

# **ANATOMY AND PHYSIOLOGY OF THE SKIN & WOUND HEALING**



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# SKIN

- **The largest organ**
- **Weighs approximately 2.7 kg (6 lbs )**
- **2 mm (0.07 inches ) thick**
- **Area - 2 square meters ( 18-20 square feet )**

- **The skin is divided into :**

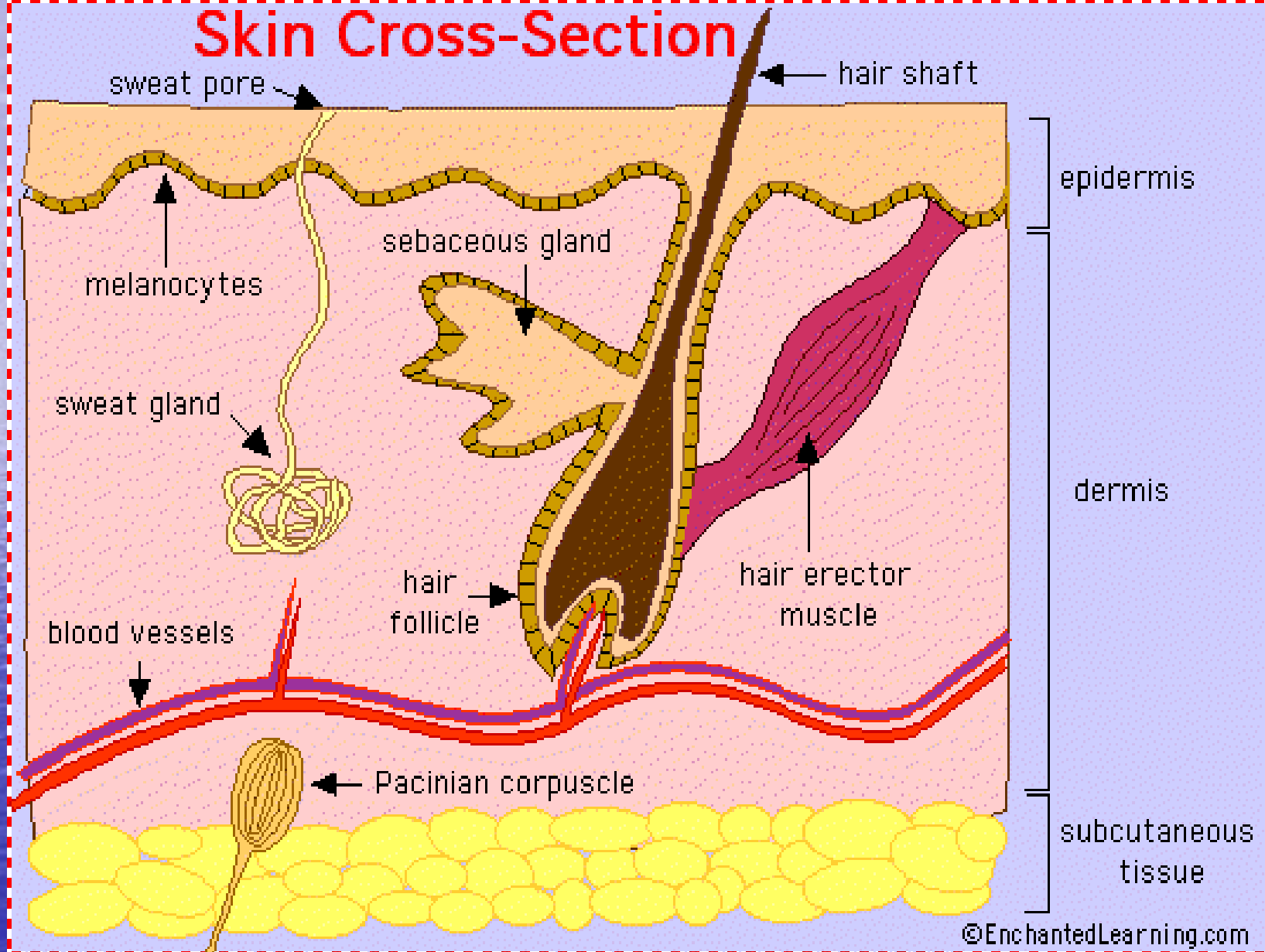
- 1. epidermis**

**-the outer layer**

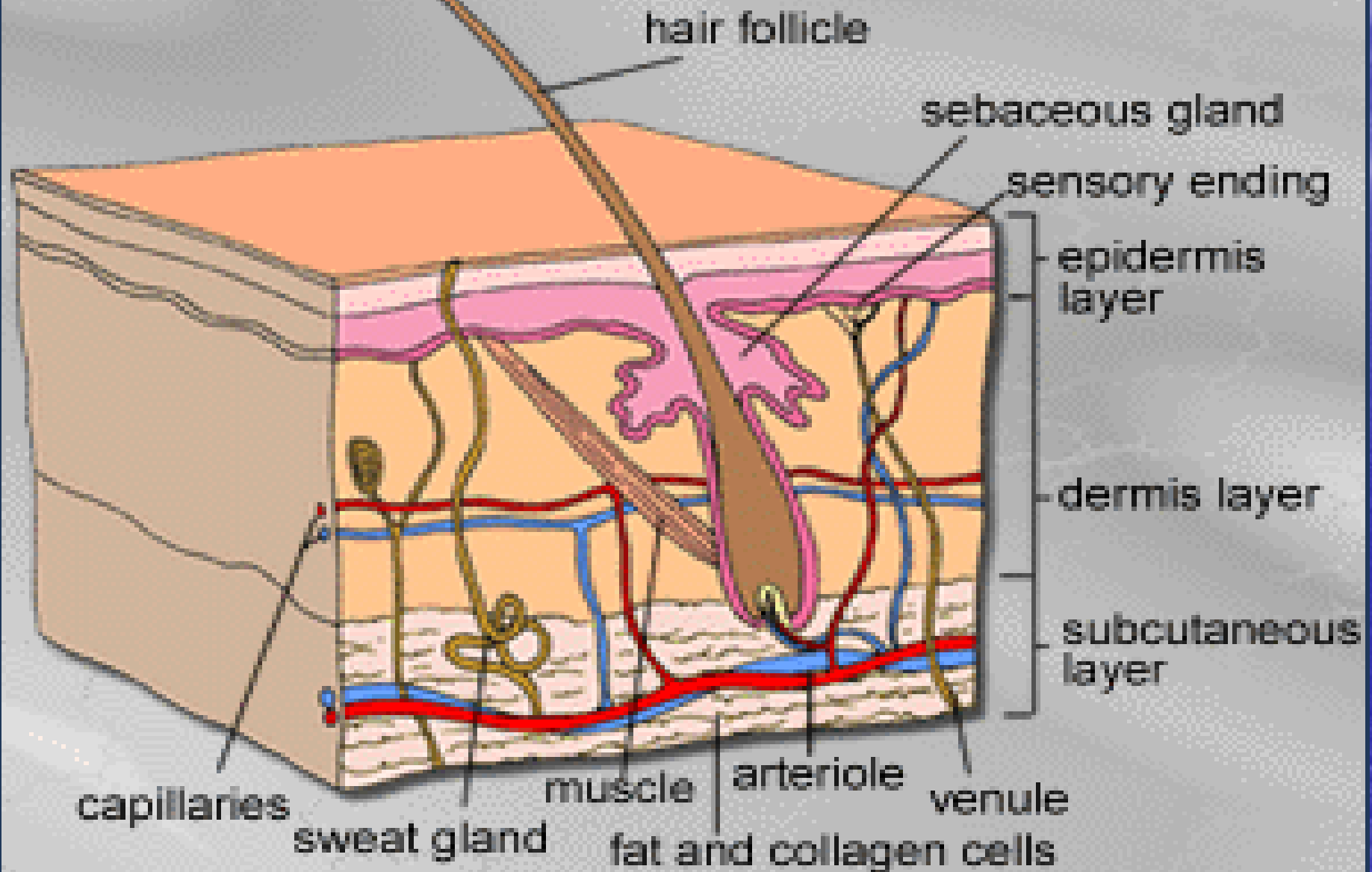
