

مقدم من فريق أفق الطبي

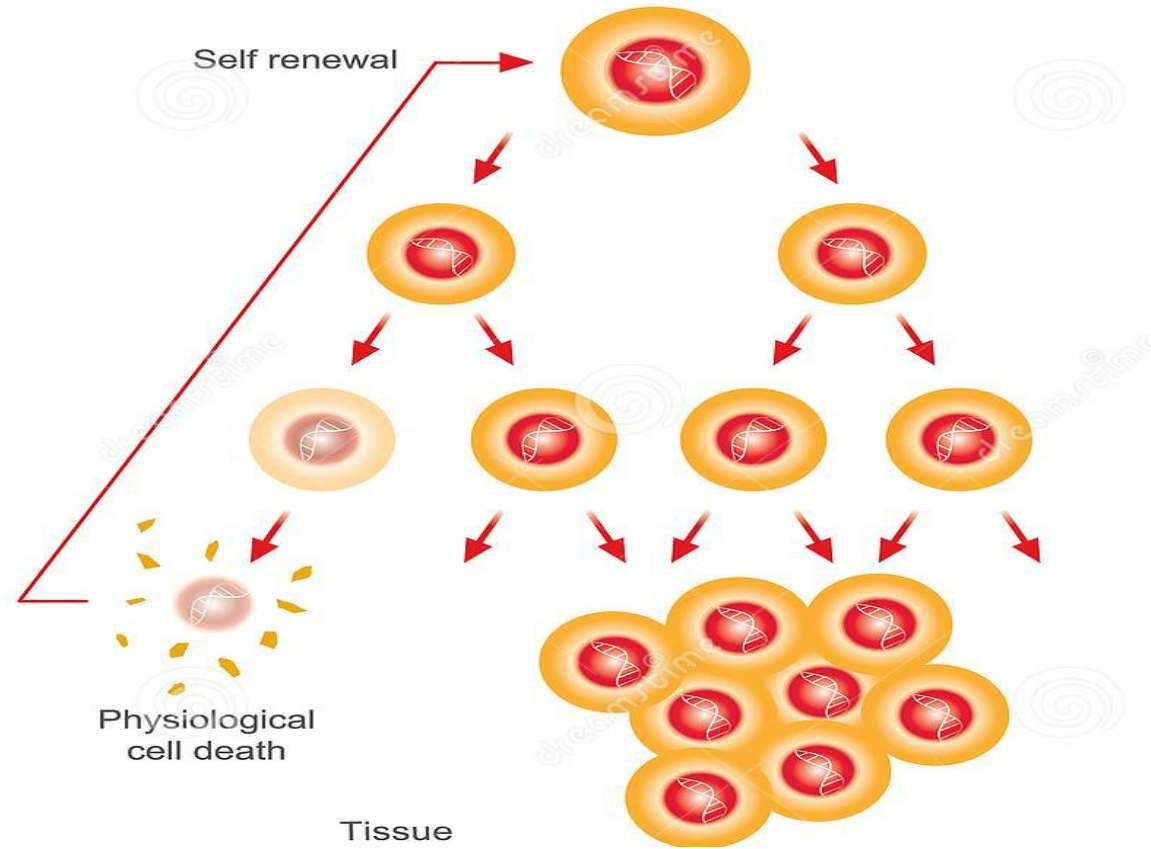


Cell proliferation& death

Dr.ImanNabil

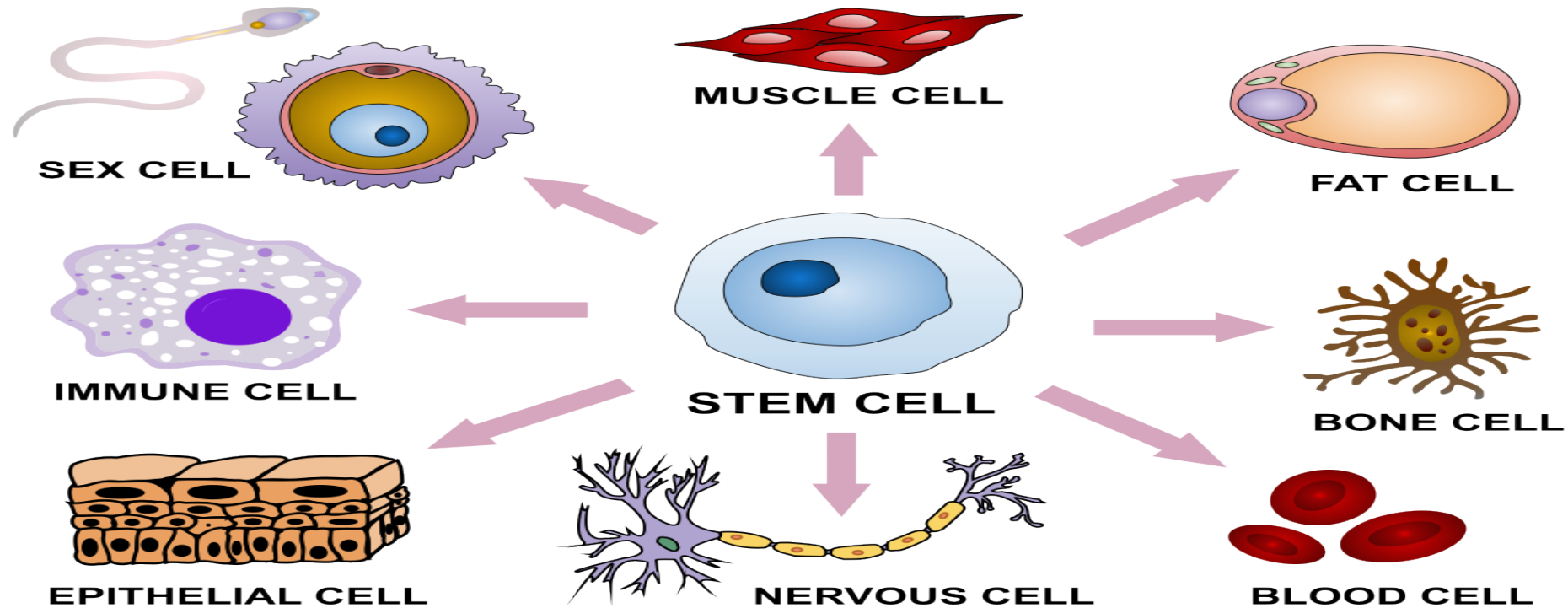


Cell proliferation



Cell differentiation

