

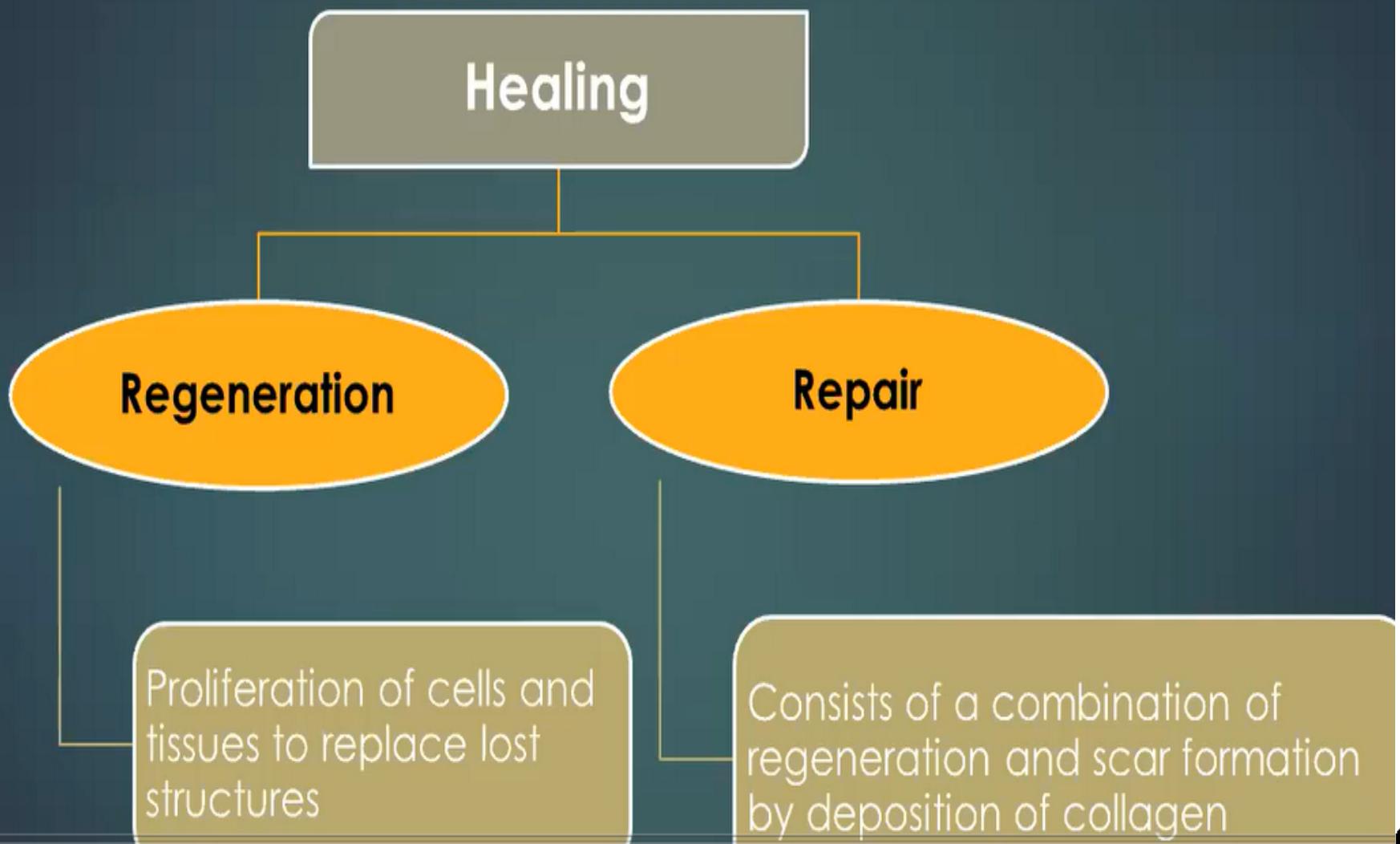


Repair



Edit with WPS Office

Healing occurs after any insult that causes tissue destruction, and is essential for the survival of the organism.



Edit with WPS Office

We have to know:-

- ▶ Cell cycle
- ▶ Types of Cells in our body.
- ▶ The role of Growth factors, Cell to cell and cell to matrix interactions.
- ▶ Angiogenesis.
- ▶ Extracellular matrix synthesis and Cell Matrix Interaction.



Edit with WPS Office

Cell cycle

The whole process is divided into three major stages:

1. Mitosis

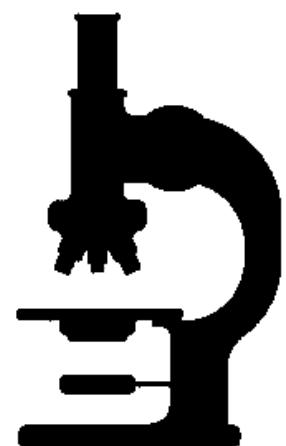
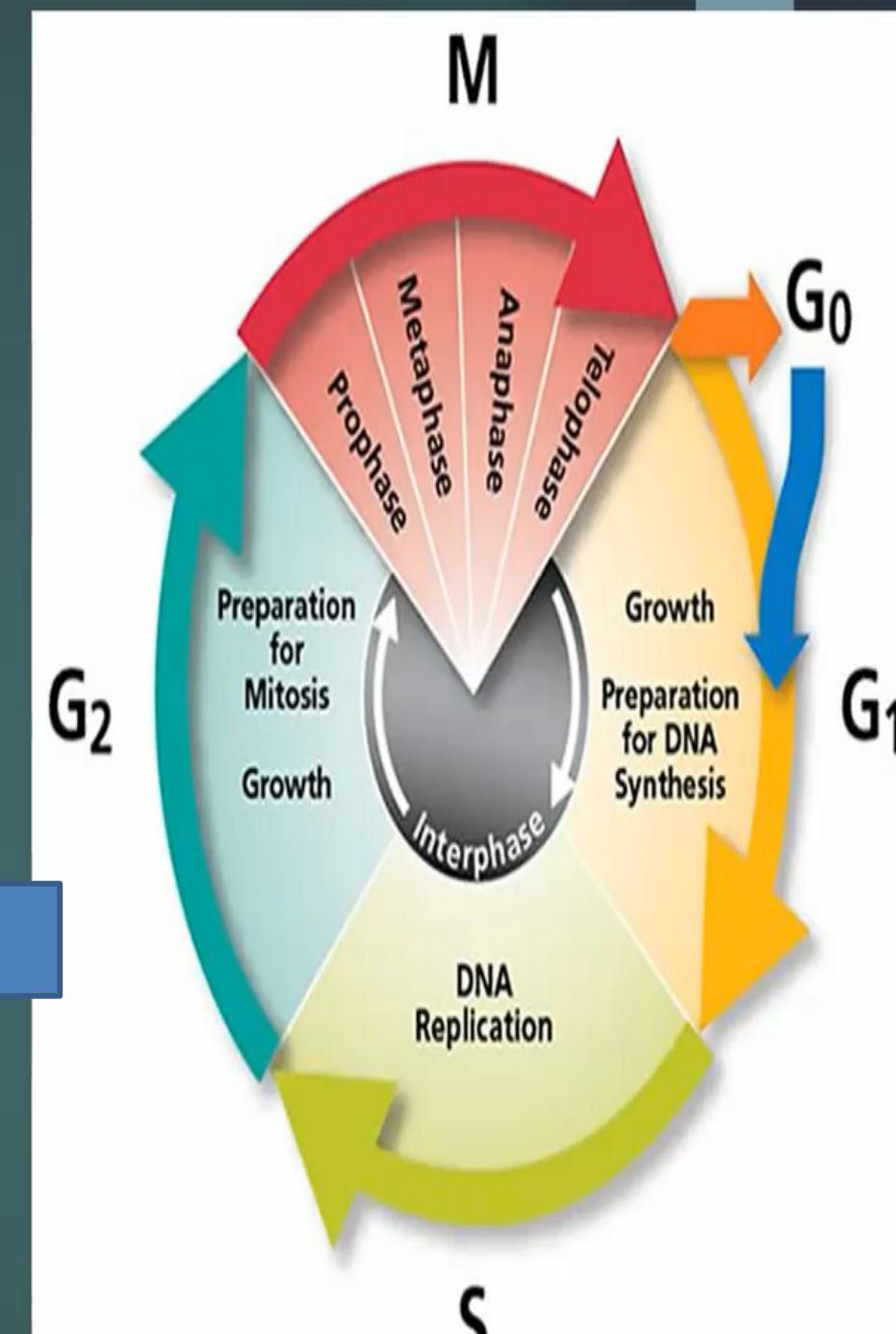
Nucleus division

2. Cytokinesis

Cytoplasm division

3. Interphase

DNA replication



A) Types of cells according to their regenerative capability

1-Labile cells

- continuously dividing cells
- replaced by regeneration
- Examples: -

Stratified squamous epithelium of skin & mucous membranes.

2-Stable cells

- quiescent cells (G0).
- enter cell cycle and divide on demand
- replaced by regeneration or fibrosis.

Examples:

Parenchymatous cells
Mesenchymal cells

3-Permanent cells

- Not replaced.
- Regeneration does not occur.
- repaired by connective tissue

Examples:

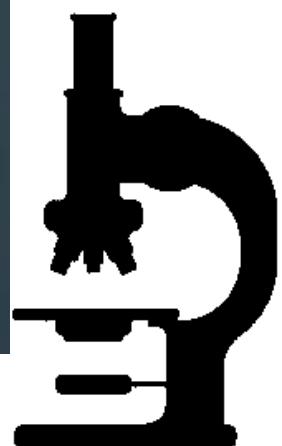
- Skeletal and cardiac muscles
- CNS neurons



A) Types of cells according to their regenerative capability

4- Stem cells

- ▶ Stem cells are blank unspecialized cells.
- ▶ All stem cells have unique general properties:
 - Replicate many times throughout the life of the organism.
 - **Self Renewal**
 - Stem cells can also divide and become **differentiated**
 - Recently they are used in replacing damaged tissue,



Edit with WPS Office

B) Growth factors

Growth
stimulators

Cell
proliferation

Growth
inhibitors



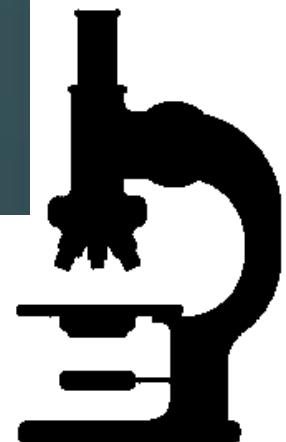
Edit with WPS Office

B) Growth factors

Growth
stimulators

Cell
proliferation

Growth
inhibitors



Edit with WPS Office

B) Growth factors

Growth stimulating factors

1. **Epidermal growth factor (EGF):** mitogenic for a variety of epithelial cells and fibroblasts in vitro.
2. **Platelet-derived Growth Factor (PDGF):** proliferation and migration of fibroblasts and smooth muscle cells.
3. **Fibroblast Growth Factors (FGFs):** stimulate the proliferation of fibroblasts and angiogenesis.

4. **Transforming Growth Factor Alpha (similar to EGF)**
5. **Transforming Growth Factor Beta.**
6. **Vascular endothelial growth factor (VEGF):** promotes angiogenesis.
7. **Interleukin-1 (IL-1) and Tumor Necrosis Factor:** TNF stimulates fibroblastic proliferation.



