TISSUE REPAIR & REGENERATION

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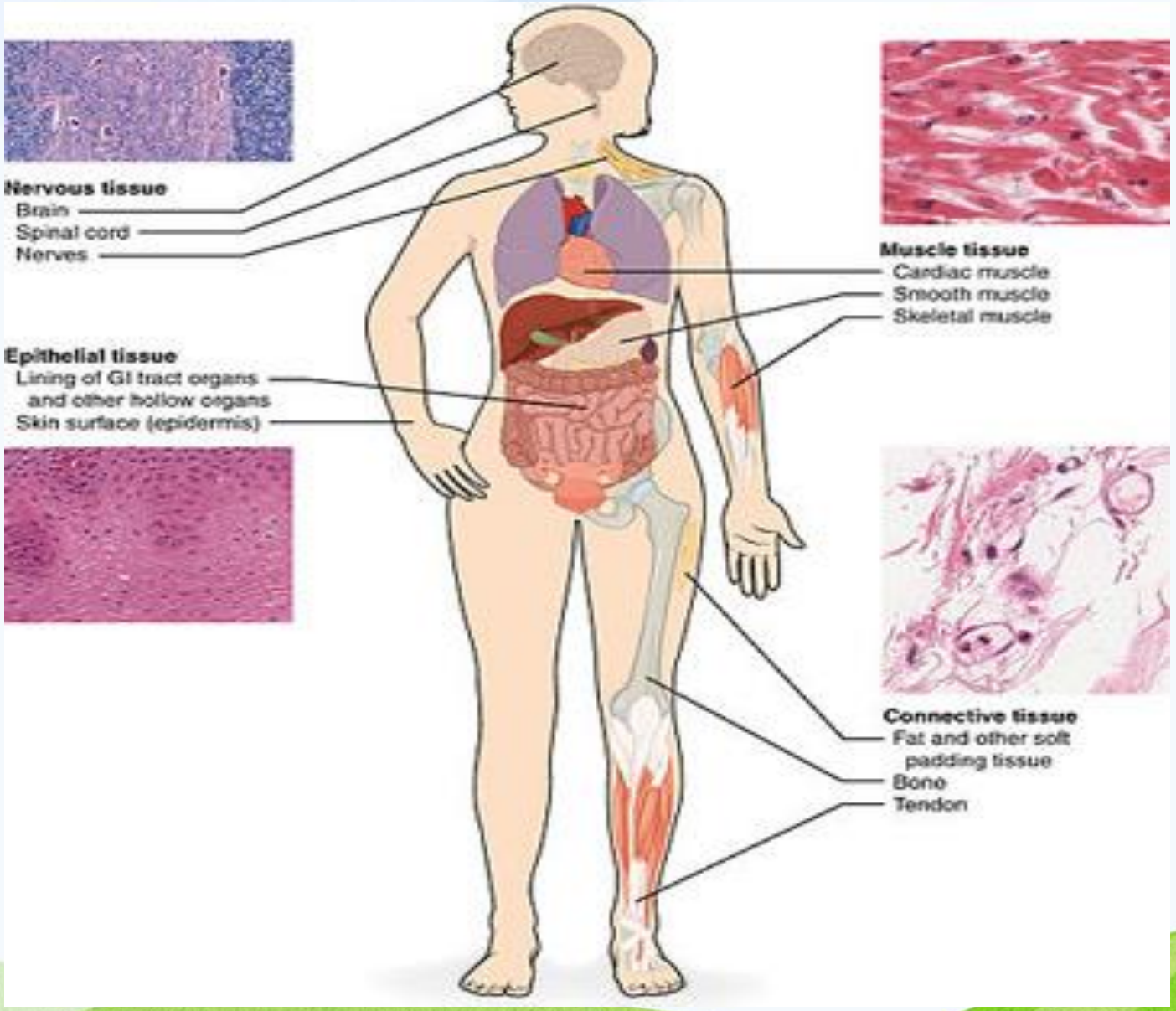
Learning Objectives

