ANATOMY AND PHYSIOLOGY
As a beauty therapist it is important that you have a good understanding of anatomy and physiology, as many of your treatments aim to improve the particular functioning of systems of the body. For example a facial massage will improve blood and lymph circulation locally, as you massage the skin’s surface, increase cellular renewal as you improve nutrition to the living cells, and remove dead skin cells. The result is healthier looking skin.

ANATOMY AND PHYSIOLOGY KNOWLEDGE REQUIREMENTS

It is necessary for you to know and understand anatomy and physiology as relevant to each beauty therapy chapter. This may be assessed through oral questioning, written test or assignment. To guide you in your studies the essential anatomy and physiology you need to know and understand for each chapter has been identified with a ✓ symbol. Look for the 🔄 to remind you to check back here for your essential anatomy and physiology knowledge!

The beauty therapy chapters with an essential anatomy and physiology knowledge requirement are:

6. Improve and maintain facial skin condition
8. Remove hair using waxing techniques
9. Provide manicure treatment
10. Provide pedicure treatment
11. Provide make-up treatment
13. Provide nail art service
15. Assist with spa treatments
12. Extend and maintain nails

Anatomy and physiology knowledge and understanding is located in this chapter, but it can also be found within each of the beauty therapy chapter where essential anatomy and physiology knowledge are identified as above.

ANATOMY AND PHYSIOLOGY ✓ ESSENTIAL KNOWLEDGE FOR CHAPTER

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The skin varies in appearance according to our race, sex and age. It also alters from season to season and from year to year, and reflects our general health, lifestyle and diet.

At puberty the chemical substances (hormones) that control many of our bodies’ activities become very active. Amongst other effects, this activity causes the skin to become more oily, and often blemishes appear on the skin’s surface. Seven out of ten teenagers find that their skin becomes blemished with blackheads, inflamed angry spots and even scars at this time: a skin disorder called acne vulgaris.

During the twenties the skin should look its best; any hormonal imbalance that occurred at puberty should by now have stabilised. As we grow older, the skin ages too. In our late twenties and early thirties we will see fine lines appearing on the skin’s surface, especially around the eyes where the skin is thinner and the skin gradually becomes drier.

At around the age of 40, hormone activity in the body becomes slower and the skin begins to lose its strength and elasticity. The skin becomes increasingly drier, and lines and wrinkles appear on the surface. In the late fifties brown patches of discoloured skin (lentigines) may appear: these are commonly seen at the temple region of the face and on the backs of the hands and are caused by ultra-violet light damage.

Fortunately help is at hand to care for the skin: there is an ever-increasing number of skin-care products from a vast and highly profitable cosmetics industry, and there are the skill and expertise of the qualified beauty therapist.

If it is your intention to become a qualified beauty professional, you need to learn about skin: its construction, its function, and how and why it is changed by both internal and external influences.

**Cells**

The human body consists of many trillions of microscopic cells. Each cell contains a chemical substance called protoplasm, which contains various specialised structures whose activities are essential to our health. If cells are unable to function properly, a disorder results.

Surrounding the cell is the **cell membrane**: this forms a boundary between the cell contents and their environment. The membrane has a porous surface which permits food to enter and waste materials to leave.
FUNCTIONS OF THE SKIN

The human skin is an organ—the largest of the body. It provides a tough, flexible covering, with many different important functions. The skin has many functions. The main functions are listed below.

**PROTECTION**

The skin protects the body from potentially harmful substances and conditions.

- The outer surface is **bactericidal**, helping to prevent the multiplication of harmful micro-organisms. It also prevents the absorption of many substances (unless the surface is broken), because of the construction of the cells on its outer surface, which form a chemical and physical barrier.
- The skin cushions the underlying structures from physical injury.
- The skin provides a **waterproof coating**. Its natural oil, **sebum**, prevents the skin from losing vital water, and thus prevents skin dehydration.
- The skin contains a pigment called **melanin**. This absorbs harmful rays of ultra-violet light.