- 2. dermis**

- 3. fat layer ( subcutaneous /  
hypodermis )**

# Skin Cross-Section



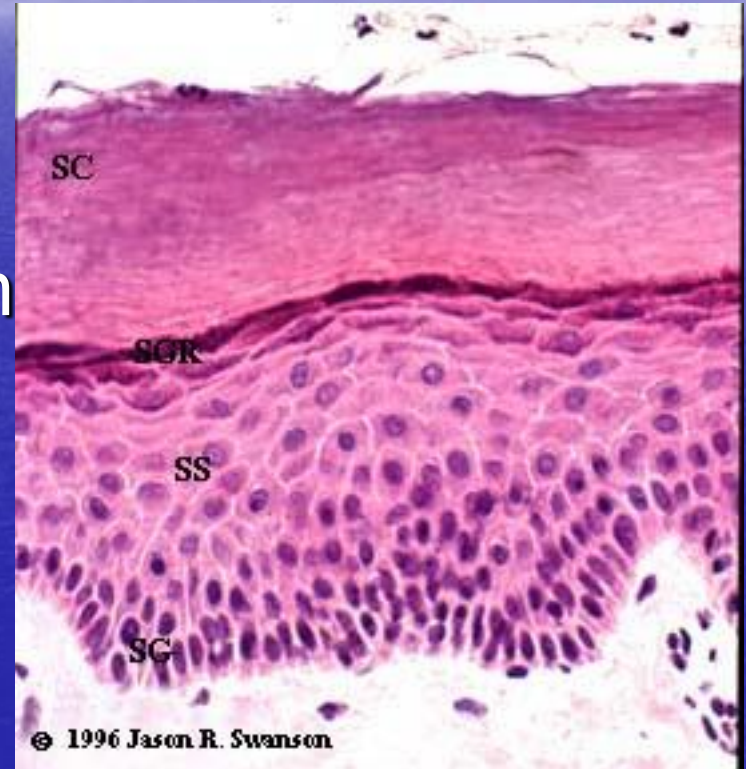
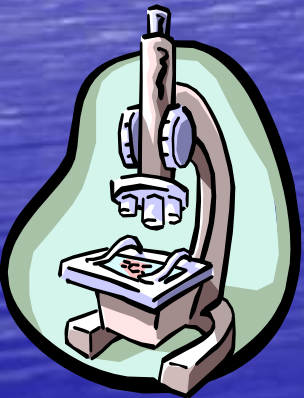
# Skin: 3-dimensional block



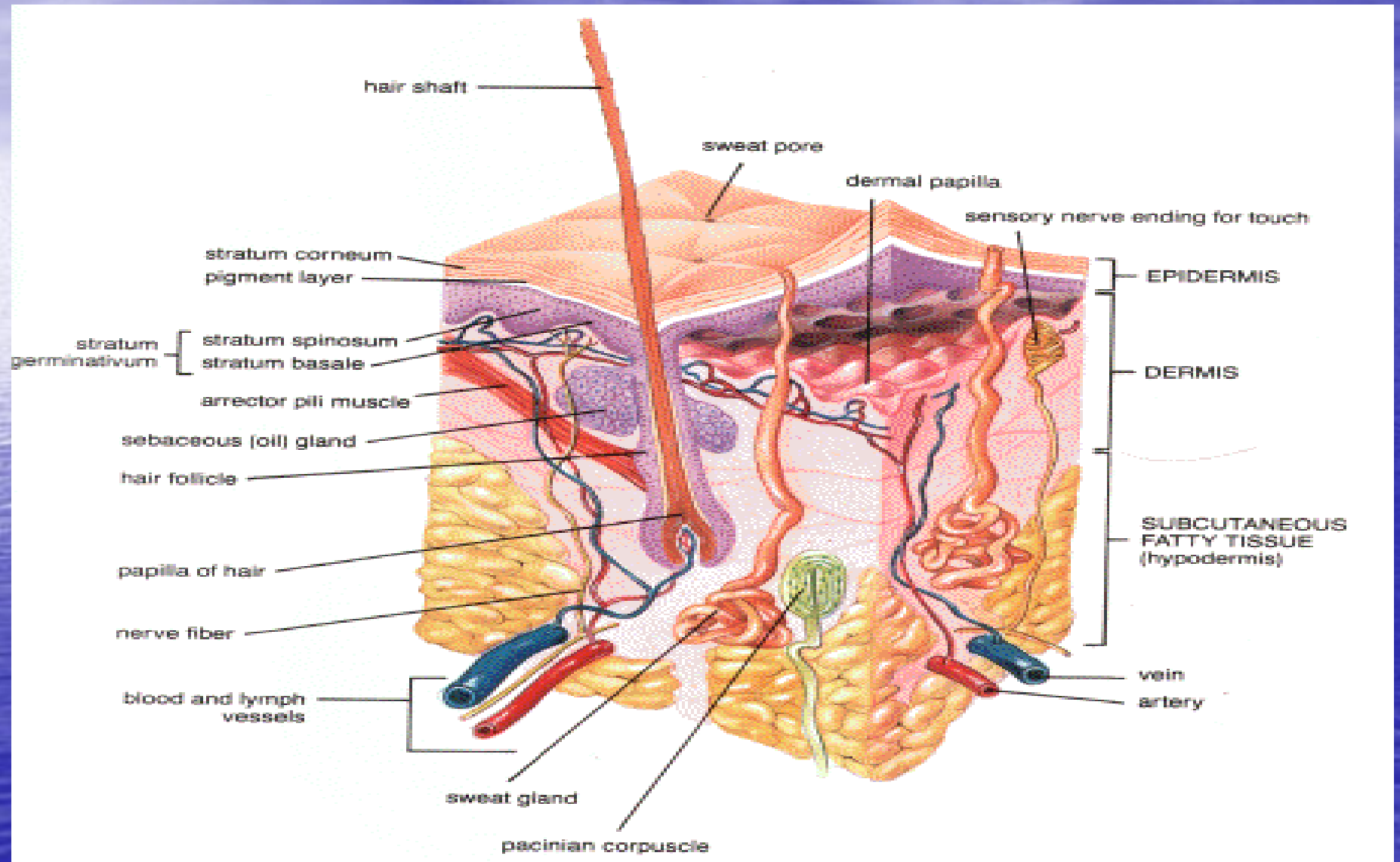


# THE EPIDERMIS

- 0.1-1.5 mm thick
- is divided into 5 layers :
  1. stratum germinativum
  2. stratum spinosum
  3. stratum granulosum
  4. stratum lucidum
  5. stratum corneum