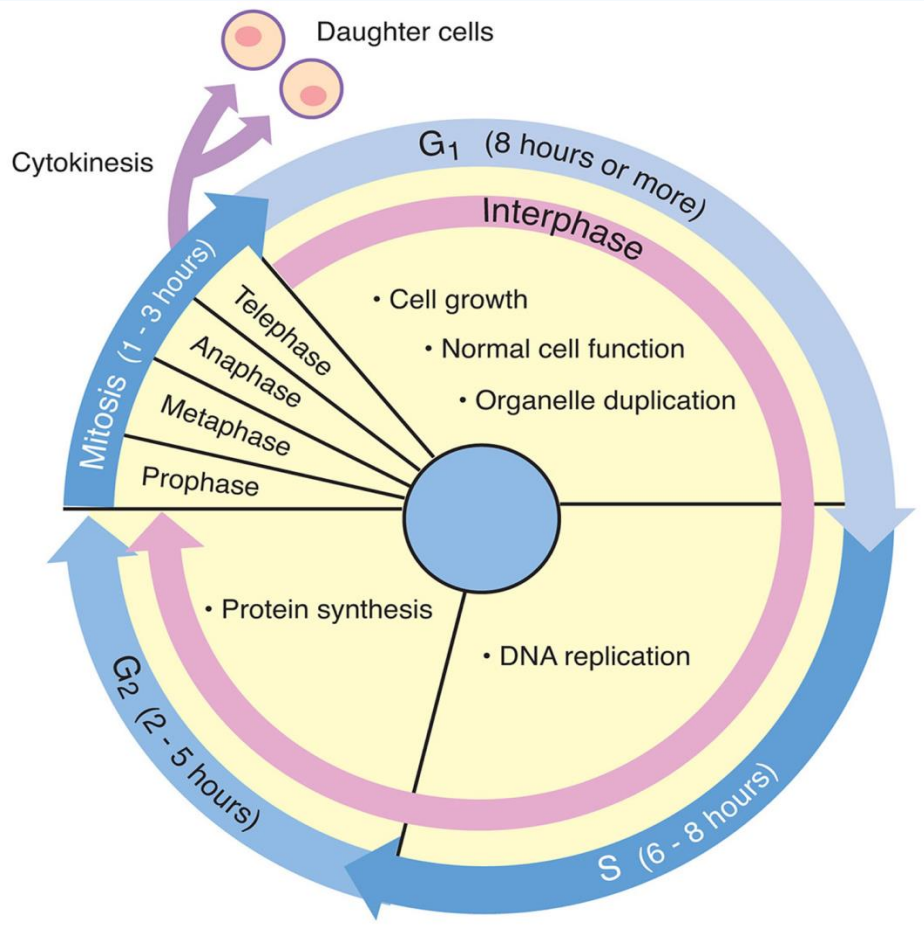
- By the end of this session, students are expected to be able to:
  - Describe the nature and mechanisms of action of growth factors
  - Explain the extracellular matrix (ECM) and cell matrix interactions
  - Describe cell and tissue regeneration

BODY TISSUES



The Control of Cell Proliferation

- Two types of cell proliferation
  a) Physiological (as in repair)
  b) Pathological (as in cancer)
- The four sequential phases
  1. G1 (gap 1) phase,
  2. S phase or synthesis phase,
  3. G2 (gap 2) phase
  4. M (mitotic) phase.



Regulation of Cell Cycle

- Cell proliferation is regulated by cyclins that, when complemented with cyclin-dependent kinases (CDKs), regulate the phosphorylation of proteins involved in cell cycle progression leading to DNA replication and mitosis.
- I cells.