- It is the process by which *unspecialized cells* acquire specialized *structural* and/or *functional* features that characterize the specialized cells.



Cell proliferation & differentiation

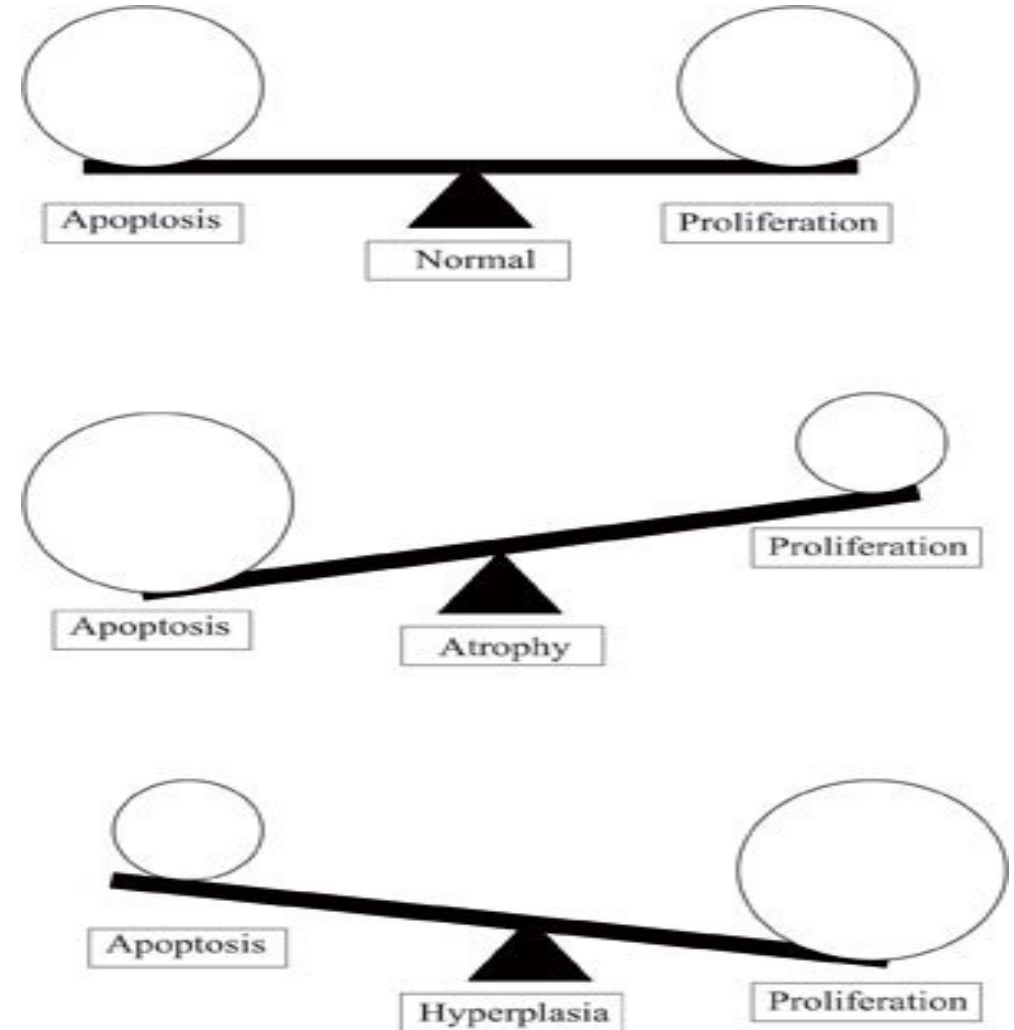
- Early development:

Rapid proliferation of embryonic cells, which then differentiate to produce the many specialized types of cells that make up the organs.

- As cells differentiate:

The rate of proliferation *decreases*, and many cells are arrested in the G0 stage.

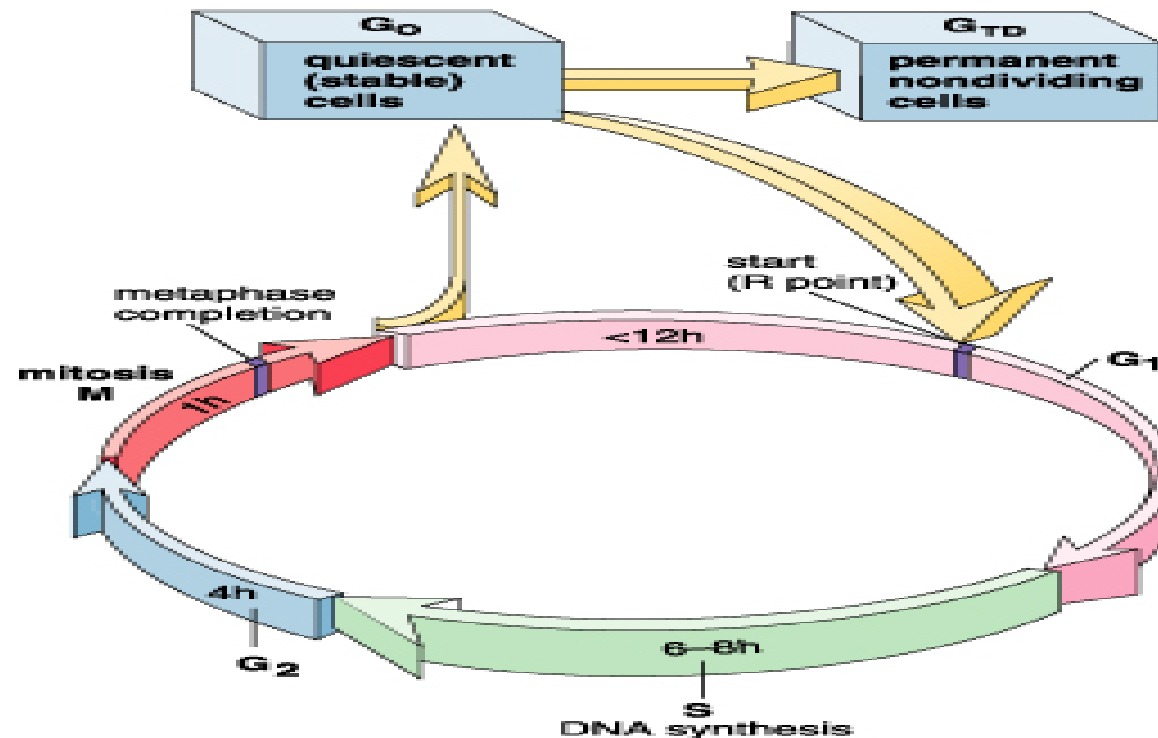
- *Cell proliferation is balanced with cell death to maintain a constant number of cells.*



