongated multinucleated and striated in appearance and surrounded by a connective tissue endomysium.

Within each muscle fibre are myofibrals or fibrals which are complex rod like organelles composed of myofilaments. These are the contractile elements of muscles. Myofibrals occupy most of the cell and appear banded and aligned to adjacent myofibrals composed of sarcomeres arranged end to end.

Sarcomeres are the contractile unit within a segment of a myofibril and are made up of contractile proteins. Sarcomeres have a thin (actin) filament and a thick (myosin) filament.

The sliding of the contractile protein thin filaments passed the thick filaments is what produces muscle shortening or contraction.

When a muscle cell contracts its individual sarcomeres shorten resulting in shortening of the cell as a whole.
Levels of Functional Organisation of a Muscle Fibre
Muscle Contraction - The Sliding Filament Theory

For more information on muscle contraction refer to online resources – such as Muscle Contraction Process: Molecular Mechanism

The sliding filament theory first described in 1954, refers to the movement of thin (actin) filaments sliding past the thick (myosin) ones so that the actin and myosin fibres overlap to a greater or lesser degree. In a relaxed muscle fibre, the thick and thin filaments overlap only slightly, but during contraction the thin filaments moved deeper into the A zone as indicated in the diagram below.

When muscle fibres are activated by the nervous system, the cross bridges (myosin heads) attach to the active (myosin binding sites on the actin thin filaments and the sliding begins. Each cross bridge attaches and detaches several times during contraction, acting much like a tiny ratchet. As this occurs simultaneously throughout the muscle cell the cell shortens. Calcium levels and Neurotransmitters such as Acetylcholine (Ach) control the transmission of nerve impulses to the Sarcolemma of the muscle fibre and the presence of Calculm ions allows the interactions to occur.

Sliding of the actin filament during muscle contraction
The above diagram illustrates the steps and sequence of events involved in the sliding of the actin filament during contraction.

How do nerve impulses cause muscle contraction? Skeletal muscle is under voluntary control. Nerve impulses that originate in the central nervous system cause muscles to contract. Both neurons and muscle tissue conduct electrical current by moving ions across cellular membranes. As indicated in the diagram below a motor neuron ends in a synapse with a muscle fiber. The neuron releases acetylcholine and transfers the action potential to the muscle tissue. The signal will travel through the tissue and trigger the contraction of individual sarcomeres.
**Motor Unit**

The below diagram illustrates the motor unit complex. Each muscle is served by at least one motor nerve with contains hundreds of motor neuron axons. As an axon enters a muscle it branches into a number of axonal terminals, each of which forms a neuromuscular junction with a single muscle fibre. The motor neuron and all the muscle fibres it supplies are called a motor unit. When a motor neuron fires (transmits an electrical impulse) all the muscle fibres it innervates respond by contracting. The average number of muscle fibres premotor unit is 150 but may be as high as several hundred or as few as 4. Muscles that exert fine control (such as the muscles controlling movements of the eye and fingers) have few motor units compared with larger weight bearing muscles with less precise movements such as the hip.
**Muscle Proprioceptors**

Muscle spindles (stretch receptors). These are the primary proprioceptors in the muscle that are sensitive to changes in muscle length.

The golgi tendon organ. This proprioceptor in the tendon near the end of the muscle fibre is sensitive to changes in muscle tension.

In addition to providing information about the movement and positioning of our body, head, arms and legs, the proprioceptors can trigger certain protective reflexes. The "stretch reflex," for example, is activated when the proprioceptors sense too much stretch or force on a muscle or tendon. To resist an unsafe change in muscle length that may lead to a torn muscle or tendon, the reflex causes the stretched muscle to contract, shorten and protect the muscle or tendon from injury.
A classic Reflex Arc – The Patellar Tendon Reflex (knee jerk reflex)

A reflex arc is a neural pathway that controls an action reflex. In higher animals, most sensory neurons do not pass directly into the brain, but synapse in the spinal cord.

This characteristic allows reflex actions to occur relatively quickly by activating spinal motor neurons without the delay of routing signals through the brain, although the brain will receive sensory input while the reflex is carried out.

An example reflex arc is the Patellar Tendon Reflex. Striking the patellar tendon with a tendon hammer just below the patella causes a stretch of the quadriceps muscles in the thigh. This stimulates sensory receptors called muscle spindles that trigger an afferent or sensory nerve impulse to the lumbar region of the spinal cord. There, the sensory neuron synapses directly with a motor neuron that conducts an efferent or motor impulse to the quadriceps muscle, triggering contraction. This contraction, coordinated with the relaxation of the antagonist hamstring muscle causes the leg to kick. This reflex helps maintain posture and balance, allowing us to walk without consciously thinking about each step.
4. **Nervous Tissue**

Is highly specialised tissue, it senses, transmits and interprets impulses.

Nervous tissue makes up the nervous system consisting of the brain, spinal cord and nerves which regulate and control body function.

**Composed of 2 major cell types:**
- Neurons - the cell itself that generates and conducts nerve impulses
- Supporting Cells - the non-conduction part that supports, insulates and protects the delicate neurons

**Interactive Question:**
Use the key to match each basic tissue type with a description below:

(a) connective tissue
(b) epithelial tissue
(c) muscle tissue
(d) nervous tissue

___ (1) composed largely of nonliving extracellular matrix; important in protection, support, defence and holding tissue fluid
___ (2) the tissue immediately responsible for body movement
___ (3) the tissue that provides an awareness of the external environment and enables us to react to it
___ (4) the tissue that lines body cavities and covers surfaces
___ (5) the tissue that includes most glands
5. Organ Level (Level Four)

At least two tissues combine together to create an organ which is a discrete structure enabling extremely complex physiological processes to occur.

For example, the Stomach organ contains all four tissue types:

As the food enters and fills the stomach, its wall begins to stretch. The areolar **connective tissue** warps and cushions the stomach organ, providing excellent support.

Then the three distinct layers of **muscle tissue** creating the stomach wall become active. They compress and pummel the food, breaking it apart physically.

At the same time secretion of the gastric juices occurs through the single layer of tall cells in the **epithelium tissue**. The food is continually being mixed with the enzyme-containing gastric juice so that the semifluid chyme is formed.

Perhaps it would help if you visualise this process as being like the preparation of a cake mix in which the floury mixture is continually folded on itself and mixed with the liquid until it reaches uniform texture.

Once the food has been well mixed, a rippling peristalsis begins in the lower half of the stomach and the contractions, activated through the nervous tissue, increase in force as the pyloric valve is approached. When the duodenum is filled with chyme and its wall is stretched, a stretch reflex, again activated by **nervous tissue**, occurs. This reflex "puts the brakes on" gastric activity and slows the emptying of the stomach by inhibiting the nerves and tightening the pyloric sphincter, thus allowing time for intestinal processing to catch up.

Generally, it takes about 4 hours for the stomach to empty completely after eating a well-balanced meal and 6 hours more if the meal has a high fat content.
6. Organ System Level (Level Five)

Organs that cooperate and work closely with one another to accomplish a common purpose are said to be part of a particular organ system known as a body system.

For example, let us extend our discussion of the stomach organ to include other associated organs. The alimentary canal and associated glands are involved here creating a special system for dealing with FOOD and FLUIDS known as the **Digestive System**. From ingestion through to rejection there are organs such as the mouth, oesophagus, stomach, intestines and rectum, systematically involved in processing your meal involving both mechanical and chemical changes.

Your body has 12 body systems in total.

**Skeletal System**

The skeleton, consisting of bones and cartilages, gives support to the body and provides protection for some organs, especially the brain and spinal cord. It also acts as a storehouse for minerals and the marrow cavities of some bones are the site of formation of blood cells.

**The Skeletal System**

The skeletal system consists of three elements: bones, cartilage and ligaments.

**Interactive Questions:**

1. Consult your medical dictionary or medical terminology text to define the following terms:

   Ankylosing spondylitis ____________________________

   Fracture ____________________________

   Osteoarthritis ____________________________

   Osteochondritis ____________________________

   Osteochondrosis ____________________________

   Osteoporosis ____________________________
2. Using Appendix A of FUNDAMENTALS, choose one condition from the previous list and note any indications or contraindications involved.

Condition: ________________________________________________________________
______________________________________________________________

Indications or Contraindications: __________________________________________
______________________________________________________________

3. Palpate each bone listed on the skeleton and say its name.

4. Consult your medical dictionary or medical terminology text to define the following terms:

   Ankylosis ________________________________________________________________
   ________________________________________________________________

   Arthritis ________________________________________________________________
   ________________________________________________________________

   Bursitis ________________________________________________________________
   ________________________________________________________________

   Degenerative joint disease ______________________________________________
   ________________________________________________________________

   Dislocation _____________________________________________________________
   ________________________________________________________________

   Ganglion cyst __________________________________________________________
   ________________________________________________________________

   Genu valgum ____________________________________________________________
   ________________________________________________________________

   Genu varum ____________________________________________________________
   ________________________________________________________________

   Gout ________________________________________________________________
   ________________________________________________________________

   Hallux malleus __________________________________________________________
   ________________________________________________________________

   Kyphosis ________________________________________________________________
   ________________________________________________________________

   Lordosis ________________________________________________________________
   ________________________________________________________________

   Rheumatoid arthritis ____________________________________________________
   ________________________________________________________________

   Scoliosis ________________________________________________________________
   ________________________________________________________________

   Slipped disk ____________________________________________________________
   ________________________________________________________________
Spinal curvature

Sprain

Subluxation

Tendinitis

5. Using Appendix A in FUNDAMENTALS, choose one condition from the previous list and note any indications or contraindications involved.

Condition: ____________________________________________________________

Indications or Contraindications: _______________________________________

Muscular System

The voluntary or skeletal muscles that move the skeleton form the muscular system; the term musculo-skeletal system is sometimes given to the bones and cartilages of the skeleton, the joints connecting them and the muscles that move them.

Tissues that are contractile make up the muscular system.

The three types of muscle tissue include cardiac muscle, smooth muscle and skeletal muscle.

Interactive Questions:
1. Locate a more complete list of muscles in your anatomy and physiology textbook or medical dictionary. Break down four muscle names not listed in this section into their word elements. You will need a medical terminology book and/or medical dictionary to complete this exercise. Example: Auricularis superior: Aur- means ear; ar- means pertaining to; superior means above or upward.

   a. ____________________________________________________________
   b. ____________________________________________________________
   c. ____________________________________________________________
   d. ____________________________________________________________

2. An excellent way to remember the names of muscles is to make up ridiculous sentences that explain listed muscle names. The crazier these sentences are, the better you will remember them. Use this memory aid as you study muscles in your anatomy and physiology lessons.

   Examples:
   Rectus femoris: Part of the quadriceps muscle that is straight (rectus) and lies near the femur (femoris)
   Memory aid: Attention rectus! Straighten up and the other three of you in the quads head out to the femur.
   Flexor carpi ulnaris: Muscle that flexes (flexor) the wrist (carpi) and hand and is attached to the ulna (ulnaris)
   Memory aid: Help! There is a big carp pulling my wrist into flexion. It has my ulna in its mouth and my hand has it around the gills.
Cardiovascular system

Otherwise known as the circulatory system, it includes the heart as a muscular pump and blood vessels with the blood that circulates through them forming a transport system for many substances. Arteries conduct blood away from the heart and veins conduct it back to the heart. Through branches of ever-decreasing size, blood reaches the blood capillaries, the microscopic vessels which form a vast network in organs and tissues and through which fluid and many substances, including blood gases (oxygen and carbon dioxide) can be exchanged. From the capillaries blood is gathered into veins of ever-increasing size to be returned to the heart. Blood consists of a fluid (plasma) containing red cells (erythrocytes, for the transport of blood gases), various types of white cells (leukocytes, for body defences, including lymphocytes) and platelets (thrombocytes, concerned with blood clotting).

The cardiovascular system consists of two parts: the heart and the blood vessels.

Arterial and Venous blood vessel systems

The cardiovascular system is responsible for transporting oxygen, hormones, nutrients and waste products around the body. The heart powers this system, pumping the blood which carries the previously mentioned contents at a rate of five litres per minute.
The heart
The heart is a muscle that is located in the thoracic region, between the lungs. It is composed of two sides and is a four chambered ‘double pump’ – the two atria at the top of the heart receive blood from various parts of the body, while the two ventricles are located at the bottom of the heart. The right ventricle pumps deoxygenated blood to the lungs and the left ventricle pumps oxygenated blood to the rest of the body. Valves exist between these chambers and ensure that blood flows in one direction.

Circulatory loops
In the human body, there are two circulatory loops:

- **Pulmonary circulation loop** – transports deoxygenated blood from the right side of the heart to the lungs; here, the blood becomes re-oxygenated and is transported back to the left side of the heart. The right atrium and right ventricle pump blood along this loop.

- **Systemic circulation loop** – transports oxygenated blood from the left side of the heart to all body tissue (apart from the heart and lungs). It also removes waste from tissue and returns deoxygenated blood to the right side of the heart. The left atrium and left ventricle pump blood along this loop.

Circulation of Blood through the Heart
**Blood vessels**

Blood vessels allow blood to travel from the heart to every area of the body and back and are sized according to how much blood passes through that particular area of the body. Blood travels through a hollow area called the lumen, which is encased in a wall (thin for capillaries and thick for arteries). The blood vessels are lined with endothelium which keeps blood inside them and prevents the formation of clots.

**There are three types of blood vessels:**

- **Arteries** – carry blood away from the heart, which is usually oxygenated; the only exception is the pulmonary trunk circulation loop, which carries deoxygenated blood from the heart to the lungs. They have high levels of blood pressure, as the blood is being pushed from the heart (hence the thicker vessel walls). Bigger arteries are more elastic, to accommodate the pressure, whereas smaller arteries are muscular and contract/expand to regulate blood flow.

  Arterioles are narrow arteries that branch off from the ends of arteries and carry blood to capillaries. They have lower blood pressure as they are greater in number, further from the heart and carry less blood per unit – therefore, the walls are much thinner than arteries. They also use muscle to regulate blood flow.

- **Capillaries** – these are the smallest, thinnest and most common blood vessels in the body. They run through just about every tissue in the body and connect arteries to venules. Gases, nutrients and waste products are exchanged between tissues in capillaries – therefore, the endothelium is thin to allow easier passage of materials, while still retaining blood cells inside the vessels.

  Precapillary sphincters regulate blood flow into capillaries by reducing blood flow to inactive tissue and directing it towards active tissue.
- **Veins** – return blood to the heart; their walls are much thinner, less elastic and less muscular than arteries (as they are not subjected to as much pressure). Instead, gravity, inertia and skeletal muscle contractions allow veins to push blood back to the heart. Many veins contain valves that prevent blood from going away from the heart. Venules perform the same function as arterioles but collect blood from capillaries, rather than deposit it.

**Functions of the cardiovascular system:**

- Transportation of blood (along with its contents) to body tissue.
- Protection – white blood cells clean up debris and fight infections; platelets and red blood cells form scabs that prevent infection and open wounds; blood also carries antibodies to help protect from specific infections.
- Regulation – helps maintain body temperature; helps balance the body’s pH; maintains concentration of body’s cells.

**Regulation of blood pressure:**

- The greater the contractions of the heart, the higher the blood pressure.
- Vasoconstriction – the diameter of an artery is reduced by contracting the muscle in the arterial wall. Blood pressure is increased and flow reduced.
- Vasodilation – the diameter of an artery is increased as the muscle in the arterial wall relaxes. This can be caused by hormones or chemicals, artificial or natural.
- An increase in blood volume equals higher blood pressure.
- Thicker blood (from clots etc.) raises blood pressure.

**Interactive Questions:**

1. List five of the disease conditions of the cardiovascular system described in the indications and contraindications section in Appendix A of FUNDAMENTALS.
   a. __________________________________________
   b. __________________________________________
   c. __________________________________________
2. Using your list, choose one condition and note any indications or contraindications involved.

Condition: ____________________________

Indications or Contraindications: ____________________________

3. Look up the medication classification “anticoagulant” in Appendix C of FUNDAMENTALS TEXT BOOK or in a pharmacology reference text.

List contraindications and side effects of these medications. Also describe contraindications to massage that may exist if someone is taking anticoagulant medication.

________________________________

________________________________

________________________________

________________________________

4. Choose a willing participant and draw the major arteries and veins on the body with washable markers. Use red for arteries and blue for veins. Notice that you can almost trace the veins because they are located near the surface of the body.

Lymphatic System

Closely allied to the cardiovascular system, the lymphatic system consists of the lymphoid organs (thymus, spleen, tonsils and lymph nodes), lymphoid follicles scattered in certain non-lymphoid organs (especially in parts of the digestive tract) and lymphatic channels (lymphatics) which drain lymphocytes and fluid from the lymphoid organs and follicles, as well as tissue fluid from other parts of the body. Lymph is the fluid within the lymphatics. Nodes may become the sites for infection or cancerous deposits derived from any part of the drainage area. The cervical, axillary and inguinal nodes are those most readily palpable and routinely examined. Apart from drainage, the system is concerned with the manufacture and transport of lymphocytes for the body’s immune responses. Part of it also transports fat absorbed from the intestine.

This system’s primary function is to transport lymph, which is a clear and colourless fluid that contains white blood cells (to fight disease). Lymph helps the body get rid of toxins, waste and other unwanted substances from the body. It also transports fatty acids from the intestines to the circulatory system.
The lymphatic system consists of:

- **Lymph vessels** – they carry lymph through the body and they resemble veins in structure.

- **Lymph nodes (600 to 700)** – make more white blood cells to fight infection.

- **Lymph** – flows upward towards the neck, through the subclavian veins. It is created from any fluid that doesn't return to the heart via the veins.

- **Tonsils** – clusters of lymphatic cells in the pharynx. They are commonly removed after persistent throat infections.

- **Adenoids**

- **Spleen** – helps protect against infection and is just above the kidney. Humans can live without this, but are more prone to injury and infection without it.

- **Thymus** – in the chest, just above the heart; it stores immature lymphocytes and prepares them to become active T cells.
The Lymphatic System

The lymphatic system is responsible for several functions and operates in the following ways:

- Returns vital substances, such as plasma protein, to the bloodstream from the tissues of the body
- Assists in maintaining fluid balance by draining fluid from the body tissues
- Helps the body defend against disease-producing substances
- Helps absorb fats from the digestive system
Interactive Questions:

Match the lymph nodes and plexuses to their correct description.

1. Parotid
2. Occipital
3. Superficial cervical
4. Subclavicular
5. Hypogastric
6. Facial
7. Deep cervical
8. Axillary
9. Mediastinal
10. Cubital
11. Para-aortic
12. Deep inguinal
13. Superficial inguinal
14. Popliteal
15. Mammary plexus
16. Palmar plexus
17. Plantar plexus

a. deeply situated nodes in the groin
b. nodes in the groin close to the surface
c. nodes under the collarbone
d. nodes draining the tissue in the face
e. lymphatic vessels in the sole of the foot (plantar)
f. lymphatic vessels in the palm of the hand (palmar)
g. nodes around or in front of the ear
h. nodes over the bone at the back of the head
i. nodes in the area beneath the stomach
j. nodes around the aorta
k. deeply situated nodes in the neck
l. lymphatic vessels around the breasts
m. nodes in the armpit
n. nodes of the elbow
o. nodes close to the surface of the neck
p. nodes in back of the knee
q. nodes in the mediastinal section of the thoracic cavity

Nervous System

A communication system, the purpose of which is to receive information from the outside world and from the body itself and to make appropriate responses. The Nervous System is divided into the central nervous system (CNS), composed of the brain and spinal cord and the peripheral nervous system (PNS), composed of cranial nerves attached to the brain and spinal nerves attached to the spinal cord. Motor nerves that supply skeletal (voluntary) muscle constitute the voluntary or somatic nervous system, while others supply cardiac muscle, smooth (involuntary) muscle and glands to form the autonomic nervous system (ANS), which is concerned with automatic or involuntary activities, such as heart rate, constriction of blood vessels, sweating, secretion in the stomach and the size of the pupil.

Nerve cells (neurons) have filamentous processes (nerve fibres) that are collected into bundles to form the nerves of the PNS and the various tracts in the brain and spinal cord. Fibres that convey
nerve impulses away from their own cell bodies (the part of the nerve cell containing the nucleus) or from the CNS are efferent fibres; these include the sensory fibres that convey general or special types of sensation, as well as those unconscious impulses concerned with reflexes. General sensations are those of touch, pain, pressure, temperature and proprioception (muscle-joint sense, which gives information on position and movement) and the special sensations are vision, smell, taste, hearing and balance (equilibrium).

Study of the nervous system is important for the massage professional and focuses on the following:
- Central nervous system (CNS)
- Peripheral nervous system (PNS)
- Autonomic nervous system (ANS)

The nervous system includes the brain, spinal cord, nerves and sense organs, which work together to receive, transmit and integrate information from inside and outside the body.

Neurons send signals through thin fibres which cause chemicals (neurotransmitters) to be released at junctions known as synapses. These give a command to a cell to behave in a certain way – this whole process takes about a fraction of a millisecond.

Sensory neurons react to stimuli such as light, sound and touch – they then send feedback to the brain through the central nervous system, communicating about the surrounding environment. Motor neurons transmit messages to activate muscles/glands.

Neurons are held in place by glial cells (neuroglia), which also destroy pathogens, remove dead neurons and ensure the signals sent by the brain reach their intended target.

The brain
This soft organ is located inside and protected by the skull – it is the main control centre of the body and contains around 100 billion neurons. Along with the spinal cord, it is part of the central nervous system – it is responsible for things like consciousness, memory, decision-making, involuntary and voluntary contractions.
The Spinal Cord
This is a long, thin column of neurons bundled together extending from the brain – it carries information down and around the body, resulting in conscious movement, as well as reflexes.

Nerves
Nerves are bundles of axons that are information highways – these bundles are known as fascicles and are wrapped in a protective layer called the perineurium; groups of these fascicles are wrapped together to form an entire nerve.