B) Growth factors

Growth Inhibitors

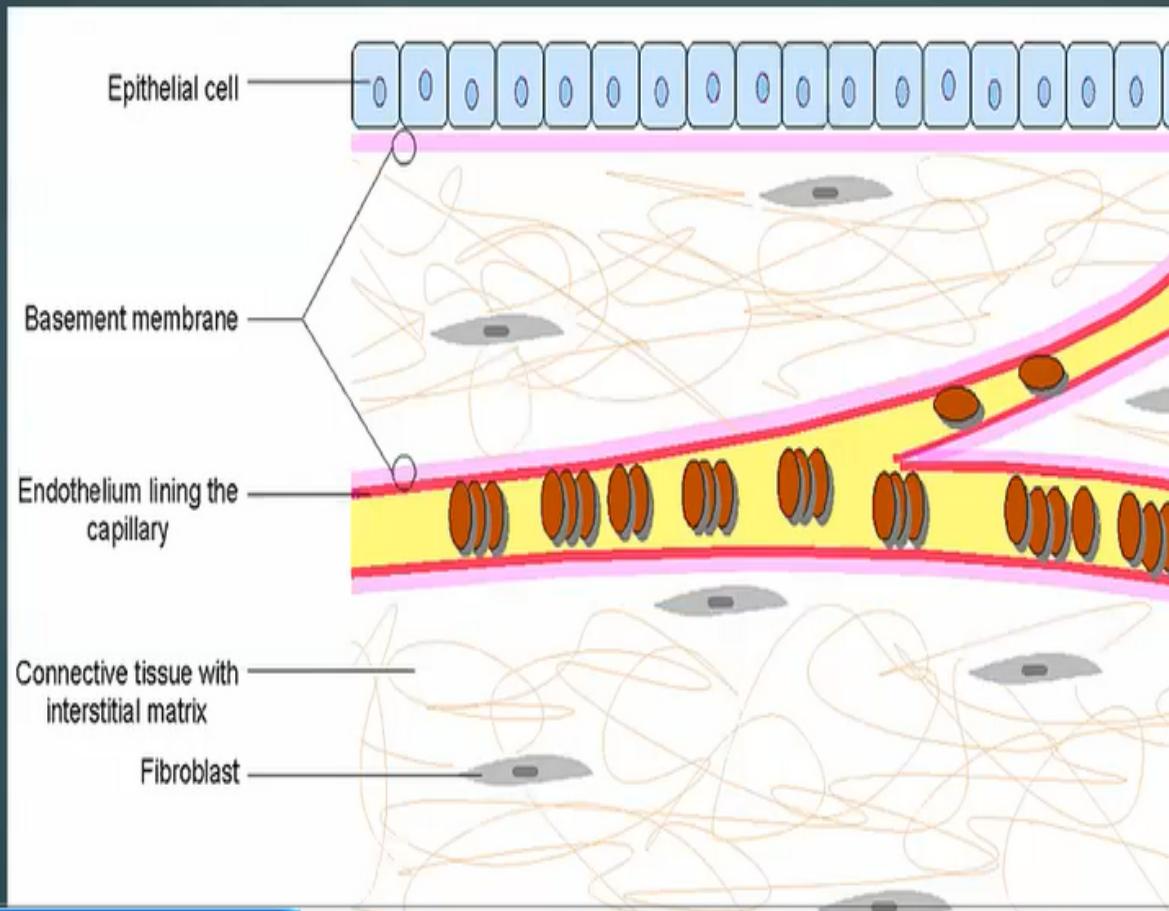
1. **Transforming growth factor beta:** It inhibits growth in most cell types; however, it stimulates fibroblast and the production of collagen and fibronectin.
2. **Alpha interferon.**
3. **Cell to Cell contact inhibition signals**



Edit with WPS Office

C) Extracellular matrix synthesis and Cell Matrix Interaction

- The **extracellular matrix (ECM)** is a collection of extracellular molecules secreted by cells that provides structural and biochemical support to the surrounding cells



Edit with WPS Office



ECM components

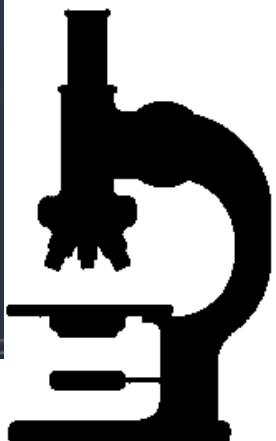
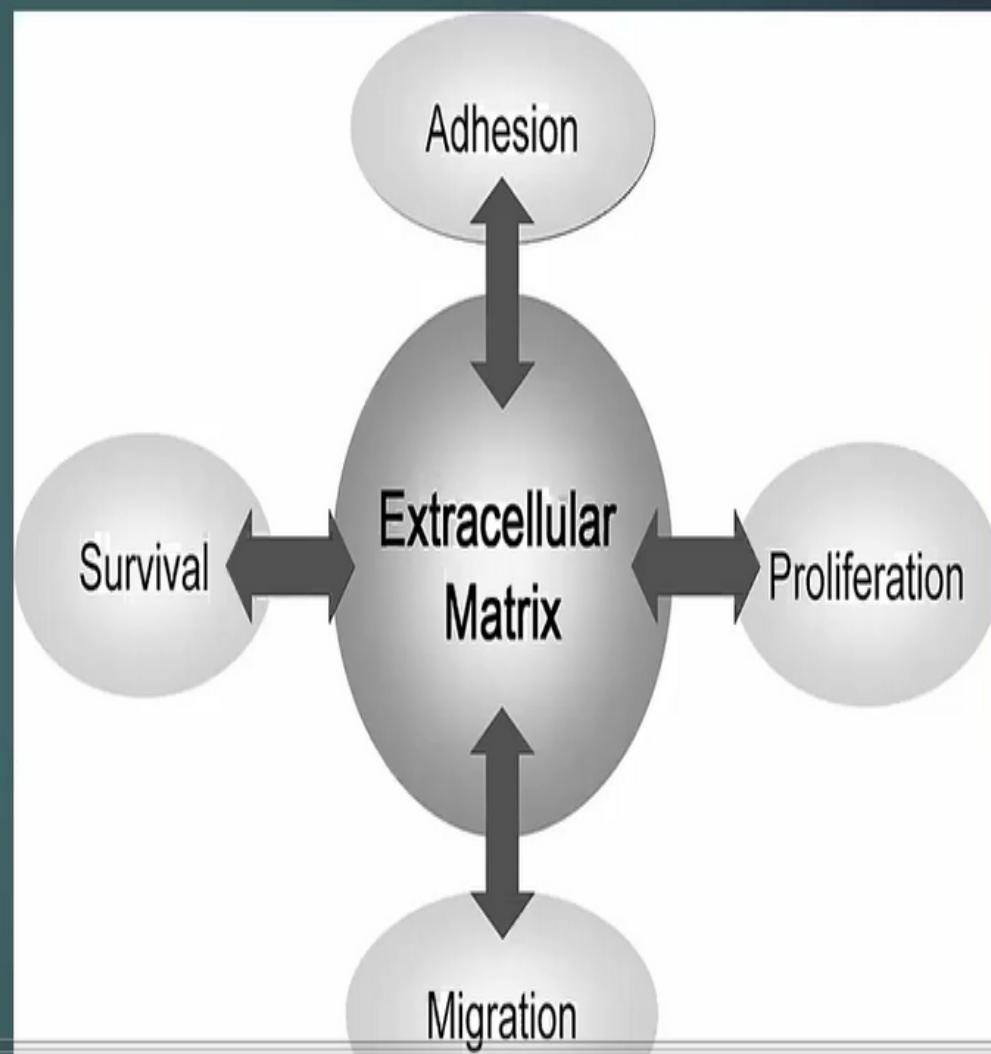
Structural
Proteins