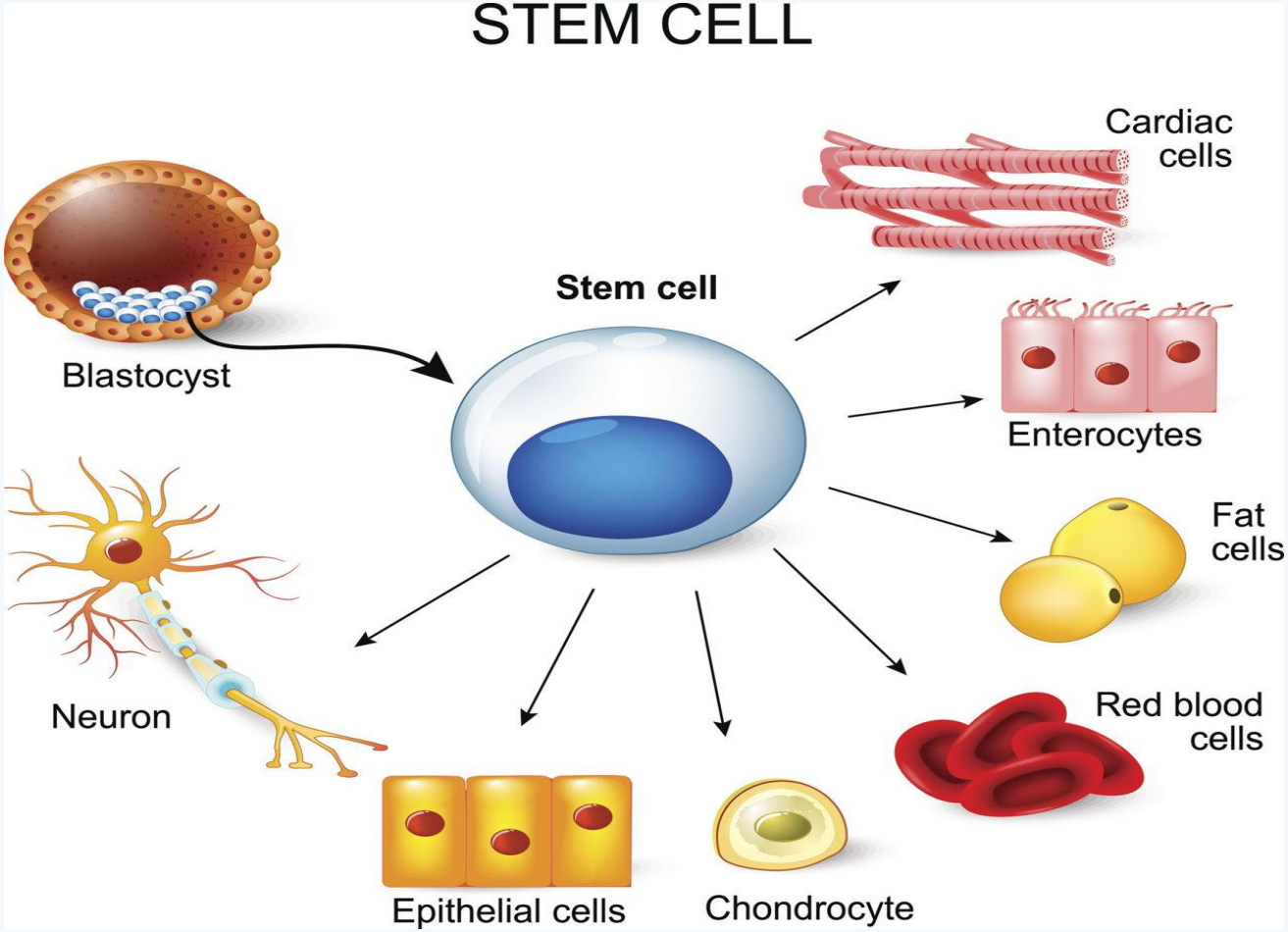
- The cell cycle is tightly regulated by stimulators and inhibitors,

- contains intrinsic checkpoint controls to prevent replication of abnormal cells

Classification of Tissues based on proliferative capacity of their cells

- Labile tissues/Continuously Dividing Tissues
  - Cells are continuously being lost and replaced by maturation from stem cells and by proliferation of mature cells e.g hematopoietic cells
- Stable Tissues
  - Cells of these tissues are quiescent (in the GO stage of the cell cycle) and have only minimal replicative activity in their normal state.
- Permanent Tissues
  - The cells of these tissues are considered to be terminally differentiated and nonproliferative in postnatal life

Stem Cells


STEM CELL
Cardiac cells
Stem cell
Blastocyst
Enterocytes
Fat cells
Neuron
Red blood cells
Epithelial cells
Chondrocyte