**HEAT REGULATION**

Humans maintain a normal body temperature of 36.8–37°C. Body temperature is controlled in part by heat loss through the skin and by sweating. If the temperature of the body is increased by 0.25–0.5°C, the sweat glands secrete sweat to the skin’s surface. The body is cooled by the loss of heat used to evaporate the sweat from the skin’s surface. If the body becomes too warm there is an increase in blood flow into the blood capillaries in the skin. The blood capillaries widen (dilate) and heat is lost from the skin.

**EXCRETION**

Small amounts of certain **waste products**, such as urea, water and salt, are removed from the body in sweat by excretion through the surface of the skin.

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Tissues, may be grouped to form the larger functional and structural units we know as **organs**, such as the heart.
The reticular layer

The dermis contains a network of protein fibres called the reticular layer. These fibres allow the skin to expand, to contract, and to perform intricate, supple movements.

This network is composed of two sorts of protein fibre: yellow elastin fibres and white collagen fibres. Elastin fibres give the skin its elasticity, and collagen fibres give it its strength. The fibres are produced by specialised cells called fibroblasts, and are held in a gel called the ground substance.

While this network is strong, the skin will appear youthful and firm. As the fibres harden and fragment, however, the network begins to collapse, losing its elasticity. The skin then begins to show visible signs of ageing.

A major cause of damage to this network is unprotected exposure of the skin to ultra-violet light and to weather. Sometimes, too, the skin loses its elasticity because of a sudden increase in body weight, for example at puberty or pregnancy. This results in the appearance of stretch marks, streaks of thin skin that is a different colour from the surrounding skin: on a white skin they appear as thin reddish streaks; on a black skin they appear slightly lighter than the surrounding skin. The lost elasticity cannot be restored.

Nerve endings

The dermis contains different types of sensory nerve endings, which register touch, pressure, pain and temperature. These send messages to the central nervous system and the brain, informing us about the outside world and what is happening on the skin’s surface. The appearance of each of these nerve endings is quite varied.

Sensory nerves

Growth and repair

The body’s blood system of arteries and veins continually brings blood to the capillary networks in the skin and takes it away again. The blood carries the nutrients and oxygen essential for the skin’s health, maintenance and growth, and takes away waste products.
Defence  |  Within the dermis are the structures responsible for protecting the skin from harmful foreign bodies and irritants.

One set of cells, the **mast cells**, burst when stimulated during inflammation or allergic reactions, and release a chemical substance called **histamine**. This causes the blood vessels nearby to enlarge, thereby bringing more blood to the site of the irritation to limit skin damage and begin repair.

In the blood, and also in the lymph and the connective tissue, are another group of cells: the **macrophages** or 'big eaters'. These destroy micro-organisms and engulf dead cells and other unwanted particles. When necessary, they travel to an area where they are needed, for example the site of an infection. They form a role in the immune system that protects the body from disease-causing micro-organisms.

Waste products  |  Lymph vessels in the skin carry a fluid called **lymph**, a straw-coloured fluid similar in composition to blood plasma. Plasma is the liquid part of the blood that disperses from the blood capillaries into the tissue spaces. Lymph is composed of water, lymphocytes (a type of white blood cell that plays a key role in the immune system), oxygen, nutrients, hormones, salts and waste products. The waste products are eliminated and usable protein is recycled for further use by the body.

Control of functioning  |  **Hormones** are chemical messengers transported in the blood. They control the activity of many organs in the body, including the cells and glands in the skin. These include **melanosomes**, which produce skin pigment, and the **sweat glands** and **sebaceous glands**.

Hormone imbalance at different times of our life may disturb the normal functioning of these cells and structures, causing various **skin disorders**.

Skin appendages  |  Within the dermis are structures called **skin appendages**. These include:

- **sweat glands**;
- **sebaceous glands**;
- **hair follicles**, which produce hair;
- nails.