Classification of the body cells according to their ability of proliferation

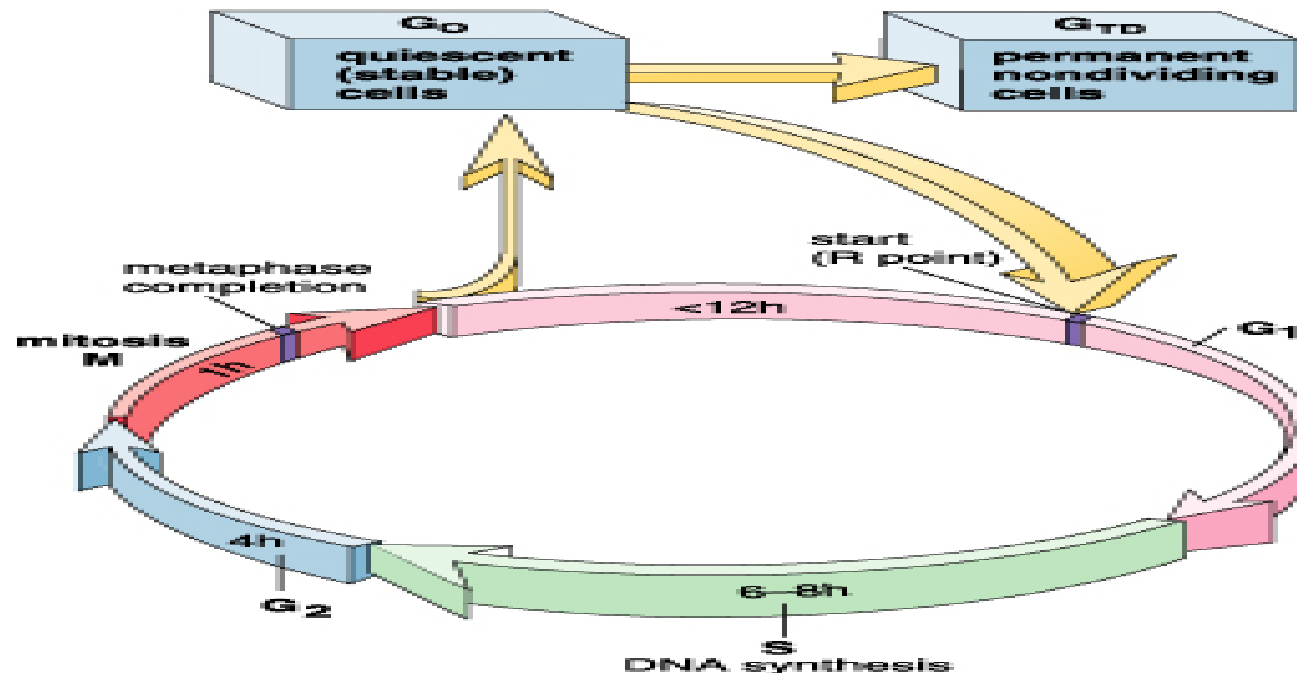
1-Static cell population(non dividing, permanent)

- They leave the cell cycle to perform specialized function (G₀ stage), e.g. cardiac muscle fibers & neurons.



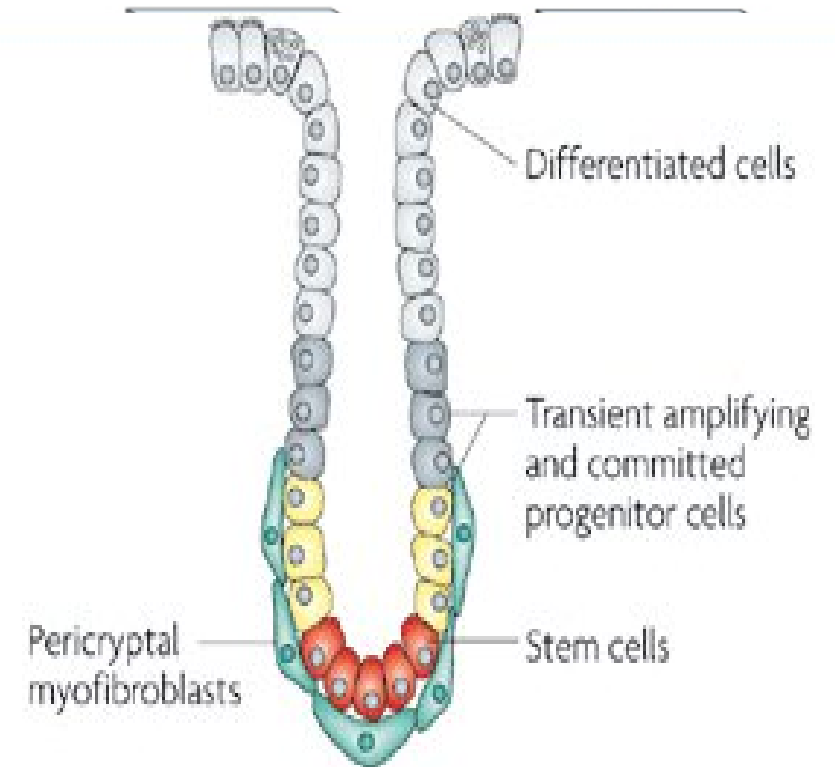
2-Stable cell population (quiescent)