Interactive Questions:
1. List five of the disease conditions of the nervous system described in the indications and contraindications section in Appendix A of FUNDAMENTALS.
   a. ____________________________________________
   b. ____________________________________________
   c. ____________________________________________
2. Using Appendix A from FUNDAMENTALS, choose one condition from your list and note any indications or contraindications involved.

Condition: _______________________________________________________

Indications or contraindications: ______________________________________

3. Choose one of the reflexes and look it up in a medical dictionary. Define the term and then write down how you think the reflex is implicated during massage.

Example:
Reflex: Psychogalvanic

Definition: Psycho- relates to the mind and galvanic pertains to electricity

Implication: This reflex involves changes in electrical activity in the body connected with mind processes or thoughts. With the galvanic skin response, changes in electrical activity are related to activity of the sweat glands. Massage stimulates the skin as well as electrical activity in the body, which in turn may influence the mind.

Your Turn:
Reflex: _______________________________________________________

Definition: _______________________________________________________

Implication: _______________________________________________________

Endocrine system

Like the nervous system, the endocrine system is for communication, but acts at a much slower rate via the hormones secreted by its various components and mostly distributed by the bloodstream. It consists of the main endocrine organs (pituitary gland and the adjacent part of the brain, the adrenal, thyroid and parathyroid glands) and various other groups of endocrine cells that are found in other organs, especially in the pancreas (where they form the islets of Langerhans), testis, ovary and digestive tract.

The endocrine system is composed of glands that produce hormones that are secreted directly into the bloodstream to stimulate cells in a specific way or to set a body function into action.

The glands are controlled by the nervous system and chemical receptors in the blood. They help maintain homeostasis (stable internal condition) by regulation of organ functions. Hormones are responsible for things like metabolism, sexual development and reproductions, mineral and sugar retention, heart rate and digestion.
**Hypothalamus**

This part of the brain directly controls the endocrine system through the pituitary gland; it is also responsible for various nervous system-related jobs. It contains neurosecretory cells – these are neurons that secrete releasing and inhibiting hormones. These hormones are responsible for the controlled release of things like growth hormone and follicle stimulating hormone.

**Pituitary gland**

This is a pea-sized piece of tissue connected to the hypothalamus, which releases hormones through blood vessels surrounding it.

*It is made of two parts:*

- **Posterior pituitary** – releases oxytocin (for childbirth contractions and release of milk for breastfeeding) and antidiuretic hormone (prevents water loss in body by reducing blood flow to sweat glands and increasing water uptake in kidneys)

- **Anterior pituitary** – controlled by the hypothalamus, it produces six vital hormones:
  - thyroid stimulating hormone (TSH)
  - adrenocorticotropic hormone (ACTH)
  - follicle stimulating hormone (FSH)
  - luteinising hormone (LH)
  - human growth hormone (HGH)
  - prolactin (PRL).

**Pineal gland**

The pineal gland produces the hormone melatonin which helps regulate the sleep-wake cycle. The pineal gland is inhibited by stimulation from the photoreceptors of the retina; light sensitivity leads to
melatonin production only in low light or darkness. Increased production causes feelings of drowsiness.

Thyroid gland
Located at the base of the neck around the lateral sides of the trachea, it produces:
- **Calcitonin** – regulating blood calcium levels
- **Triiodothyronine and thyroxine** – regulating metabolic rate.

Parathyroid glands
They produce parathyroid hormone (PTH) when calcium ion level drop too low – this stimulates the osteoclasts to break down the calcium stores from bones, so they are released into the bloodstream. It also triggers kidneys to return calcium back into the bloodstream.

Adrenal glands
Found above the kidneys, they are made of two layers:
- **Adrenal cortex**
  - produces glucocorticoids (breaks down proteins and lipids; reduces inflammation and triggers immune response)
  - mineralocorticoids (help regulate mineral ions concentration in the body)
  - androgens e.g. testosterone (regulate growth and activity of cells).
- **Adrenal medulla** – produces epinephrine and norepinephrine, helping increase blood flow to the brain and muscles under stress (known as 'fight or flight' reaction). They increase heart rate, breathing rate and blood pressure, while decreasing blood flow to organs that are not involved in responding to emergencies.

Pancreas
This is a large gland near the stomach which releases glucagon to raise blood glucose levels and insulin to lower them after eating.
Gonads
These are the ovaries (in females) and testes (in males), which produces sex hormones – they determine the respective secondary sex characteristics of adults.

Their function:
- **Testes** – releases testosterone (causes growth and increases in strength of the bones and muscles, particularly during puberty; causes inherited hair loss; triggers sexual development)
- **Ovaries** – release oestrogen and progesterone (for ovulation and pregnancy; for sexual and growth development during puberty)

Thymus
Found behind the sternum, it produces thymosins (to develop t-lymphocytes during foetal and child development). During puberty, it becomes inactive and is replaced by adipose tissue.

Other hormone producing organs:
- **Heart** – atrial natriuretic peptide (ANP) in response to high blood pressure levels.
- **Kidneys** – erythropoietin (EPO) in response to low levels of oxygen in the blood.
- **Digestive system** – cholecystokinin (CCK), secretin, and gastrin are all produced by the organs of the gastrointestinal tract.
- **Adipose** – produces the hormone leptin that is involved in the management of appetite and energy usage by the body.
- **Placenta** – human chorionic gonadotropin (HCG) assists progesterone by signalling the ovaries to maintain the production of oestrogen and progesterone throughout pregnancy.
Local hormones – prostaglandins and leukotrienes are produced by every tissue in the body (except for blood tissue) in response to damage.

Interactive Questions:

1. List five of the disease conditions of the endocrine system described in the indications and contraindications section in Appendix A of FUNDAMENTALS.
   a. ________________________________
   b. ________________________________
   c. ________________________________
   d. ________________________________
   e. ________________________________

2. Using Appendix A of FUNDAMENTALS, choose one condition from your list and note any indications or contraindications involved.
   Condition: ________________________________
   ________________________________
   ________________________________
   ________________________________
   Indications or contraindications: ________________________________
Integumentary System (Skin)

Properly, but not commonly, called the integument or Integumentary system, it forms the protective outer covering of the body and includes specialised derivatives – nails, hair, sebaceous glands (which lubricate the surface) and sweat glands which, in association with the blood flow through the skin, play a vital part in the control of body temperature (by surface evaporation). The breasts (mammary glands), which are modified sweat glands, secrete milk for the newborn and are described in the section on the thorax. Through its sensory nerve supply (cutaneous nerves, with specialized endings and receptors) the skin assesses the body's environment; certain kinds of skin cells are concerned with pigmentation, immune responses and the synthesis of Vitamin D.

The components of the skin are:

- Hair
- Nails
- Sweat glands
- Oil glands
- Blood vessels
- Lymph vessels
- Nerves
- Muscles.

Layers of Human Skin

The anatomy of the integumentary system consists of:

- The epidermis – this is comprised of squamous cells which create keratin – this is a major component of skin, hair and nails. It is the outermost layer of the skin. It can either be thick (on the palms of hands and feet) or thin (rest of the body) skin.
- **Dermis** – this is the thickest layer of the skin (90 per cent) and it supports the epidermis. It contains special cells that help regulate temperature, fight infection, store water and supply nutrients and blood to the skin. They also detect sensations and give skin its strength and flexibility.

  It contains blood vessels, lymph vessels, sweat glands, sebaceous glands, hair follicles, sensory receptors, collagen and elastin.

- **Hypodermis** – this innermost layer of the skin helps insulate the body and cushions the internal organs. It is composed of fat and loose connective tissue and connects skin to underlying tissues through collagen, elastin and reticular fibres from the dermis. It contains a specialised tissue called adipose that stores excess energy as fat. Blood vessels, lymph vessels, nerves and hair follicles also extend through this layer of the skin.

**Human Skin Receptors**

The integumentary system consists of the skin and its appendages, including hair and nails.

**Interactive Questions:**

1. Using Appendix A of FUNDAMENTALS, list at least three skin conditions that could be contagious.
   a. ______________________________________________________
   b. ______________________________________________________
   c. ______________________________________________________

2. Using Appendix A of FUNDAMENTALS, choose one condition from your list and note any indications or contraindications involved.
   Condition: _______________________________________________
**Indications or contraindications:**

---

**Respiratory System**

Concerned with the exchange of oxygen and carbon dioxide between blood and air. These exchanges take place in the lungs; the rest of the respiratory system is the respiratory tract, which is simply a conducting pathway for air and includes the nose and paranasal sinuses, pharynx, larynx, trachea and bronchi. Part of the larynx acts as a respiratory sphincter, concerned with the production of voice.

The respiratory system supplies oxygen and removes carbon dioxide from the cells of the body. The two phases of respiration are external and internal.

**Nose/nasal cavity**

This nasal cavity is the primary tract through which air moves; the nose is made of cartilage, bone, muscle and skin, and protects the nasal cavity. The nasal cavity warms, moisturises and filters air that enters the body before it goes to the lungs. Hairs and mucus trap dust and other contaminants. Exhaled air returns moisture and heat to the nasal cavity before exiting the body.

**Mouth**

This is the secondary tract through which breathing takes place and is used when extra air is needed. However, it doesn’t warm and moisturise air as well as the nose and doesn’t filter as well. However, it allows more air to enter the body quicker.

**Pharynx**

This is the throat and is a muscular funnel that goes from the end of the nasal cavity to the oesophagus and larynx. It contains the epiglottis, which is a flap of cartilage that moves between the trachea and oesophagus, blocking the correct passage, depending if you are eating or not – preventing choking.

**Larynx**

This is the voice box and contains vocal cords, the epiglottis and is constructed of cartilage.

**Trachea**

This is the windpipe and is made of cartilage rings – it connects the larynx to the bronchi and allows passage of air into the lungs – it contains mucus to trap external bodies from reaching the lungs. This mucus is then moved toward the pharynx, where it is swallowed and digested.
**Bronchi/bronchioles**

This is where the airway splits into two branches, which then split into secondary branches (two in the left lung, three in the right lung). Secondary bronchi then split into tertiary bronchi and then into bronchioles, which further split until they become less than a millimetre in diameter – these are known as terminal bronchioles and transfer air into the alveoli of the lungs. Muscle tissue in the bronchi and bronchioles helps regulate airflow – they relax when more air is required (e.g. during exercise) and contract when resting to prevent hyperventilation.

**Lungs**

The lungs are organs and are surrounded by a pleural membrane to allow expansion and a negative pressure space to allow for passive filling of the lungs as they relax. The left lung is slightly smaller, to accommodate the heart and only has two lobes, comparative to the right lung’s three. They contain around 30 million alveoli, which are tiny cup-shaped structures that allow the exchange of gases between the air in the lungs and the blood passing through the capillaries.

**Muscles of respiration**

There are muscles surrounding the lungs that allow air to be inhaled and exhaled from the lungs. The primary muscle responsible for this is the diaphragm – situated at the floor of the thorax. When it contracts, it moves into the abdominal cavity and allows air to be pulled into the lungs; relaxation of the muscle allows air to flow back out of the lungs. Intercostal muscles between the ribs assist the diaphragm in expanding and compressing the lungs.
Types of respiration

There are two types of respiration:

- **External respiration** – the exchange of gases from the air into the blood.
- **Internal respiration** – the exchange of gases between blood and the tissues of the body.

Homeostatic control of respiration

When the body is resting, it maintains what is called eupnoea – this is a steady breathing rate and happens during rest. When we become active, the body requires more oxygen and is producing more carbon dioxide – therefore, chemoreceptors send signals to the brain which will instruct the body to increase its rate and depth of breathing to cope with the situation.

Interactive Questions:

1. List five of the disease conditions of the respiratory system described in the indications and contraindications section in Appendix A of FUNDAMENTALS.
   a. __________________________________________
   b. __________________________________________
   c. __________________________________________
   d. __________________________________________
   e. __________________________________________

2. Using Appendix A of FUNDAMENTALS, choose one condition from your list and note any indications or contraindications involved.
   Condition: __________________________________________
   __________________________________________
   Indications or contraindications: __________________________________________

Digestive System

Concerned with the digestion and absorption of the foodstuffs necessary to provide the chemical energy for all body functions. The digestive or alimentary tract is composed of the mouth, pharynx, oesophagus, stomach, small intestine (duodenum, jejunum and ileum) and large intestine (caecum and appendix, colon, rectum and anal canal). The digestive processes of the stomach and intestines are assisted by the secretions of the major digestive glands – liver (with the gallbladder) and pancreas.

The digestive system enables you to consume and digest food and absorb the nutrients into the bloodstream for use by the body. In the GI tract, tubes join from the mouth to the anus, so that food and drink which is ingested is digested and leaves the body as faeces, once all useful nutrients have been extracted.

These useful nutrients include:

- **Carbohydrates** – they can be simple and complex; they are used for energy and make up 45-65 per cent of the total daily calorie intake.
- **Protein** – they are broken down into amino acids, which are the building blocks of the body and are used for growth and repair.

- **Fats** – these are a rich source of energy and help absorb vitamins in the body. They make up 20-35 per cent of daily calories; they are broken down into fatty acids and glycerol. The body also stores excess energy as fat.

- **Vitamins** – they can be water-soluble and fat-soluble; each vitamin has a different role in the growth and health of the body. Fat-soluble vitamins are stored in fat, whereas water-soluble vitamins are flushed out in urine.

There are bacteria in the GI tract called gut flora that help the digestion process, along with the nervous and circulatory systems.

Food moves through the GI tract via peristalsis (the movement of organ walls), which also allows the contents to be absorbed.

**The organs involved in the digestive system include:**

- **Mouth** – for chewing and breaking down starches
- **Oesophagus** – for swallowing
- **Stomach** – for letting food enter and mix with digestive juices; it breaks down protein
- **Small intestine** – for peristalsis and breaking down starches, protein and carbohydrates
- **Pancreas** – to break down starches, fats and protein
- **Liver** – to break down fats
- **Large intestine** – to change waste products into faeces and to excrete it from the body during a bowel movement.

The anatomy of the digestive system can be compared with that of a long muscular tube that travels a path through the body. The organs of the digestive system break down food and transport food and waste through these muscular tubes.

**Interactive Questions:**

1. List five of the disease conditions of the digestive system described in the indications and contraindications section in Appendix A of FUNDAMENTALS.
   a. ____________________________________________________________
   b. ____________________________________________________________
   c. ____________________________________________________________
2. Using Appendix A of FUNDAMENTALS, choose one condition from your list and note any indications or contraindications involved.

Condition: ____________________________________________
_______________________________________________________

Indications or contraindications: ___________________________
Urinary System (Excretory System)

In both sexes, the urinary or excretory system consists of paired kidneys and ureters and a single urinary bladder and urethra. The urinary system produces, stores and eliminates urine in order to maintain the body's proper content of water and dissolved substances.

The parts of the urinary tract include:

- **Kidneys** – they filter about 136 to 170 litres of blood to make one to two litres of urine.

- **Ureters** – they carry urine from the kidneys to the bladder.

**Bladder** – it expands as it fills with urine, and the emptying of it is controlled by the person. During urination, the bladder empties through the urethra. The sphincters (internal and external) control whether urine stays in the bladder or exits through the urethra.

Immune System

Our immune system, a built-in specific defence system, stalks and eliminates with great precision, almost any type of pathogen that intrudes into the body.

Although certain organs of the body (notably, lymphatic and cardiovascular organs) are intimately involved with the immune response, the immune system is a functional system rather than an organ system in an anatomical sense. Its "structures" are trillions of individual immune cells, which inhabit lymphatic tissues and circulate in body fluids and a diverse array of molecules.

The immune system protects the body both directly, by cell attack and indirectly by releasing mobilising chemicals and protective antibody molecules. The resulting highly specific resistance to disease is called immunity (immune-free).

The human body is able to resist organisms or toxins that tend to damage the tissues and organs that make up the body.

Interactive Questions:
1. List five of the disease conditions of the lymphatic and immune system described in the indications and contraindications section in Appendix A of FUNDAMENTALS.
   a. ________________________________________________________________
   b. ________________________________________________________________
   c. ________________________________________________________________
   d. ________________________________________________________________
   e. ________________________________________________________________

2. Using Appendix A of FUNDAMENTALS, choose one condition from your list and note any indications or contraindications involved.
   Condition: __________________________________________________________
   __________________________________________________________
   Indications or contraindications: ________________________________________
   __________________________________________________________

Reproductive System

The reproductive systems of the male and female are each geared toward fulfilling specific roles. The male's is designed to generate sperm cells containing half of the genetic material necessary for the development of a baby and deliver that material to the female's system. The female's reproductive system is designed to generate an ovum, or egg, which carries the other half of the genetic material, to be fertilised by the sperm cells from the male. The female's reproductive tract is also designed to support the gestating foetus until it is born, approximately nine months after fertilisation. Since some of the male genital organs are shared with some urinary organs, the combined systems are often called the genito-urinary system.

The male reproductive system consists of:

- **Testes** – encase in the scrotum, they contain sperm, which are the male sex cells. They also make male sex hormones, for sexual development
- **Glands** – they create fluids that mix with sperm
- **Sperm ducts** – the sperm travel through these and are mixed with fluids from the glands, created semen
- **Urethra and the penis** – the urethra can either pass out urine or semen of the body, depending on whether you are urinating or having sexual intercourse.
The female reproductive system consists of:

- **Ovaries** – they contain hundreds of unfertilised eggs (ova). A woman has these cells from birth (compared to the continual production of sperm in men).

- **Fallopian tubes** – these connect the ovaries to the uterus. Every month, when an ovary releases an egg, they are transferred through the fallopian tubes to the uterus.

- **Uterus** – also known as the womb, this muscular organ is where fertilised eggs develop into foetuses.

- **Cervix** – this is a ring of muscle on the lower part of the uterus – it serves to hold the baby in during pregnancy.

- **Vagina** – this is a muscular tube that goes from the cervix to the outside of the female body. This is also the entrance for a man’s penis during sexual intercourse. The opening of the vagina has a vulva (two folds of skin, called labia). The urethra opens into the vulva and is the exit for urine; however, it is a separate entity to the vagina.

**Fertilisation**

When a man ejaculates into a woman’s vagina during sexual intercourse, the sperm cells travel to the uterus through the cervix; there, if it meets with an egg, fertilisation happens and an embryo forms from the fertilised egg. This then develops into a foetus and then a baby.
**Foetus development**

The foetus requires:

- **Protection** – this is done by the uterus and amniotic fluid.
- **Oxygen and nutrients** – this is provided by the placenta.
- **Waste removal** – this is also performed by the placenta.

The placenta grows in the wall of the uterus and is connected to the foetus via an umbilical cord – it lets substances pass between the blood supplies of the mother and foetus via diffusion but never lets the blood mix together.

**Birth**

After nine months, the baby is fully developed and ready to be born and the cervix relaxes as the uterus wall muscles contract to push the baby out of the body.

**Puberty**

As a child grows into an adult, they go through puberty (between the ages of ten and 15) – where their reproductive system develops so that they can produce children of their own.

**Some of the other changes include:**

- Growth of underarm hair
- Growth of pubic hair
- Body smells become stronger
- Increased rate of bone and muscle growth
- Emotional development.
In males, the following changes happen:

- The voice breaks
- Testes start producing sperm
- Shoulders get wider
- Testes and penis enlarge
- Hair growth on the face and chest.

In females, the following changes happen:

- Development of breasts
- Ovaries start releasing eggs and periods begin
- Hips get wider.

Special Senses - smell, taste, vision, equilibrium and hearing

Special senses allow us to interact with and to detect changes in our environment.

You should be aware of the following special senses:

- **Hearing** – initiated by sound waves interacting with sensory receptors in the ear.
- **Equilibrium** – initiated by motion interacting with sensory receptors in the ear.
- **Vision** – initiated by light interacting with sensory receptors in the retina of the eye.
- **Taste** – initiated by chemicals interacting with sensory receptors in the tongue.
- **Smell** – initiated by chemicals interacting with sensory receptors in the nose.

The Ear

The ear is the sense organ that detects sounds. The vertebrate ear shows a common biology from fish to humans, with variations in structure according to order and species. It not only acts as a receiver for sound, but plays a major role in the sense of balance and body position. The ear is part of the auditory system. Note the following:

- The external, middle and inner sections of the ear contain the organs for balance and hearing.
- The visible part of the ear is called the auricle – it directs sound waves to the ear canal.
- The ear canal is lined with hairs and ceremonious glands that create earwax to protect the eardrum.
- The middle ear contains bones called ossicles – the hammer, the anvil and the stirrup. They transmit sound vibration to the oval window from the tympanic membrane (the connection with the inner ear).
- The middle ear contains the Eustachian tube, which connects to the pharynx and allows equalisation of air pressure between external and internal environments.
The inner ear contains fluid and interconnecting chambers/tunnels in the temporal bone. The cochlea is responsible for hearing and the semicircular canals and vestibule for balance.

The Ear:

The Eyes

The eyes are responsible for sight. They are located within the orbits of the skull, one on either side of the nose. The eyeball is protected by the bony socket within which it is located and by the eyebrow ridge. The eyelids protect the frontal surface of the eyeball and tears prevent friction between the eyelids and surface of the eye.

The eyeball, or globe, is spherical in shape and about 2.5 cm across. It houses many structures that work together to facilitate sight.
The Eye

The eye is composed of three layers:

- **The sclera** – the outermost layer of white, connective tissue – it contains the cornea (a transparent area of the eye that allows light to enter the eye).
- **The choroid** – the second layer, containing blood vessels and pigment cells.
- **The retina** – the innermost layer, containing the light sensitive cells, cones and rods.

Another component of the eye is:

**The iris** – the coloured part of the eye that controls how much light enters.

Light travels to various objects where it undergoes reflection. This reflected light can then travel towards the eye; where it passes through the cornea, aqueous humour, the lens and the vitreous humour, before forming an image on the retina. Nerve endings in the retina transmit electrical impulses along the optic nerve to the brain. The optic nerve emerges from the back of the eyeball and passes to the optic chiasma, an area at the base of the brain.

Here, further processing occurs so that the image is given meaning. Even if all of the structures of the eye work perfectly, what we know as vision cannot happen without the brain's interpretation of the electrical impulses sent by the retina. The optic nerve is the bundle of retinal fibres that exits the back of the eye and transports electrical impulses to the brain where they are interpreted in the primary visual cortex.