**Sweat glands**  |  **Sweat glands** or **sudoriferous glands** are composed of epithelial tissue, which extends from the epidermis into the dermis. These glands are found all over the body, but are particularly abundant on the palms of the hands and the soles of the feet. Their function is to regulate body temperature through the evaporation of sweat from the surface of the skin. Fluid loss and control of body temperature are important to prevent the body overheating, especially in hot, humid climates. For this reason, perhaps, sweat glands are larger and more abundant in black skins than white skins.

There are two types of sweat glands: eccrine glands and apocrine glands. **Eccrine glands** are simple sweat-producing glands, found over most of the body, appearing as tiny tubes (**ducts**). The eccrine glands are responsive to heat. These glands contain melanin-containing cells (melanosomes), which produce skin pigment.

**Apocrine glands** are large sweat-producing glands found in the axillae (armpits), perineum (area between the legs and the anus) and pubic region. When the surface has been broken, the skin at the site of the injury is replaced but may leave a scar. This initially appears red, due to the increased blood supply to the area, required while the skin heals. When healed, the redness will fade.

**Pores** allow the absorption of some facial cosmetics into the skin. Many facial treatments are therefore aimed at cleansing the pores, some with a particularly deep cleansing action, as with cosmetic cleansers and facial masks. The pores may become enlarged due to congestion caused by dirt, dead skin cells and cosmetics. The application of an **astringent** skin-care preparation creates a tightening effect upon the skin’s surface, slightly reducing the size of the pores.

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**HEALTH AND SAFETY**

We each have approximately two to five million sweat glands.

**TIP**

Excessive sweating, which can occur through exposure to high temperatures or during illness, can lead to skin dehydration—insufficient water content. Fluid intake must be increased to rebalance the body fluids.

**Pore size**

Pores allow the absorption of some facial cosmetics into the skin. Many facial treatments are therefore aimed at cleansing the pores, some with a particularly deep cleansing action, as with cosmetic cleansers and facial masks. The pores may become enlarged due to congestion caused by dirt, dead skin cells and cosmetics. The application of an **astringent** skin-care preparation creates a tightening effect upon the skin’s surface, slightly reducing the size of the pores.
Acid mantle: Sweat and sebum combine on the skin's surface, creating an acid film. This is known as the acid mantle, and discourages the growth of bacteria and fungi.

Acidity and alkalinity are measured by a number called the pH. An acidic solution has a pH of 0–7; a neutral solution has a pH of 7; and an alkaline solution has a pH of 7–14. The acid mantle of the skin has a pH of 5.5–5.6.

THE HAIR

THE STRUCTURE AND FUNCTION OF HAIR AND THE SURROUNDING TISSUES

A hair is a long, slender structure which grows out of, and is part of, the skin. Each hair is made up of dead skin cells, which contain the protein called keratin. Hairs cover the whole body, except for the palms of the hands, the soles of the feet, the lips, and parts of the sex organs.

Hair has many functions:
- scalp hair insulates the head against cold, protects it from the sun, and cushions it against bumps;
- eyebrows cushion the browbone from bumps, and prevent sweat from running into the eyes;
- eyelashes help to prevent foreign particles entering the eyes;
- nostril hair traps dust particles inhaled with the air;
- ear hair helps to protect the ear canal;
- body hair helps to provide an insulating cover (though this function is almost obsolete in humans), has a valuable sensory function, and is linked with the secretion of sebum onto the surface of the skin.

Hair also plays a role in social communication.

The structure of hair

Most hairs are made up of three layers of different types of epithelial cells: the medulla, the cortex and the cuticle.

The medulla is the central core of the hair. The cells of the medulla contain soft keratin, and sometimes some pigment granules. The medulla only exists in medium to coarser hair—there is usually no medulla in thinner hair.

The cortex is the thickest layer of the hair, and is made up of several layers of closely packed, elongated cells. These contain pigment granules and hard keratin.
Each hair grows out of a tube-like indentation in the epidermis, the hair follicle. The walls of the follicle are a continuation of the epidermal layer of the skin.