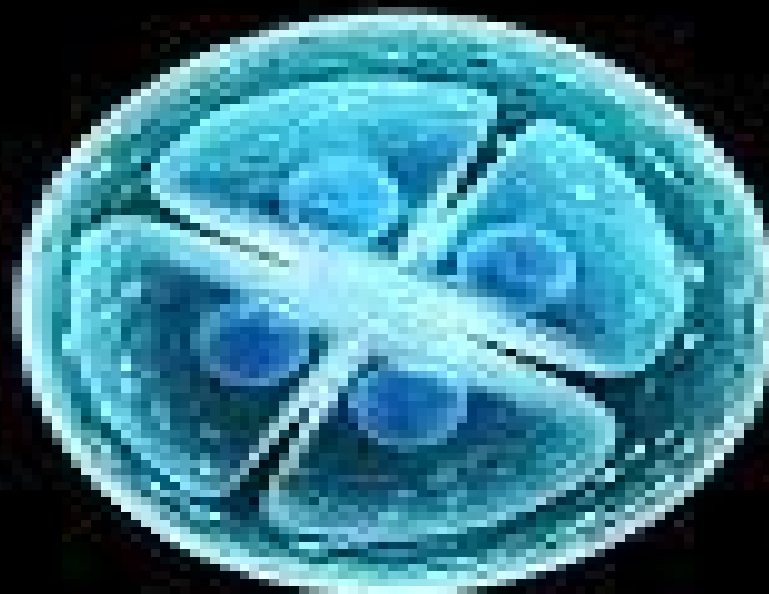
- They are considered to be in G₀ stage but *they may be stimulated to divide by signals* e.g. smooth muscle fibers and the cells of the liver.



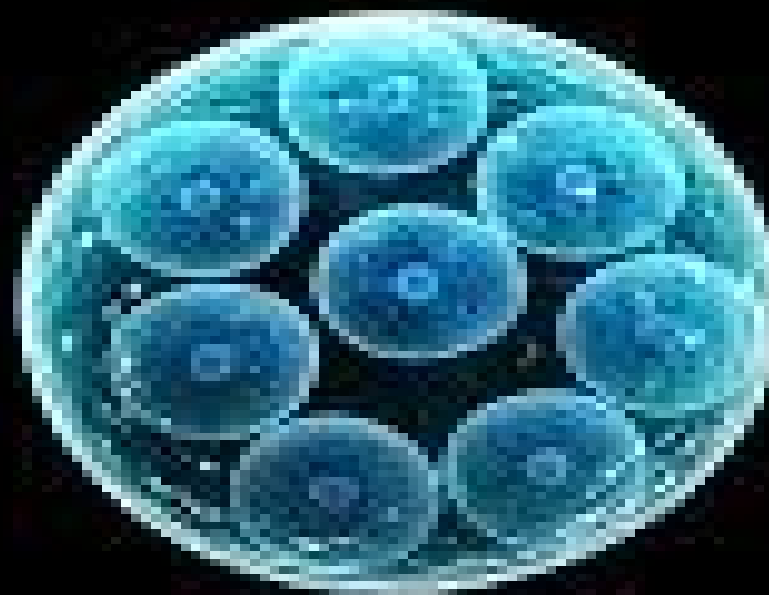
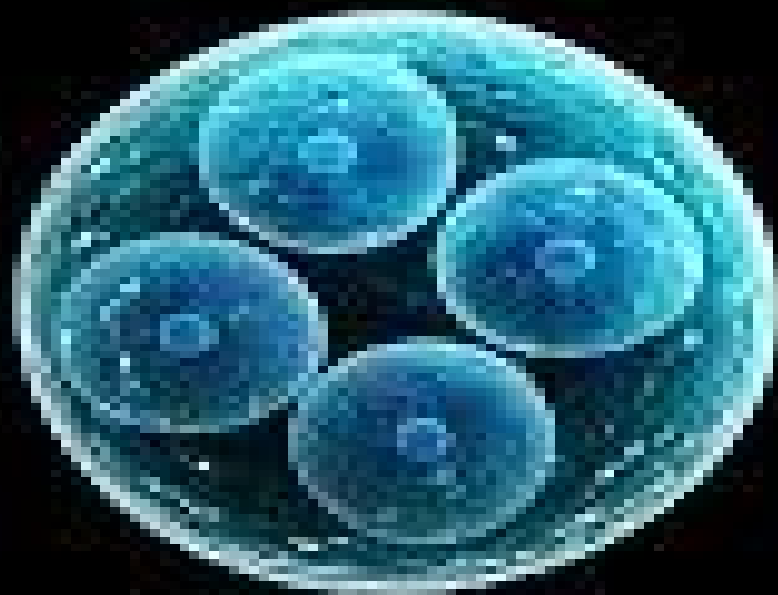
3-Labile cell population

- They are fully differentiated cells (can not divide), but their continuous renewal occurs by *proliferation of the stem cells* e.g. cells have short life span as blood cells, epithelial cells of the skin & epithelial cells lining the digestive tract