The eyelids, eyelashes and eyebrows are all designed to protect the eye from dirt and dust that might enter it and cause damage. The globe sits inside the orbital cavity, a bony pocket lined with fatty tissue as a cushion. Together these provide additional protection against injury. Six muscles attach at various points to the sclera and enable the globe to move in many directions inside the orbit.

**The Mouth and Tongue**

- Taste buds are found on the tongue, the palate of the roof of the mouth and part of the pharynx.
➢ Taste buds are made up of epithelial cells on the exterior and taste cells in the interior.
➢ Taste is determined when the chemical is dissolved in saliva and transferred to the taste cortex in the parietal lobe of the brain via the facial, glossopharyngeal and vagus nerves.

The tongue is a muscular organ located on the floor of the mouth. It is an extremely mobile structure and an important accessory organ in such motor functions as speech, chewing and swallowing. It has taste receptors (taste buds) or chemoreceptors which are most numerous on the upper and lateral surfaces of the tongue. The four basic tastes are sweet, sour, salty and bitter. The tip of the tongue is most sensitive to sweet and salty substances, the edges of the tongue are most sensitive to sour substances and the back of the tongue is most sensitive to bitter substances. Substances must be in solution (in saliva) so that they can enter the opening in a taste bud and stimulate the nerve ending.

The Tongue - principal structures:

Taste
- The area of the tongue with the most intense taste sensations is located towards the back of the tongue.
- Touch is also detected by nerve endings in the mouth.
Fibres from the 7th, 9th and 10th cranial nerves carry taste impulses, via the brain stem; to an area of the cerebral cortex where the taste is experienced. Taste is intricately linked with the sense of smell and the sense of taste depends on stimulation of the olfactory receptors.

Both senses have a protective function, in detecting substances, which could be harmful.

**The Nose**

The nose is a complex structure and some of its functions are necessary for life while others are useful. The function of the nose in terms of its role in respiration - as part of the respiratory system is to:

- house the nostrils, or nares, which admit and expel air for respiration in conjunction with the mouth
- filter air that is breathed in (nose hairs catch airborne bacteria and dust particles to prevent them from reaching the lungs)
- warm and moisten incoming air
- prevent loss of moisture with outgoing air (reclaiming moisture from the air before it is exhaled)
- act as a receptor for odours - air drawn in contains odour molecules which flow past turbinates (structures that divide the nasal passage) which direct it toward the olfactory epithelium (nerves or receptors) - it contacts the olfactory receptor neurons which transform the features of the molecule into non-painful electrical impulses in the brain, ie we are alerted to the fact that we can smell something
- assist speech acoustics (airflow through the nose and nasal passages contributes to vocal resonance and clarity as anyone who has ever had a blocked nose will realise)

The nose has olfactory receptors (chemoreceptors) which respond to airborne chemicals and odour molecules. The receptors generate impulses, which are transmitted to the brain for interpretation. Olfactory receptors are situated in the mucous membrane lining the upper part of the nose. Smell receptors are very sensitive and can adapt readily. This adaptation means that an individual can
become accustomed to an odour when constantly exposed to the same stimulus. The sensations of smell and taste play an important part in stimulating the secretion of digestive juices.

The common cold is the most common medical condition related to the nose, and can lead to difficulties with breathing and sleep.

**Other problems that can affect the nose:**

- Deviated septum – shifting of the wall that divides the nasal cavity into halves
- Nasal polyps – swellings of the nasal lining that occur inside the nasal passages and sinuses
- Nosebleeds
- Rhinitis - inflammation of the nose and sinuses sometimes caused by allergies
- Nasal fractures.

**The nose and nasal cavities:**

![Diagram of the nose and nasal cavities](image-url)
The Throat

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.

The pharynx:

The Voice Box

The larynx, commonly called the voice box or glottis, is the passageway for air between the pharynx above and the trachea below.

The larynx (posterior view)
Interactive Questions:

Use the key to match each basic tissue type with a description below:

<table>
<thead>
<tr>
<th>Body Systems</th>
<th>Structural Components</th>
<th>Functional Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal System</td>
<td>Hair, Skin, Nails</td>
<td>Forms the external body covering; protects deeper tissues from injury; synthesizes vitamin D; site of cutaneous (pain, pressure, etc) receptors and sweat and oil glands.</td>
</tr>
<tr>
<td>Muscular System</td>
<td>Skeletal muscles</td>
<td>A functional system that protects the body via the immune response, in which foreign substances are attacked by the lymphocytes and/or antibodies.</td>
</tr>
<tr>
<td>Cardiovascular System</td>
<td>Cartilage, Joint, Bones</td>
<td>Protects and supports body organs; provides a framework the muscles use to cause movement; blood cells are formed within bones; stores minerals.</td>
</tr>
<tr>
<td>Lymphatic System</td>
<td>Brain, Sensory receptor, Spinal cord, Nerves</td>
<td>Fast acting control system of the body; responds to internal and external changes by activating appropriate muscles and glands.</td>
</tr>
<tr>
<td>Nervous System</td>
<td>Pineal gland, Pituitary gland, Thyroid gland (parathyroid glands on posterior aspect), Thymus gland, Adrenal gland, Pancreas, Testis (male), Ovary (female)</td>
<td>Glands secrete hormones that regulate processes such as growth, reproduction and nutrient use (metabolism) by body cells.</td>
</tr>
<tr>
<td>Endocrine System</td>
<td>Heart, Blood vessels</td>
<td>Allows manipulation of the environment, locomotion and facial expression; maintains posture; produces heat.</td>
</tr>
<tr>
<td>Integumentary System</td>
<td>Thoracic duct, Lymph nodes, Lymphatic vessels</td>
<td>Blood vessels transport blood which carries oxygen, carbon dioxide, nutrients, wastes, etc; the heart pumps blood.</td>
</tr>
<tr>
<td>Respiratory System</td>
<td>Red bone marrow, Thymus, Lymph nodes, Spleen, Lymphocyte</td>
<td>Eliminates nitrogenous wastes from the body; regulates water, electrolyte and acid-base balance of the blood.</td>
</tr>
<tr>
<td>Digestive System</td>
<td>Liver, Oral cavity, oesophagus, Stomach, Small intestine, Large intestine, Rectum, Anus</td>
<td>Keeps blood constantly supplied with oxygen and removes carbon dioxide; the gaseous exchanges occur through the walls of the air sacs of the lungs.</td>
</tr>
<tr>
<td>Urinary System</td>
<td>Kidney, Ureter, Urinary bladder, Urethra</td>
<td>Picks up fluid leaked from blood vessels and returns it to blood; disposes of debris in the lymphatic stream; houses white blood cells involved in immunity.</td>
</tr>
<tr>
<td>Reproductive System</td>
<td>Male - Seminal vesicles, Prostate gland, Penis, Vas deferens, Testis, Scrotum</td>
<td>Breaks down food into absorbable units that enter the blood for distribution to body cells; indigestible foodstuffs are eliminated as faeces.</td>
</tr>
<tr>
<td></td>
<td>Female - Mammary glands (in breasts), Ovary, Uterine tube, Uterus, Vagina</td>
<td>Overall function is production of offspring, through production of sperm (male) and eggs (female).</td>
</tr>
<tr>
<td></td>
<td>Lung, Nasal cavity, Pharynx, Larynx, Trachea, Bronchus</td>
<td></td>
</tr>
</tbody>
</table>
7. Organism Level (Level Six)

The sum total of all levels creates the organism, the human being.

The human being is the highest level of organisation and represents all other levels working together to maintain life.

Maintaining Life

Now that you’re aware of the structural levels composing the human body, the question that naturally follows is, what does this highly organised human body do? Like all complex animals, human beings maintain their boundaries, move, respond to environmental changes, take in and digest nutrients, carry out metabolism, dispose of wastes, reproduce themselves and grow.

It cannot be emphasised too strongly that the multi-cellular state and the parcelling out of vital body functions to several different organ systems result in interdependence of all body cells. No individual’s organ systems work in isolation. Instead, they work together cooperatively to promote the well-being of the entire body.

Let us now discuss each of the essential life processes and the system they are delegated to in the human body.

Maintenance of Boundaries

Every living organism must be able to maintain its boundaries so that its internal environment (inside) remains distinct from the external environment surrounding it (outside).

In single-celled organisms, the boundary is an external limiting membrane that contains and admits needed substances while restricting the entry of potentially damaging or unnecessary substances.

Similarly, all the cells of our body are surrounded by a selectively permeable membrane.

Additionally, the body as a whole is enclosed and protected by the Integumentary system, or skin. The Integumentary system plays an important role in protecting our internal organs from drying out (which would be fatal), bacterial invasion, and the damaging effects of an unbelievable number of chemicals and physical factors in the external environment.

Movement

Movement includes all the activities promoted by the muscular system, such as propelling ourselves from one place to another by walking, running, or swimming and manipulating the external environment with our nimble fingers. The muscular system is aided by the skeletal system, which provides the bony framework that the muscles pull on as they work. Movement also occurs when substances such as blood, foodstuffs and urine are propelled through internal organs of the cardiovascular system, digestive and urinary systems, respectively. On the cellular level, the muscle cell’s ability to move by shortening is more precisely called contractility.

Responsiveness

Responsiveness, or irritability, is the ability to sense changes (stimuli) in the environment and then react or respond to them. For example, if you cut your hand on broken glass, a withdrawal reflex occurs – you involuntarily pull your hand away from the painful stimulus (the broken glass). It is not necessary to think about it – it just happens! Likewise, when carbon dioxide in your blood rises to
dangerously high levels, chemical sensors respond by sending messages to brain centres controlling respiration and your breathing rate is accelerated.

**Digestion**

Digestion is the process of breaking down ingested foodstuffs by the digestive system into simple molecules that can be absorbed into the blood for distribution to all body cells by the cardiovascular system. In a simple, one celled organism such as amoeba, the cell itself is the ‘digestion factory’ but in a complex multi-cellular human body, the digestive system performs this function for the entire body.

**Metabolism and Growth**

Metabolism (a state of change) is a broad term that encompasses all chemical reactions that occur within body cells. It includes breaking down complex substances into their simpler building blocks, synthesising more complex cellular structures from simpler substances and using nutrients and oxygen to produce (via cellular respiration) ATP, the energy-rich molecules that power cellular activities.

Metabolism depends on the digestive and respiratory systems to make nutrients and oxygen available to the blood and on the cardiovascular system to distribute these needed substances throughout the body. Metabolism is regulated largely by hormones secreted by glands of the endocrine system.

Growth is an increase in size of a body part or the organism. It is usually accomplished by increasing the number of cells. However, individual cells also increase in size when not dividing.

**Excretion**

Excretion is the process of removing excreta or wastes from the body. If the body is to continue to operate as we expect it to, it must get rid of useful substances produced during digestion and metabolism. Several organ systems rid the body of indigestible food residues in faeces and the urinary system disposes of nitrogen-containing metabolic wastes, such as urea and uric acid in urine.

Carbon dioxide, a by-product of cellular respiration, is carried in the blood to the lungs, where it leaves the body in exhaled air.

**Reproduction**

Reproduction can occur at the cellular or organism level. In cellular reproduction the original cell divides, producing two identical daughter cells that may then be used for body growth and repair. Reproduction of the human organism, or making a whole new person, is the major task of the reproductive system. When a sperm unites with an egg, a fertilised egg forms, which then develops into a bouncing baby within the mother's body.

The reproductive system is directly responsible for producing offspring, but its function is exquisitely regulated by hormones of the endocrine system. Because males produce sperm and females produce eggs (ova), there is a division of labour in the reproductive process and the reproductive organs of males and females are quite different (see figure 1.2). Additionally, the female's reproductive structures provide the site for fertilisation of eggs or sperm, then protect and nurture the developing foetus until birth.
Transport
Transportation of materials (waste, food and respiratory gases) occurs via the Cardiovascular System. Nutrients, taken in via the diet, contain the chemical substances used for energy and cell building. Nutrients are required for the chemical reactions that go on in cells and for oxygen transport in the blood. For example, the mineral calcium helps to make bones hard and is required for blood clotting.

Respiration
Without oxygen, cells can survive for only a few minutes. Approximately 20% of the air we breathe is oxygen. It is made available to the blood and body cells by the cooperative efforts of the respiratory and cardiovascular systems.

Survival Needs
The ultimate goal of all body systems is to maintain life. However, life is extraordinarily fragile and requires several factors. These factors, which we will call survival needs, include nutrients, oxygen, water, appropriate temperature and atmospheric pressure.

1. Water
Water accounts for 60% to 80% of body weight and is the single most abundant chemical substance in the body. It provides the watery environment necessary for chemical reactions and the fluid base for body secretions and excretions. Water is obtained chiefly from ingested foods or liquids and is lost from the body by evaporation from the lungs and skin and in body excretions.

2. Nutrients
Nutrients, taken in via the diet, contain the chemical substances used for energy and cell building. Most plant-derived foods are rich in carbohydrates, vitamins and minerals, whereas most animal foods are rich in proteins and fats. Carbohydrates are the major energy fuel for body cells. Proteins and to a lesser extent fats are essential for building cell structures. Fats also cushion body organs, form insulating layers and provide a reserve of energy–rich fuel.

3. Oxygen
All the nutrients in the world are useless unless oxygen is also available, because the chemical reactions that release energy from foods are oxidative reactions that require oxygen.

4. Body Temperature
If chemical reactions are to proceed at life sustaining rates, body temperature must be maintained around 37°C (98°F). As body temperature drops below this point, metabolic reactions become slower and slower and finally stop. When body temperature is too high, chemical reactions proceed so rapidly that the body proteins lose their characteristic shape and stop functioning. At either extreme, death occurs. Most body heat is generated by the activity of the skeletal muscles.

5. Atmospheric Pressure
The force exerted on the surface of the body by the weight of air is referred to as atmospheric pressure. Breathing and exchanging oxygen and carbon dioxide in the lungs depend on appropriate atmospheric pressure. At high altitudes, where the atmospheric pressure is lower and the air is thin,
gas exchange may be inadequate to support cellular metabolism. However, the bone marrow eventually compensates by forming more red blood cells.

The mere presence of these survival factors is not sufficient to maintain life. They must be present in appropriate amounts as well: excesses and deficits may be equally harmful. For example, oxygen is essential but extremely high levels of oxygen are toxic to body cells. Similarly, the food ingested must be of high quality and in proper amounts: otherwise, nutritional disease, obesity, or starvation is likely. Also, while the listed needs are the most crucial, they do not even begin to encompass all of the body’s needs. For example, we can, if we must, live without gravity, but the quality of life suffers.

**Homeostasis**

When you think about the fact that your body contains trillions of cells in nearly constant activity and that remarkably little usually goes wrong with it, you begin to appreciate what a marvellous machine your body is. Walter Cannon, an American physiologist of the early twentieth century, spoke of the ‘wisdom of the body’ and he coined the word homeostasis to describe its ability to maintain relatively stable internal conditions even though there is continuous change in the outside world. Although the literal translation of homeostasis is “unchanging,” the term does not really mean a static, or unchanging, state. Rather it indicates a dynamic state of equilibrium, or a balance, in which internal conditions change and vary, but always within relatively narrow limits.

In general, the body is in homeostasis when its needs are adequately met and its functions are occurring smoothly. But maintaining homeostasis is much more complex than it appears at first glance. Virtually every organ system plays a role in maintaining the constancy of the internal environment. Adequate blood levels of vital nutrients must be continuously present and heart activity and blood pressure must be constantly monitored and adjusted so that the blood is propelled with adequate force to reach all body tissues. Also, wastes must not be allowed to accumulate and body temperature must be precisely controlled.

A wide variety of chemical, thermal and neural factors act and interact in complex ways – sometimes bolstering and sometimes impeding the body as it works to maintain its ‘steady rudder.’
8. Medical Terminology

This section describes the medical terminology that the massage professional most often encounters, particularly as it relates to charting and record-keeping procedures. To study this section, you may find a medical dictionary or your online search engine beneficial to search certain medical terms. Exploring medical terminology automatically provides an overview of anatomy and physiology. This section is not meant to replace an anatomy and physiology text, but rather to provide a quick reference in preparation for the development of effective record-keeping and charting skills. When used with a standard anatomy and physiology textbook, this section can help focus the information so that it is more specific to the field of massage.

Competencies

After completing this section, you should be able to:

- Identify the three word elements used in medical terms
- Combine word elements into medical terms
- Comprehend unfamiliar medical terms
- Identify pertinent abbreviations used in health care and their meanings
- Use relevant anatomic and physiologic terminology correctly
- Use the information in this chapter for effective professional record keeping

Objectives

Using the information presented in this section, you will be able to perform the following:

Medical Terminology

- Define words by breaking them down into their word elements
- Identify indications for and contraindications to massage
- List and define anatomic and physiologic terms by body system
- List and identify common abbreviations

Key Terms

The following key terms are referred to in this section:

- Abbreviations
- Assessment
- Body, mind, and spirit
- Bodywork
- Care or treatment plan
- Charting
- Client
- Client records
- Clinical massage
- Contraindication
- Database
- Deep tissue
- Deep tissue work/massage
- Discipline
- Documentation
- Goals
- Modality
- Motor tone
- Muscle tone
- Nomenclature
- Patient
- Physical agent
- Prefix
- Progress or session notes
- Qualifiable
- Quantifiable
- Root word
- SOAP notes
- Soft tissues
- Special tests
- Standards of care
- Standards of practice
Introduction

The study of medical terminology provides a key to understanding the accepted language of the sciences. As massage therapy again moves into the position of a medically valid service, the massage professional will find it increasingly important to be able to speak, write and understand scientific language. In addition, the massage professional must be able to maintain client records accurately.

The ability to record written information accurately and concisely depends on the correct use of terminology and an organised approach to charting procedures. This section provides an outline of the medical terminology most often encountered by the massage professional.

Fundamentals of Medical Terminology

Having agreement with regard to terminology is important. Without a common language, we cannot communicate. To be able to communicate with their clients in a common language that both can understand is the responsibility of massage professionals.

Because most structures in the body have formal Greek and Latin names, learning Anatomy is similar to learning a new language.

To prevent misunderstanding, anatomists have a universally accepted terminology that allows body structures to be located and identified with a minimum of words and a high degree of precision.

The use of such precise terminology precludes ambiguity and ensures accuracy in descriptions.

Interactive Questions:

1. Discuss why multiple terms for the same method might have developed.

2. Discuss difficulties that may occur as a result of differences in terminology.

Medical terms are made up of combined word elements. A term can be interpreted easily by separating the word into its elements. These word elements include prefixes, roots and suffixes.
Interactive Questions:

1. The beauty of medical terminology is that it allows new words to be created as needed. Example: Oligorhinoscoliosis: oligo, small; rhino, nose; scoliosis, curve. From the lists of prefixes, root words and suffixes in the tables provided below create your own example.