# THE SKIN

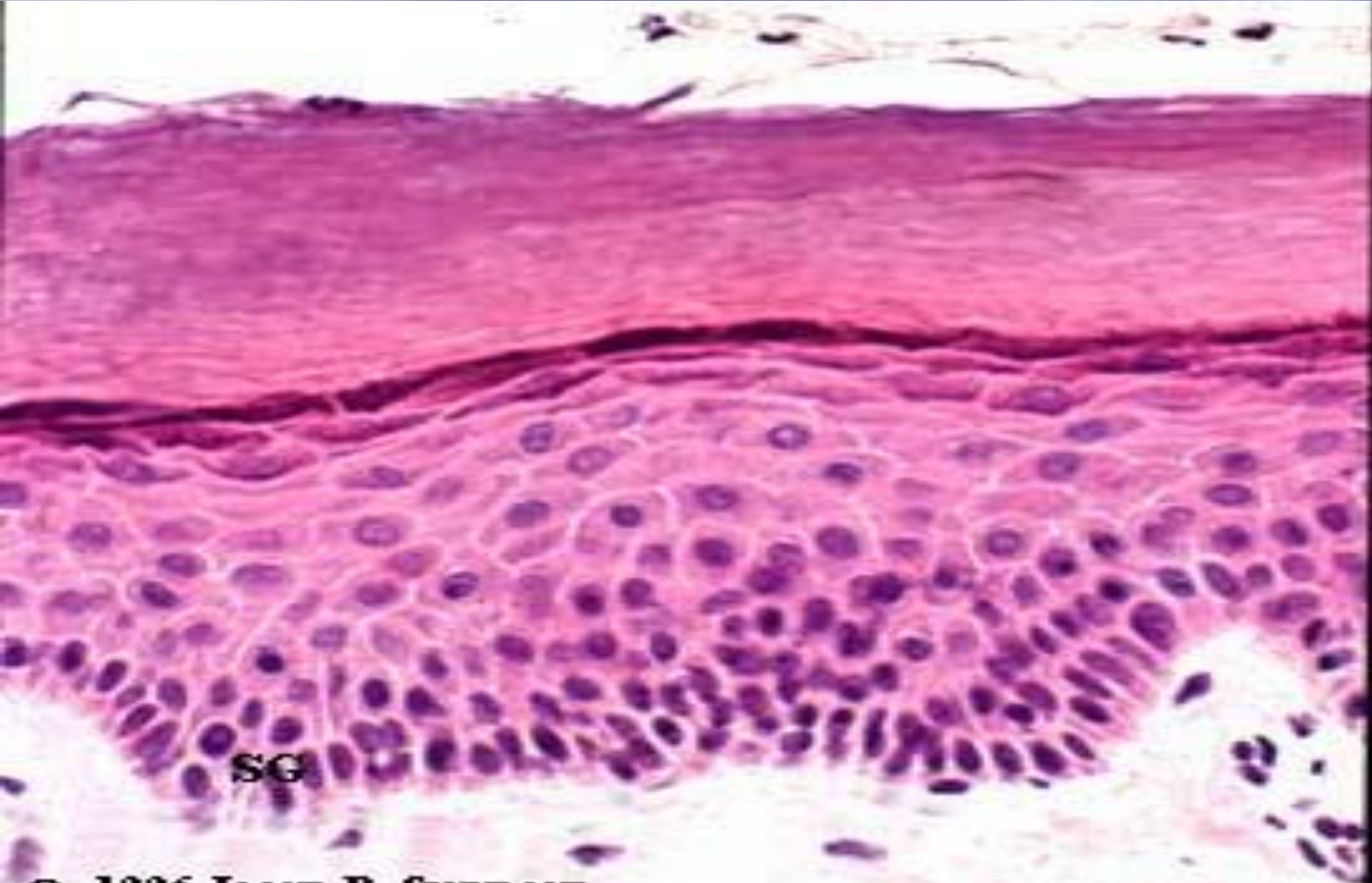




# STRATUM GERMINATIVUM

- -provides the germinal cells for regeneration of the epidermis
- -separated from the dermis by a layer of basement membrane
- After mitotic division of the basal cells ,the new cells will undergo keratinization as it migrates to the surface
- Contains melanocytes which produce melanin

