The Integumentary System

This system consists of the skin, hair, nails and exocrine glands. A gland is an organ within the body that produces substances such as hormones or mucus to be released for use in the body. Exocrine glands are those that use ducts (tubes) to secrete their products outside of themselves to other areas of the body or even to the surface of the body. These include sweat glands (which secrete a water based solution for cooling the body) and sebaceous glands (which secrete a waxy, oily substance to lubricate and waterproof the skin). Endocrine glands on the other hand secrete substances via the blood stream and they include the pancreas (which releases insulin for sugar regulation), the thyroid gland (which makes hormones to regulate growth) and the testicles (which secrete testosterone for the development of the male reproductive organs).

Humans have hair on most body areas (exceptions include the palms and lips). Each hair is made up of densely arranged dead cells. Inside the skin is the hair's root and above is the hair shaft (or follicle). Hairs have a range of functions including:

- Head hair insulates in the cold and cools in the heat (sweat evaporates from soaked hair which has a cooling effect).
- Touch Sense – each hair follicle has a nerve fibre that senses touch and movement of air around it.
- Protection – the eyebrows and eyelashes prevent dust, sweat and water entering the eyes.

Nails on our toes and fingers are composed of a tough protein called keratin, which is also found in hooves and horns of animals. Nails have the function of protecting the tips of the fingers and toes. They also allow intricate movements as they improve the feeling of the fingertips. Also they are used as a tool for scraping and digging.

The skin is the largest part of the integumentary system. It is also the largest organ in the body, making up around 15% of the body's total mass. It covers a large surface area which on average is 2 m^2. The skin is made up of many parts and contains a variety of different tissues, vessels and cells.

The **epidermis** is the outermost layer of the skin which is around 50 cells thick (this equates to only 1/10th of a millimetre). This layer is quite tough and almost scaly, the cells found here are called **corneocytes**. It is water resistant and you will notice that water runs off your skin or forms droplets on its surface. This layer contains small holes called **sweat pores** that let sweat out from within the body for cooling and to oil the surface. Under this initial layer but still within the epidermis, are cells that protect the body from sunlight called **melanocytes**. The third layer within the epidermis is the **Langerhans cells** which find and fight pathogens. The last layer is the **Merkel cells** which are connected to nerves along the bottom of the epidermis cells and help with feeling and touch.

The second major section of the skin is the **dermis**; it is the deepest layer and gives the skin its strength and stretchiness. The dermis is made of tightly packed connective tissue (tough fibres surrounded by other cells and flexible materials) and other components such as elastic collagen. There are two layers within the dermis; the first is called the **papillary layer** which lies alongside the bottom of the epidermis. It has finger-like projections (called **dermal papillae**) that stick up into the epidermis and increase the surface area so more blood vessels and nerve fibres can interact with the top layer. These nerves (called **free-nerve endings**) look like branching trees and are responsible for feelings such as pain, hot, cold and pressure. Other nerves called **Meissner's corpuscles** are globular in shape and are responsible for feeling

touch. The second and inner layer of the dermis is thick and tough to provide strength and elasticity; it does this through the presence of collagen and elastin fibres running in a range of directions. Blood vessels that form loops (mainly the tiny **capillaries**) for nutrient supply and temperature regulation are also found in the dermis. This layer is much thicker than the papillary layer and is called the **reticular layer**. The **hair's root** can be found near the base of this layer and the **sebaceous glands** (that secrete oil along the hair) are found beside the **hair's shaft**. The hair goes through the papillary layer to the epidermis and external environment. Attached to the shaft of the hair and the papillary layer are **erector muscles** which pull the hair straight up when cold or frightened (we know this as 'goose bumps'). Also within the dermis are two types of sweat glands:

- **Eccrine sweat glands**: Produce a solution of water and salts directly through a sweat pore in the epidermis. They are found all over the skin.
- **Apocrine sweat glands**: Produce a thick oily liquid directly to the shaft of the hair.

The final layer of the skin is the **hypodermis**. It is closest to the muscles and bones within the body. It is made up of yellow fat storage cells (called **adipose tissue**) and stretchy fibres that allow the skin to move separately of the muscle beneath it. The fat stored here insulates the body by trapping the heat that is made when the muscles move. The beginning of many blood vessels and nerves are also found in this layer. **Lamellar corpuscles** are found in the hypodermis (some are also in the lower dermis); they resemble fingerprints and are responsible for sensing and detecting vibration and pressure.