2. What are the three word elements and how are they used?
### Common Prefixes

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Prefix</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a-, an-</td>
<td>Without or not</td>
<td>intro-</td>
<td>Into, within</td>
</tr>
<tr>
<td>ab-</td>
<td>Away from</td>
<td>leuk-</td>
<td>White</td>
</tr>
<tr>
<td>ad-</td>
<td>Toward</td>
<td>macro-</td>
<td>Large</td>
</tr>
<tr>
<td>ante-</td>
<td>Before, forward</td>
<td>mal-</td>
<td>Bad, illness, disease</td>
</tr>
<tr>
<td>anti-</td>
<td>Against</td>
<td>mega-</td>
<td>Large</td>
</tr>
<tr>
<td>auto-</td>
<td>Self</td>
<td>micro-</td>
<td>Small</td>
</tr>
<tr>
<td>bi-</td>
<td>Double, two</td>
<td>mono-</td>
<td>One, single</td>
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<tr>
<td>circum-</td>
<td>Around</td>
<td>neo-</td>
<td>New</td>
</tr>
<tr>
<td>contra-</td>
<td>Against, opposite</td>
<td>non-</td>
<td>Not</td>
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<tr>
<td>de-</td>
<td>Down, from, away from, not</td>
<td>para-</td>
<td>Abnormal</td>
</tr>
<tr>
<td>dia-</td>
<td>Across, through, apart</td>
<td>per-</td>
<td>By, through</td>
</tr>
<tr>
<td>dis-</td>
<td>Separation, away from</td>
<td>peri-</td>
<td>Around</td>
</tr>
<tr>
<td>dys-</td>
<td>Bad, difficult, abnormal</td>
<td>poly-</td>
<td>Many, much</td>
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<tr>
<td>ecto-</td>
<td>Outer, outside</td>
<td>post-</td>
<td>After, behind</td>
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<tr>
<td>en-</td>
<td>In, into, within</td>
<td>pre-</td>
<td>Before, in front of, prior to</td>
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<tr>
<td>endo-</td>
<td>Inner, Inside</td>
<td>pro-</td>
<td>Before, in front of</td>
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<tr>
<td>epi-</td>
<td>Over, on</td>
<td>re-</td>
<td>Again</td>
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<td>eryth-</td>
<td>Red</td>
<td>retro-</td>
<td>Backward</td>
</tr>
<tr>
<td>ex-</td>
<td>Out, out of, from, away from</td>
<td>semi-</td>
<td>Half</td>
</tr>
<tr>
<td>hemi-</td>
<td>Half</td>
<td>sub-</td>
<td>Under</td>
</tr>
<tr>
<td>hyper-</td>
<td>Excessive, too much, high</td>
<td>super-</td>
<td>Above, over, excess</td>
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<tr>
<td>hypo-</td>
<td>Under, decreased, less than normal</td>
<td>supra-</td>
<td>Above, over</td>
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<tr>
<td>in-</td>
<td>In, into, within, not</td>
<td>trans-</td>
<td>Across</td>
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<tr>
<td>inter-</td>
<td>Between</td>
<td>uni-</td>
<td>One</td>
</tr>
<tr>
<td>intra-</td>
<td>Within</td>
<td></td>
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## Common Root Words

<table>
<thead>
<tr>
<th>Root (Combining Vowel)</th>
<th>Meaning</th>
<th>Root (Combining Vowel)</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>abdomin (o)</td>
<td>Abdomen</td>
<td>neur (o)</td>
<td>Nerve</td>
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<tr>
<td>aden (o)</td>
<td>Gland</td>
<td>ocul (o)</td>
<td>Eye</td>
</tr>
<tr>
<td>adren (o)</td>
<td>Adrenal gland</td>
<td>orth (o)</td>
<td>Straight, normal, correct</td>
</tr>
<tr>
<td>angi (o)</td>
<td>Vessel</td>
<td>oste (o)</td>
<td>Bone</td>
</tr>
<tr>
<td>arterio (o)</td>
<td>Artery</td>
<td>ot (o)</td>
<td>Ear</td>
</tr>
<tr>
<td>arthr (o)</td>
<td>Joint</td>
<td>ped (o)</td>
<td>Child, foot</td>
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<tr>
<td>bronch (o)</td>
<td>Bronchus, bronchial</td>
<td>pharyng (o)</td>
<td>Pharynx</td>
</tr>
<tr>
<td>card, cardi (o)</td>
<td>Heart</td>
<td>phleb (o)</td>
<td>Vein</td>
</tr>
<tr>
<td>cephal (o)</td>
<td>Head</td>
<td>pnea</td>
<td>Breathing, expiration</td>
</tr>
<tr>
<td>chondr (o)</td>
<td>Cartilage</td>
<td>pneum (o)</td>
<td>Lung, air, gas</td>
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<tr>
<td>col (o)</td>
<td>Colon</td>
<td>proct (o)</td>
<td>Rectum</td>
</tr>
<tr>
<td>cost (o)</td>
<td>Rib</td>
<td>psych (o)</td>
<td>Mind</td>
</tr>
<tr>
<td>cran (i)</td>
<td>Skull</td>
<td>pulm (o)</td>
<td>Lung</td>
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<td>cyan (o)</td>
<td>Blue</td>
<td>py (o)</td>
<td>Pus</td>
</tr>
<tr>
<td>cyst (o)</td>
<td>Bladder, cyst</td>
<td>rect (o)</td>
<td>Rectum</td>
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<tr>
<td>cyt (o)</td>
<td>Cell</td>
<td>rhin (o)</td>
<td>Nose</td>
</tr>
<tr>
<td>derma</td>
<td>Skin</td>
<td>stern (o)</td>
<td>Narrow, constriction</td>
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<td>duoden (o)</td>
<td>Duodenum</td>
<td>stern (o)</td>
<td>Sternum</td>
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<td>encephal (o)</td>
<td>Brain</td>
<td>stomat (o)</td>
<td>Mouth</td>
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<tr>
<td>enter (o)</td>
<td>Intestines</td>
<td>therm (o)</td>
<td>Heat</td>
</tr>
<tr>
<td>fibro (o)</td>
<td>Fiber, fibrous</td>
<td>thorac (o)</td>
<td>Chest</td>
</tr>
<tr>
<td>gastr (o)</td>
<td>Stomach</td>
<td>thromb (o)</td>
<td>Clot, thrombus</td>
</tr>
<tr>
<td>gyn, gyn, gyneco</td>
<td>Female</td>
<td>thyr (o)</td>
<td>Thyroid</td>
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<tr>
<td>hem, hema, hemo, hemat (o)</td>
<td>Blood</td>
<td>toxic (o)</td>
<td>Poison, poisonous</td>
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<tr>
<td>hep (o)</td>
<td>Liver</td>
<td>trache (o)</td>
<td>Tracheae</td>
</tr>
<tr>
<td>hydr (o)</td>
<td>Water</td>
<td>ur (o)</td>
<td>Urine, urinary tract, urination</td>
</tr>
<tr>
<td>hyster (o)</td>
<td>Uterus</td>
<td>urethr (o)</td>
<td>Urethra</td>
</tr>
<tr>
<td>ile (o), ili (o)</td>
<td>Ileum</td>
<td>urin (o)</td>
<td>Urine</td>
</tr>
<tr>
<td>laryng (o)</td>
<td>Larynx</td>
<td>uter (o)</td>
<td>Uterus</td>
</tr>
<tr>
<td>mamm (o)</td>
<td>Breast, mammary gland</td>
<td>vas (o)</td>
<td>Blood vessel, vas deferens</td>
</tr>
<tr>
<td>my (o)</td>
<td>Muscle</td>
<td>ven (o)</td>
<td>Vein</td>
</tr>
<tr>
<td>myel (o)</td>
<td>Spinal cord, bone marrow</td>
<td>verteb (o)</td>
<td>Spine, vertebrae</td>
</tr>
<tr>
<td>neph (o)</td>
<td>Kidney</td>
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</tbody>
</table>
## Common Suffixes

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>-algia</td>
<td>Pain</td>
</tr>
<tr>
<td>-asis</td>
<td>Condition, usually abnormal</td>
</tr>
<tr>
<td>-cele</td>
<td>Hernia, herniation, pouching</td>
</tr>
<tr>
<td>-cyte</td>
<td>Cell</td>
</tr>
<tr>
<td>-ectasis</td>
<td>Dilation, stretching</td>
</tr>
<tr>
<td>-ectomy</td>
<td>Excision, removal of</td>
</tr>
<tr>
<td>-emia</td>
<td>Blood condition</td>
</tr>
<tr>
<td>-genesis</td>
<td>Development, production, creation</td>
</tr>
<tr>
<td>-genic</td>
<td>Producing, causing</td>
</tr>
<tr>
<td>-gram</td>
<td>Record</td>
</tr>
<tr>
<td>-graph</td>
<td>Diagram, recording instrument</td>
</tr>
<tr>
<td>-graphy</td>
<td>Making a recording</td>
</tr>
<tr>
<td>-lasis</td>
<td>Condition of</td>
</tr>
<tr>
<td>-ism</td>
<td>Condition</td>
</tr>
<tr>
<td>-itis</td>
<td>Inflammation</td>
</tr>
<tr>
<td>-logy</td>
<td>Study of</td>
</tr>
<tr>
<td>-lysis</td>
<td>Destruction of, decomposition</td>
</tr>
<tr>
<td>-mega(y)</td>
<td>Enlargement</td>
</tr>
<tr>
<td>-oma</td>
<td>Tumor</td>
</tr>
<tr>
<td>-osis</td>
<td>Condition</td>
</tr>
<tr>
<td>-pathy</td>
<td>Disease</td>
</tr>
<tr>
<td>-penia</td>
<td>Lack, deficiency</td>
</tr>
<tr>
<td>-phasia</td>
<td>Speaking</td>
</tr>
<tr>
<td>-phobia</td>
<td>Exaggerated fear</td>
</tr>
<tr>
<td>-plasty</td>
<td>Surgical repair or reshaping</td>
</tr>
<tr>
<td>-plegia</td>
<td>Paralysis</td>
</tr>
<tr>
<td>-rhago, -rhagia</td>
<td>Excessive flow</td>
</tr>
<tr>
<td>-rhea</td>
<td>Profuse flow, discharge</td>
</tr>
<tr>
<td>-scope</td>
<td>Examination instrument</td>
</tr>
<tr>
<td>-scopy</td>
<td>Examination using a scope</td>
</tr>
<tr>
<td>-stasis</td>
<td>Maintenance, maintaining a constant level</td>
</tr>
<tr>
<td>-stomy, -ostomy</td>
<td>Creation of an opening</td>
</tr>
<tr>
<td>-tomy, -otomy</td>
<td>Incision, cutting into</td>
</tr>
<tr>
<td>-uria</td>
<td>Condition of the urine</td>
</tr>
</tbody>
</table>
Abbreviations

Abbreviations are shortened forms of words or phrases. When you use abbreviations in any record keeping, including charting, provide an abbreviation key either on the forms or in a conspicuous place in the file. Using an overabundance of abbreviations makes reading difficult and requires interpretation. Jargon should also be avoided in record keeping.

Interactive Questions:

1. Define abbreviations and provide guidelines for their use.

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2. In a medical dictionary, look up and define each of the following terms related to diseases:

Bacterial

Cancer

Congenital

Degenerative

Epidemic

Exacerbation

Fungal
3. Write a descriptive statement about a fictional client. Use at least five terms listed in this section.

Example: Mr. X reveals during the client history procedure that he is suffering from an acute exacerbation of a chronic viral infectious process.

Your Turn. _____________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

**General Structural Plan of the Body**

Directional terms are used to describe how one body part relates to another.

**Interactive Questions:**

1. Consult your medical dictionary or medical terminology text to define the following terms:

   Anterior _____________________________________________________________

   _________________________________________________________

   Caudad _____________________________________________________________

   _________________________________________________________

   Cephalad _____________________________________________________________

   _________________________________________________________

   Deep _____________________________________________________________

   _________________________________________________________

   Distal _____________________________________________________________

   _________________________________________________________

   Dorsal _____________________________________________________________

   _________________________________________________________
Anatomical Position

The Anatomical Position is a standard body position that provides an initial reference point to help describe body parts and position accurately. Most directional terminology used in these notes and the accompanying textbook refer to an individual’s body as if it were in the anatomical position, regardless of its actual position.

If you get confused about a particular body position or directional term always refer back to the anatomical position. You will note that many body system charts depict the body in this position.

The anatomical position is with:

- the body erect
- head, eyes and toes forward
- upper limbs by the sides
- palms facing forward

Other positions used in anatomical description:

- **Prone** lying face down
- **Supine** lying face up
- **Neutral** the position adopted by a body part midway between two opposite positions
- **Resting** the position adopted by the body or body part where its mass is supported by an external force, e.g. lying in bed or sitting in a chair

Midline of the Body

On occasions the term "Midline" will be referred to when describing other body positions or directions. The midline is an imaginary line that passes through the middle of the body. Not unlike the body's plumbline used in posture analysis.
Fundamental Divisions of the Body

The most fundamental divisions of the body are the axial and appendicular regions.

Axial Region

The axial region makes up the axis of the body, consisting of the:

1. Head
2. Neck
3. Trunk
   3.1 Thorax
   3.2 Abdomen
Appendicular Region

The appendicular region makes up the appendages of the body, consisting of the:

1. Upper Extremity
   1.1 Shoulder
   1.2 Upper Limb
2. Lower Extremity
   2.1 Pelvis
   2.2 Lower Limb
Abdominal Quadrants and Regions

The abdomen is divided into four quadrants and nine regions, the names of which are used to describe the location of body structures, pain, or discomfort.

Interactive Questions:

1. List the four abdominal quadrants in the picture below.

![Abdominal Quadrants](image1)

2. Study the diagram of the nine abdominal regions below. Once you have memorised the names and numbers, test yourself by touching each landmark on yourself.

![Abdominal Regions](image2)
Body Regions

The human body is divided into 6 major regions, all identifiable on the surface. These 6 body regions can be subdivided into more specific localised areas.

Head Region

1. Cranium (Skull, Braincase)
   - Cranial
   - Auricular (Ear)
2. Face
   - Orbital (Eye)
   - Nasal (Nose)
   - Buccal (Cheek)
   - Oral (Mouth)
   - Mandibular (Chin)

Neck Region

3. Anterior Neck (Cervical Region)
4. Posterior Neck (Nuchal Region)

Trunk Region

5. Thorax
   - Pectoral (Chest)
   - Scapular (Shoulder Blade)
   - Interscapular (Between Shoulder Blades)
6. Abdomen (Stomach)
7. Pelvis
   - Inguinal (Groin)
   - Perineum (Floor of Pelvis)

Upper Extremity

8. Deltoid (Shoulder)
9. Axillary (Armpit)
10. Brachial (Upper Arm - Humeral Region)
11. Cubital (Elbow)
12. Antebrachium (Forearm)
13. Carpal (Wrist)
14. Hand
Back
15. Thoracic (Ribs)
16. Lumbar (Lower Back)
17. Sacroiliac (Between Buttocks)

Lower Extremity
18. Gluteal (Buttock)
19. Femoral (Upper Leg, Thigh)
20. Patellar (Anterior Knee)
21. Popliteal (Posterior Knee)
22. Crural (Lower Leg)
23. Malleolar (Ankle)
24. Tarsal (Foot)

Interactive Questions:
1. Stand in front of a mirror and identify each landmark and point of surface anatomy and body region. Say the words out loud.
Interactive Questions:

1. Study the diagram below. Once you have memorised the terms test yourself by touching each landmark on yourself.
9. Directional Terms

A number of directional terms are used by anatomists to explain precisely where one body structure is in relation to another. Although most of these terms are also used in everyday conversation, keep in mind that their anatomical meanings are very precise.

Superior
- situated above or directed upward
- in human anatomy, situated nearer the vertex of the head in relation to a specific reference point
- also known as cranial or cephalad
- opposite of inferior

Inferior
- situated below or directed downward
- situated nearer the soles of the feet in relation to a specific reference point
- also known as caudal/caudad
- opposite of superior

Anterior
- denoting the front surface of the body; often used to indicate the position of one structure relative to another, i.e. situated nearer the front part of the body
- also known as ventral
- opposite to posterior

Posterior
- denoting the back surface of the body
- often used to indicate the position of one structure relative to another, i.e. nearer the back of the body
- also known as dorsal
- opposite to anterior

Medial
- relating to the middle or center; nearer to the median or midsagittal plane
- opposite to lateral

Lateral
- on the side
- farther from the median or midsagittal plane
- opposite to medial
Intermediate

- lying between two structures one of which is medial and the other lateral

Proximal

- nearest the trunk/centre of the body, or the point of origin
- employed only with reference to the limbs
- opposite to distal

Distal

- situated away from the trunk/center of the body, or from the point of origin
- employed to the extremity or distant part of the limb
- opposite to proximal

Superficial

- pertaining to or situated near the surface.
- opposite to deep

Deep

- further away from the surface
- opposite to superficial

Ipsilateral

- on the same side, with reference to a given point
  - e.g. a dilated pupil on the same side as an extradural hematoma
  - also known as homolateral
- opposite to contralateral

Contralateral

- relating to the opposite side
  - e.g. as when pain is felt or paralysis occurs on the side opposite to that of the lesion
  - also known as heterolateral
- opposite to ipsilateral
Radial
- used in the upper limb
- lateral, or nearer, to the "thumb side" of the forearm or hand
- paired with ulnar

Ulnar
- use in the upper limb
- medial, or nearer, to the little finger side of the forearm or hand
- paired with radial

Palmer
- used in the upper limb for anterior

Planter
- used in the lower limb for the sole of the foot

Internal
- inner aspect of a body cavity or organ
- opposite to external

External
- outer aspect of a body cavity or organ
- opposite to internal

Peripheral
- towards the outer part or surface of the body
- opposite to central

Central
- towards the centre of the body
- opposite to peripheral
Review

The following sentences use directional terms to describe the position of body parts.

- The head is superior to the abdomen
- The navel is inferior to the chin
- The breastbone is anterior to the spine
- The heart is posterior to the breastbone
- The heart is medial to the arm
- The arms are lateral to the chest
- The collarbone is intermediate between the breastbone and shoulder
- The elbow is proximal to the wrist
- The knee is distal to the thigh
- The skin is superficial to the skeletal muscles
- The lungs are deep to the skin
- The wrist is distal to the elbow
- The hip is lateral to the navel
- The nose is superior to the chin
- The toes are anterior to the heel
- The scalp is superior to the skull

Quadruped

Whereas the terms **ventral** and **anterior** are synonymous in humans, this is not the case in four-legged animals. **Ventral** specifically refers to the belly of a vertebrate animal and thus is the **inferior** surface of four-legged animals.

Likewise, although the **dorsal** and **posterior** surfaces are the same in humans, the term dorsal specifically refers to an animal's back. Thus, the **dorsal** surface of four-legged animals is their **superior** surface.

Additionally, the **superior/inferior** term pair mean toward and away from the head end respectively in humans, but the term pair **cephalad/caudal** conveys this meaning in four-legged animals.
10. Body Planes

The study of Anatomy often involves dissection, in which the body or its organs are sectioned (cut) along an imaginary line called a plane.

Sagittal Plane

- vertical plane
- runs longitudinally and divides the body into right and left portions
- also known as Medial Plane
- many sagittal planes are possible

There are two types of sagittal planes:

1. Midsaggital
   passes through the midline of the body and divides it into equal left and right portions
2. Parasaggital
   passes through the body, offset from the midline and divides the body into unequal left and right portions.

Interactive Questions:

Colour in the midsaggital and parasaggital planes shown below.
Frontal Plane
- vertical plane
- runs longitudinally and divides the body into anterior and posterior portions
- also known as Coronal Plane
- lies at right angles to the Sagittal Plane

Transverse Plane
- horizontal plane
- runs horizontally across and at a right angle to the long axis of the body dividing it into superior and inferior parts
- also known as Horizontal Plane
- many transverse planes are possible
- runs at right angles to both the sagittal and frontal planes
- cross-sections are Transverse Planes, e.g., cross section of a limb or the heart

Interactive Questions:
Colour in the frontal and transverse planes shown below.
Interactive Questions:
Colour in and label the body planes.
Label the directional terms.
Body Cavities
The body cavities contain the organs and are divided into ventral and dorsal regions. The back or posterior surface of the trunk is also divided into the following regions:

- Cervical region: the neck (seven cervical vertebrae)
- Thoracic region: the chest (twelve thoracic vertebrae)
- Lumbar region: the loin (five lumbar vertebrae)
- Sacral region: the sacrum (five sacral vertebrae that are fused into one bone)
- Coccyx: the tailbone (four coccygeal vertebrae that are fused into one bone)

Closed Body Cavities
Within the axial portion of the body are two major closed body cavities that contain internal organs.

Ventral Body Cavity
Located nearer to the ventral, or anterior surface of the body, and is the larger of the closed body cavities housing a group of internal organs collectively called the viscera.

There are two main subdivisions:

- The more superior Thoracic Cavity is surrounded by the ribs and muscles of the chest.
- The inferior Abdominopelvic Cavity is separated from the Thoracic Cavity by the diaphragm.

Dorsal Body Cavity
Located nearer to the dorsal, or posterior, surface of the body and is subdivided into:

The Cranial Cavity within which the brain is encased by the skull.

The Vertebral Cavity running between the bony vertebral column which encloses delicate spinal cord.

Open Body Cavities
In addition to the major closed body cavities, there are other smaller and generally tubular body cavities which are open to the body's exterior:

Oral Cavity
Commonly called the mouth which is continuous with the Digestive Tract and also opens to the exterior at the anus.

Nasal Cavity
Located posterior to the nose and is part of the Respiratory Tract.

Perineum Cavities
Part of the reproductive tract and urinary tract.

Orbital Cavities
House the eyes and present them in an anterior position.

Ear Cavities
Carved into the temporal bone of the skull and contain the tiny bones associated with the transmission of sound.
Interactive Questions:

1. Shown is a diagram of the body cavities listed below.
   Label and color in the cavities and list the structures found in each.
   - Vertebral Cavity
   - Abdominal Cavity
   - Thoracic Cavity
   - Cranial Cavity
   - Pelvic Cavity

Interactive Questions:

2. The main cavities of the body include the abdominal and pelvic cavities. List three organs in each of these cavities.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Medical Imaging Devices

The ability to interpret sections through the body is becoming increasingly important in the clinical sciences because new medical imaging devices produce sectional images rather than three dimensional images.

X-ray Images

Conventional X-rays are still the workhorse of diagnostic imaging techniques and account for half of all imaging currently done. What x-rays do best is visualise hard, bony structures and peer at the chest to locate abnormally dense structures in the lungs.

Radiograph

X-rays produce a shadowy negative of the internal structures of the body. Dense structures absorb the X-rays most and so appear as light areas on the radiograph, whereas hollow air-containing organs and fat, which absorb x-rays to a lesser extent, appear as dark areas.
As an example, following is a list of structures, from darkest (black) to lightest (white), as they would appear on an X-ray film – 1 being the darkest, 2 being the next darkest and so on.

1. air in lungs
2. soft tissues
3. femur (bone of the thigh)
4. gold (metal) filling in a tooth

Fluoroscope

In a variation of radiography, X-ray images are viewed on a fluorescent screen, or fluoroscope as they are being generated.

Scanning

New imaging techniques introduced in the 1970’s not only reveal the internal structure of our body but also provide information about the workings. The CAT and PET scans now account for about 25% of imaging.

CAT Scan

CAT (Computed Axial Tomography) is a refined version of X-ray equipment. CAT ends the confusion resulting from images of overlapping structures seen in conventional X-rays and has all but eliminated exploratory surgery.

PET Scan

PET (Positron Emission Tomography) advantage is that it can send images about metabolic processes by scanning the injected radioisotopes.

MRI Scan

MRI (Magnetic Resonance Imaging) uses magnetic fields to obtain information on the body’s structure.

Sonography

Sonography or ultrasound has some distinct advantages over the above approaches to investigating the body. Firstly, the equipment is inexpensive and secondly the high-frequency sound waves (ultrasound) used as its energy source have no adverse effect on the body.

Summary

Without a common language, we cannot communicate. Massage professionals must be able to communicate with their clients in a common language that both can understand; it is just as important that they understand the communications of other health professionals.

The information presented in this section is especially pertinent to an understanding of massage as it relates to anatomy, physiology, pathophysiology, and client records. Because the basis for medical terminology is scientific language, understanding this information helps the massage student understand massage therapy research, as well as articles and books on subjects related to massage. Learning the names of muscles, bones, joints, and other anatomic structures lays a firm foundation for understanding and correctly using medical terminology.
11. Physical Health Status

Introduction to primary health care

The purpose of this section is to describe the wide range of skills and knowledge that are required when assessing the health status of a client. Health care practitioners come into contact with multiple clients on the same day, and therefore must be capable of making quick assessments and decisions about their physical health so that the right course of action can be taken. Australia has a wide range of health facilities and services. It is essential for all of these services to find out as much information about clients as possible.

Primary health care

In Australia, the first point of call for someone who has medical needs is usually through primary health care. This generally means it is located outside of hospitals, and clients do not require a referral for such care.