# STRATUM GERMINATIVUM

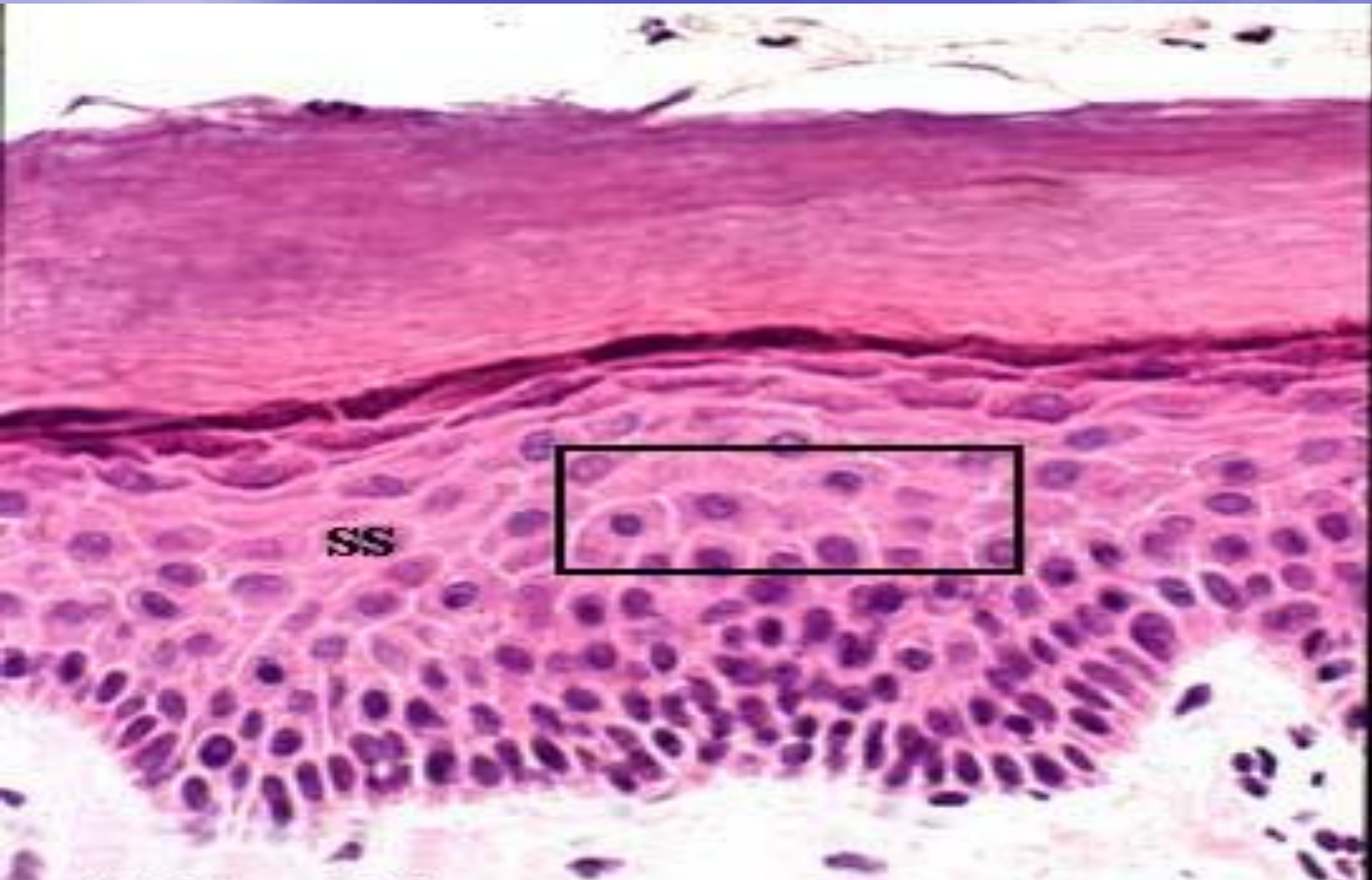


SG

# STRATUM SPINOSUM

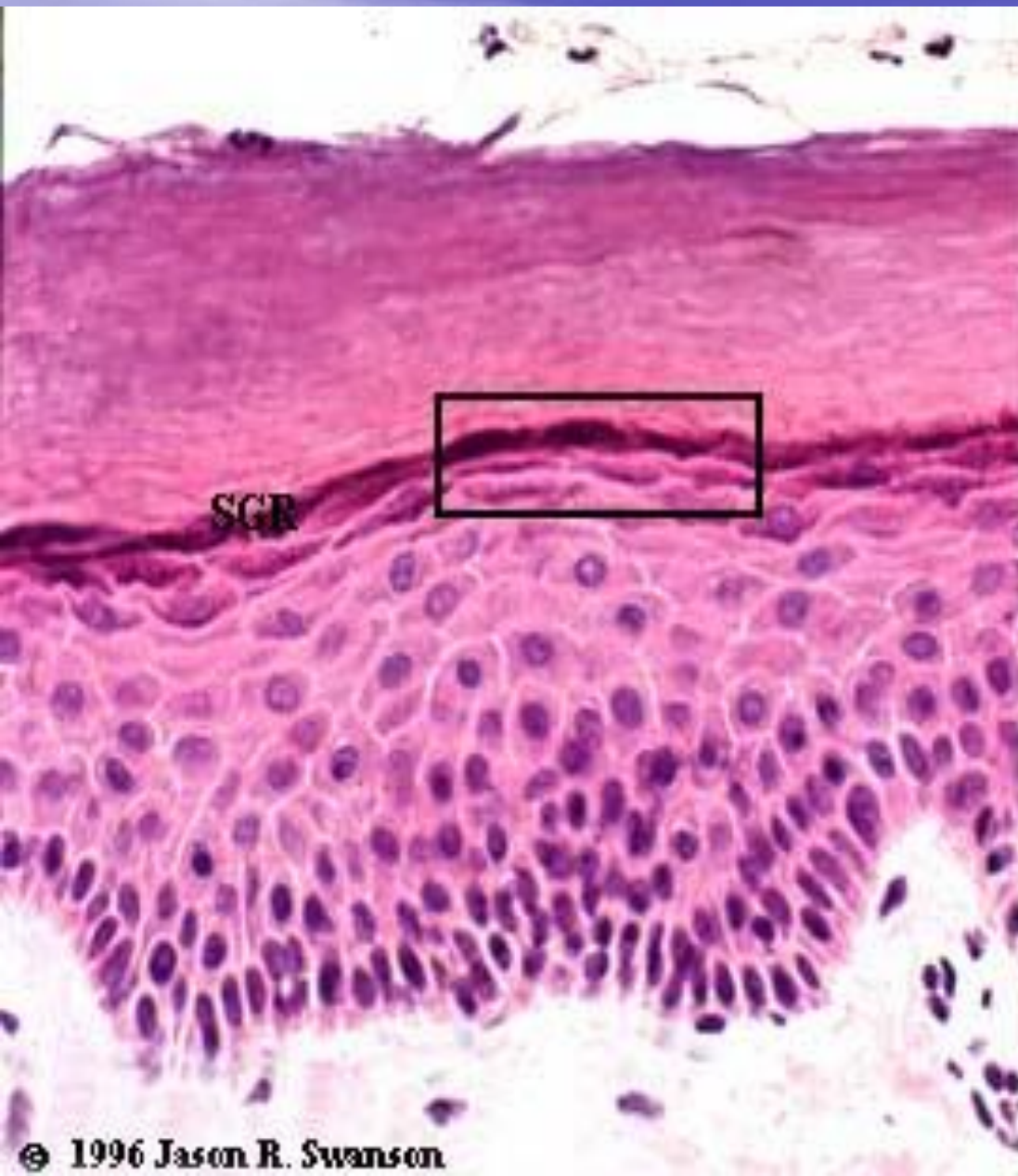
- Squamous cell layer / “ spiny layer” / prickle-cell layer
- Thickest layer
- Cells are held together with spiny projections ( desmosomes )
- These maturing cells are called squamous cells / keratinocytes
- Keratinocytes produce keratin
- Also contains Langerhans cells
- This is where **blisters** form

