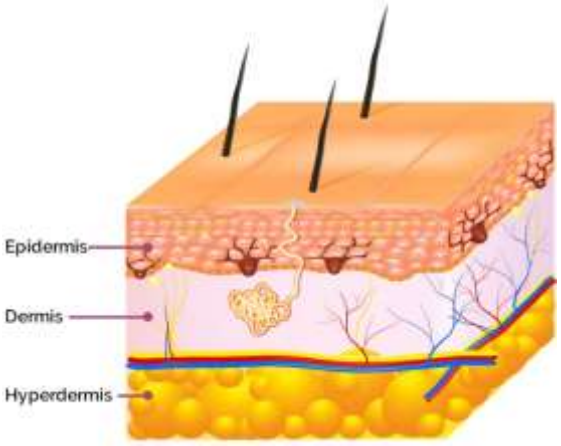
THE SKINS STRUCTURE



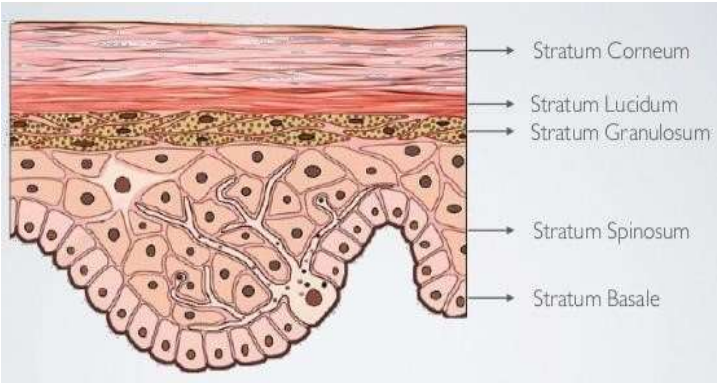
The skin is made up of 3 layers

1. **The Epidermis**
2. **The Dermis**
3. **The Hypodermis**

ANATOMY OF THE EPIDERMIS

Stratum Corneum: Most superficial layer exposed to the outer environment. This dry, dead layer helps prevent the penetration of microbes and the dehydration of underlying tissues. Average 15-30 layers of cells.

Stratum Lucidum: Found only in the soles of the feet and palms of the hand.



Stratum Granulosum: This is the layer where part of keratin production occurs. Keratin is a protein that is the main component of skin.

Stratum Spinosum: This layer gives the skin strength as well as flexibility. Langerhans cells as well as squamous cells are located here.

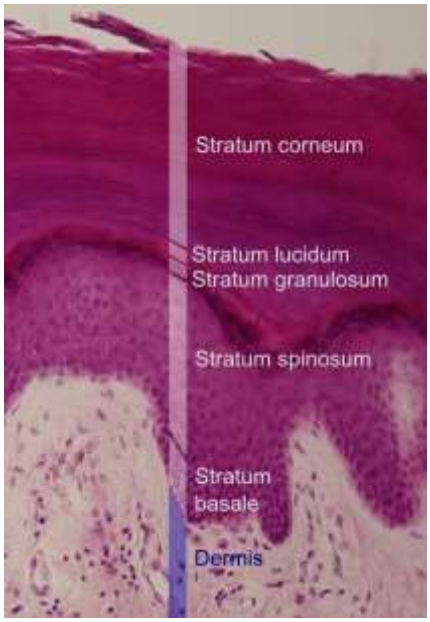
Stratum Germinativum or Stratum Basale: where the cells, called keratinocytes, are formed before moving up to the surface of the epidermis This layer also contains melanocytes, the cells that are largely responsible for determining the color of our skin and protecting our skin from the harmful effects of UV radiation.

THE EPIDERMIS

The epidermis is the outer layer of the skin and is the first to show changes in the surface texture and appearance. It functions as a barrier to the external environment.

A unique characteristic of the epidermis is its ability to continuously regenerate new cells. The epidermis constantly sheds old dead cells on its surface while new ones are formed beneath it in the Basal Cell Layer. Calls have an average life span of 19-34 days at which they move from the Basal Cell layer up towards the Stratum Corneum where they are shed.

The cells of the epidermis move from the bottom of the epidermis to the top layer, building up a large amount of keratin and develop a tough outer shell. Once these cells reach the top layer, they flake off and the process is then repeated.