Stem cells



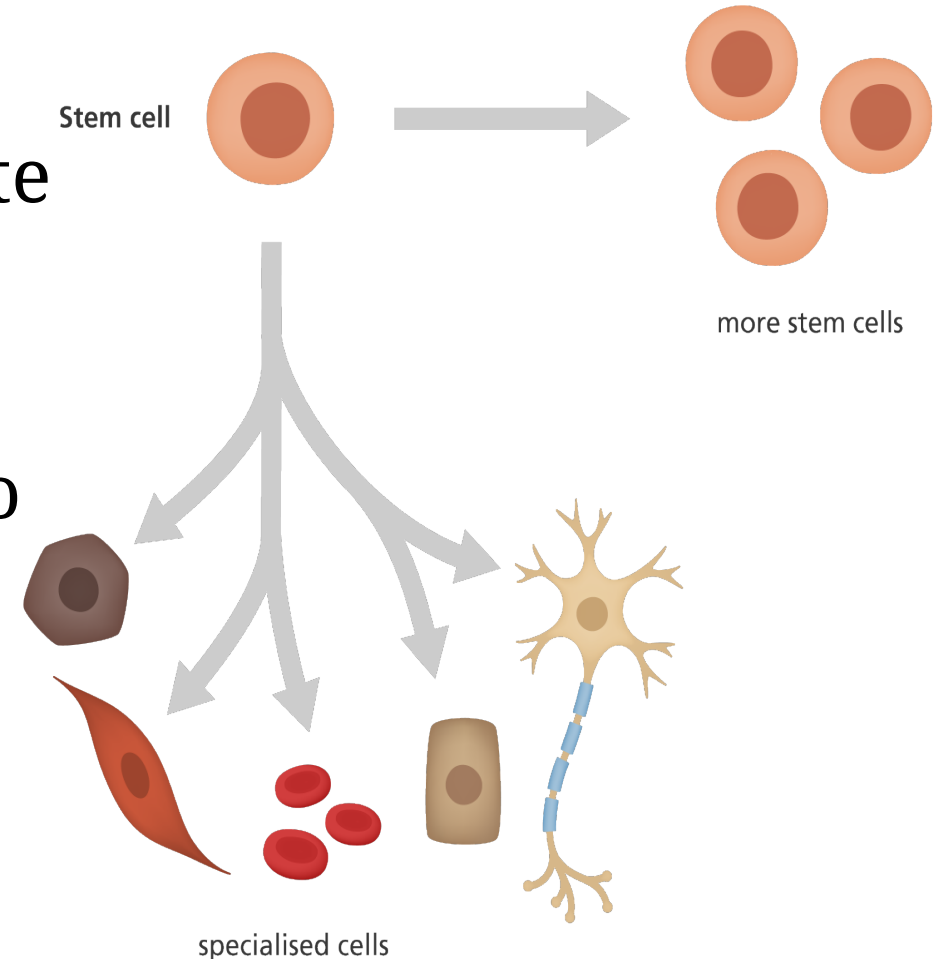
Stem cells

- **Definition:** undifferentiated (unspecialized) cells that can proliferate & differentiate to give a specialized cells.