# STRATUM SPINOSUM





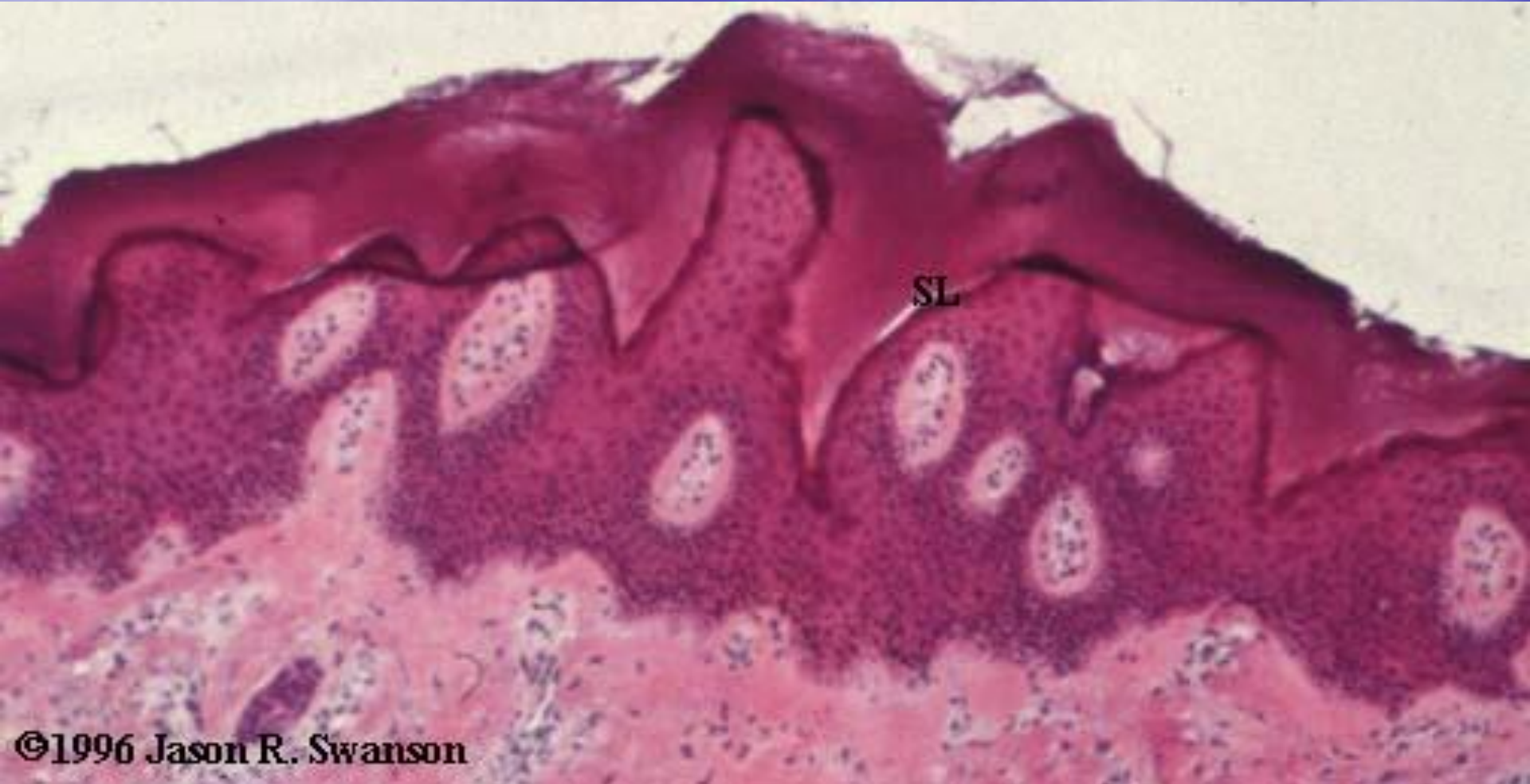
# STRATUM GRANULOSUM



-cells accumulate dense basophilic keratohyalin granules

- These granules contain lipids and together with the desmosomal connections help to form a waterproof barrier to prevent fluid loss

# STRATUM LUCIDUM



©1996 Jason R. Swanson

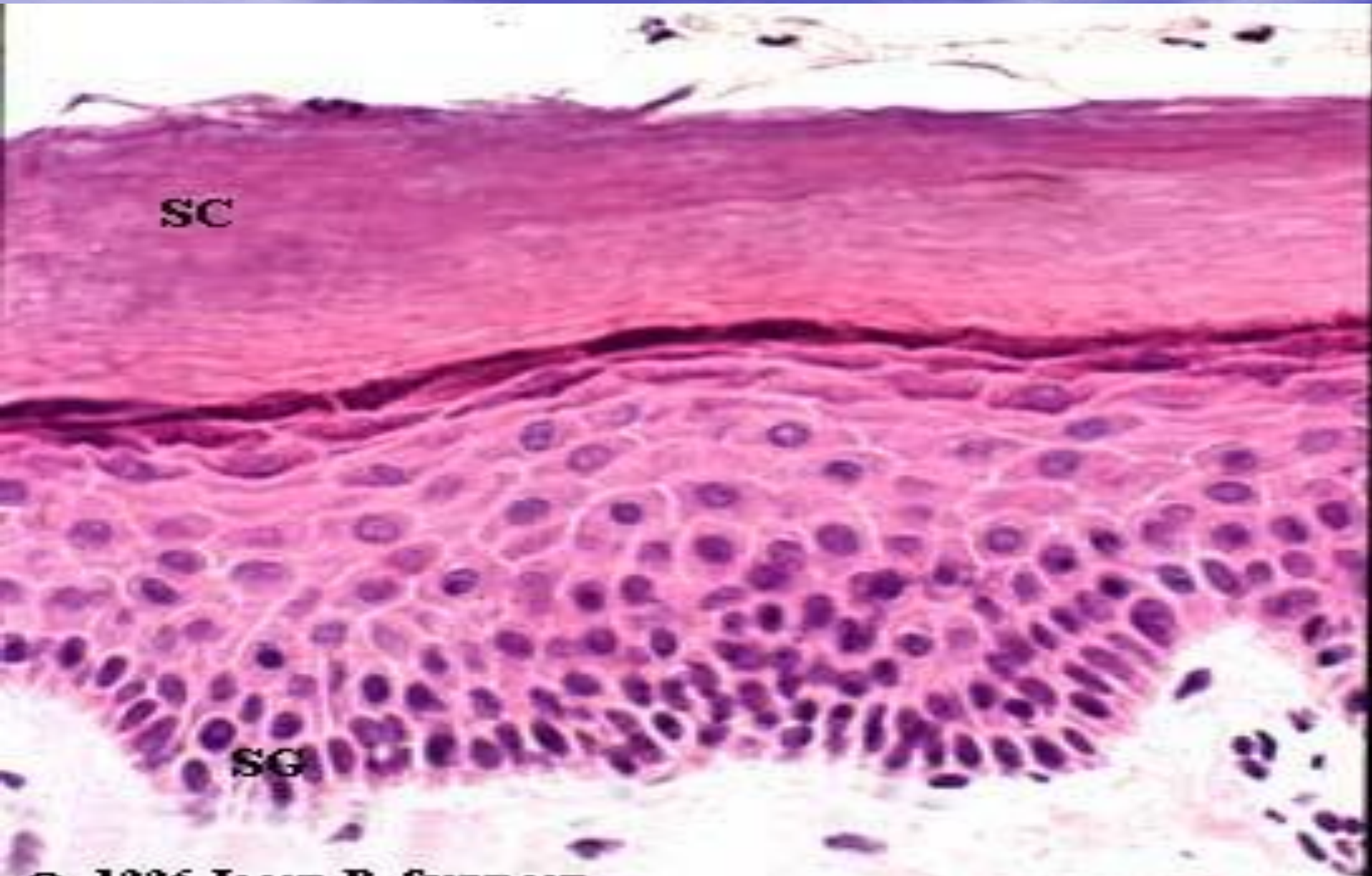
- represents a transition from s.granulosum to s. corneum
- Normally seen only in thick epidermis

# STRATUM CORNEUM

- - 'horny layer'
- Made up of 10-30 thin layers of dead cells
- External pressure / friction gives rise to **corns** / **calluses**
- Replacement process of the cells takes about a month
- In psoriasis the process is abnormally accelerated