The arrector pili muscle is attached at an angle to the base of the follicle. Cold, aggression or fright stimulates this muscle to contract, pulling the follicle and the hair upright.

The sebaceous gland is attached to the upper part of the follicle; from it, a duct enters directly into the hair follicle. The gland produces an oily substance, sebum, which is secreted into the follicle. Sebum waterproofs, lubricates and softens the hair and the surface of the skin; it also protects the skin against bacterial and fungal infections. The contraction of the arrector pili muscle aids the secretion of sebum.

The dermal papilla, a connective tissue sheath, is surrounded by a hair bulb. It has an excellent blood supply, necessary for the growth of the hair. It is not itself part of the follicle, but a separate tiny organ which serves the follicle.

The bulb is the expanded base of the hair root. A gap at the base leads to a cavity inside, which houses the papilla. The bulb contains in its lower part the dividing cells that create the hair. The hair continues to develop as it passes through the regions of the upper bulb and the root.

The matrix is the name given to the lower part of the bulb, which comprises actively dividing cells from which the hair is formed.

The hair follicle extends into the dermis, and is made up of three sheaths: the inner epithelial root sheath, the outer epithelial root sheath and the surrounding connective-tissue sheath.

The inner epithelial root sheath grows from the bottom of the follicle at the papilla, both the hair and the inner root sheath grow upwards together. The inner surface of this sheath is covered with cuticle cells, in the same way as the outer surface of the hair: these cells lock together, anchoring the hair firmly in place.

The inner root sheath ceases to grow when level with the sebaceous gland.

The outer epithelial root sheath forms the follicle wall. This does not grow up with the hair, but is stationary. It is a continuation of the growing layer of the epidermis of the skin.

The connective-tissue sheath surrounds both the follicle and the sebaceous gland, providing both a sensory supply and a blood supply. The connective-tissue sheath includes, and is a continuation of, the papilla.

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Hair shapes

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<td>Less oval</td>
<td>Round</td>
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The Structure and Function of the Nail

Nails grow from the ends of the fingers and toes and serve as a form of protection. They also help when picking up small objects. Dark streaks caused by pigmentation are common on the nail plate of black-skinned clients. These tend to increase with age.

The nail plate

The nail plate is composed of compact translucent layers of keratinised epidermal cells: it is this that makes up the main body of the nail. The layers of cells are packed very closely together, with fat but very little moisture.

The nail gradually grows forward over the nail bed, until finally it becomes the free edge. The underside of the nail plate is grooved by longitudinal ridges and furrows, which help to keep it in place.

In normal health the plate curves in two directions:

- transversely—from side to side across the nail,
- longitudinally—from the base of the nail to the free edge.

There are no blood vessels or nerves in the nail plate: this is why the nails, like hair, can be cut without pain or bleeding. The pink colour of the nail plate derives from the blood vessels that pass beneath it—the nail bed.

Function: To protect the living nail bed of the fingers and toes.

The free edge

The free edge is the part of the nail that extends beyond the fingertip; this is the part that is filed. It appears white as there is no nail bed underneath.

Function: To protect the fingertip and the hyponychium (see page 106).

The matrix

The matrix, sometimes called the nail root, is the growing area of the nail. It is formed by the division of cells in this area, called mitosis, which is part of the stratum germinativum layer of the epidermis. It lies under the eponychium (see page 106), at the base of the nail, nearest to the body. The process of keratinisation takes place in the epidermal cells of the matrix, forming the hardened tissue of the nail plate.

Function: To produce new nail cells.

The nail bed

The nail bed is the portion of skin upon which the nail plate rests. It has a pattern of grooves and furrows corresponding to those found on the underside of the nail plate; these interlock, keeping the nail in place, but separate at the end of the nail to form the free edge. The nail bed is liberally supplied with blood vessels, which provide the nourishment necessary for continued growth; and sensory nerves, for protection.