Wound Healing

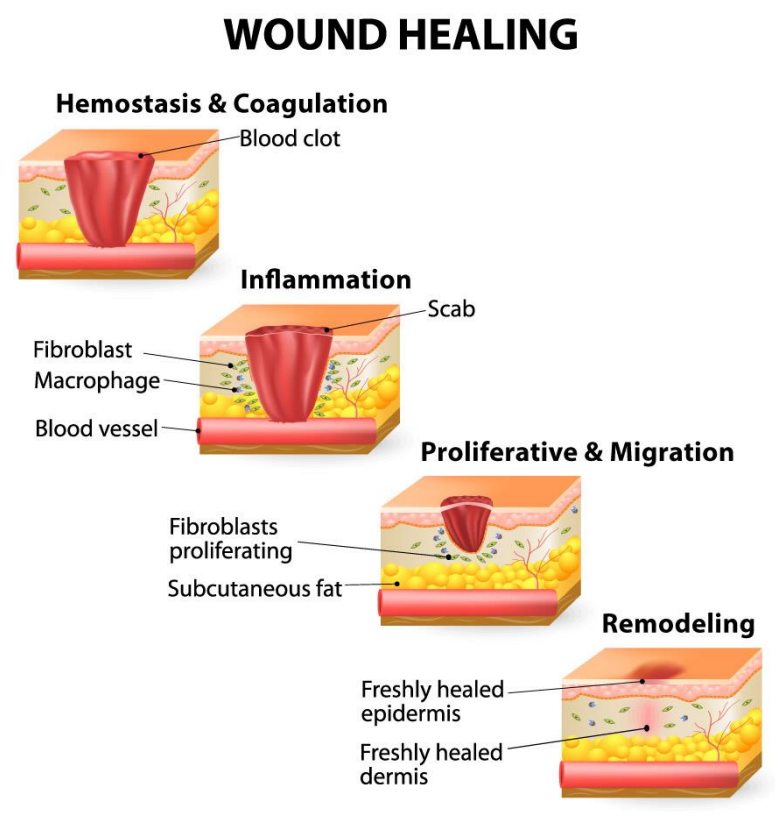
- It is a complex and dynamic process of coordinated series for restoring cellular structures and tissue layers.
- Healing involves 2 distinct processes:
  1. Regeneration
     - when healing takes place by proliferation of parenchymal cells and usually results in complete restoration of the original tissues.
  2. Repair
     - when healing takes place by proliferation of connective tissue elements resulting in fibrosis and scarring. At times, both the processes take place simultaneously.

Processes involved

- **Chemotaxis**- movement of motile cells
- **Phagocytosis**- Phagocytosis, process by which certain living cells called phagocytes ingest or engulf other cells or particles
- **Granulation** – where an injury fills with a matrix of fibrous **connective tissue** and **blood vessels**
- collagen degradation-
- collagen remodeling -
- angiogenesis, epithelization, and the production of new glycosaminoglycans and proteoglycans

Distinct phases

- Hemostasis & Coagulation phase
- Inflammatory phase
- Proliferative phase
- Remodelling phase



Types of Wound Healing

- Primary wound healing
  - This is also known as healing by first intention.
  - Occurs within hours of repairing a full-thickness surgical incision when edges of the wound are in aposition.
- Delayed primary wound healing
  - Occurs if the wound edges are not reapproximated immediately.
  - By the fourth day, phagocytosis of contaminated tissues is well underway, and the processes of epithelialisation, collagen deposition, and maturation are occurring

- Secondary healing
  - This is also known as healing by secondary intention.
  - Secondary healing results in an inflammatory response that is more intense than with primary wound healing.
  - In addition, a larger quantity of granulomatous tissue is fabricated because of the need for wound closure.