Primary health care services include:

- General practitioner services
- Dental practitioners
- Nurses
- Pharmacists
- Indigenous health workers
- Physiotherapists
- Chiropractors
- Dieticians

Making efforts to ensure the above primary services provide a high standard of care is a key priority of government and state departments, due to their overall importance in health care. Primary health care accounted for 36.1% ($50.6 billion) of total health expenditure in 2011-12 in comparison to 38.2% ($53.5 billion) on hospital services, so it is a central component of the overall health system. Within primary care, a large proportion of people will seek the services of a General Practitioner (GP), where they will normally see a doctor, nurse, or healthcare professional. Reasons for attending a GP can be wide ranging, such as suffering from minor illnesses, minor injuries, or concerns about general health.

Initial observations

A lot of information can be gained from the first contact a client makes with a healthcare professional. It is important that decisions about what questions to ask the client and what actions they will require are thought about almost straight away, as the stretch on medical services means that appointments are limited in time and the healthcare professional must come to a conclusion about the issues of a client and their future needs within a short space of time.

Initial observations may include:

- Height/ body shape
- Style of walk
Identifying Health Problems through Observation

Based on the information that can be gained through observation and considering your knowledge of the body systems, you should attempt to identify problems that already exist with the client’s health, or potential problems that might arise in the future.

As has been presented, information about the health of a client can be gained from various sources. For example, you can observe them; the way they walk, their appearance, their behaviour and their breathing rate.

There are occasions when observing the client will not provide the healthcare professional with adequate information to assess identify health problems. For example, a client could be suffering with a heart condition without there being any visible indicators. Similarly, a client might be walking with a limp sustained from a sporting injury, and the healthcare professional might presume it is a permanent defect; there needs to be further methods of assessment to identify the severity and temporality of health problems.

Height/ body shape

When a healthcare professional first observes a patient, they will inevitably make judgements about their body size and shape. Of course it is not possible to make an informed judgement regarding a client’s health from simply observing them – for this, you need information on their body fat percentage, diet, level of exercise, whether they are a smoker, and family history of illness. It can still be useful to make assessments of client’s height and body shape because it can help to form the basis of what actions the healthcare professional believes are necessary to confirm physical health status, such as whether the client needs to be weighed or have their body fat percentage measured.

Gait/Style of walk

Someone’s style of walk can also send a message to a healthcare professional about their health status. A walking abnormality can signify a number of things, such as a genetic condition, a disease, disability, or injury. While a nurse, for example, will likely be able to notice that a client has a walking abnormality, they would not be able to distinguish the cause of the problem. Factors such as arthritis, shin splints, tendonitis, and nervous system conditions could also be a cause of a walking defect. Observing a patient’s style of walk enables the health care worker to arrange further assessments if they notice a problem.

Disability

Healthcare professionals may be able to observe a range of disabilities that a client has. A physical disability is likely to affect a person’s mobility or dexterity. A person with a physical disability may need to use some sort of equipment for support with mobility, and this is something that can be observed straight away – it will form the basis of further assessments.

Breathing rate
Healthcare professionals will be able to notice if a patient is breathing heavily from walking and/or having to take large breaths while talking. This could provide indications about their physical health, such as emphysema, which is a type of chronic obstructive pulmonary disease that causes damage to the air sacs in the lungs and the surrounding tissues, or asthma where there is swelling and inflammation of the airways that carry air in and out of the lungs. Noticing heavy breathing will lead to further questioning or assessments about such conditions.

**Questioning client**

**Family history**

A key aspect of assessing the physical health of a client is to establish their family history of health conditions. Families have a number of common factors in relation to health, particularly their genes, and quite often their environment and lifestyle. When considered together, such factors can provide signs of medical conditions running in a family. If there is a history or patterns of a condition in the family, healthcare professionals can utilise this information to determine whether a client, other family members, or future generations are at a heightened risk of developing this condition.

Key disorders to establish in a family medical history include:

- Heart disease
- High blood pressure
- Stroke
- Certain cancers
- Diabetes.

These complex conditions are influenced by a range of genetic factors, environmental situations, and lifestyle decisions. In addition to these, a family history can additionally provide information regarding the risk of less common diseases caused by mutations to a single gene, such as sickle cell anaemia and cystic fibrosis.

Even though a family medical history offers details about the risk of specific health concerns, if a client has relatives with a medical condition this does mean the client will also develop that condition. In contrast, a patient without a family history of a disorder could still be at risk of developing that disorder, particularly if they make poor environmental or lifestyle choices.

Finding out about the client’s family medical history should be encouraged for medical professionals who are responsible for providing a high standard of care. While it may not be possible or necessary to ask about family history at every point of contact within primary health care, it is a valuable process to discover this information on a client’s first appointment with a new health service. This will enable the client to take actions to reduce his or her risk. The health history of the client’s parents, grandparents and siblings should be sought.

**Advice/ actions of the healthcare professional when conditions are present:**

- For clients who have an increased susceptibility to certain cancers, such as breast, ovarian, bowel and womb cancer, healthcare professionals may well recommend regular screening (such as mammography or colonoscopy) at a younger age than usual.

- Healthcare workers may also encourage more frequent testing for people with a condition that runs in their family, such as high blood pressure and diabetes.
In addition, lifestyle alterations such as implementing a healthier diet, exercising frequently, and ceasing smoking are recommended to clients in order to lower their likelihood of developing heart disease and other common diseases.

If clients are unaware of their medical history and there is a lack of information on your service’s database, clients should be advised to speak to relatives about their health. For example, have they experienced any medical problems, and when did they occur? Such information could be obtained at a family gathering or over the phone. Furthermore, locating medical records and documentation (such as obituaries and death certificates) can facilitate the completion of a family medical history.

**Lifestyle factors**

In nearly all circumstances for clients seeking health care services, information will need to be sought regarding their lifestyle choices. Lifestyle includes the behaviour and activities that make up your daily life. This includes things such as the work you do, leisure activities, diet, and interactions with others. Healthcare professionals should question patients on various lifestyle factors that will contribute towards determining their physical health.

<table>
<thead>
<tr>
<th>Lifestyle factor</th>
<th>Risk/ recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>Smoking is one of the major illnesses contributing to illness and death in Australia. It increases your chances of developing over 50 types of illnesses; about 90% of lung cancers are caused by cancer, while it also increases risk of coronary heart disease, stroke, peripheral vascular disease (damaged blood vessels), cerebrovascular disease (damaged arteries that supply blood to your brain). The above conditions can also be caused by passive smoking (breathing in second hand smoke); healthcare workers should question whether people are active as well as passive smokers.</td>
</tr>
<tr>
<td>Physical inactivity</td>
<td>Physical inactivity can contribute to coronary heart disease, obesity, high blood pressure, breathlessness, poor posture, osteoporosis, type 2 diabetes, depression. The World Health Organisation (WHO) recommends adults to do a minimum of 150 minutes of moderate-intensity physical activity per week, such as leisure swimming, brisk walking and swimming, or 75 minutes of vigorous-intensity activity, including running and playing high-intensity sports.</td>
</tr>
<tr>
<td>Diet</td>
<td>A healthy diet provides the body with the nutrient to maintain wellbeing and fight disease. Diets high in saturated fats, refined carbohydrates, and highly processed foods are less likely to correspond with a healthy body, and can lead to conditions such as obesity, type 2 diabetes, high cholesterol, respiratory problems, coronary heart disease and stroke.</td>
</tr>
</tbody>
</table>
The information that clients provide verbally is perhaps the most important method of identifying actual or potential health problems. Firstly, they will most likely be seeking the health service for a particular reason rather than a general health check-up, and this therefore enables the health professional to question the client on what it is they are suffering with/concerned about. This will then form the basis of the health checks that will be conducted. Further to being informed about what the client believes the problem to be, valuable information can be gained from discovering their family history of health conditions. This can help to form the basis of potential health problems a client may have, as previously presented.

Questioning the client about their lifestyle is most likely to present potential health problems that should be the subject of further health checks. Whether they are a smoker or not, whether they have a healthy balanced diet, and whether they exercise to the recommended amount should produce information as to whether the client has a high risk of developing certain health problems.

Documentation

Medical records
Further to observations and questioning of the client, healthcare professionals can gain valuable information from reviewing relevant documentation. Documentation should not necessarily only be applicable to a client at their first time of contact with a health service. For example, if a client is attending an appointment suffering with tonsillitis but has attended the service in the past, it might be useful to check their medical records to see if they have had the illness in the past and what action was taken. Medical records can provide the healthcare professional with detailed information of the client’s physical health up until the present period, and this can save time when it comes to asking questions in an appointment. Additionally, a client might have forgotten about an illness or procedure they had a long time ago, so documentation can help prevent there being an incomplete client medical history.

Medical records indicate the previous health status of the client and are a useful tool to indicate whether their current health problems are ones that could arise again in the future. For example, they might have an ongoing condition such as diabetes which would be detailed in their medical records. Health records can also tell you about potential problems. A previous appointment might have indicated that they were a heavy smoker, or a physical test might have found them to be overweight based on their body mass index (BMI). A healthcare professional might as a result try to gauge whether such risk factors has resulted in the development of a health problem in the meantime.

Immunisation history
Immunisation is a simple, safe and effective way of protecting children against harmful diseases that can lead to serious health problems and possibly even death. The Immunisation Register helps health professionals track immunisation levels in Australia. If a child has an appointment with a health professional they can look at this register to see whether they child is due or has missed out on a vaccination. Detailed information about the ages that children should receive certain vaccines can be found at the National Immunisation Program Schedule on the Department of Health and Immunise Australia Program’s website.

While immunisation records are generally used by healthcare professionals to determine whether a client is up to date with their vaccinations, pre-assessment history take questionnaires are a more useful method of establishing whether they have actual or potential health problems. Client History forms can produce similar types of information that can be gained from questioning the client about their lifestyle choices and family history of illness.
Health/History Intake Forms

Client health intake forms are usually designed for use in primary care settings when a client is attending a service for the first time. They are a vital means for doctors and nurses as well as other practitioners such as massage therapists to form understanding of the state of health of the client. Questionnaires can be designed to establish the client’s current physical wellbeing, their history of illnesses and/or disease, and their lifestyle choices such as diet, alcohol intake, level of exercise, whether they are a smoker and their profession for example. Such information being collected from a form can save the health practitioner from having to ask a series of questions to the client every time they use the service, as the answers can be translated onto a health database.

Factors impacting on health problems

It has been highlighted that healthcare professionals should attempt to gain as much information as possible in order to identify health problems or potential concerns of a client. However, identifying issues based on your knowledge of body systems may only have a limited impact on responding to the health problems of the client; there are many determinants of health which can be different from one client to the next, and these need to be considered when thinking about interventions.

Clients are often unable to control many aspects that impact on their health, so it is vital that external factors are considered by health professionals so that they do not blame clients for certain aspects of health or set targets that are unattainable.

Determinants of health include:

- Social and economic status
- Physical environment
- Individual characteristics.

Social and economic status

Evidence suggests that people with higher income and higher social status are linked to better overall health.

Reasons for this include:

- Being able to afford higher quality foods that are not processed or high in saturated fats.
- People of higher income smoke less on average.
- People of higher socio-economic status are more likely to have taken preventative health care actions
  - Immunising children against contagious diseases
  - Screening tests for cancer
- Those who can take out private health insurance to cover services not covered by Medicare (public health scheme), such as physiotherapy or dental services. People
who can afford hospital cover can also receive some services, such as consultation and surgery, performed more quickly than those without insurance.

- People of higher income are less likely to have financial stresses, which can impact on blood pressure and mental wellbeing.
- People of higher income are better able to afford sporting memberships and the equipment that is required to participate.

**Physical environment**

**Housing**

The link between poor housing and a person's health is complex and involves many factors. There is evidence to suggest that there is an increased risk of developing cardiovascular disease and respiratory disease as well as anxiety from living in poor housing. While it is difficult to establish a causal link relationship between poor housing and health, factors such as damp, mould, a lack of heating, and structural defects produce hazards to health.

You will have to consider that housing conditions are sometimes beyond the control of individuals, and are dependent on income or the support of their family.

**Employment**

Working in certain conditions can impact negatively on a person's health or risk of injury. **For example, working with/in:**

- Asbestos
- Chemicals
- Iron and steel
- Manufacturing
- Mining
- Petroleum products.

Being in contact within such industries heightens the chances of inhaling high levels of dangerous fumes that can damage health.

Healthcare professionals should also consider the level of physical activity within a job. If for example someone has an office job where they are sitting at a desk for the majority of the day, then this will impact upon their health if they do not exercise outside of work.

**Individual characteristics**

Individual characteristics are those that are unique to the client and form the basis of their physical health. These can include the information such as their genetics or lifestyle choices, such as their diet, level of exercise, alcohol consumption, and whether they smoke, although these are also influenced by socio-economic factors.
12. Identify variation from normal physical health status

A client's health status is important prior to delivering massage therapy.

As practitioners we need to understand some of the issues or diseases that might impact on the different systems of the human body using a detailed knowledge of the structure and functioning of body systems to check the health status prior to massage treatment. A thorough health check and understanding of common disorders problems and complaints affecting the body systems inform the practitioner of the client's wellness and the level of service they can receive in terms of massage as well as whether referral to other health practitioners may be needed.

Factors that could impact on body systems or might have a contributory effect on impairment and problems leading to disease include:

- a range of different pathogens and disease processes
- inherited genetic conditions
- diet and nutritional factors
- medications currently being taken by the client
- trauma, toxins and other environmental hazards
- use of alcohol, tobacco and other drugs/substances
- environmental factors impacting health - exposure to chemicals, dust, sunlight, cold etc
- level and type of physical activity
- stress
- interrelationship between body systems
- emotional responses
- patterns of thinking
- fatigue
- medical treatments that the client might be currently undertaking and potential impacts
- degenerative changes in vital organ systems
- the loss of normal control mechanisms such as the uncontrolled growth of cancer cells
- a range of different pathogens and disease processes

When attempting to identify physical conditions that might affect a client's health and which might need to be taken into consideration, a number of factors will be important.

For instance:

- environmental conditions, e.g.
  - temperature and its impact on the client
- a range of internal and external body factors, e.g.
  - stress, tension, discomfort
  - the effect of exertion and anxiety on pulse rate and blood pressure
  - medications currently being taken by the client
  - dietary factors
  - medical treatments that the client might currently be undergoing
It is also important when attempting to identify physical conditions to take into consideration the fact that some clients will be affected by complex or co-morbid conditions, that is, there will be more than one issue or problem to be identified and accommodated.

In some instances a client could wish to engage your services in order to recover from a particular ailment, injury or illness. By way of example, a person recovering from breast cancer surgery might wish to undertake a suitable exercise program, in order to restore mobility, flexibility and confidence. This might help to relieve the discomfort associated with surgery and treatment; however, in designing and developing a program it will be necessary to take into consideration the fact the client is undergoing other treatment as well, such as radiotherapy or chemotherapy. It will be necessary therefore, when identifying the physical conditions that might affect the client's health, to ensure that you collect as much information as possible from the client about their current needs and about any conditions that might impact on treatment or health care plans that you develop. Make allowance for the fact that the chemotherapy, radiotherapy or other cancer treatments might impact on identification of the client's current physical condition.

When making an identification and attempting to make judgements about the most appropriate actions to take it is important to be sure that the methods you are using and any equipment you are using are appropriate and accurate.

Do not, however, attempt to diagnose or to treat problems when you are not qualified or authorised to do so. If you feel that a client has issues or problems requiring specialist diagnosis and/or treatment, they should be referred to the appropriate specialists.

**Actual or potential problems regarding health status**

To identify client needs use observation and/or questioning. Consult with the client, ask a range of open and closed questions and work with the client to identify any actual or potential problems regarding their health status. If the client is unable, due to: their age (e.g. a minor), disability, illness or frailty, to be directly consulted then you will need to consult with their authorised representative - a parent, carer, guardian, advocate or person who holds power of attorney.

Information might also come from a range of other sources including:

- family and significant others
- the family GP
- specialist providers who have previously been involved with the client/patient
- other service providers

The four main health dimensions covered by comprehensive assessment are medical health and physical, psychological and social functioning:

1. **Medical assessment** includes the presenting complaint, past medical history, review of medications, smoking and alcohol, nutritional status, dentition, immunisation status.
2. **Physical assessment** includes personal activities of daily living, instrumental activities of daily living, as well as balance and mobility.
3. **Psychological assessment** includes cognition and mood.
4. **Social assessment** includes living arrangements, social support, carer burden, financial circumstances, services and living environment.

In the Massage field, questioning might involve interviewing the client (or their representative) face-to-face or over the phone, direct questioning (utilising a standard set of questions) or asking the client to complete history intake form.
More general observation and testing might include:

- general observation
- physical and psychological testing
- various observational measurement processes, eg blood pressure, heart rate, temperature etc
- other testing procedures, eg blood tests, cognitive testing
- physical examination and manipulation

Testing procedures might be designed to elicit information about:

- disabilities
- mental health
- AOD (alcohol and other drugs) issues
- nutritional status
- medications currently in use
- current illnesses
- potential health problems

It will, in most cases, be necessary to address both current and historical health status and/or issues.

Health history might include:

- history of any presenting problem (character, severity and duration of symptoms)
- history of any actual or potential problems associated with activities of daily living
- client concerns and beliefs regarding their problems
- past health history, including use of alcohol, tobacco and other substances
- medications being taken
- allergies
- family circumstances, including identifying environmental health factors that may contribute to client’s health issues
- basic dietary information, including diet history to determine food and drink intake

**Culture**

Other areas that might need to be addressed will include culture and language.

Clients from culturally and linguistically diverse backgrounds might require special consideration. It will be necessary to organise access to appropriate interpreter services if a client of a culturally and linguistically diverse background cannot meaningfully participate in the assessment process. A professional interpreter should be used whenever possible. Failing this, try to use a member of clinical staff rather than a family member or friend. This can help avoid bias and misinterpretation. Consider, however, having a family member present during the assessment because a person with limited proficiency in English might feel particularly vulnerable.

Ensure that assessment processes take account of differences in culturally determined attitudes to health and illness, understanding of information and illness related behaviours.

**Checking health status**

Health workers such as Massage Therapists should use their knowledge and understanding of the structure and functioning of body systems to check the health status of clients. This should be done
prior to the design of health care plans or programs and prior to delivery of health interventions. This is necessary to ensure that plans meet client needs and will positively contribute to client health and wellbeing and to ensure that suitable adaptations are made to accommodate problems associated with the client’s current health status.

Clients who get adequate rest, reduce stress, drink healthy amounts of good quality drinking water, do not smoke, drink moderate amounts of alcohol (or none), follow a proper diet and undertake some sort of exercise, will be able to improve health status.

Health service workers must ensure, however, that they do not attempt to identify, diagnose, treat or accommodate problems unless they are qualified and authorised to do so.

**Significance of physical health status**

Treatment/care programs will be affected by the health status of the client. If the client has, for instance, co-morbidity issues or complex needs, these will make a difference to the way in which care plans/programs are designed, developed and implemented. Their extra needs will have to be accommodated. If, however, the client is strong and healthy then the care plan will take this into consideration.

Unless you are qualified to assess and diagnose a client’s health it will be necessary to identify the issues that you consider to be important/relevant, to record the information and report to other health professionals who are authorised to make proper diagnoses and/or to develop treatment/care options. The ability of workers to identify and clarify client health issues will depend on their training, qualifications, experience, job role and the organisation’s requirements and expectations.

When developing and implementing appropriate interventions it might be necessary to consult with a range of professionals. This will assist with clarification of the client’s health status and aid in determining how proposed interventions will impact on their condition. This will enable workers to determine whether extra care or treatment strategies must be implemented or whether plans should be adapted to meet special needs.

These professional people might include:
- doctors
- medical specialists, surgeons, diagnosticians
- therapists - physiotherapists, chiropractors
- optometrists
- podiatrists
- mental health professionals
  - psychiatrists, psychologists
- dentists, orthodontists
- dieticians and nutritionists
- social workers and counsellors
- registered and qualified teachers/trainers

In some cases it might also be necessary to consult with:
- emergency services
- police
- financial advisors
- lawyers
Other personnel with whom it might be necessary to consult (while ensuring compliance with privacy legislation), to clarify the significance of physical health status in relation to a particular intervention, might include the client's family and significant others, case managers, section supervisors, a family doctor and other services which have previously interacted with the client. An intervention is a process, plan or strategy that is implemented in order to reduce the issues associated with clients (of all ages) at risk, to improve the physical and psychological health and wellbeing of clients and to increase their options with regard to participating in the community and living a productive and rewarding life.

Information from the listed sources might include:

- health history
- history of associated issues
- summary of health assessment findings
- information about potential impact of a range of internal and external factors on health
- information on likely causes and management of uncomplicated health conditions
- information on strategies to maintain good health and manage chronic health problems
- information on specific health issues and available health care services/treatments

If a therapist is uncertain of their capability, has limits placed upon what they can do or does not have the qualifications or authority to conduct examinations, make diagnoses or assess the physical health status of clients, they must not step outside of those limits. To do so could result in misinterpretation of health-based information, misdiagnosis/identification and incorrect approach to treatment/care.

**Referring clients with serious health problems**

As has been suggested, primary health care is a highly important component of Australia's health system, and is often the first point of contact for individuals with minor conditions. However, many clients attend primary health services with potentially serious issues that require the attention of specialist professionals or facilities.

When referring patients to other services, each health care practice will have their own specific policies about the procedure for referring patients to other services.

**Organisation requirements may refer to:**

- Organisational policies and/or procedures
- Medicare protocols
- Health service guidelines.

For further information on Medicare protocols, refer to the following:

GP's and dental practitioners have to refer client's to specialist health professionals, who might be more competent when dealing with serious health issues or when clients require surgery. There are a number of other circumstances though where upon examination of a client, aspects of health are noticed that require further examination by specialists in the field or emergency care is needed.

**Need for emergency response**

If a client reports that they are experiencing chest pain or tightness, organisational requirements may state they should be administered with
Glyceryl trinitrate (GTN) spray to try and relieve the pain (for angina). If the chest pain and tightness persists after 15 minutes, then it is recommended that the client receives immediate emergency care and an ambulance should be called. They could be experiencing the early stages of a heart attack, so transferring the client to a hospital is crucial.