# STRATUM CORNEUM

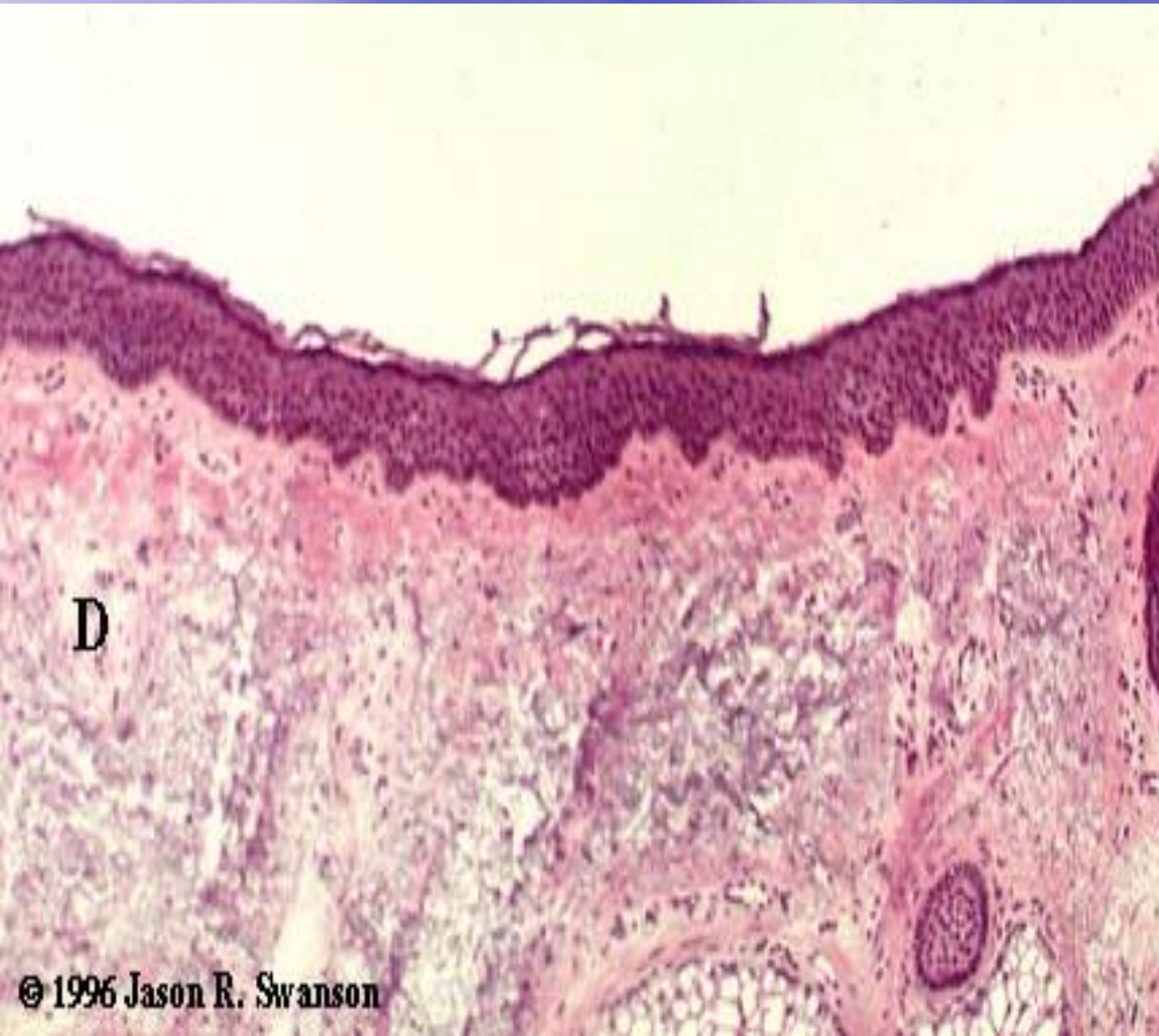




**CALLOUS**



# DERMIS



- 1.5 to 4 mm thick
- has most of the skin structures
- Contains collagen , elastin , water , scavenger cells , sweat glands ( apocrine and eccrine ) , sebaceous glands , nerve endings , blood and lymph vessels
- divided into papillary and reticular dermis

# **MOIST WOUND** **HEALING**

**“a moist environment as created beneath a semi permeable membrane allows optimal conditions for the re-epithelization of surface wounds”**

**(Winter, 1971)**



# PAPILLARY DERMIS



- mainly loose connective tissue
- contains vascular networks for supply of vital nutrients and for thermoregulation
- also contains nerve endings and Meissner corpuscles
- The vasculature interdigitates in areas called the dermal papillae