Types of wounds

- Acute or chronic:
  - acute wounds heal uneventfully (with no complications) in the predicted amount of time while chronic wounds take a longer time to heal and might have some complication

ACUTE Recent wound which has yet to progress through the sequential stages of healing

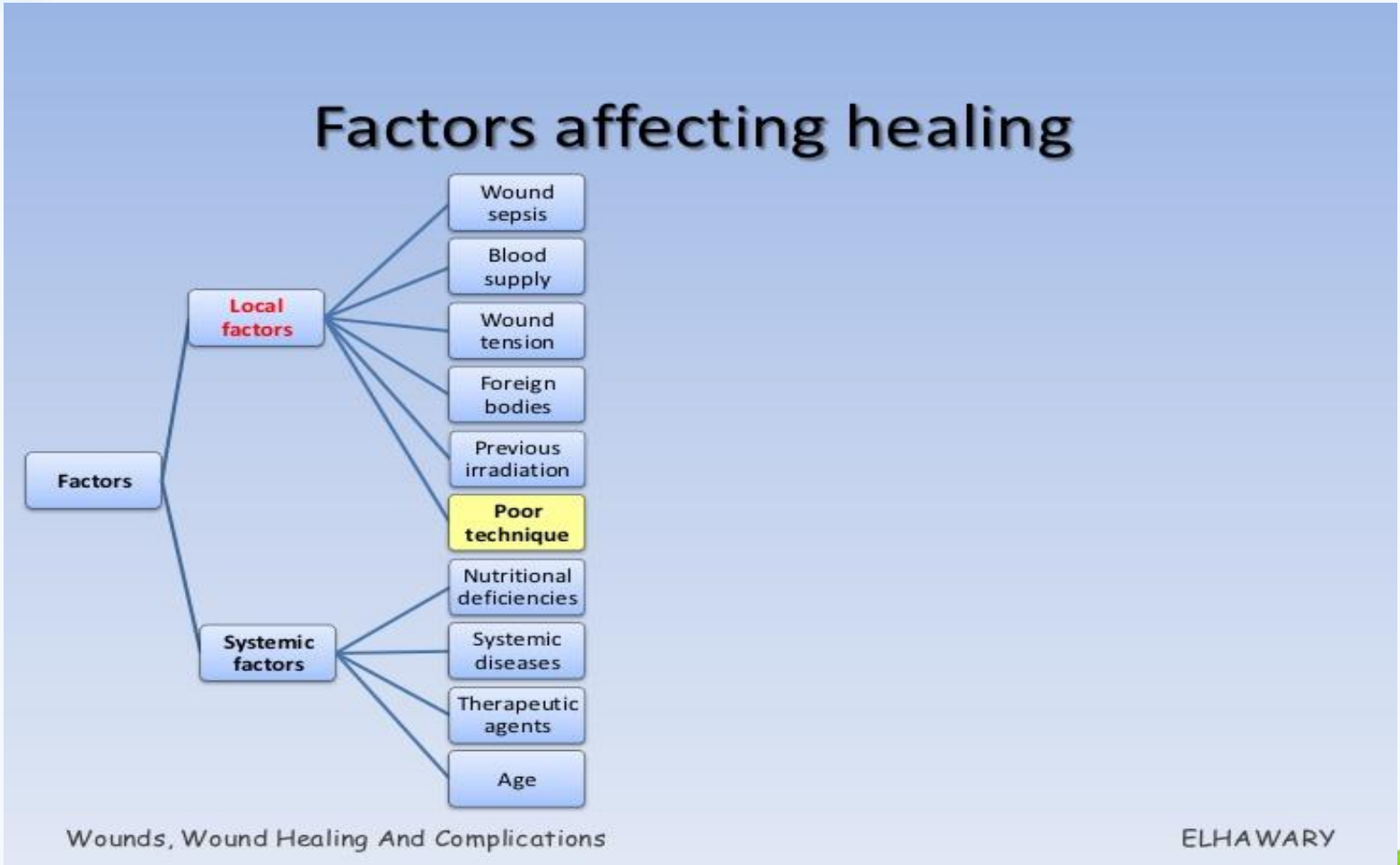
CHRONIC Wound that has arrested in one of the wound healing stages usually inflammatory phase

- open or closed:
  - open/penetrating wounds have exposed underlying tissue while closed/non-penetrating wounds doesn't