Adhesive
glycoproteins

Proteoglycans

Functions of ECM

It does much more than just fill the spaces around cells to maintain tissue structure.



Edit with WPS Office

Regeneration

Regeneration is proliferation of residual cells to replace the lost structures

Regeneration involves

- ▶ Cell proliferation, (driven by growth factors)
- ▶ Integrated extracellular matrix, and
- ▶ development of mature cells

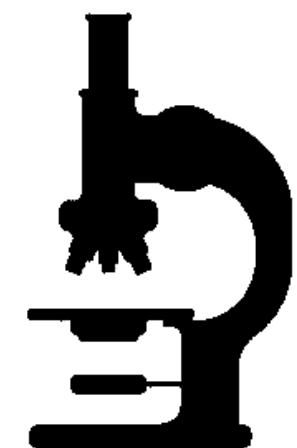
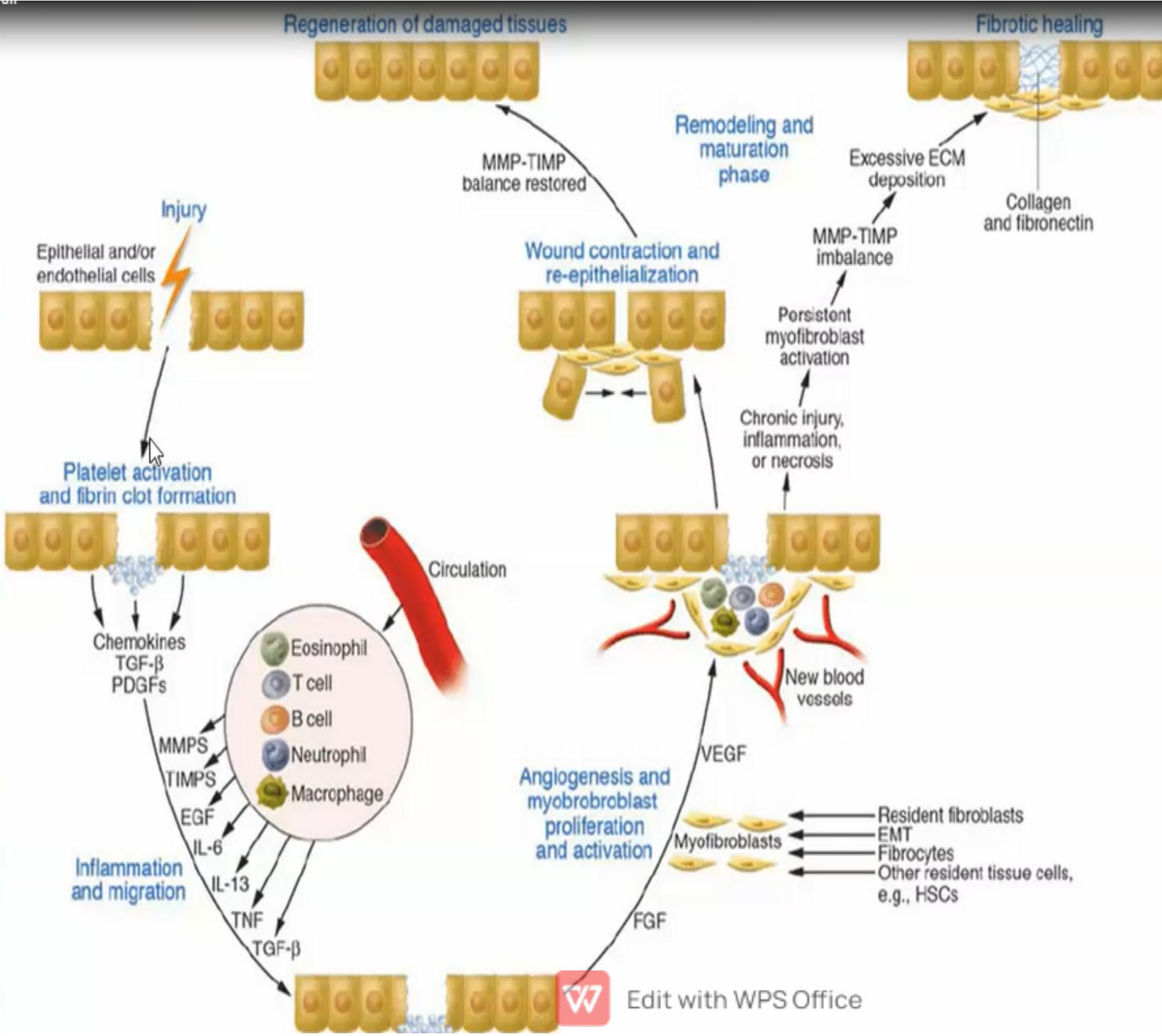


Edit with WPS Office

Repair by fibrosis

- ▶ The main healing process is repair by deposition of collagen and other ECM components → **SCAR**.
- ▶ In contrast to regeneration which involves the restitution of tissue components, ***repair is a fibro-proliferative response that “patches” rather than restores the tissue.***





Repair by fibrosis

Stages:

1. Inflammation
2. Angiogenesis
3. Migration and proliferation of fibroblasts
4. Deposition of extracellular matrix
5. Organization of collagen “remodeling”
6. Fibrosis – scar formation.