LIPIDS

Lipids are molecules that make up the building blocks and structure of living cells. They control Inflammation by being inflammation mediators.

Lipids are impermeable and selective so they will only let some cells in and out which makes it special as it decides what to absorb and what to defuse, which keeps toxins out. Impermeable simply means that it does not allow molecules to freely pass it. Only water and gasses can easily pass through (and a Plasma device creates a gas by design). This means that large molecules and small polar molecules cannot cross the bilayer (and thus the cell membrane) without the assistance of other structures.

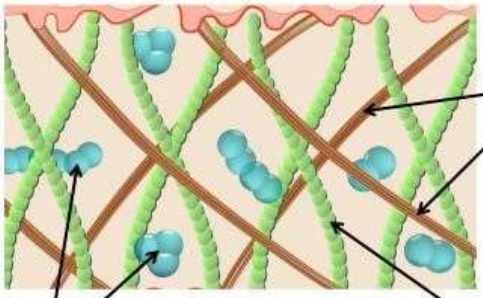
Examples of lipids include:

- Fats
- Oils
- Waxes
- Certain vitamins
- Most of the non-protein membrane of cells

THE DERMIS

- The dermis gives the skin its strength, shape, laxity and flexibility. It is made up of 2 layers: the papillary layer and the reticular layer.
- The dermis contains the collagen bundles, blood vessels, fibroblasts, hair follicles, lymph glands, sweat glands and nerve endings.
- The dermis is composed of approximately 95% collagen and is about 35 times thicker than the epidermis.
- The subcutaneous layer of tissue below the dermis is made up of a network of fat cells and collagen bundles. It is also where the larger blood vessels and nerves are found.

The combination of collagen, elastin and hyaluronic acid create the extra cellular matrix (ECM) of the dermal layer. They are all made by fibroblasts.



Type I collagen is the most abundant form of collagen in the skin, it is also the strongest. Collagen provides strength.

Hyaluronic acid is a charged molecule which is attracted to water. It acts like a sponge holding vast amounts of water in the skin, plumping out the skin reducing the appearance of fine lines and wrinkles, as well as improving the skin's hydration.

Elastin is another protein made by fibroblasts. It has the ability to stretch and recoil to its original shape giving the skin suppleness and flexibility.

COLLAGEN

- The main component of the dermis.
- It is a fibrous family of proteins.
- A major stress resistant material of the skin.
- Collagen fibers exist in a constant state of flux.
- Represents 70% of the skin's dry weight.
- The collagen molecules are often crosslinked, for extra strength - tensile strength.
- The synthesis of collagen fibrils is performed by the fibroblasts.
- There are several types of collagen (14 to be exact). 80-90% of collagen in the body consists of only three types.

Type I – the most abundant form of collagen in the skin – more than 90% of the collagen on our bodies is Type I. It is the strongest type of collagen in our skin and is the end product of the healing process.

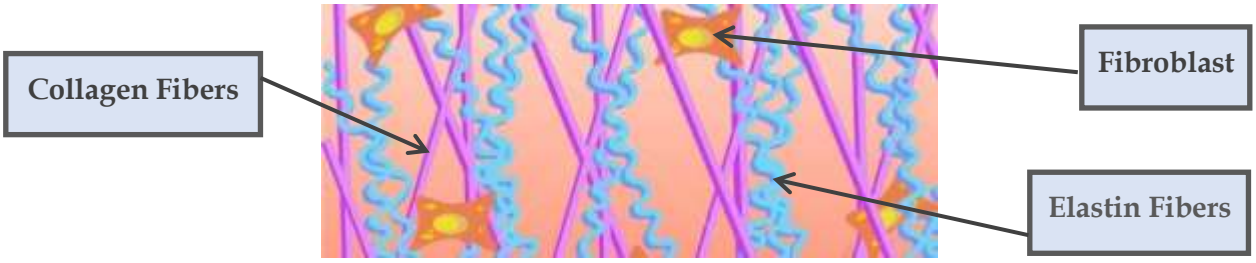
Type II – primarily found in cartilage.