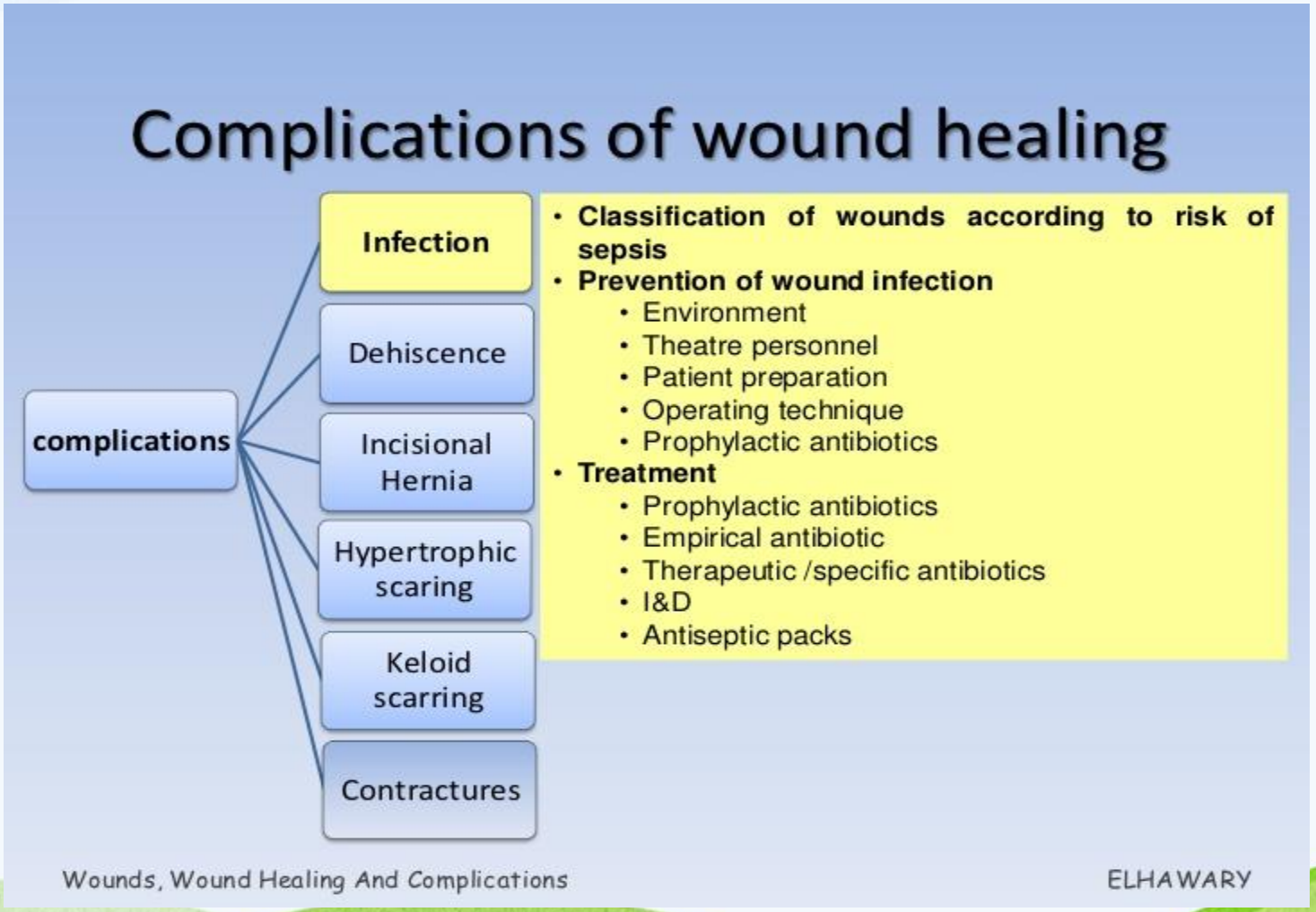
- Clean or Infected wound:
  - Clean wounds have no foreign materials or debris inside, whereas contaminated wounds or infected wounds might have dirt, fragments of the causative agent, bacteria or other foreign materials.