Function: To supply nourishment and protection.
The nervous system therefore co-ordinates the activities of the body by responding to stimuli received by sense organs, including the nose, tongue, eyes, ears and skin.

**THE MUSCULAR SYSTEM**

Muscles are responsible for the movement of body parts. Each is made up of a bundle of elastic fibres bound together in a sheath, the **fascia**. Muscular tissue contracts (shortens) and produces movement. Muscles never completely relax—there are always a few contracted fibres in every muscle. These make the muscles slightly tense and this tension is called muscle tone.

Muscle tissue has the following properties:

- it has the ability to contract;
- it is extensible (when the extensor muscle in a joint contracts the corresponding flexor muscle will be stretched or lengthened);
- it is elastic—after contraction or extension it returns to its original length;
- it is responsive—it contracts in response to nerve stimulation.

A muscle is usually anchored by a strong tendon to one bone: the point of attachment is known as the muscle’s **origin**. The muscle is likewise joined to a second bone: the attachment in this case is called the muscle’s **insertion**. It is this second bone that is moved: the muscle contracts, pulling the two bones towards each other. (A different muscle, on the other side of the bone, has the contrary effect.) Not all muscles attach to bones, however: some insert into an adjacent muscle, or into the skin itself. The muscles with which we are concerned here are those of the face, the neck and the shoulders.

**FACIAL MUSCLES**

Many of the muscles located in the face are very small and are attached to (insert into) another small muscle or the facial skin. When the muscles contract, they pull the facial skin in a particular way; this creates facial expressions.

With age, the facial expressions that we make every day produce lines on the skin—frown lines. The amount of tension, or **tone**, also decreases with age. When performing facial massage, the aim is to improve the general tone of the facial muscles.
The occipital branch supplies the back of the head and the scalp; the temporal branch supplies the sides of the face, the head, the scalp and the skin; the facial branch supplies the muscles and tissues of the face.

These arteries also divide repeatedly, successively becoming smaller and smaller until they form tiny blood capillaries. These vessels are just one cell thick, allowing substances carried in the blood to pass through them into the tissue fluid, which bathes and nourishes the cells of the various body tissues.

The blood capillaries begin to join up again, forming first small vessels called venules, then larger vessels called veins. These return the blood to the heart.

Veins are less elastic than arteries, and are closer to the skin’s surface. Along their course are valves, which prevent the backflow of blood.

The main veins are the external and internal jugular veins. The internal jugular vein and its main branch, the facial vein, carry blood from the face and head. The external jugular vein carries blood from the scalp and has two branches: the occipital branch and the temporal branch. The jugular veins join to enter the subclavian vein, which lies above the clavicle.

Blood returns to the heart, which pumps it to the lungs, where the red blood cells take on fresh oxygen, and where carbon dioxide is expelled from the blood. The blood returns to the heart, and begins its next journey round the body.

The Arteries of the Arm and Hand

The arm and hand are nourished by a system of arteries that carry oxygen-rich blood to the tissues. You can see the colour of the blood from the capillaries beneath the nail; it is these that give the nail bed its pink colour.

The brachial artery supplies blood to the upper arm. This branches into the ulnar and radial artery, which supplies the forearm and fingers. The radial and ulnar arteries are connected across the palm by a superficial and deep palmar arch. These arteries divide to form the metacarpal and digital arteries, which supply the palm and fingers.

The veins of the arms and hands

Veins deliver deoxygenated blood back to the heart. Blood which has had oxygen removed appears blue. Veins often pass through muscles. Each time muscles contract, veins are squeezed and the blood is pushed along. Massage is particularly beneficial to help this process.
These principal lymphatic vessels then empty their contents into a vein at the base of the neck, which in turn empties into the vena cava. The lymph is mixed into the venous blood as it is returned to the heart.