Type III – reticulate (main component of reticulate fibers), commonly found alongside Type I. Produced by Fibroblasts and eventually synthesize into Type I*. Type III collagen is the first collagen made following a trauma, although it is weaker than Type I, it is sufficiently strong to begin healing a wound.

*On average- it takes three months for Type III Collagen to turn into Type I Collagen.

ELASTIN

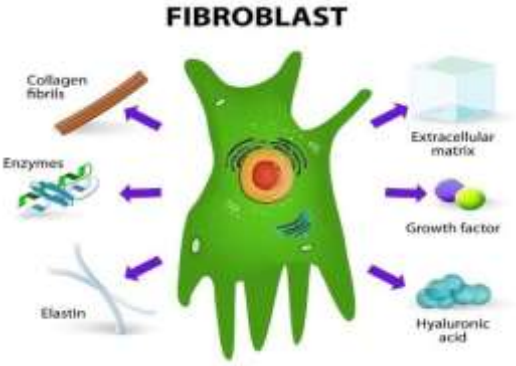
- **Elastin** is another protein made by **fibroblasts**. It has the ability to **stretch** and **recoil** to its original shape, giving the skin **suppleness** and flexibility.
- A common feature of all elastin sequences is that they are rich in glycine, proline, and lysine. In humans, elastin is synthesized early in life, as a fetus.
- Elastin production stops at puberty.
- In humans, elastin is synthesized early in life. By age 40 (approximately) elastin biosynthesis in humans slows down to a trickle.
- The appearance of skin wrinkles and other aging processes are directly related to the loss of elastin.



THE ROLE OF MACROPHAGES & FIBROBLASTS

Debridement refers to the removal of debris and the cleansing of a **wound** by the body. The main mode of debridement is **phagocytosis**, or

"eating" of foreign objects by inflammatory cells such as macrophages (white blood cells). Think of an army of Pac-men soldiers eating away any dirt, foreign matter, cancer cells and fluid in the skin and body.



Dormant fibroblasts are called fibrocytes. Fibroblasts and fibrocytes are two states of the same cell. A fibroblast cell has a lifespan of a couple of months, whereas fibrocytes live longer in their "hibernating" state. Fibrocytes lurk through our body waiting for the signal to provide more collagen. Months without any sign that the body needs more of their glue, and they disappear until damage is done.