Angiogenesis

Definition:

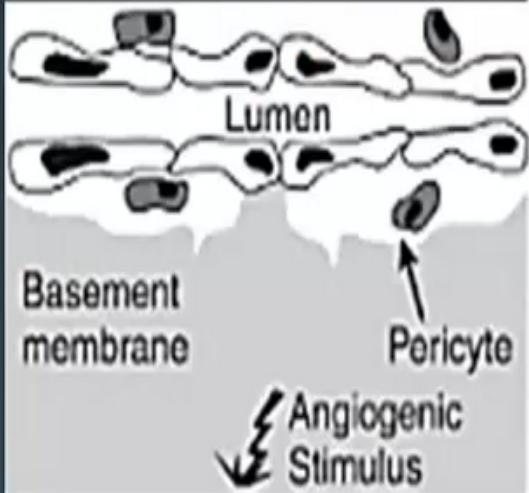
- Angiogenesis is the process of new blood vessel formation, from a preexisting vessel.
- **VEGF** is the most important growth factor involved in physiologic angiogenesis as well as angiogenesis occurring in chronic inflammation, wound healing and tumors.



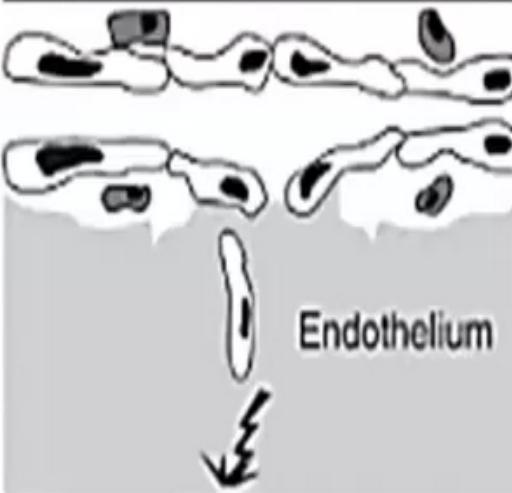
Edit with WPS Office

Steps of Angiogenesis

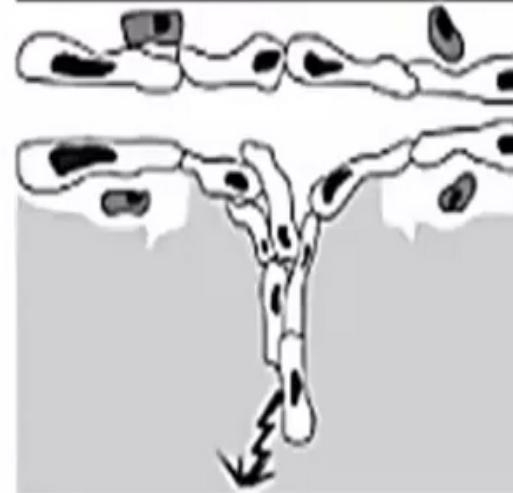
1. Protease Production



2. Migration



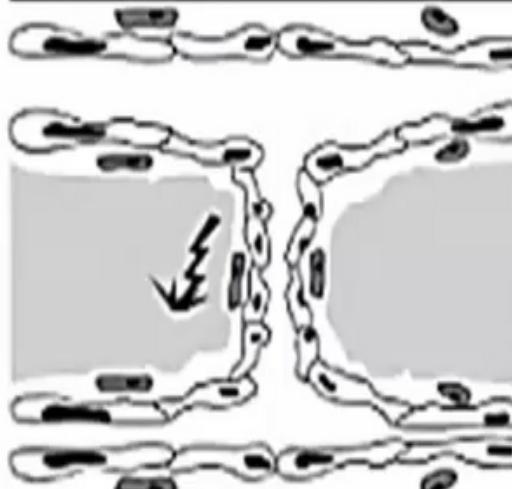
3. Proliferation



4. Vascular Tube Formation



5. Maturation



Granulation Tissue

- ▶ Granulation tissue is the hallmark of tissue repair
- ▶ Characters:-
 1. Red granular
 2. Soft, Moist
 3. Bleeds easily