Another situation where your organisational policies might state the need to call for an ambulance is if a client is having an acute asthmatic attack. During an asthma attack, the airways become swollen and inflamed. This causes the muscles around the airways to contract, and the bronchial tubes to narrow. An asthma attack does not improve can become life threatening and therefore requiring of emergency services.

**Referring for hospital treatment**

Upon examination of a client or observing the results of a health check, it may be necessary to refer them to a department at a hospital. Organisational requirements may dictate that clients do not require emergency care, but need to see specialist healthcare professionals within a set period of time, such as within two weeks.

**Examples of when a client might have a potentially serious issue:**

- If a female discovers a breast lump, they should be referred for further tests for cancer as quickly as an appointment is available.
- If a client is suffering from abdominal pain or has suddenly experienced changing bowel habits, they should be referred for tests, especially for bowel cancer.
- If a client has experienced repeated urinary tract infections.
- If a client has repeatedly suffered from tonsillitis, they should be referred to ear, nose, and throat (ENT) department of a hospital.
- When a client has a mole or skin lesion that has changed colour or enlarged in size, they should be transferred for assessment with a suspected melanoma.
- Following a urinalysis, if a male does not have an infection, but they have an elevated prostate specific antigen (PSA) above 5, they should be referred to the urology department of a hospital to test for prostate cancer.

**Referring children**

Organisational policies might be different when having to refer children with potentially serious health problems. There are also different conditions that children might present with that require referrals.

An appointment with a child and their parent might indicate that they are struggling to see the writing at the front of the classroom, or are having difficulties hearing. Most workers in primary health care in such circumstances will have a duty to refer the child to an optician or for a hearing test.

Another aspect of work within healthcare is safeguarding the wellbeing of potentially vulnerable individuals. While this can be a difficult task for staff who might suspect that a child is being mistreated, it could help to protect them in the future. If there is suspicion that a child has been neglected or mistreated, your organisational requirements might state that you should contact the police or social services.

**Referring to other services**
While referring situations involving clients to the police is rare, it is vital that healthcare professionals do not overlook doing so, as they have a responsibility to safeguard patients who could be at threat or could cause harm to others.

**Health board**

If you have found through testing or suspect that a client has contracted a contagious disease, you should refer the case to your local health board or contact the Australian Health Practitioner Regulation Agency (AHPRA).

**Contagious diseases might include:**

- Salmonella
- HIV/AIDS
- MRSA
- Measles
- Tuberculosis.

**Standard medical methods and protocols**

**Health checks**

The method of health checks that may be conducted on a client will vary according to the health care profession and the information gathered about a client’s physical status pre-assessment.

The following are common medical check methods used by different health professionals including some risk factors and variations from normal.

**BMI is measured by:**

- Taking clients height (metres)
- Taking their weight (kilograms)
- Divide the weight in kilograms by height in metres, and then dividing the answer by the height to find out BMI. For example, 70kg divided by 1.75 (m) is 40. Then divide 40 by 1.75 to get 22.9 – this is the BMI. Alternatively, the BMI is calculated by dividing your weight in kilograms by your height in metres squared.
- Your BMI is said to be underweight if it is lower than 18.5, healthy if it is between 18.5 and 25, overweight if it is between 25 and 30, and obese if it is above 30.

**Changes to BMI**

Reasons for changes to a client’s BMI could be wide ranging, and it is important for a healthcare professional to establish why such changes have occurred. There are of course circumstances where an increase in BMI would not be a health concern. For example, a client might have previously been underweight and advised to improve their diet and
exercise routine to become healthier; increasing BMI in such a case may be the desired outcome. Similarly, a client’s BMI is likely to increase if they are pregnant, and this is not something to be concerned about. It must also be remembered that BMI does not calculate how much fat or lean tissue (muscle) the body carries. As a result, a client might have been exercising regularly and maintained a healthy diet since their previous check, and as a result has gained muscle mass. This is likely to increase their overall body weight and BMI, so it is important for a healthcare assistant to make judgement as to whether a client has gained fat or muscle.

**Risk factors associated with a change to BMI:**

- An increase in BMI that brings an individual into the overweight or obese categories has many risk factors. Weight gain during adulthood is consistently associated with an increased risk of developing:
  - several types of cancer
  - coronary heart disease
  - type 2 diabetes
  - stroke
  - hypertension
  - musculoskeletal problems
  - respiratory problems
  - gastrointestinal and liver disease.

- Weight cycling (repeatedly losing and gaining large amounts of weight) is a risk factor for various cancers.

- Losing large amounts of weight also has risk factors if the individual's BMI drops to lower than 18.5 (underweight). A low body weight puts an individual at an increased risk of developing infections and diseases as their immune system is weakened
  - underweight people are likely to consume insufficient protein, fat and antioxidants which help support a healthy body
  - under-eating also causes the body to draw upon its lean tissue for energy, and this can lead to poor muscle strength, an inability to regulate body temperature and fatigue.

**Pulse rate**

A normal resting heart rate for an adult ranges from 60 to 100 beats per minute. The pulse can be measured where an artery passes close to the skin. The fitter you are, the lower your resting heart rate is likely to be.

**To measure the pulse in the wrist:**

- Have the client hold out one of their hands, with the palm facing upwards and elbow slightly bent.
 Place your index and middle finger on the inside of their wrist, at the base of their thumb.

 Press the skin slightly so you can feel their pulse – if you can't feel anything, you may need to press a little harder or move your fingers around.

 You could count for 60 seconds to find the beats per minute, or to save time, count for 30 seconds and multiply the beats by two, or for 15 seconds and multiply by four.

**Waist circumference**

To measure waist circumference, ensure that the tape is placed midway between the uppermost border of the iliac crest (hip bone) and the lower border of costal margin (rib cage). The reading should be taken when the tape is snug and does not compress the skin. Waist circumference can provide information regarding the distribution of body fat and is a useful indicator for conditions such as coronary heart disease and type 2 diabetes. Having a waste circumference larger than 94cm (37 inches) if you're a man, and 80 cm (31.5 inches) if you're a female means there is a higher risk of developing health problems.

**Blood pressure**

Blood pressure is a measure of the force of blood on the walls of the arteries as it is pumped from the heart to other parts of the body. If blood pressure is too high, the risk of conditions such as stroke, heart attack, heart failure, kidney damage and eye problems is increased.

**Blood pressure should be taken more regularly if the client:**

  Has a family history of high blood pressure

  Has a high amount of salt if their diet

  Is overweight or obese

  Does not exercise regularly

  Is a smoker

  Drinks large amounts of alcohol.

To take blood pressure, a cuff is usually placed around the arm of the client and pumped up to restrict the blood flow. The pressure is then slowly released as the pulse is checked. Hearing how their pulse beats after the cuff is released enables a measurement to be taken, producing a blood pressure reading.

Blood pressure is measured in millimetres of mercury (mmHg) and it has two numbers, for example 130/80mmHg. The top number is the systolic blood pressure (the pressure of the blood when your heart pushes blood out) and the bottom one is the diastolic blood pressure (the lowest pressure when your heart relaxes between beats).

There are many different factors that can contribute towards high blood pressure. Factors responsible for variations to the recommended cholesterol levels might be down to the client's lifestyle.
Lifestyle factors include:

- **An unhealthy diet** – a diet that is high in saturated fat increases the risk of developing high blood pressure. Men are generally advised to eat no more than 30g of saturated fat per day, with the figure being 20g for women. Foods high in saturated fat include butter, cheese, fatty cuts of meat, and cake.

- **Lack of physical activity** – associated with an increased in LDL (‘bad cholesterol’).

- **Smoking** – acrolein (a chemical in cigarettes) prevents HDL (‘good cholesterol’) from transporting cholesterol from fatty deposits to the liver, causing atherosclerosis (narrowing of the arteries).

- **Excessive alcohol intake** – drinking large quantities of alcohol on a regular basis can increase cholesterol and triglyceride levels.

- **Obesity** – being overweight or obese increases the likelihood of having high levels of LDL cholesterol and triglycerides and lower levels of HDL.

High cholesterol does not have any specific symptoms, but if a client has it, it can lead to serious problems affecting the heart and circulation, e.g. heart attack and stroke. Symptoms such as angina (chest pain) are associated with heart disease and clients should be advised to seek medical help if they notice pain in the chest.

**Blood pressure**

The reasons for variations to blood pressure are similar to those of cholesterol in terms of lifestyle factors. A further factor you might identify as being a cause of raised blood pressure is if the client has a large amount of salt in their diet. The body removes unwanted fluid by filtering blood through the kidneys. To do this the kidneys use osmosis to draw the extra water out of the blood, and this requires a delicate balance of sodium and potassium to pull the water across a wall of cells from the bloodstream into a collecting channel that leads to the bladder. Eating foods with a high level of salt increases the amount of sodium in the bloodstream and this damages the balance between sodium and potassium, thus limiting the ability of the kidneys to remove the water. Higher blood pressure can result due to the extra strain on the blood vessels that lead to the kidneys. Unlike primary hypertension, which tends to develop gradually over the years, secondary hypertension tends to appear suddenly and can cause much higher levels of blood pressure.

**Causes of secondary hypertension:**

- Obstructive sleep apnoea
- Kidney problems
- Adrenal gland tumours
- Thyroid problems
- Inherited defects in blood vessels (congenital)
- Some medications, such as, cold remedies, decongestants, birth control pills, over-the-counter pain relievers and some prescription drugs
Illegal drugs, such as cocaine and amphetamines

Alcohol abuse or chronic alcohol use.

A variation from normal blood pressure increases the likelihood of developing cardiovascular disease, which are diseases of the heart and blood vessels.

For example:

- **Stroke** – when the blood supply to a part of the brain is cut off
- **Heart attack** – when the supply of blood to the heart becomes blocked
- **Embolism** – when a blood clot blocks the flow of blood in a vessel
- **Aneurysm** – when a blood vessel wall bursts and causes internal bleeding
- **Vascular dementia** – when blood flow to the brain is reduced, causing parts of the brain to become damaged.

**Urine test**

Obtaining a urine sample is a useful test for a healthcare professional to assess what is happening inside the body of the client. Lab technicians use urine test strips to indicate whether you have a range of conditions. The strips are plastic and have small squares covered with different chemical signals on it.

**Urinalysis is a common test that's done for several reasons:**

- **To assess overall health** – as part of a routine medical exam, pregnancy check-up, pre-surgery assessment, or on admission to hospital to screen for a range of disorders, including diabetes, kidney disease and liver disease.
- **Diagnosing a medical condition** – a healthcare professional may suggest urinalysis to help diagnose the cause of abdominal pain, back pain, frequent or painful urination, blood in your urine or other urinary problems.
- **Monitoring a medical condition** – if a client has been diagnosed with a medical condition, such as kidney disease or urinary tract disease, a healthcare professional may recommend frequent urine tests to monitor the condition and treatment.

**Preventative Medicine**

An increasingly vital component of health care is to work within a preventative framework, whereby measures are taken to prevent diseases and illnesses from occurring, rather than only focusing on a treatment framework. Healthcare professionals need to be confident in identifying variations from normal health status. If an aspect of health, such as blood pressure, is increasing and the client and healthcare professionals are unaware of this, then the chances of developing a threatening condition is vastly increased as interventions cannot be made. Identifying variations from normal health is more likely to occur if individuals regularly attend medical check-ups.

**Medical check ups**

It is recommended that you have regular check-ups from the age of 20 and above – these can include a variety of tests to make sure that the internal organs and musculoskeletal systems are working correctly.

**Tests to identify variation in health include:**
- **A complete physical** – have one every five years from the ages of 20-45; every two years from 45-65; and every year thereafter.

- **Dental check-ups** – teeth should be cleaned and checked by a dentist every six months to a year. If you smoke or chew tobacco, these exams are even more important.

- **Eye exam** – if you wear glasses or contact lenses, you should have an eye exam every two years, or yearly if you have diabetes. From the age of 40, you need a complete eye exam every two years.

- **Colon exam** – you should get your colon tested from around the age of 40 upwards, as colon cancer is the third most common form of cancer:
  - yearly faecal occult blood test (FOBT)
  - a flexible sigmoidoscopy every five years
  - double-contrast barium enema every five years
  - colonoscopy every 10 years.

- **Prostate check (for men)** – for men over 60, or 50 if a family history of prostate cancer exists.

- **Skin check** – for melanoma and non-melanoma (every two to three years from the age of 20 and every year after the age of 40).

- **Blood pressure check** – every two years (or every year if you have high blood pressure).

- **Electrocardiogram (to test for heart disease)** – this should be tested at the age of 40.

- **Cholesterol check** – every five years.

- **C-Reactive Protein (CRP)** – to detect cardiovascular disease.

- **Mammogram (to detect breast cancer)** – from around the age of 40, in combination with a breast exam.

- **Pap smear and pelvic exam** – every year, from around the age of 18.

- **Bone density** – for osteoporosis (from around the age of 65 onwards; or 50, if a history of fractures/problems is present).

- **Immunisation** – things like flu jabs, pneumonia and vaccinations (especially for senior citizens).

- **Diabetes check**

- **BMI test**

- **Thyroid check**.
Normal health levels

For some of the above tests it is not possible to produce a figure to demonstrate whether a client is within a 'normal range' of health, e.g. when conducting a skin test, a colon exam, dental check-up, or eye exam. Such tests can nonetheless establish whether variations exist from a prior assessment, such as if a client’s teeth are in a worse condition or if they have developed a skin condition in a skin test. Many of the tests enable data to be produced, which can be compared with recommended or normal ranges and with results of prior tests on the client, so that differences over time can be assessed.

Examples of variation from normal health:

<table>
<thead>
<tr>
<th>Health test</th>
<th>Data Intrepretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure test</td>
<td>90/60 or less – low blood pressure</td>
</tr>
<tr>
<td></td>
<td>Between 90/60 and 120/80 – ideal and healthy blood pressure</td>
</tr>
<tr>
<td></td>
<td>More than 120/80 and less than 140/90 – above normal range and should be lowered</td>
</tr>
<tr>
<td></td>
<td>Above 140/90 – high blood pressure (hypertension)</td>
</tr>
<tr>
<td>Cholesterol check</td>
<td>Total cholesterol – should be 5.0 millimoles per litre (mmol/L) or lower</td>
</tr>
<tr>
<td></td>
<td>Low density lipoprotein cholesterol (LDL) – should be 3 mmol/L or lower</td>
</tr>
<tr>
<td></td>
<td>High density lipoprotein cholesterol (HDL) – should be above 1 mmol/L</td>
</tr>
<tr>
<td></td>
<td>Triglycerides – should be under 1.7 mmol/L</td>
</tr>
<tr>
<td>CRP</td>
<td>Less than 1 mg/L – low risk of cardiovascular disease</td>
</tr>
<tr>
<td></td>
<td>Between 1 and 2.9 mg/L – intermediate risk of cardiovascular disease</td>
</tr>
<tr>
<td></td>
<td>Greater than 3 mg/L – high risk of cardiovascular disease</td>
</tr>
<tr>
<td></td>
<td>Above 10 mg/L – need for further testing to determine cause of severe inflammation in the body</td>
</tr>
<tr>
<td>BMI</td>
<td>Underweight - lower than 18.5</td>
</tr>
<tr>
<td></td>
<td>Healthy - between 18.5 and 25</td>
</tr>
<tr>
<td></td>
<td>Overweight - between 25 and 30</td>
</tr>
<tr>
<td></td>
<td>Obese - above 30</td>
</tr>
</tbody>
</table>

Diabetes

Measuring blood glucose levels differs in comparison to other tests as it requires finding out the levels before and after a meal. Recommended targets also vary between groups.

Recommended blood glucose levels:

<table>
<thead>
<tr>
<th>Target groups</th>
<th>Before meals</th>
<th>2 hours after meals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non diabetic</td>
<td>4.0 to 5.9 mmol/L</td>
<td>Under 8 mmol/L</td>
</tr>
<tr>
<td>Adult with Type 1 diabetes</td>
<td>4 to 7 mmol/L</td>
<td>Under 9 mmol/L</td>
</tr>
<tr>
<td>Adult with Type 2 diabetes</td>
<td>4 to 7 mmol/L</td>
<td>Under 8.5 mmol/L</td>
</tr>
<tr>
<td>Children with Type 1 diabetes</td>
<td>4 to 8 mmol/L</td>
<td>Under 10 mmol/L</td>
</tr>
</tbody>
</table>
13. Common Disorders, Problems & Complaints of Body Systems

Some of the issues massage therapists might need to be aware of and might check with clients during the history and client intake process will include those relating to the following body systems:

The Cardiovascular System

Cardiovascular disease involves the heart or blood vessels (arteries and veins). People living in most Western countries face high and increasing rates of cardiovascular disease. By the time heart problems are detected, the underlying cause can be quite advanced. There is, therefore, increased emphasis on preventing and modifying risk factors. Some of these risk factors can be addressed by healthy eating, exercise and avoidance of smoking. Massage therapists need to be in a position to check the cardiovascular health of clients, to identify risk factors and to discuss with clients avoidance procedures, as well as procedures to manage existing heart disease in the context of the receiving massage treatment.

Cardiac issues that might require massage practitioners to use detailed knowledge of the structure and functioning of body systems and be contraindicated for massage or require referral to the clients’ health practitioner include:

- congestive cardiac failure
- angina pectoris
- cardiac arrest
- thrombosis
- congenital heart defects

The Respiratory System

The primary function of the respiratory system is to provide oxygen to blood so that it can be transported to the various parts of the body. The following illnesses might impact on massage treatment care plans and preclude treatment depending on the client’s individual situation and the acute or chronic nature of the condition. More information is provided in Subject 3 Massage Therapy.

- lung disease
- tuberculosis
- bronchitis
- asthma
- pneumonia
- cough remedy
- common cold and flu
- emphysema
- pleurisy
- collapsed lung
- sleep apnoea
- snoring

The Muscular system
Muscular system issues can be long or short term, chronic or acute. The muscular system is comprised of the bones, muscles, joints and tissues in and around the joints.

There are three types of muscle: skeletal, smooth and cardiac (heart). Two of these kinds - skeletal and smooth are part of the muscular system.

Skeletal muscle is what most people think of as muscle, the type that can be contracted to move the various parts of the body. Skeletal muscles are bundles of contractile fibres that are organised in a regular pattern, so that under a microscope they appear as stripes (hence, they are also called striped or striated muscles).

Skeletal muscles vary in their speeds of contraction. Skeletal muscles, which are responsible for posture and movement, are attached to bones and arranged in opposing groups around joints.

For example, muscles that bend the elbow (biceps) are countered by muscles that straighten it (triceps). These countering movements are balanced. The balance makes movements smooth, which helps prevent damage to the muscular system. Skeletal muscles are controlled by the brain and are considered voluntary muscles because they operate with a person’s awareness.

The size and strength of skeletal muscles are maintained or increased by regular exercise. In addition, growth hormone and testosterone help muscles grow in childhood and maintain their size in adulthood.

Smooth muscles control certain bodily functions that are not readily under a person's control. Smooth muscle surrounds many arteries and contracts to adjust blood flow. It surrounds the intestines and contracts to move food and faeces along the digestive tract. Smooth muscle also is controlled by the brain but not voluntarily. The triggers for contracting and relaxing smooth muscles are controlled by the body's needs, so smooth muscles are considered involuntary muscle because they operate without a person's awareness.

Cardiac muscle forms the heart and is not part of the muscular system. Like skeletal muscle, cardiac muscle has a regular pattern of fibres that also appear as stripes under a microscope. However, cardiac muscle contracts and relaxes rhythmically without a person's awareness.

Ligaments are tough fibrous cords composed of connective tissue that contains both collagen and elastic fibres. The elastic fibres allow the ligaments to stretch to some extent. Ligaments surround joints and bind them together. They help strengthen and stabilise joints, permitting movement only in certain directions. Ligaments also connect one bone to another (such as inside the knee).

Tendons are tough bands of connective tissue made up mostly of a rigid protein called collagen. Tendons firmly attach each end of a muscle to a bone. They are often located within sheaths, which are lubricated to allow the tendons to move without friction.

Bursas are small fluid-filled sacs that can lie under a tendon, cushioning the tendon and protecting it from injury. Bursas also provide extra cushioning to adjacent structures that otherwise might rub against each other, causing wear and tear for example, between a bone and a ligament or a bony prominence and overlying skin (such as in the elbow, kneecap, or shoulder area).

Muscular issues that might require massage practitioners to use detailed knowledge of the structure and functioning of body systems may include:

- bone development issues
- chronic back pain
- injury as a result of falls
- fractures/accident
- spinal and lumbar issues
• connective tissue issues
• muscle and limb disorders
• bone and other types of cancer
• autoimmune disorders
• mixed connective tissue disease (MCTD)
• polymyositis and dermatomyositis
• relapsing polychondritis
• systemic lupus erythematosus (SLE)
• effects of ageing
• bone and joint infections, eg infectious arthritis
• osteomyelitis
• bone and joint tumours
• primary cancerous bone tumours
• metastatic bone tumours
• achilles tendon bursitis
• achilles tendon enthesopathy
• corns and calluses
• inferior calcaneal bursitis
• medial plantar nerve entrapment
• plantar fasciosis
• plantar fibromatosis
• carpal tunnel syndrome
• tendinosis
• gout and pseudogout
• hand disorders
• infections
• injuries
• osteoarthritis (OA)
• psoriatic arthritis
• spondylitis
• rheumatoid arthritis (RA)
• fibromyalgia
• muscular dystrophies and related disorders
• osteoporosis

To check health status and identify these issues or issues relating to the muscular system, prior to delivering massage intervention or service in line with a treatment plan of care it may be necessary to conduct, or to refer the client to a medical or allied health care practitioner who can conduct one or more of the following tests:
• physical examination
• laboratory tests
• nerve tests
• X-rays
• dual-energy X-ray absorptiometry (DEXA)
• computed tomography (CT) and magnetic resonance imaging (MRI)
• bone scanning
• joint aspiration
arthroscopy

The Endocrine System

Endocrinology is a specialised area of medicine; however, massage therapists need to be aware of some of the issues that might impact on the design and development of care plans.