# RETICULAR DERMIS

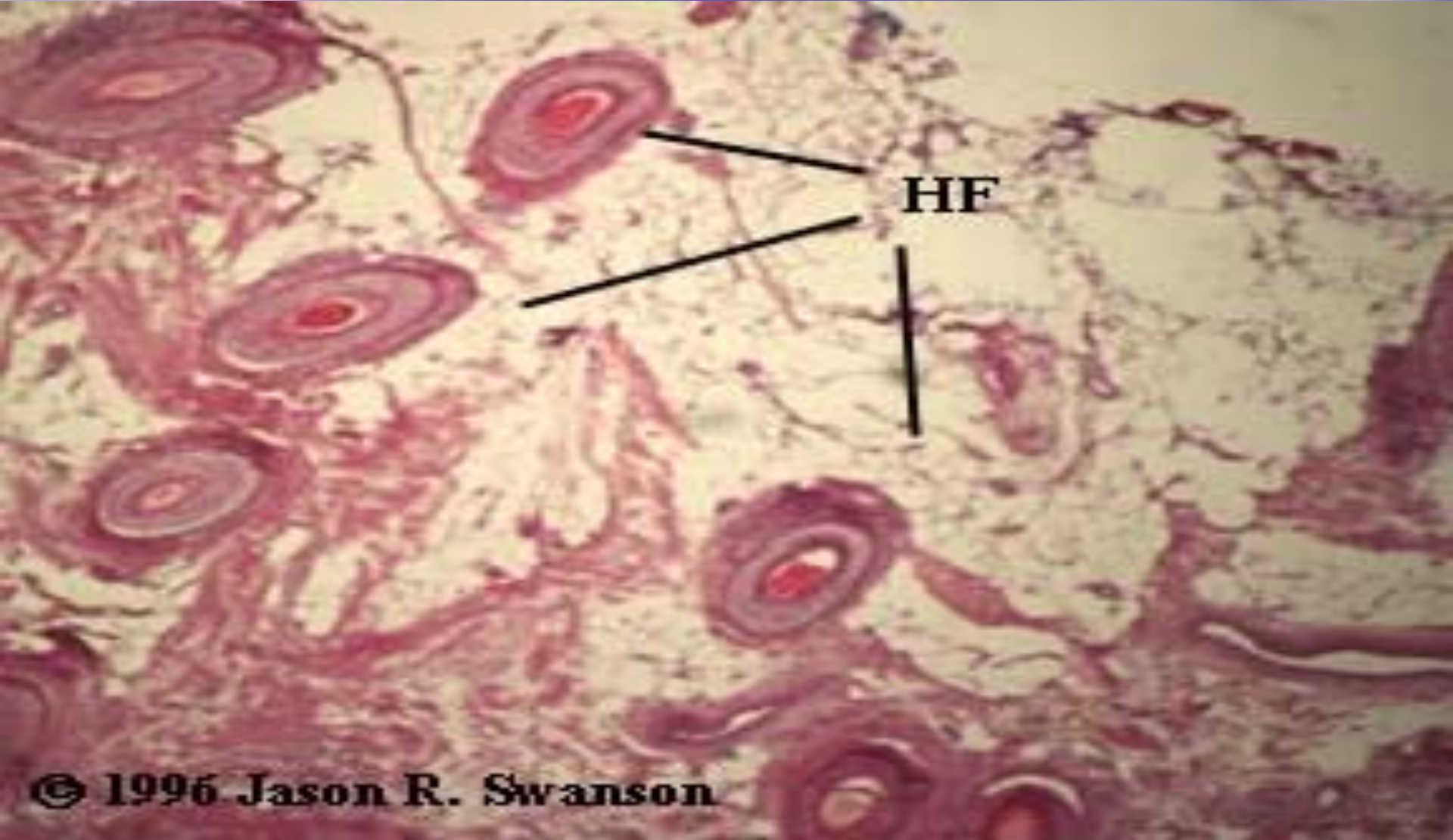


-consists of dense irregular connective tissues

-Gives strength and elasticity

-Houses glands and hair follicles

# APPENDAGES

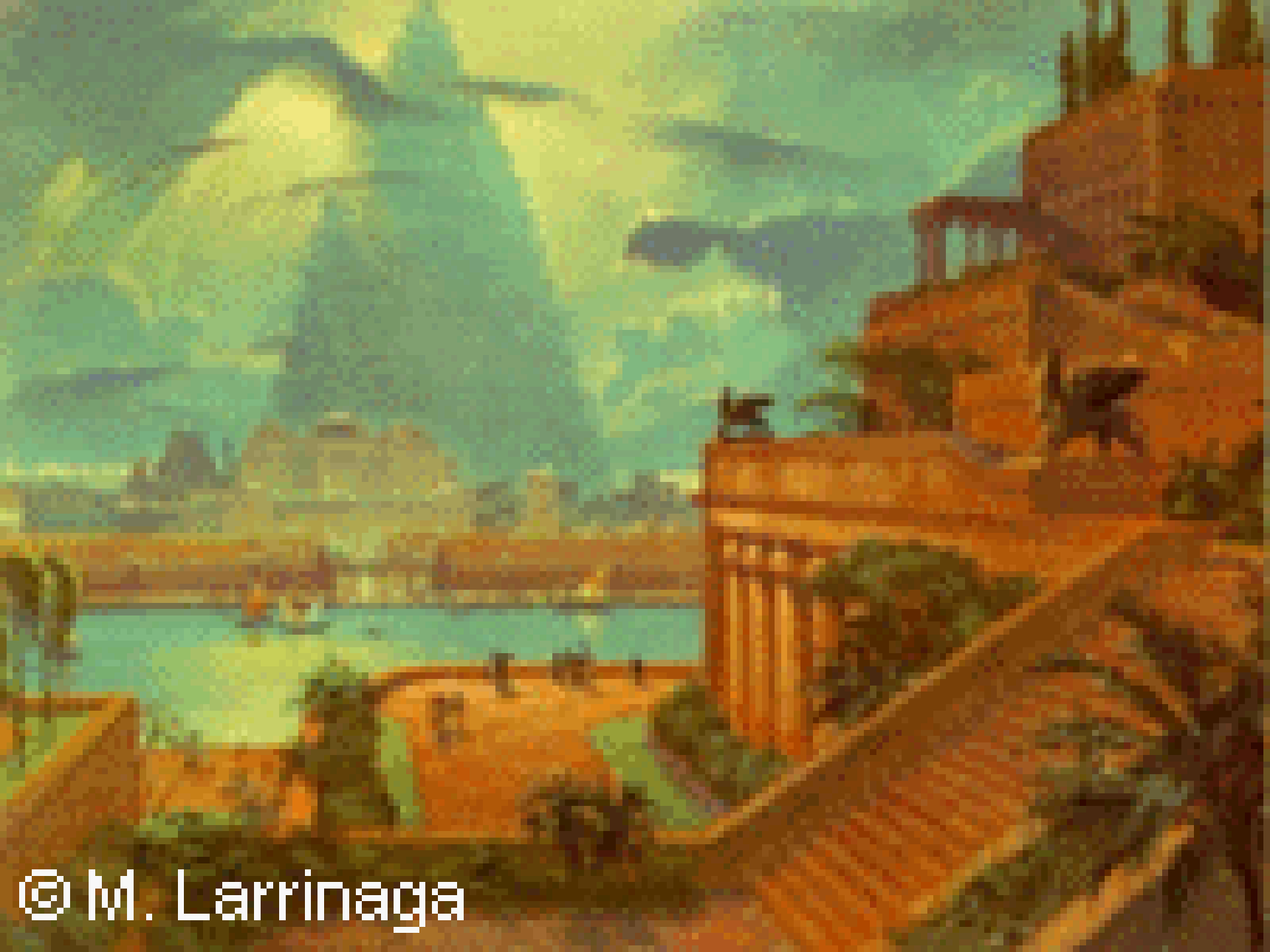


**Hair follicles (HF) , sweat glands and sebaceous glands (SG) – epidermal in origin**



# HYPODERMIS

- Deepest layer
- Not found in thin skin areas eg. Eyelids , nipples , genitals and shins
- Subcutaneous tissue acts as an insulator and as a shock absorber
- Also stores fat as an energy reserve
- Blood vessels , nerves , lymph vessels and hair follicles also cross this area



© M. Larrinaga



# PHYSIOLOGY OF THE SKIN

- **PROTECTION**

- mechanical , chemical , thermal trauma
- invasion of pathogens
- dehydration

- **SENSATION**

- pain , heat , cold , touch , pressure , vibration
- for both pleasure and defence

- **COMMUNICATION**

- changes in skin colour , facial expression , body odour ( from sweat and sebaceous glands )



- **Thermoregulation**

- radiation of heat from blood vessels
- excretion and evaporation of sweat
- convection and conduction of heat
- insulation by hair and subcutaneous tissue

- **Metabolic Synthesis**

- involves melanin , keratin , vitamin D

- **Cosmesis**







# WOUND HEALING



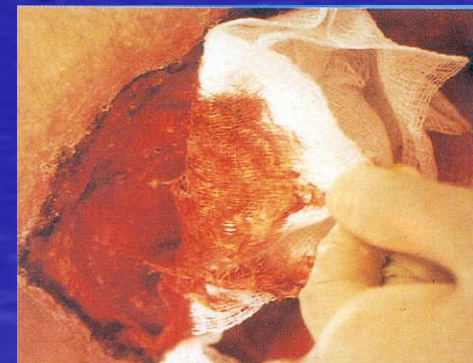


**WOUND  
HEALING**



# What is the definition of a wound ?

- A wound is an injury to the integument or to the underlying structures that may or may not result in a loss of skin integrity. Physiological function of the tissue is impaired .



Gauze

# Types of tissue injury :

- **Partial thickness injury**

- limited to the epidermis and superficial dermis with no damage to the dermal blood vessels .( healing occurs by regeneration of epithelial tissue )



- **Full thickness injury**

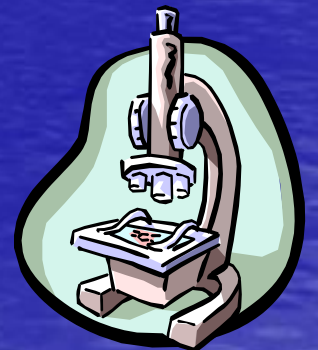
- injury involves loss of the dermis and extends to deeper tissue layers and disrupts dermal blood vessels .



# WOUND HEALING

- - is a complex series of events , that are interlinked and dependant on one another and can be defined as the physiological processes by which the body replaces and restores function to damaged tissues .