- **Stem cell properties:**

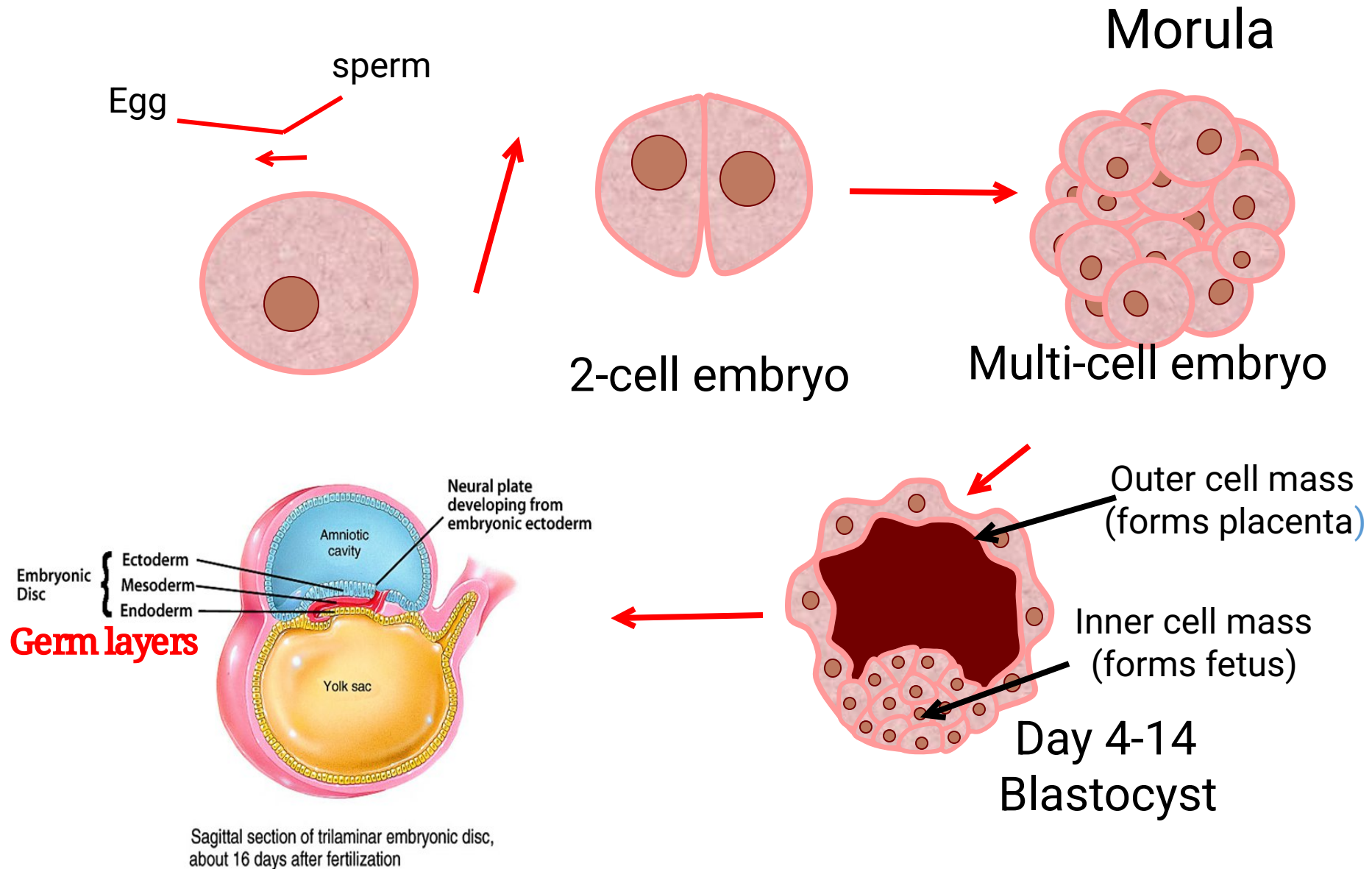
1- Self-renewal the ability of the cell to go through numerous cycles of cell division while maintaining the undifferentiated state.

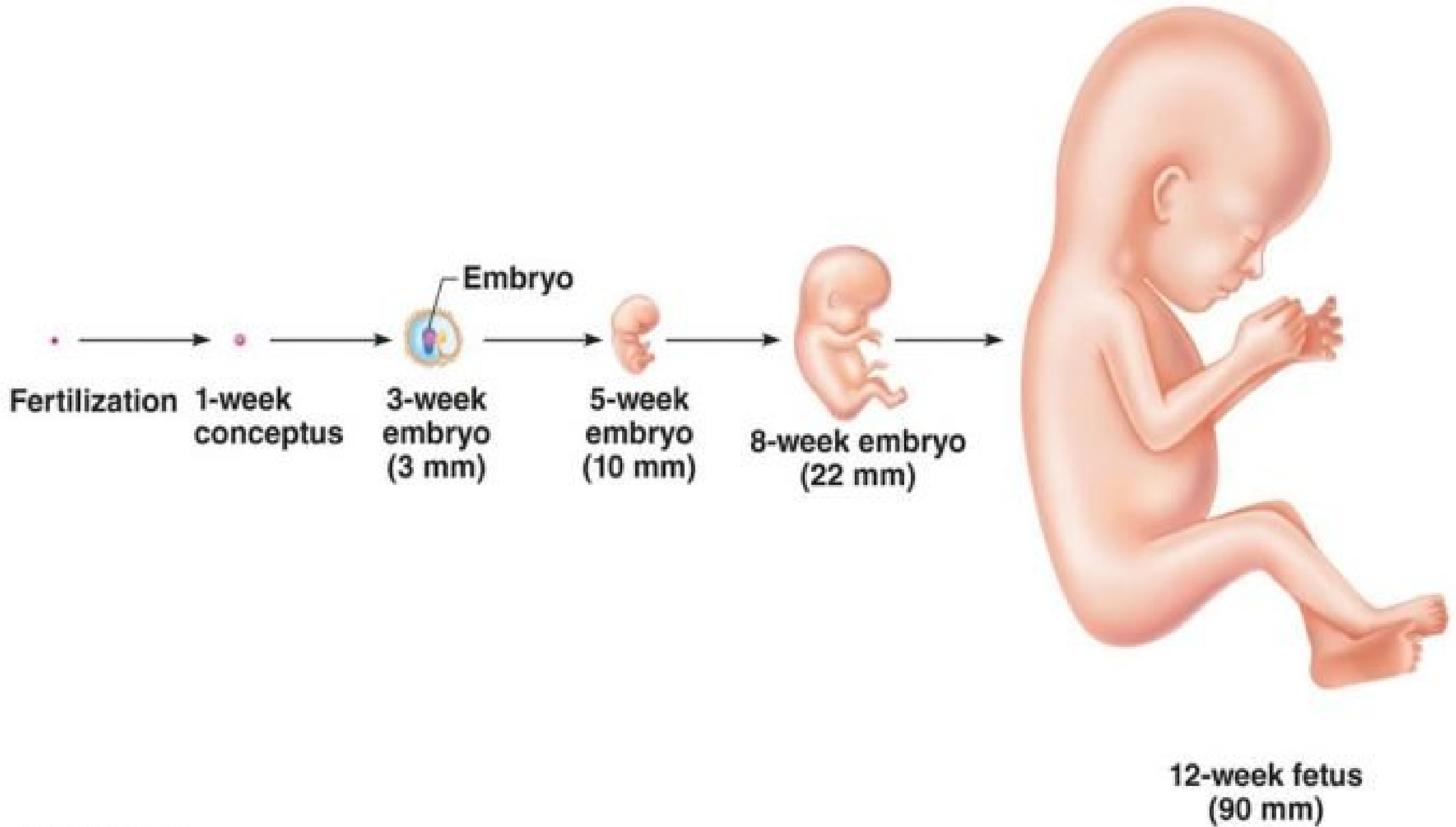
2- Potency the capacity to differentiate into different cell types.