- Internal or External Wounds
  - Internal wounds result from impaired immune and nervous system functions and/or decreased supply of blood, oxygen or nutrients to that area; such as in cases of chronic medical illness (diabetes, atherosclerosis, deep vein thrombosis).
  - External wounds are usually caused by penetrating objects or non-penetrating trauma, and other miscellaneous causes as thermal, chemical, bites & stings, Electrical,

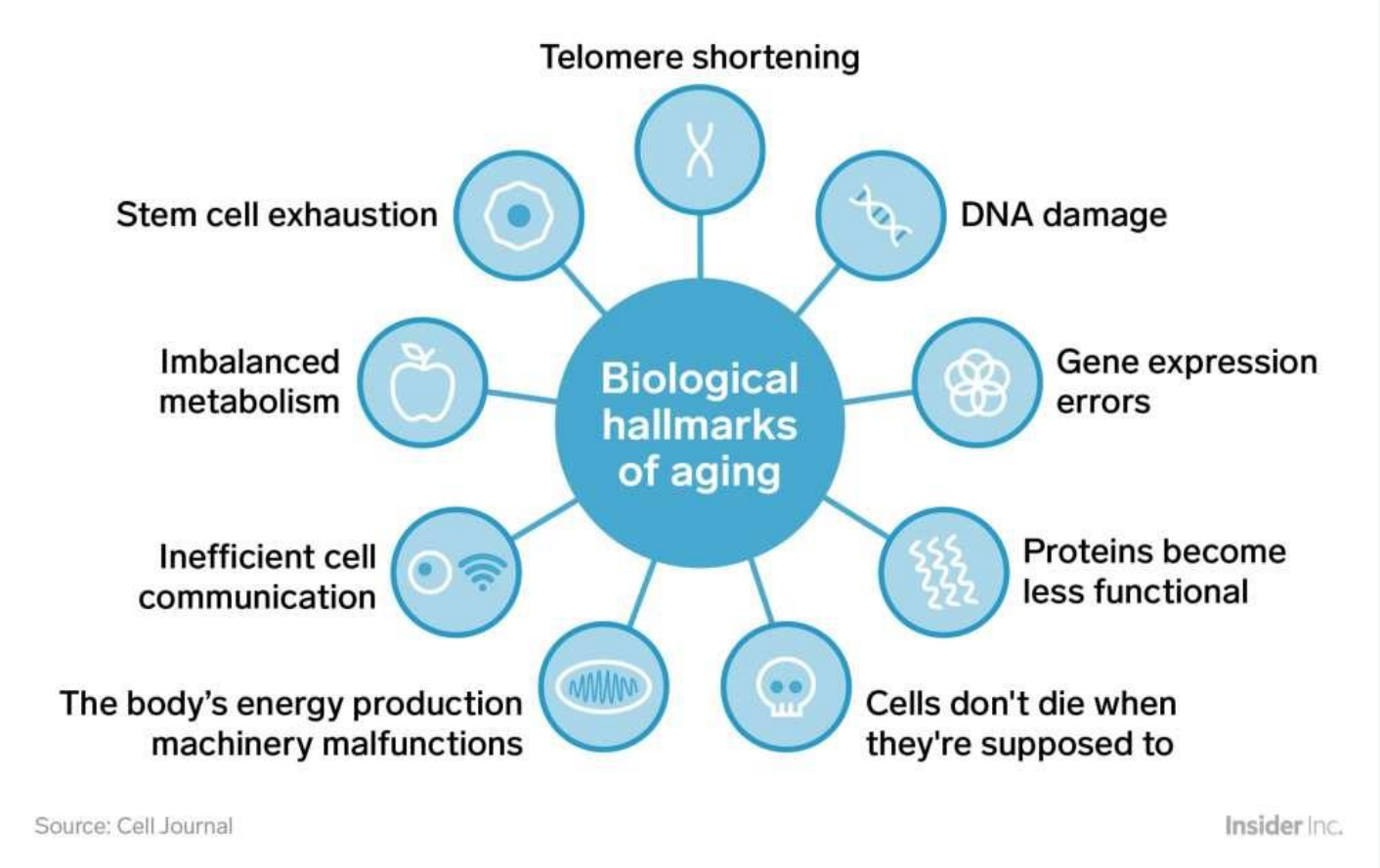
Factors influencing wound healing



Complication of wound healing



Body Aging Process



Read more on the aging process