**Lymph Nodes**

**Lymph nodes or glands** are tiny oval structures which filter the lymph, extracting poisons, pus and bacteria, and thus defending the body against infection by destroying harmful organisms. **Lymphocytes**, found in the lymph glands, are special cells which produce **antibodies** which enable us to resist invasion by micro-organisms.

When performing massage, the hands should be used to apply pressure to direct the lymph towards the nearest lymph node: this encourages the speedy removal of waste products. Various groups of lymph nodes drain the lymph of the head and neck.

**Lymph nodes of the head**

- The **buccal group** drains the eyelids, the nose and the skin of the face.
- The **mandibular group** drains the chin, the lips, the nose and the cheeks.
- The **mastoid group** drains the skin of the ear and the temple area.
- The **occipital group** drains the back of the scalp and the upper neck.
- The **submental group** drains the chin and the lower lip.
- The **parotid group** drains the nose, eyelids and ears.

**Lymph nodes of the neck**

- The **superficial cervical group** drains the back of the head and the neck.
- The **lower deep cervical group** drains the back area of the scalp and the neck.

**Lymph nodes of the chest and arms**

- The nodes of the armpit area drain various regions of the arms and chest.

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Learn and remember these names of the main regions of the head and neck. Not only will this assist you in recalling the names and locations of the bones, it will also help you greatly with the names and locations of muscles, arteries, veins, nerves and lymph nodes.
You have now learnt about the related anatomy and physiology for the beauty therapy chapters with an essential knowledge requirement.

To test your level of knowledge, answer the following short questions. These will prepare you for your summative (final) assessment.

**Skin structure and function**

1. Referring to the cross section of the skin, name and briefly describe the function of the structures shown in 1–4.

![Cross section of the skin diagram]

2. Name six functions of the skin.

3. Name the layers of the epidermis shown in 1–5. Which layer is continuously being shed?

![Epidermis layers diagram]

4. What are tissues? Name three types of body tissues.
Beauty Therapy: The Foundations

Hair growth cycle
1. What are the different stages of the hair growth cycle called?
2. What happens to the hair at each stage?
3. What relevance has the hair growth cycle for a wax depilation treatment?
4. What is the difference in the time between the hair growth cycle anagen to telogen for scalp hair and eyebrow hair?

Nail structure and function
1. Referring to the cross section of the nail, briefly describe the name and function of each of the numbered areas.

2. Why does the nail bed appear pink?
3. Why does the nail bed contain nerve endings?

Nail growth
1. In which part of the nail structure do the cells divide to form the nail?
2. As the nail cells grow forward they harden; what is this process called?
3. How long does it take for a fingernail to grow from cuticle to free edge?
4. When do nails grow faster—in summer or winter?
5. What is the difference in growth rate between fingernails and toenails?
6. Why does localised massage to the hand and foot encourage healthy nail growth?
7. What other factors affect nail growth?
1. What happens when muscles contract?

2. What structure attaches a muscle to a bone?

3. On the diagram of the muscles of the face, name muscles 1–6. What are the actions of these muscles?

4. On the diagram of muscles that move the head and neck, name muscles 1–5. What are the actions of these muscles?
Central nervous system and autonomic nervous system

1. The neurological system transmits messages between the brain and other parts of the body. There are two main divisions. What are they called?

2. What is the central nervous system composed of?

3. What is the difference between sensory nerves and motor nerves?

4. To what are the main sensory nerve endings in the skin receptive?

5. How do nerve impulses pass along nerve fibres?

6. How do nerves stimulate muscles to contract?
7 What is meant by the autonomic nervous system?

8 How many pairs of cranial nerves emerge from the brain?

9 Those of concern to the beauty therapist when performing facial massage are the 5th, 7th and 11th cranial nerves.

   What is the function of the:
   ■ 5th, known as trigeminal nerve
   ■ 7th, known as the facial nerve
   ■ 11th, known as the accessory nerve?

10 Name the main branches of the 7th cranial facial nerve, items 1–5 in the diagram.