**–Tortora & Grabowski 2000**



# PHYSIOLOGY OF WOUND HEALING

- Complex series of events that can be divided into 2 stages :

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graph TD; A[Complex series of events] --- B[Haemostasis]; A --- C[Tissue Repair]
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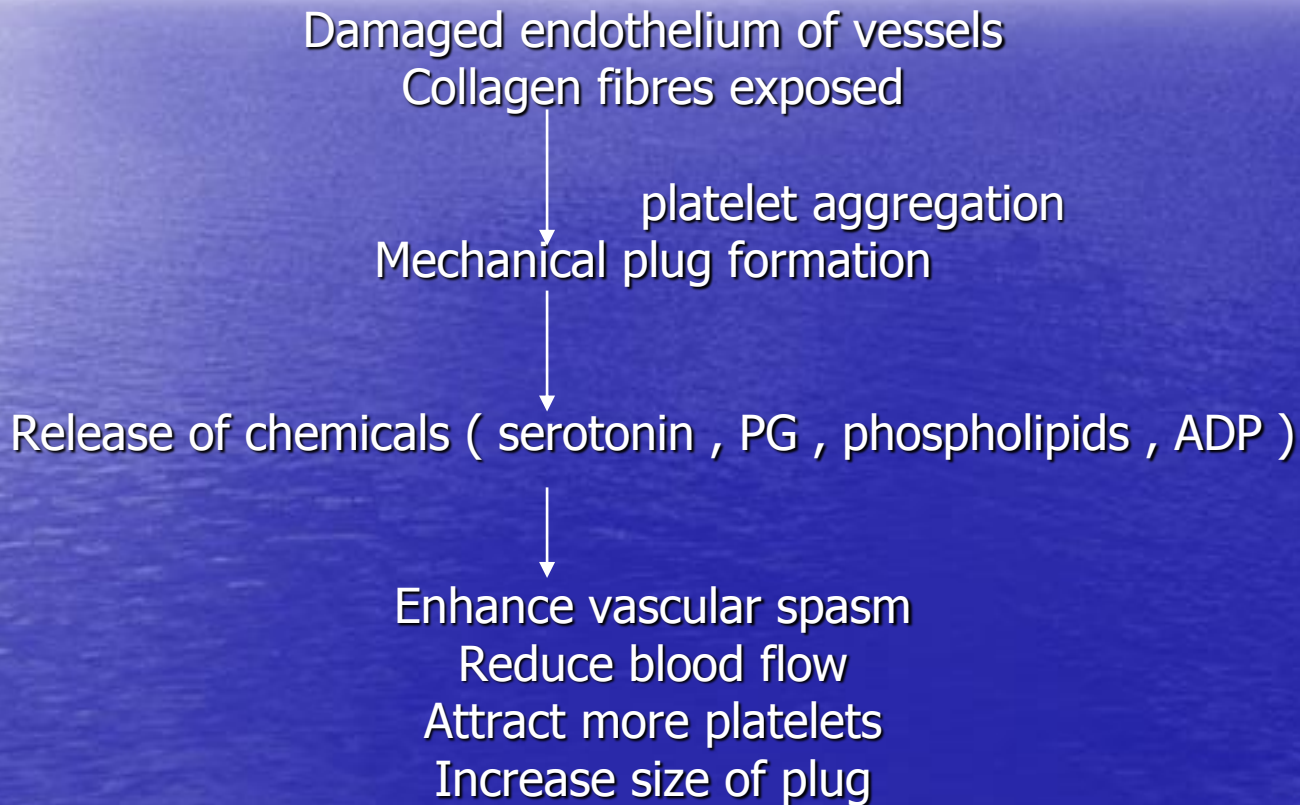
**Haemostasis**

**Tissue Repair**

# HAEMOSTASIS

- Has 3 components :
  1. **Vasoconstriction response**
    - bleeding stopped by arterial spasm
  2. **Platelet response**
    - formation of a platelet plug
  3. **Biochemical response**
    - formation of a blood clot

# PLATELET RESPONSE



# BIOCHEMICAL RESPONSE

- Formation of a blood clot through a process involving :
  - intrinsic clotting pathway
  - extrinsic clotting pathway
  - clot retraction (wound edges brought closer )
  - fibrinolysis ( breakdown of the clot )



# TISSUE REPAIR

- 3 phases of tissue repair (Westaby 1985) :
  - a. **Inflammation** ( Inflammatory Phase )
  - b. **Reconstruction** ( Proliferative Phase )
  - c. **Maturation** ( Remodelling Phase )



# 1. Inflammatory Phase ( 0-3 days )

- Capillaries contract and thrombose to facilitate haemostasis
- Ischaemia causes release of histamine and other vasoactive chemicals that cause a vasodilatation of surrounding tissue .
- Erythema , swelling , heat and discomfort is produced .
- Phagocytosis – arrival of PMNL (protect the wound from bacterial invasion ) & macrophages ( clear the wound of debris )

## 2. RECONSTRUCTION / PROLIFERATIVE PHASE ( 2- 24 days )

- Macrophages continue to clean the wound of debris (destructive phase) and stimulate fibroblasts to produce collagen (granulation) (fibroblastic phase )
- Angiogenesis commences ( new vascular network ).
- Wound epithelialisation ( epithelial cell migration) and wound contraction ( wound edges pull together to reduce defect ).

### 3. MATURATION PHASE ( 24 DAYS – 1 YEAR )

- Remodelling phase where the main function is to increase the tensile strength ( the original collagen formed during the reconstruction phase is slowly replaced by new more organised collagen .
- Decrease in the vascularity and size of the scar ( scar tissue is only 80% as strong as the original tissue )



# MODES OF WOUND HEALING

- **Primary Intention**  
-when there is minimal tissue loss and the edges of the wound are held in close apposition by either sutures , clips or tape. Minimal scarring results .
- **Delayed Primary Intention**  
- when the wound is infected or contains foreign bodies and requires intensive cleaning prior to primary closure 3-5 days later .
- **Secondary Intention**  
-wound healing is delayed and occurs by a process of granulation , contraction and epithelialisation . Scarring results .

- **Skin Graft**

- autograft ( from another site of the body)
- allograft ( between allogenic individuals )
- xenograft ( donor graft of tissue transplanted between different species )
- cultured epidermis ( cultivation of epidermis from the donor / recipient's body)

- **Flap**

- skin / cutaneous flaps (skin and superficial fascia ) and composite tissue flaps  
( fasciocutaneous , myocutaneous , osteomyocutaneous flaps)which can be a free flap or a pedicle flap .

# FACTORS AFFECTING WOUND HEALING

<b>Systemic Factors</b>	<b>Local Factors</b>
Metabolic disorders -DM , Renal failure	Necrosis , Scab
Respiratory disorders (COAD )	Infection
Circulatory disorders Anaemia , CCF	Prolonged inflammation
Immune deficiency HIV , RA , malignancy	Exudate
Immunosuppressive therapy	Cellular dysfunction
Nutritional state Dehydration , vitamin deficiency	Biochemical imbalance –pH
Medications ( steroids , anti coagulants )	Hypoxia

## **Psychological factors**

Stress & anxiety

Depression

Motivation &  
concordance

Factitious injury  
(intentional /  
unintentional)

Sleep deprivation

## **Lifestyle factors**

Age

Employment

Hobbies/Interests

Cultural / Religious  
beliefs

Financial status

# ABERRANT WOUND HEALING

- Exuberant granulation
- Keloid formation
- Hypertrophic Scar
- Contracture