Endocrine glands secrete hormones. The purpose of the secreted hormones is to evoke a specific response in other cells of the body. Hormones are secreted into the bloodstream, giving them access to all other cells of the body.

Endocrine glands

- the thyroid gland is located in the front of the neck; it secretes hormones to regulate metabolism
- parathyroid glands (4) are located behind the thyroid; they secrete hormones that control over calcium levels throughout the body
- the adrenal glands (2) are located on the top of each kidney where the inner part secretes adrenaline, outer part secretes aldosterone and cortisol to maintain salt levels in the blood, maintain blood pressure, help control kidney function and control fluid concentrations in the body
- the neuroendocrine glands of the pancreas are located deep in the abdomen behind the stomach - the pancreas is primarily a digestive organ it also contains endocrine cells which secrete: insulin, glucagon, somatostatin to control blood glucose (blood sugar) and glucose metabolism
- the pituitary gland, located at the base of the brain, secretes thyroid stimulating hormone (TSH), follicle stimulating hormone (FSH), adrenocorticotropic hormone (ACTH) and others to control the activity of many other endocrine glands (thyroid, ovaries, adrenal, etc)

Endocrine problems might include:

- adrenal conditions
- anaemia
- cystic fibrosis
- fertility
- lysosomal and lipid storage disorders
- metabolic syndrome
- mitochondrial disorders
- neuroendocrinology
- parathyroid disorders
- pituitary disorders
- thyroid disorders

Diabetic conditions are caused by endocrine abnormalities.

Type 1 diabetes occurs when the pancreas fails to produce enough insulin. Symptoms include excessive thirst, hunger, urination and weight loss. In children and teens, the condition is usually an autoimmune disorder in which specific immune system cells and antibodies produced by the immune system attack and destroy the cells of the pancreas that produce insulin. The disease can cause long-term complications including kidney problems, nerve damage, blindness and early coronary heart
disease and stroke. To control their blood sugar levels and reduce the risk of developing diabetes complications, people with this condition need regular injections of insulin.

Type 2 diabetes occurs because the body is unable to respond normally to insulin. Children and teens with the condition tend to be overweight and it is believed that excess body fat plays a role in the insulin resistance that is characteristic of the disease. The symptoms and possible complications of Type 2 diabetes are basically the same as those of Type 1. Some people can control their blood sugar level with dietary changes, exercise and oral medications.

Massage therapists should be aware of any endocrine conditions that affect their clients. These conditions will affect the needs of clients and medications being taken to remedy endocrine problems may interact with other medications or health programs including massage treatment developed and provided for the client. Work closely with the medical team when providing massage to clients with diabetes and other endocrine diseases.

The Nervous System

The nervous system is a complex, highly specialised network which organises and directs interactions between people and the world around them. It controls and regulates:

- sight, hearing, taste, smell and feeling (sensation)
- voluntary and involuntary functions, such as movement, balance and coordination
- the actions of most other body systems, eg blood flow and blood pressure
- the ability to think and reason - have thoughts, memories and use language

The nervous system is divided into the brain and spinal cord (central nervous system, or CNS) and the nerve cells that control voluntary and involuntary movements (peripheral nervous system, or PNS).

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 can occur slowly and cause a gradual loss of function (degenerative), or they can occur suddenly and cause life threatening problems (acute). Symptoms might 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
- congenital problems
- mental health problems - anxiety disorders, depression, or psychosis
- exposure to toxins, such as carbon monoxide, arsenic, or lead
- degenerative problems like:
  - Parkinson's disease
  - multiple sclerosis (MS)
  - amyotrophic lateral sclerosis (ALS)
  - Alzheimer's disease
  - Huntington's disease
  - peripheral neuropathies
  - Guillain-Barre syndrome
- infections might occur in the:
  - brain (encephalitis or abscesses)
  - membrane surrounding the brain and spinal cord (meningitis)

**Impact of depression on health**
The following table indicates how a mental health issue such as depression can affect and have an impact on more than one body system.

<table>
<thead>
<tr>
<th>Body system</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central nervous system</td>
<td>➢ Can lead to sleeping difficulties, inability to concentrate, memory problems</td>
</tr>
<tr>
<td></td>
<td>➢ Some people who are depressed may use alcohol or drugs</td>
</tr>
<tr>
<td></td>
<td>➢ Can cause headaches and chronic body aches that may not respond to medication</td>
</tr>
<tr>
<td>Digestive system</td>
<td>➢ Depression often has an impact on the appetite</td>
</tr>
<tr>
<td></td>
<td>➢ Binge eating can lead to type 2 diabetes</td>
</tr>
<tr>
<td></td>
<td>➢ Other fail to eat nutritious food and suffer from cramps or malnutrition</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>➢ There is a close link between depression and stress; stress hormones increase heart rate and tighten blood vessels, putting the body in heightened risk of chest pain, heart attack, or stroke</td>
</tr>
</tbody>
</table>

Other body system conditions and behaviours that may affect the nervous system include:
- overuse of or withdrawal from prescription and non-prescription medicines, illegal drugs, or alcohol
- brain tumour
- respiratory failure
- heart failure
- stroke and transient ischaemic attack (TIA)
- liver failure (hepatic encephalopathy)
- kidney failure (uraemia)
- thyroid dysfunction (overactive or underactive thyroid)
- high blood sugar (diabetes) or low blood sugar (hypoglycaemia)
- electrolyte problems
- nutritional deficiencies, such as vitamin B1 (thiamine) or vitamin B12 deficiency

If a client has any of these conditions or symptoms relative to these conditions they must be identified because they will affect the way in which the client responds to care and treatment programs.

The Digestive System

The gastrointestinal (GI) tract is a long hollow tube stretching from the head to the end of the trunk, including the mouth, pharynx, oesophagus, stomach, small intestine and large intestine. The salivary glands, liver, gallbladder and pancreas are also important parts of this far-reaching system.

The main purpose of the GI tract is to break down carbohydrates, fats and proteins into molecules small enough to be absorbed through cell membranes. In that way, it provides the cells with the necessary energy for life and health.
Digestion begins in the mouth when food is chewed and starch is broken down by ptyalin, an enzyme secreted in saliva. Food then enters the stomach, where it is reduced to tiny particles and further transformed by gastric juices. The solid portion remains in the stomach for one to six hours until it liquefies completely; liquid passes into the duodenum (small intestine), where numerous enzymes produced by the pancreas, along with bile from the liver, break it down further for absorption. When it finally arrives in the large intestine, all nutritional value has been spent and the only remaining process is the removal of water before final elimination.

Some serious conditions, diseases and injuries that can cause nervous system problems include:
- indigestion/heart burn
- irritable bowel syndrome
- diverticular disease/diverticulosis
- inflammatory bowel disease
- ulcerative colitis
- Crohn's disease
- leaky gut syndrome
- candidiasis
- cancer

It is important to identify these conditions so they can be treated and appropriate action can be taken to accommodate beneficial dietary changes or supplements.

The Urinary System

Problems in the urinary system can be caused by ageing, illness, or injury. As people age kidney structure changes and this can cause them to lose some of their ability to remove wastes from the blood. The muscles in the ureters, bladder and urethra also tend to lose some of their strength. As a result, older people can have urinary infections because the bladder muscles do not tighten enough to empty it completely. A decrease in strength of muscles of the sphincters and the pelvis can also cause incontinence, the unwanted leakage of urine.

Illness or injury can also prevent the kidneys from filtering the blood completely or block the passage of urine.

Some serious conditions, diseases and injuries that can cause urinary system problems include:
- cancer
- renal failure
- enlarged prostate
- enuresis
- erectile dysfunction
- haemolytic uremic syndrome
- incontinence
- kidney stones
- urethritis
- penetrating injuries to the kidneys, ureters, or bladder
- urine retention in men
- urinary tract infection
- benign prostatic hyperplasia (BPH)
- painful bladder syndrome/interstitial cystitis (PBS/IC)
- prostatitis
- proteinuria
- chronic kidney disease (CKD)
- end-stage renal disease (ESRD)

The Reproductive System

The reproductive system is a system of organs which work together for the purpose of reproduction. Many non-living substances such as fluids, hormones and pheromones are important accessories to the reproductive system.

The major organs of the human reproductive system include the external genitalia (penis and vulva) as well as a number of internal organs including the gamete producing gonads (testicles and ovaries).

Diseases of the human reproductive system are common and widespread.

They include:
- sexually transmitted diseases/infections
- congenital abnormalities
- cancers
- yeast infections
- autoimmune disorders
- functional issues such as:
  - impotence
  - hypogonadism
  - ectopic pregnancy
  - hypoactive sexual desire disorder
  - female sexual arousal disorder
  - premature ejaculation

The Integumentary System

The integumentary system is the organ system that protects the body from damage. It comprises skin and its appendages which includes hair, nails, glands and receptors.

It serves to waterproof, cushion and protect deeper tissues, excrete wastes through sweat, regulate temperature and is the attachment site for sensory receptors to detect pain, sensation, pressure and temperature. It also provides vitamin D synthesis.

The integumentary system has multiple roles in homeostasis. All body systems work in an interconnected manner to maintain the internal conditions essential to the function of the body. The skin protects the body and acts as the body's first line of defense against infection, temperature change and other challenges to homeostasis. It protects the body from dehydration, protects against abrupt changes in temperature and stores water, fat, glucose and vitamin D.

Some serious conditions, diseases and injuries that can cause integumentary system problems include:
- rashes/psoriasis
- blisters
- fungal infections
- infection
- irritation
- sunburn
- skin cancer
- acne
- herpes/cold sores
In identifying integumentary problems it is possible in many cases to alleviate these with appropriate treatment and referral. This will aid client comfort, wellness and wellbeing.

The Lymph & Lymphatic System

The lymphatic system is a network of tubes throughout the body that drains fluid (lymph) from tissues and empties it back into the bloodstream. Lymph is filtered through the spleen, thymus and lymph nodes before being emptied into the blood. This system manages the fluid levels in the body, filtering out bacteria and housing white blood cells.

Lymphatic vessels weave through the entire body, apart from the central nervous system. Some lymphatic vessels have valves (similar to the valves in veins), which stop the lymph from running back the wrong way.

Organs involved in the lymphatic system include the spleen, thymus and lymph nodes.

Some serious conditions, diseases and injuries that can cause lymphatic system problems include:
- glandular fever
- Hodgkin’s disease
- oedema
- tonsillitis
- infections
- blockage
- lymphoedema
- lymphangiosarcoma
- lymphangioleiomyomatosis

The special senses-smell, taste, vision, equilibrium and hearing, touch

Everything we know about the world comes to us through our senses - sight, hearing, touch, smell, and taste. The brain areas involved are called the somatosensory areas.

These include:

The visual system
Sight/seeing. Many problems that afflict the special senses are the result of normal ageing. As people grow older, their lacrimal glands become less active. The eyes become dry and are more prone to infection and irritation. The muscles of the iris also become less efficient and the lens tends to lose its crystal clarity. These conditions cause less light to reach the retina, thereby reducing vision.

The auditory system
Hearing/equilibrium. The ears might be affected by ear inflammations or infections. Generally, after the age of sixty, the organ of corti begins gradually to deteriorate and the ability to hear high tones and human speech decreases. The auditory system - ear/middle ear is also responsible for maintaining balance - keeping a person’s equilibrium.

Chemoreception
The olfactory system - smell and the gustatory system - taste. Smell and taste, the chemical senses, are usually sharp throughout childhood and adult life. They gradually begin to decrease when a person

- cuts and bruises
- burns
- yeast infections
- dermatitis
reaches middle age because of a loss in the number of chemoreceptor cells. During life, impairment of smell and taste are usually the result of a nasal cavity inflammation (due to a cold, an allergy, or smoking) or a head injury. More serious infections in the nasal or oral cavity, such as oral candidiasis (yeast infection of the mucous membranes of the oral cavity), can impair smell and taste.

**Mechanoreception**

Touch - is a special sense, but the body's touch receptors are closely linked to the integumentary system. The sense of touch includes pain, heat, pressure, vibration. Proprioception enables a person to sense their own body and the relative position of neighbouring body parts.

Some of the disorders problems or diseases that can afflict the special senses include:

- otitis media - infection of the middle ear
- injury
- astigmatism
- arteriosclerosis of the eye's blood vessels
- cataracts
- deafness/blindness
- tinnitus
- conjunctivitis
- cancers
- farsightedness
- equilibrium issues - nausea, vertigo
- glaucoma
- Meniere's disease
- farsightedness
- rupture of eardrum
- sensorineural deafness (presbycusis)
- gingivitis
- halitosis
- abscesses

The special senses can often be affected by problems in other parts or systems of the body. It is therefore important to know about sensory problems and other problems that might link or relate to sensory issues. This will make it easier to develop appropriate plans for taking care of the body as a whole.

**Oral Health Diseases**

**Gum Disease**

One of the most prevalent forms of oral health disease is gum disease. Through the destruction of the tissue and bone that holds teeth in place, gum disease is the main reason adults lose their teeth (edentulous). Inadequate brushing and flossing can leave sticky plaque on the teeth. Plaque, which consists mainly of bacteria, can harden into tartar, infect the gums and, if left untreated, cause a steady deterioration that progress through two disease process stages - gingivitis and periodontitis.
Gum disease onset Gingivitis

Plaque forms along the gum line and infection causes the gums to become red and inflamed, pulling away slightly from the neck of the tooth. Infection hasn’t yet reached the bone.

A healthy tooth and gums

A healthy tooth is held snugly within the jaw bone by connective tissue and a tight seal is formed where the gums meet the neck of the tooth.

How healthy gums look

Gums are pink, not red and form a smooth, firm seal where the root widens into the exposed tooth.

Diseased gums

The gums turn a bright red and become swollen, shiny and irregular. Pockets form between teeth and gums. The gums can move against the teeth and often bleed when flossing or brushing.

Periodontitis

As a progression of gingivitis, infection spreads into the jaw causing bone loss. The gums pull further away from the teeth until a dental probe can fit 3.5mm deep into the space. If left unchecked the teeth become loose and fall out.
Dentures

For elderly people born before the 1940s, dental disease was widespread, and in a time before fluoride, floss and dental implants, many people had dentures at a relatively early age. Dentures are used to replace teeth damaged by decay and periodontitis (gum disease). With advances in dentistry, a focus on preventative maintenance and widespread use of fluoride, the number of people with "false teeth" has declined. But even today, nearly one out of four people age 65 and older have lost all of their teeth.

Younger generations are maintaining better oral hygiene and keeping their natural teeth longer; therefore the frequency of complete dentures has lessened over the years, however, improper dental care still lead to extensive tooth decay and gum disease, and dentures may be used to replace teeth that have been lost. A common problem among denture wearers is ill-fitting dentures, which cause pain when dentures rub against the gums, leading to soreness and swelling and callus formation. Left untreated, this can lead to infection and further oral health impacting on other body systems and make wearing dentures intolerable.

Although the massage therapist does not work directly with clients and their oral health they are involved in providing facial massage to muscles of the face and jaw including clients with TMJ (temporomandibular joint) dysfunction which may require referral to a dentist for further investigation.
14. Basic Pharmacology

Overview

Any chemical that affects the physiologic processes of a living organism can broadly be defined as a drug. The study or science of drugs is known as pharmacology. Pharmacology encompasses a variety of topics, including the following:

- Absorption
- Biochemical effects
- Biotransformation (metabolism)
- Distribution
- Drug history
- Drug origin
- Drug receptor mechanisms
- Excretion
- Mechanisms of action
- Physical and chemical properties
- Physical effects
- Therapeutic (beneficial) effects
- Toxic (harmful) effects

Information to Help Clarify Medication Actions

A massage therapist must understand the reason a client is taking a medication and the action of that medication to be able to determine the potential interaction of the drug with the physiologic effects of massage and the adjustments to massage that may be necessary.

The following information must be gathered which be obtained before the massage. The client may be able to supply information, and supervising medical personnel also can explain the actions of medications. Many reputable drug compendia are available online that can provide information on medications and dietary supplements. A trusted community pharmacist also may be a great resource for information about a specific drug or therapy.

- Drug name (generic name and brand name)
- Reason the client is taking the drug
- What does the medicine do?
- When and how is the medication taken?
- What are the possible side effects (reactions of the body to the medicine)?
- Will the medicine react with any other medicines, food, or drinks?
- Should any activities be avoided?
- Are there any signs indicating that the medicine is working?

Common Medications and possible implications for Massage

The information in the following sections can help the massage practitioner determine what interaction, if any, massage may have with a medication. General categories and examples are given for each classification. This is not meant to be an exhaustive list, but rather a general guide for the more commonly prescribed drugs and their brand names. It is important to research any medication, vitamin, dietary supplement, or herb a client takes for its action in the body and possible interaction with massage.
Cardiovascular Medications

Vasodilators (Including Antianginal Drugs)

Examples: nitroglycerin (Nitro-Dur, Nitrostat), isosorbide dinitrate (Isordil) or isosorbide mononitrate (Monoket), hydralazine, minoxidil

Vasodilating medications cause the blood vessels to dilate (widen). Some of the antihypertensive agents lower blood pressure by dilating the arteries or veins. Other vasodilators are used in the treatment of angina (chest pain), hypertension, heart failure, and diseases characterized by poor circulation.

Implications for massage

Massage has a mild peripheral vasodilatory effect. The action of the medications may increase the effect of the massage. The blood pressure lowering effect of massage may result in dizziness after the massage. Have the client contract and relax the leg muscles for 1 to 2 minutes before getting off the massage table.

Beta Blockers

Examples: atenolol (Tenormin), bisoprolol (Zebeta), carvedilol (Coreg), labetalol (Normodyne, Trandate), metoprolol (Lopressor, Toprol-XL), propranolol (Inderal)

Beta-blocking medications block nerve stimulation of the heart and blood vessels, slowing the heart rate and reducing high blood pressure. They are used in the treatment of a wide range of diseases, including angina, hypertension, migraine headaches, heart failure, and arrhythmias.

Implications for massage

These drugs may distort the expected effect of the massage. Caution is warranted, and the massage therapist should watch for any exaggerated effects. The client may be susceptible to cold. Massage may help with the constipation that can be a side effect of these drugs. The blood pressure–lowering effect of massage may result in dizziness after the massage. Have the client contract and relax the leg muscles for 1 to 2 minutes before getting off the massage table.

Calcium Channel Blockers

Examples: amlodipine (Norvasc), Diltiazem (Cardizem LA, Tiazac), nifedipine (Adalat CC, Procardia XL), verapamil (Calan, Verelan, Covera HS)

Calcium channel blockers are thought to prevent angina and arrhythmias by blocking or slowing calcium flow into muscle cells, which results in vasodilation (widening of the blood vessels) and greater oxygen delivery to the heart muscle.

Implications for massage

The expected effect of the massage may be distorted. Care must be taken to watch for any exaggerated effects. Massage may help with constipation. The blood pressure–lowering effect of massage may result in dizziness after the massage. Have the client contract and relax the leg muscles for 1 to 2 minutes before getting off the massage table.
Antiarrhythmics

Examples: amiodarone (Cordarone, Pacerone), digoxin (Lanoxin), dronedarone (Multaq), propafenone (Rythmol), sotalol (Betapace, Betapace AF), quinidine, and some beta blockers or calcium channel blockers (see above)

Antiarrhythmics are prescribed when the heart does not beat rhythmically or smoothly (a condition called arrhythmia). The broad class is composed of many pharmacologically different types of agents, all with varying effects on electrical impulse conduction and the rate and force of contraction of the heart.

Implications for massage
The client may complain of joint and muscle pain and swelling in the extremities that are medication related. If this occurs, refer the client to the prescribing physician. Massage may help with constipation. The client may experience dizziness after the massage. Have the client contract and relax the leg muscles for 1 to 2 minutes before getting off the massage table.

Antihypertensives and Diuretics

Examples of antihypertensives: beta blockers, calcium channel blockers, angiotensin-converting enzyme (ACE) inhibitors (including benazepril, captopril, enalapril, lisinopril, quinapril), angiotensin receptor blockers (ARBs) (including candesartan, irbesartan, losartan, olmesartan, telmisartan, valsartan), prazosin, terazosin, clonidine, and minoxidil.

Examples of diuretics: chlorothiazide; chlorthalidone; hydrochlorothiazide; budesonide; furosemide; torsemide.

Examples of potassium-sparing diuretics: spironolactone, triamterene, amiloride.

Combinations of antihypertensives:

Clients commonly are prescribed a medication that is a combination of two antihypertensives, including diuretic combinations.

High blood pressure, or hypertension, occurs when the pressure of the blood against the walls of the blood vessels is higher than what is considered normal; this condition eventually can damage the brain, eyes, heart, and kidneys. Diuretics are used in antihypertensive therapy. Many diuretics may deplete the body of potassium unless they are the potassium-sparing kind, and a potassium supplement or food source high in potassium may be recommended by the physician.

Implications for massage
The expected effect of the massage may be distorted. Care must be taken to watch for any exaggerated effects. Massage may help with constipation. The blood pressure–lowering effect of massage may result in dizziness after the massage. Have the client contract and relax the leg muscles for 1 to 2 minutes before getting off the massage table. The stress-reducing effect of massage may affect the dosage of these medications. Have clients monitor themselves carefully and ask their physicians to watch for a possible need to reduce the dosage or change the medication. Massage has the effect of increasing fluid movement and may enhance the diuretic effect temporarily.
Cardiac Glycosides (Digitalis Glycosides)

Examples: digoxin (Lanoxin)

Cardiac glycosides slow the heart rate but increase contraction force. Their uses include regulating irregular heart rhythm, increasing the volume of blood pumped by the heart, and medicating congestive heart failure.

Implications for massage

Monitor the client’s heart rate, because massage tends to slow the heart rate. If the rate falls below 50 beats per minute, stop the massage and refer the client immediately to the physician. Regular use of massage may affect the dosage of this medication. Have the client monitor the dose carefully with the physician.