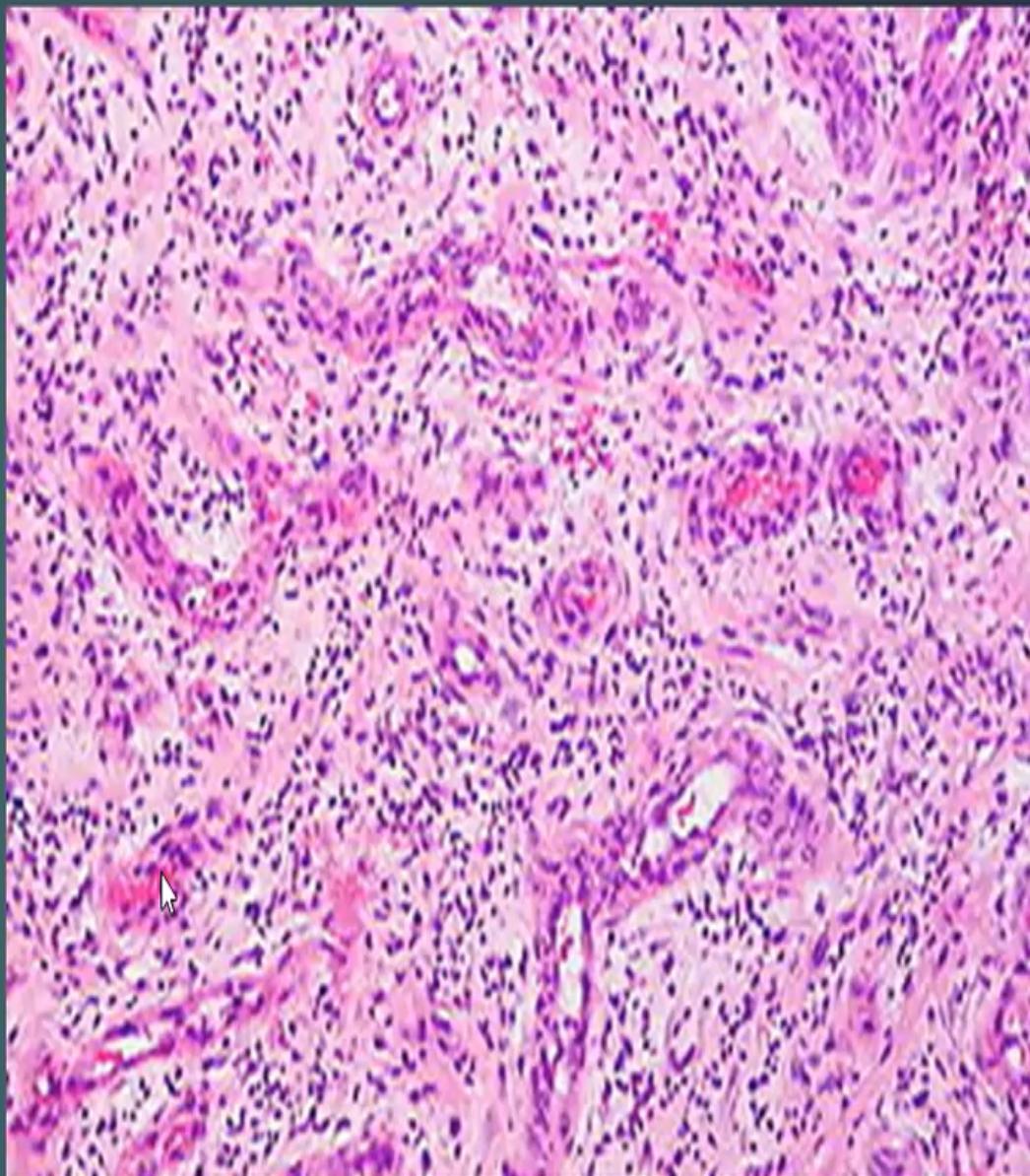


Edit with WPS Office

Granulation Tissue

► Microscopically:

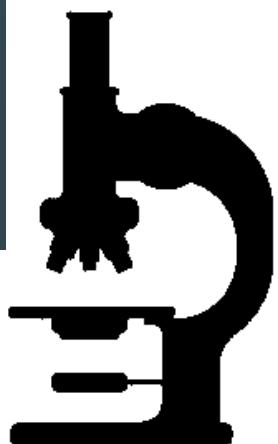
It is Formed of neo capillaries, extracellular matrix with fibroblasts +/- necrotic tissue and scattered inflammatory cells; macrophages.



Edit with WPS Office

Repair of nervous system

- ▶ No regeneration can occur.
- ▶ The necrotic cells are removed by microglia and then replaced by proliferation of glial cells.
- ▶ This process is called **gliosis**.



Edit with WPS Office

Healing of wounds

Healing by primary union (1st intention)

Wound characteristics:

- ▶ Non-gaping, clean (non infected), with minimal tissue loss and approximated edges.

Examples:

- ▶ Stitched surgical wound

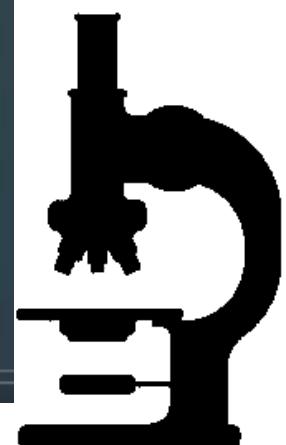
Healing by secondary union (2nd intention)

Wound characteristics:

- ▶ Gaping and infected wound with marked tissue loss and widely separated edges.

Examples:

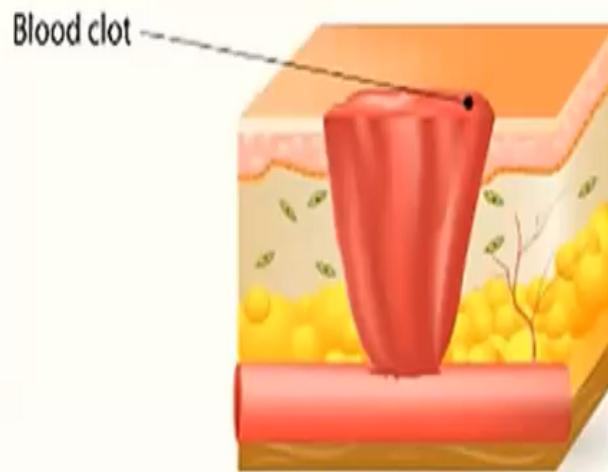
- ▶ Abscess, ulcer,



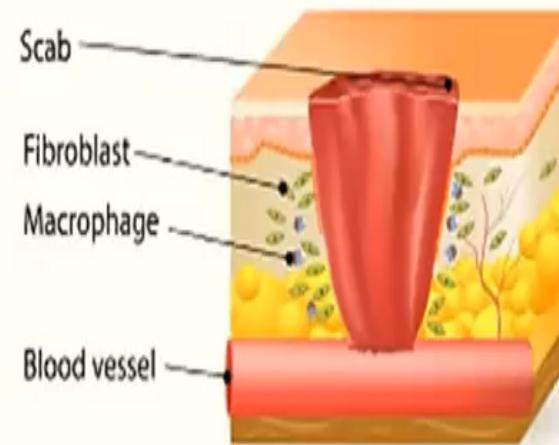
Stages of wound healing

1. Clot formation
2. Granulation tissue
3. Epithelialization
4. Collagen Formation
5. Scar
6. Maturation of scar

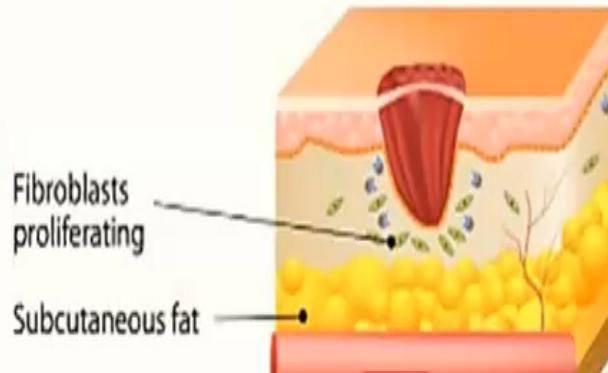
Hemostasis



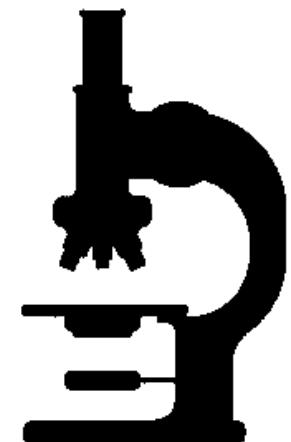
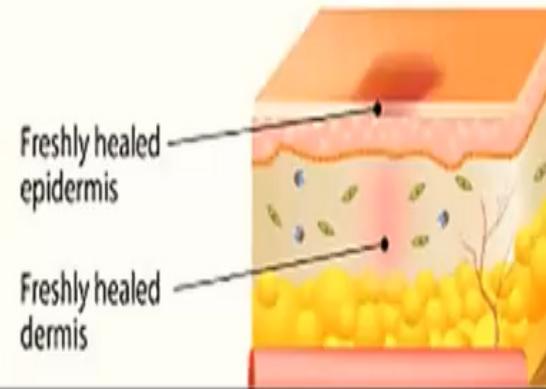
Inflammatory



Proliferative



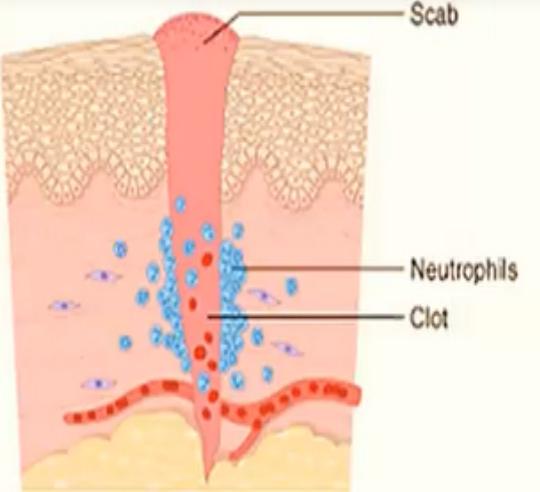
Remodeling



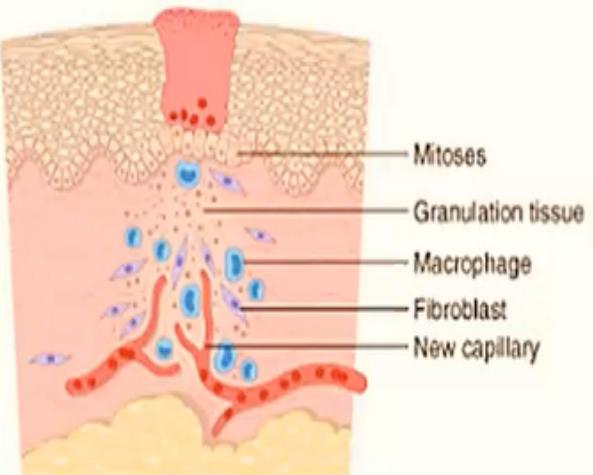
HEALING BY FIRST INTENTION

HEALING BY SECOND INTENTION

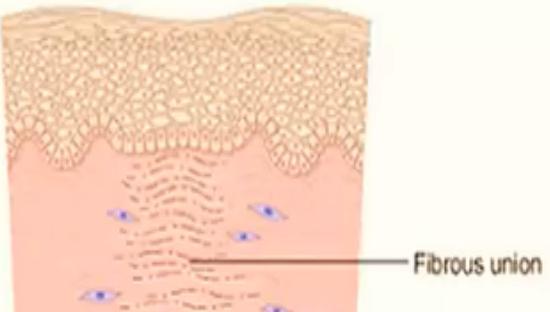
24 hours



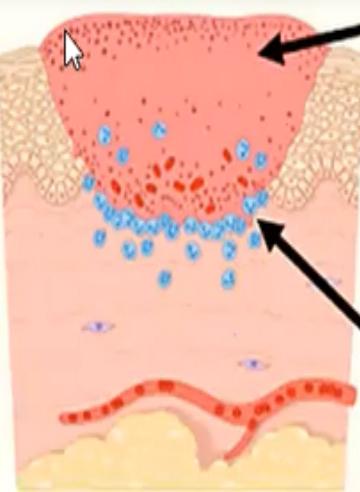
3 to 7 days



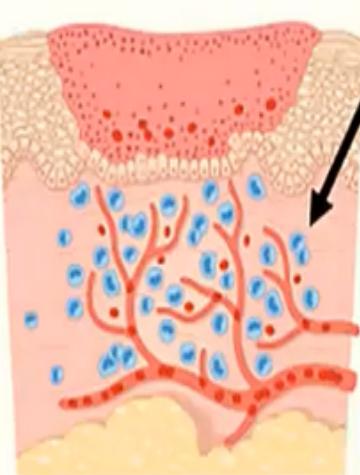
Weeks



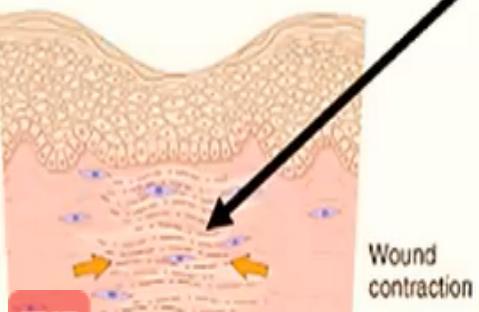
Larger scab (clot)



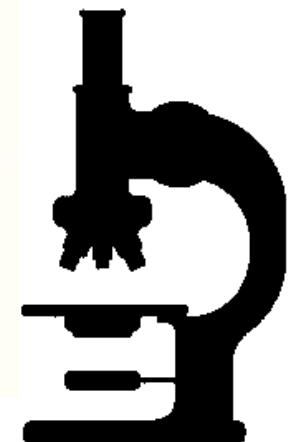
Inflammation more intense because there is more necrotic debris, exudate and fibrin to remove