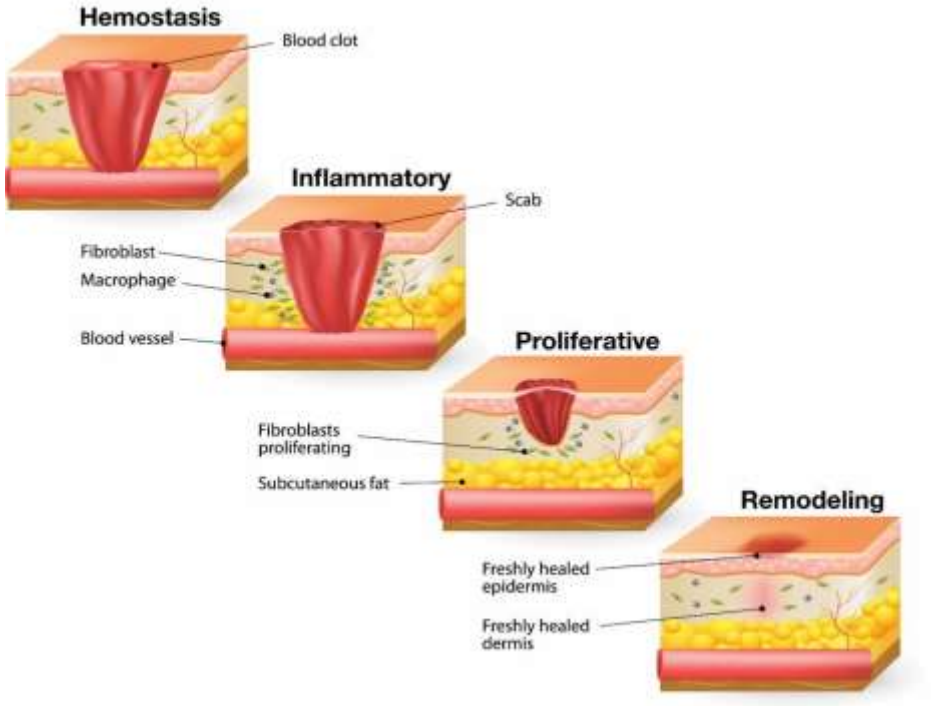
4 STEP PROCESS OF HEALING

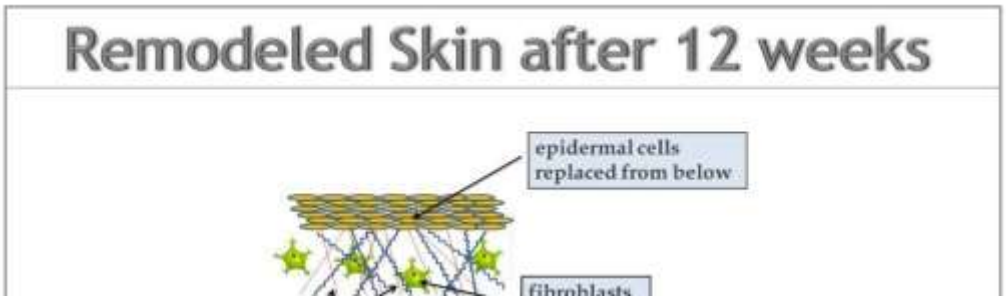
1. **Hemostasis –** the process of the wound being closed by clotting. The blood changes from a liquid to a gel like matter. The first step of hemostasis is when blood vessels constrict to restrict the blood flow. Next, platelets stick together in order to seal the break in the wall of the blood vessel. As the gel dries it becomes a crust or scab. Coagulation occurs and reinforces the platelet plug with threads of fibrin which are like a molecular binding agent.

2. **Inflammation –** the second stage of wound healing and begins right after the injury. The fluid engorgement allows healing and repair cells (white blood cells) to move to the site of the wound. These white blood cells, growth factors, nutrients and enzymes create the swelling, heat, pain and redness commonly seen during this stage of wound healing. Typically lasts 2-7 days.

3. **Proliferative Phase –** the third phase in the healing process and lasts 6-21 days. This phase is characterized by the presence of granulation tissue and ultimately epithelialization. Fibroblasts are a key cell in this phase. Fibroblasts are responsible and lay the foundation for new extracellular matrix (ECM) for collagen and granulation tissue. In this phase, we go through proliferation, growth of new tissue, angiogenesis, collagen deposition, granular tissue formation, wound contracture and epithelial cell migration. Granulation tissue consists of macrophages, fibroblasts, immature collagen and blood vessels. Angiogenesis is the formation of new vessels that developed within the granular tissue in order to supply it with blood and nutrients. As granulation tissue develops, fibroblasts stimulate the production of collagen, which gives tissue strength and structure.

4. **Maturation –** also called the remodeling stage of wound healing, the maturation phase is when collagen is remodeled from type III to type I and the wound fully closes. This can take several months to 2 years to complete. The cells that had been used to repair the wound but which are no longer needed are removed by apoptosis, or programmed cell death.





REVIEW

- At the site of the damaged tissue, platelets in the blood release thromboplastins
- Thromboplastins convert the inactive enzyme prothrombin to the active thrombin
- Thrombin converts fibrinogen in the plasma to its insoluble form; fibrin
- Fibrin creates a mesh of fibers, like a gauze, in which platelets and red blood cells become trapped
- The clot prevents further bleeding and the entry of pathogens
- White blood cells in the affected area release histamine
- Histamine increases the permeability of the capillaries making them 'leaky'
- More tissue fluid than normal leaves the capillaries causing swelling or edema
- Blood flow to the affected area increases making it red (vasodilation)
- White blood cells – which can change their shape – squeeze through the pores of the capillary
- Macrophages at the wound site secrete fibroblastic growth factors
- These growth factors attract fibroblasts from surrounding tissue, some stem cells also develop in to myofibroblasts
- Fibroblasts begin to deposit Type III Collagen at the site of the wound allowing it to start the healing process
- Granulation begins when the fibroblasts produce a new extra cellular matrix (ECM)
- The developing ECM consists of Type III Collagen, Hyaluronic Acid, Elastin and Myofibroblasts