Anticoagulants and Medications That Inhibit Platelets

Examples: warfarin (Coumadin, Jantoven), dabigatran (Pradaxa), ticagrelor (Brilinta), clopidogrel (Plavix), heparin, enoxaparin (Lovenox), dalteparin (Fragmin), aspirin

Anticoagulants and platelet inhibitors are medications that prevent blood clotting (blood thinners). They may be used in the treatment of conditions such as stroke, heart disease, embolism (blood clots), and abnormal blood clotting.

Implications for massage

The response to stress levels can affect the action of anticoagulants. Massage alters the body’s response to stress and may interact with the dosage of this medication. Avoid any massage methods that may cause bruising, including compression, friction, tapotement, and skin rolling. Do not massage an injection site. Watch for bruising and report any bruising to the client. Joint swelling and aching may result from the use of these medications. Refer clients who have any joint symptoms to the physician.

Antihyperlipidemics

Examples: cholestyramine (Questran), colestipol, ezetimibe, atorvastatin (Lipitor), lovastatin, simvastatin (Zocor), pravastatin (Pravachol), rosuvastatin (Crestor), gemfibrozil, fenofibrate (Lipofen, Lofibra), omega-3 fatty acids (Lovaza)

Antihyperlipidemics are used to reduce the serum levels of cholesterol and/or triglycerides, which form plaque on the walls of arteries. The statins reduce the body’s internal production of cholesterol. Some antihyperlipidemics bind to bile acids in the gastrointestinal tract, reducing the body's absorption of cholesterol.

Implications for massage

Occasional muscle pain and joint pain can occur when statin or fibrate medications are used. Refer clients who complain of these conditions to a physician. Massage may help constipation. Some people experience occasional dizziness. Watch clients carefully as they get up from the massage table.

Gastrointestinal Medications

Anticholinergics
Examples of anticholinergics: dicyclomine (Bentyl), hyoscyamine (Levsin, Levbid, NuLev, Symax)
Examples of opioid with anticholinergic: diphenoxylate, atropine (Lomotil, Lonox)

Anticholinergic medications slow or block nerve impulses at parasympathetic nerve endings, preventing muscle contraction and glandular secretion in the organs involved. Because these medications slow the action of the bowel by relaxing the muscles and relieving spasms, they are said to have an antispasmodic action. They also can help alleviate diarrhea.

**Implications for massage**
The client’s response to relaxation effects may be altered as a result of alteration of parasympathetic action.

**Antiulcer Medications**
Examples: cimetidine (Tagamet), famotidine (Pepcid), ranitidine (Zantac), omeprazole (Prilosec), lansoprazole (Prevacid), sucralfate (Carafate)

These medications relieve symptoms and promote healing of gastrointestinal ulcers. They also relieve gastrointestinal reflux of stomach acid, which may cause chronic heartburn. Most work by suppressing the production of excess stomach acid. Sucralfate works by forming a chemical barrier over an exposed ulcer, protecting the ulcer from stomach acid.

**Implications for massage**
The stress reduction capacity of massage may enhance the effectiveness of these medications.

**Hormones**
A hormone is a substance produced and secreted by a gland. Hormones stimulate and regulate body functions. Most often hormone medications are used to replace naturally occurring hormones that are not being produced in amounts sufficient to regulate specific body functions. This category of medication includes oral contraceptives and certain types of medications used to combat inflammatory reactions.

**Antidiabetic Medications**
Examples: glipizide, glyburide

The treatment of diabetes mellitus may involve the administration of insulin or oral antidiabetic medications. Glucagon is given only in emergencies (e.g. insulin shock or when blood sugar levels must be raised quickly). Oral antidiabetic medications are used for the treatment of type 2 diabetes (adult onset, insulin resistant). Early medications in this category induced the pancreas to secrete more insulin by acting on small groups of cells in the pancreas that make and store insulin. Newer oral agents often help increase the insulin sensitivity of the tissues. Individuals with insulin-dependent (juvenile onset, or type 1) diabetes must control their blood sugar levels with insulin injections.

**Implications for massage**
Changes in stress levels may affect the dosage. The client’s physician should monitor the dosage if massage is used on a regular basis. Do not provide vigorous massage, because it may
put undue stress on the system, requiring the blood sugar level to adjust. Avoid massaging injection or infusion sites.

**Sex Hormones**

Examples: Oestrogens (Estradiol, Premarin, Cenestin), oral contraceptives, progesterones (medroxyprogesterone [Provera]), androgens (testosterone, Androgel)

Oestrogens are used as replacement therapy to treat symptoms of menopause in women whose bodies are no longer producing sufficient amounts of estrogen. Medroxyprogesterone is used to treat uterine bleeding and menstrual problems. Most oral contraceptives (birth control pills) combine oestrogen and a progesterone, but some contain only a progesterone. Testosterone stimulates cells that produce male sex characteristics, replace hormone deficiencies, stimulate red blood cells, and suppress estrogen production. Athletes sometimes take medications called anabolic steroids (chemicals similar to testosterone) to reduce the elimination of protein from the body, which results in an increase in muscle size. This use of these medications is dangerous; anabolic steroids can adversely affect the heart, nervous system, and kidneys.

**Implications for massage**

Oestrogens can change the body’s blood clotting ability. Watch for bruising and adjust pressures as needed. Be aware of any symptoms of blood clots and refer the client to the physician immediately if these are noted. Most hormones can increase fluid retention. Massage may temporarily increase fluid movement, reducing swelling. Unusual fluid retention should be referred to the prescribing physician immediately. Hormones have a widespread effect on the body and mood. Emotional states may fluctuate, and the ability to handle stress changes with the hormonal fluctuations. Massage can reduce stress levels, help even out mood, and promote a sense of well-being.

**Steroids**

Examples: dexamethasone (Decadron), methylprednisolone (Medrol), prednisolone (Orapred), prednisone

Examples of common steroid hormone creams or ointments: triamcinolone, hydrocortisone

Oral steroid preparations may be used to treat inflammatory diseases such as arthritis, or conditions such as poison ivy, hay fever, or insect bites. Steroids also may be applied to the skin to treat certain inflammatory skin conditions.

**Implications for massage**

Changes in stress levels may affect the dose. The client’s physician should monitor the dosage if massage is used on a regular basis. Avoid any massage methods that may create inflammation, such as friction, skin rolling, or stretching methods that pull excessively on the tissue.

**Thyroid Medications**

Example: levothyroxine (Synthroid, Levoxyl, Levoxine), thyroid (Bio-throid)

**Implications for massage**
Changes in stress levels may affect the dosage. The client should monitor the dosage if massage is used on a regular basis.

**Anti-infective Medications**

**Antibiotics**

Examples: aminoglycosides, cephalosporins, macrolides (erythromycin, clarithromycin, azithromycin), penicillins (including ampicillin and amoxicillin), quinolones (ciprofloxacin, levofloxacin), tetracyclines

Antibiotics are used to treat a wide variety of bacterial infections. There are many different classes of antibiotics. Antibiotics do not destroy viruses, such as those that cause the common cold.

**Antivirals**

Example: acyclovir (Zovirax), valacyclovir (Valtrex), medications used to treat HIV infection

Antiviral medications are used to combat viral infections; however, they do not eliminate or cure viral infections. Medications for HIV may predispose an individual to accumulation of lactic acidosis and muscle soreness; be alert to possible medication side effects, and if lactic acidosis may be present, refer the client to the physician before proceeding with the massage.

**Antifungals**

Example: nystatin, fluconazole (Diflucan), itraconazole (Sporanox), ketoconazole (Nizoral)

Fungal infections are treated to prevent the growth of fungi and to cure the condition. Many topical antifungals are used to treat fungal skin conditions such as athlete’s foot or groin itch.

**Pediculicides and Scabicides**

Example: lindane, permethrin (Elimite), pyrethrins (Pronto Plus), benzyl alcohol (Ulesfia), spinosad (Natroba)

Pediculicides and scabicides are used to treat lice and/or scabies infestations. Lindane can cause serious neurotoxicity and must be carefully applied and handled.

**Implications for massage for anti-infective medications**

A person who is taking an anti-infective medication may have a stressed immune system or may be truly immunocompromised. They may also have an infection that is considered contagious to others. Therefore, it is important to avoid overstressing the system when providing massage and to take care not to expose clients to contagious diseases, such as colds, the flu, or infestations. Postpone appointments if necessary. Gastrointestinal side effects are common with many antibiotics. Massage may calm symptoms temporarily. Universal precautions are required when dealing with any bacterial, viral, or other conditions caused by infectious pathogens.
Antineoplastic Medications

Examples: tamoxifen (Nolvadex), flutamide, etoposide, Gleevec, Sprycel, Sutent, Tarceva, Votrient

Antineoplastic medications are used in the treatment of cancer. Most of the medications in this category prevent the growth of rapidly dividing cells, such as cancer cells. Antineoplastics are without exception extremely toxic and can cause serious side effects. Many more cancer drugs now are supplied in oral form, and the number of treatments is expanding rapidly.

Implications for massage

Individuals undergoing chemotherapy are physiologically stressed because of the toxicity of the medications. Work gently and under the direct supervision of the client’s physician.

Central Nervous System Medications

Antianxiety Drugs/Sedatives

Examples: benzodiazepines diazepam (Valium), lorazepam (Ativan), alprazolam (Xanax), temazepam (Restoril); buspirone (Buspar); diphenhydramine (Unisom); hydroxyzine (Atarax); zaleplon (Sonata); zolpidem (Ambien); eszopiclone (Lunesta); barbiturates (phenobarbital, secobarbital).

Antianxiety drugs and sedatives are used in the treatment of anxiety, panic disorder, and insomnia. They selectively reduce the activity of certain chemicals in the brain.

Implications for massage

These medications generally act as central nervous system (CNS) depressants. Massage can increase or decrease the effect of these medications, depending on whether the massage is structured to have a more stimulating or relaxing effect. The dosage of these drugs needs to be carefully monitored when they are used in conjunction with massage. Watch for excessive drowsiness. The physician may be able to reduce the dosage if massage is used on a regular basis. Work in conjunction with the prescribing physician.

Antipsychotics

Examples: phenothiazines haloperidol, risperidone (Risperdal), aripiprazole (Abilify), olanzapine (Zyprexa), quetiapine (Seroquel), clozapine (Clozaril, Fazaclo)

Major tranquilisers or antipsychotic agents usually are prescribed for clients with psychoses (certain types of mental disorders) or for bipolar illness. These medications calm certain areas of the brain but permit the rest of the brain to function normally.

Implications for massage

These medications generally act as CNS depressants. Massage can increase or decrease the effect of these medications, depending on whether the massage is structured to have a more stimulating or relaxing effect. Because of the potential effects on blood pressure or dizziness, the client should avoid sudden positional changes after the massage. The dosage of these drugs needs to be monitored carefully when they are used in conjunction with massage. These medications are used to treat severe mental disorders. Work only with direct supervision.
from the prescribing physician. Massage can help with constipation in individuals taking these drugs.

**Antidepressants**

Examples: tricyclic antidepressants (amitriptyline), selective serotonin reuptake inhibitors (SSRIs; e.g., fluoxetine [Prozac, Sarafem], sertraline [Zoloft], paroxetine [Paxil]), serotonin/norepinephrine reuptake inhibitors (SNRIs; e.g., venlafaxine [Effexor]), and monoamine oxidase inhibitors (MAOIs; e.g., phenelzine)

Antidepressants are used to combat depression. They also are used as preventive therapy for migraine headaches, severe premenstrual syndrome, and neuropathic types of pain, although the manner in which they help relieve pain is not clearly understood. They work mostly by increasing the concentration of certain chemicals necessary for proper nerve transmission in the brain.

**Implications for massage**

Massage nonspecifically causes a shift in neurotransmitters and other brain chemicals. Massage has a stimulating effect on the CNS even when used for relaxation. The relaxation effect is a secondary result of the nervous system stimulation. Massage can increase serotonin levels. Watch carefully for any increase or decrease in the effect of the medications. Work with the supervision of the prescribing physician to adjust the dosage when massage is used as part of therapy. Massage can help with constipation.

**Amphetamines and Related Stimulants**

Examples: methylphenidate (Ritalin, Concerta, Metadate, Daytrana), dexamethylphenidate (Focalin), amphetamine salts (Adderall)

Amphetamines are adrenergic medications that are nervous system stimulants. They commonly are used to treat attention deficit disorders and occasionally may be used as anorectics (medications used to reduce the appetite). These medications temporarily quiet the part of the brain that causes hunger, but they also keep a person awake, speed up the heart, and raise blood pressure. After 2 to 3 weeks, these medications begin to lose their effectiveness as appetite suppressants. They also are used to treat narcolepsy. Amphetamines stimulate most people, but they have the opposite effect on hyperkinetic children and adults. When hyperkinetic children and adults take amphetamines or adrenergic medications, their level of activity is reduced. Most likely, amphetamines selectively stimulate parts of the brain that control activity.

**Implications for massage**

Massage nonspecifically causes a shift in neurotransmitters and other brain chemicals. Massage has a stimulating effect on the CNS even when used for relaxation. The relaxation effect is a secondary result of the nervous system stimulation. Watch carefully for any increase or decrease in the effect of the medications. Work with supervision from the prescribing physician, who may need to adjust the dosage when massage is used as part of therapy. Massage can help with constipation.

**Anticonvulsants**
Examples: phenobarbital, phenytoin (Dilantin), carbamazepine (Tegretol), lamotrigine (Lamictal), leviracetam (Keppra), divalproex (Depakote), gabapentin (Neurontin), pregabalin (Lyrica).

Anticonvulsants are used to control seizures and other symptoms of epilepsy. They selectively reduce excessive stimulation in the brain. Some of these medications are used as mood stabilisers for bipolar illness or to treat neuropathic pain syndromes. Implications for massage: Massage has a stimulating effect on the CNS even when used for relaxation. The relaxation effect is a secondary result of the nervous system stimulation. Watch carefully for any increase or decrease in the effect of the medications. Work with supervision from the prescribing physician when massage is used as part of therapy.

**Antiparkinsonism Agents**

Examples: carbidopa-levodopa (Sinemet), bromocriptine (Parlodel), benztropine (Cogentin), trihexyphenidyl, ropinirole (Requip), pramipexole (Mirapex), entacapone (Comtan)

Parkinson’s disease is a progressive disorder that is caused by a chemical imbalance of dopamine in the brain. Antiparkinsonism drugs are used to correct the chemical imbalance, thereby relieving the symptoms of the disease. Benztropine and trihexyphenidyl also are used to relieve tremors caused by other medications. Ropinirole and pramipexole may be used to treat restless leg syndrome at night.

**Implications for massage**

Massage nonspecifically causes a shift in neurotransmitters and other brain chemicals, including dopamine. Massage has a stimulating effect on the CNS even when used for relaxation. The relaxation effect is a secondary result of the nervous system stimulation. Watch carefully for any increase or decrease in the effect of the medications. Work for excessive drowsiness. Work with supervision from the prescribing physician, who may adjust the dosage when massage is used as part of therapy. Massage can help with constipation.

**Analgesics**

Analgesics are used to relieve pain. They may be either narcotic or nonnarcotic. Narcotics act on the brain to cause deep analgesia and often drowsiness. Narcotics relieve pain and give the client a feeling of well-being. They also are addictive.

A number of analgesics contain codeine or other narcotics combined with nonnarcotic analgesics (e.g., aspirin or acetaminophen). Tylenol #3 and Vicodin are examples.

Nonnarcotic pain relievers include the following:

- Salicylates, such as aspirin (relieve pain, antiinflammatory, and treat fever)
- Acetaminophen (relieves pain and fever but does not reduce inflammation)
- Nonsteroidal antiinflammatory medications (NSAIDs; e.g., celecoxib, ibuprofen, naproxen, oxaprozin) (inhibit prostaglandins, reducing pain and inflammation; some agents [ibuprofen] also relieve fever)

**Implications for massage**
Massage reduces pain perception in several ways: through gate control hyper stimulation analgesia and counter irritation and by stimulating the release of pain-inhibiting or pain-modifying chemicals in the body. Massage supports analgesics and has the potential to reduce the drug dosage and the duration of treatment. Aspirin thins the blood. Watch for bruising. Timing of the massage in relation to the analgesic dosage may be important. Pain perception is inhibited when a person is taking analgesics. Feedback mechanisms for pressure and massage intensity are not accurate. Reduce the intensity of massage and avoid methods that cause inflammation. Narcotics are constipating, and massage can help with constipation. Dizziness may result with the use of these medications. Have the client relax and contract the muscles of the legs for a few minutes before getting off the table.

**Anti-inflammatory Medications**

Anti-inflammatory medications reduce the body’s inflammatory response. Inflammation is the body’s response to injury, and it causes swelling, pain, fever, redness, and itching.

Examples of anti-inflammatory medications include:

- **NSAIDs**: See Analgesics.
- **Steroids**: corticosteroids (e.g., prednisone, methylprednisolone, prednisolone, dexamethasone).

Note: Skeletal muscle relaxants often are given in combination with an anti-inflammatory medication such as aspirin. However, some doctors believe that aspirin and rest are better for alleviating the pain and the inflammation of muscle strain than are skeletal muscle relaxants. When sore muscles tense, increasing muscle tone, they cause pain, inflammation, and spasm. Skeletal muscle relaxants (e.g., orphenadrine, cyclobenzaprine, meprobamate, and chlorzoxazone) can relieve pain and these symptoms.

**Implications for massage**

Massage therapists should not perform any techniques that create inflammation or damage tissue. Mood may be altered in addition to pain perception. Feedback mechanisms for pressure and massage intensity are not accurate. The intensity of the massage should be reduced. Massage can reduce muscle spasm, reducing the need for muscle relaxants. Muscle spasm often is a protective response acting to immobilise an injured area. Use massage to reduce but not remove these protective spasms. Many anti-inflammatory medications are available over the counter (OTC), and the client may neglect to report their use to the massage therapist. Ask clients whether they are taking any OTC medications.

**Respiratory Medications**

**Antitussives**

Examples: dextromethorphan, codeine, hydrocodone

Antitussives control coughs. Dextromethorphan is available in OTC products; narcotic antitussives are available by prescription.

**Expectorants**

Examples: guaifenesin
Expectorants are used to change a nonproductive cough to a productive one (one that brings up phlegm). Expectorants are supposed to increase the amount of mucus produced. However, drinking water or using a vaporizer or humidifier is probably as effective for increasing the production of mucus.

Decongestants

Examples: phenylephrine. Restricted sale: pseudoephedrine. Removed from U.S. market: ephedrine, phenylpropanolamine hydrochloride

Decongestants constrict blood vessels in the nose and sinuses to open air passages. Adrenergic agents (decongestants) are available as oral preparations, nose drops, and nose sprays. Oral decongestants are slow acting but do not interfere with the production of mucus or the movement of the cilia (special hairlike structures) of the respiratory tract. They can increase blood pressure; therefore, they should be used cautiously by clients with high blood pressure. Topical decongestants (nose drops or sprays) provide fast relief. They do not increase blood pressure as much as oral decongestants, but they do slow cilia movement. Topical decongestants should not be used for more than a few days at a time.

Implications for massage

Avoid the prone position, because it increases congestion

Bronchodilators

Examples: theophylline, aminophylline, albuterol, salmeterol, formoterol

Bronchodilators (agents that open the airways in the lungs) and agents that relax smooth muscle tissue, such as that found in the lungs, are used to improve breathing. Inhalant bronchodilators are most commonly prescribed for asthma and chronic obstructive pulmonary disease (COPD; e.g., emphysema) and act directly on the muscles of the breathing tubes. Theophylline and aminophylline have limited use.

Antihistamines

Examples: Nonsedating or low sedating: loratadine (Claritin), fexofenadine (Allegra), cetirizine (Zyrtec)

Traditional (sedating): diphenhydramine (Benadryl), clemastine (Tavist-1), dimenhhydrinate (Dramamine)

Histamine is a body chemical that, when released, typically causes swelling and itching. Release of histamine is often a response to exposure to an allergen. Antihistamines counteract these symptoms of allergy by blocking the effects of histamine. Antihistamines are commonly used for mild respiratory or skin allergies, such as hay fever (seasonal allergies) or hives. Some types of antihistamines are also used to prevent or treat the symptoms of motion sickness.

Implications for massage for respiratory medications:

Bronchodilators are sympathomimetic and act on sympathetic nerve stimulation. Because some respiratory agents can reduce sweating, heat hydrotherapy should be avoided.
Antihistamines can excite or depress the CNS. Most of these medications can cause drowsiness. Because they act on the CNS, the expected results of the massage can be distorted. The client may be unable to relax or may be excessively drowsy and dizzy after the massage. Many massage methods produce reddening of the skin caused by the release of histamine. This reaction may be altered and feedback may be inaccurate in clients taking antihistamines. Avoid this type of work with such clients. Codeine can cause constipation. Massage may prove beneficial. Many of these medications are available over the counter, and clients may neglect to report their use to the therapist. Make sure to ask clients if they are taking any OTC medications.

**Vitamins and Minerals**

Vitamins and minerals are chemical substances that are vital to the maintenance of normal body function. Many people take supplemental vitamins and minerals. Multivitamins, calcium, vitamin C, and vitamin D supplements are especially common. A high intake of supplements, especially individual vitamins, can cause adverse reactions or may have implications for massage. The practitioner needs to investigate further to determine any suspected interaction. At this point, specific research has not been done to determine what the specific interactions might be. It is necessary to compare the effects of the vitamin and/or mineral with the type of massage application to determine whether the two together are inhibitory or synergistic.

**Dietary Supplements and Herbs**

Herbs and other dietary supplements are agents used to support certain functions of the body. None of these agents are regulated in the same manner as drugs, and unlike drugs, they are not intended to be used to diagnose, treat, cure, or prevent any disease. However, their action may be similar to that of pharmaceutical medications. Some medications are derivatives of plants. Ask clients whether they are taking herbs or other dietary supplements, and if so, the names and their reasons for taking them. The practitioner needs to investigate further to determine any suspected interactions. At this point, specific research has not been done to determine what the specific interactions might be. It is necessary to compare the effects of the supplement with the type of massage application to determine whether the two together are inhibitory or synergistic.