Larger amounts of granulation tissue - larger defect



Involves wound



Edit with WPS Office

Features	Healing by first intention	Healing by 2 nd intention
Type of wound	Non-gaping wound	Gaping wound
Infection	Usually not present	Present
The amount of granulation tissue	Scanty	Larger amount
Healing period	Short	Longer time
Healing direction	Direct (bridge) healing	The gap can't be directly bridged
Wound contraction	Generally not a feature	A prominent feature
The outcome	Thin linear scar	Bigger and contracted scar
Complications	Infrequent	Frequent



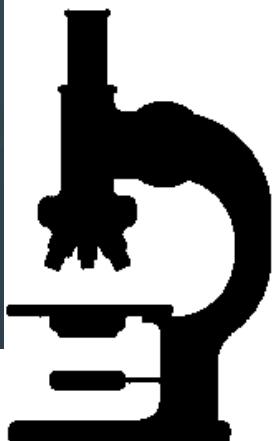
Factors That Influence Wound Healing

Systemic Factors

- **Nutrition:** e.g, vitamin C deficiency.
- **Metabolic status:** DM is associated with delayed healing
- **Circulatory status**
- **Hormones** such as glucocorticoids have anti-inflammatory inhibit collagen synthesis.

Local Factors

- **Infection**
- **Mechanical factors,**
- **Foreign bodies,**
- **Size, location, and type of wound.**



Complications of wound healing

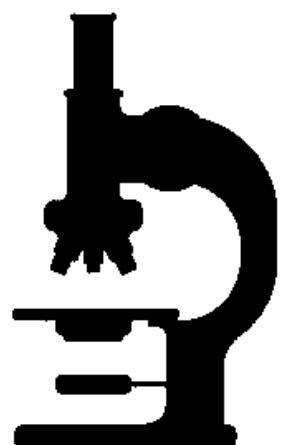
1. **Cosmetic Deformities** due to extensive scarring
2. **Contracture** : an exaggerated wound contraction
3. **Function loss** e.g. due to contracture of scars around joints.
4. **Keloid**: exuberant scar protruding on the surface.



Edit with WPS Office

Complications of wound healing

5. **Chronic Ulcer:** loss of epithelial continuity.
6. **Sinus:** blind ended tract, opening to a surface by a single opening
7. **Fistula**(an opening tract between 2 hollow organs).
8. **Implantation epidermoid cyst.**
9. Rarely carcinoma.



Edit with WPS Office

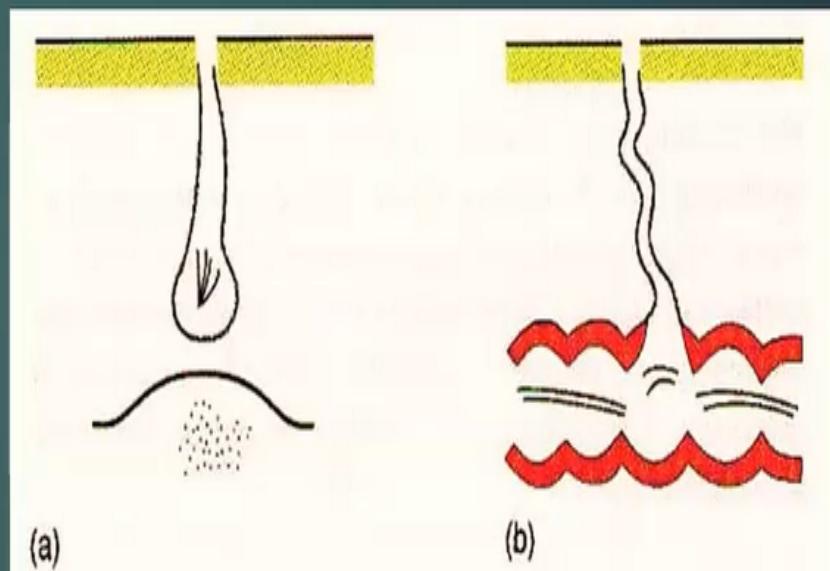
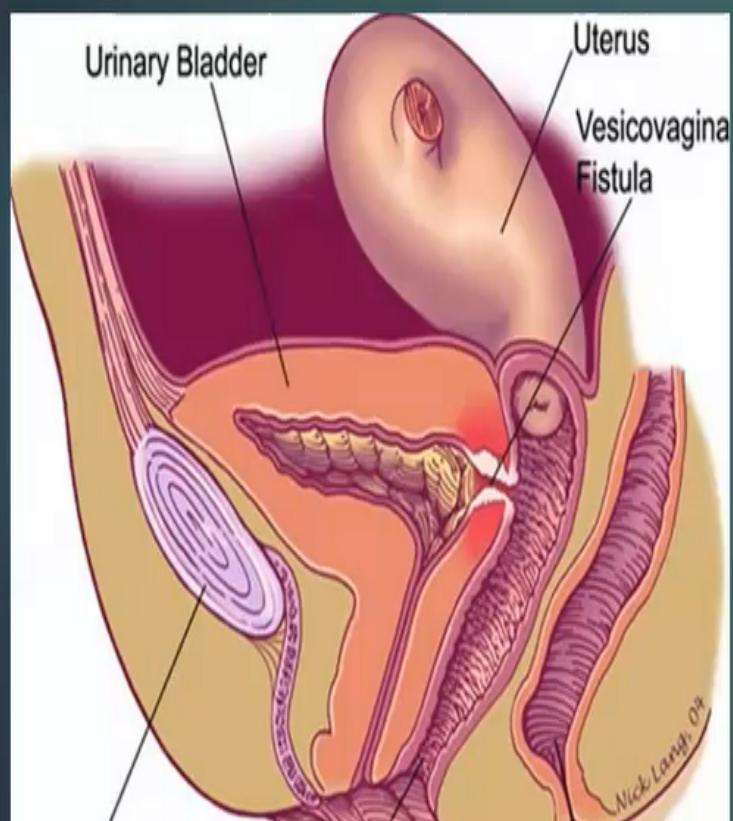


Fig. 12.18 (a) A sinus, and (b) a fistula. Both usually arise from a preceding abscess. (a) This shows that a sinus is a blind track, in this case a pilonidal sinus with its hairs. (b) This shows that a fistula is a track



Edit with WPS Office