Types of stem cells

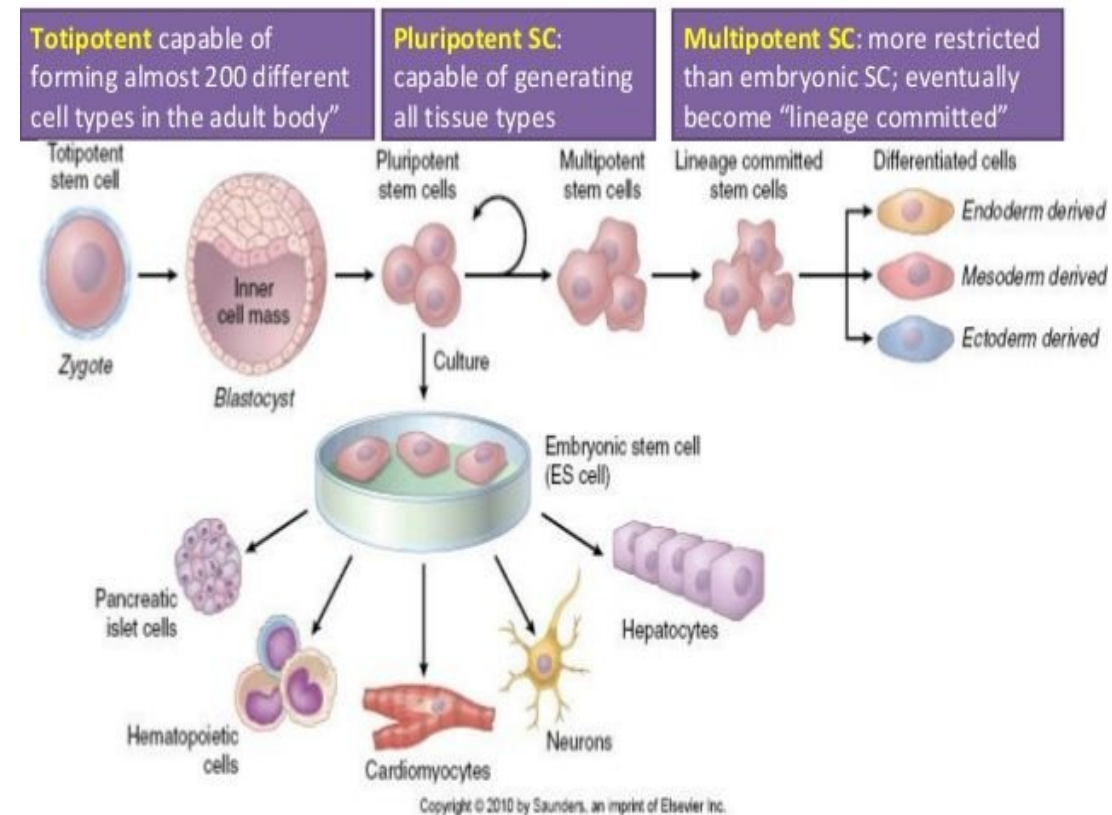
Stages of Embryogenesis





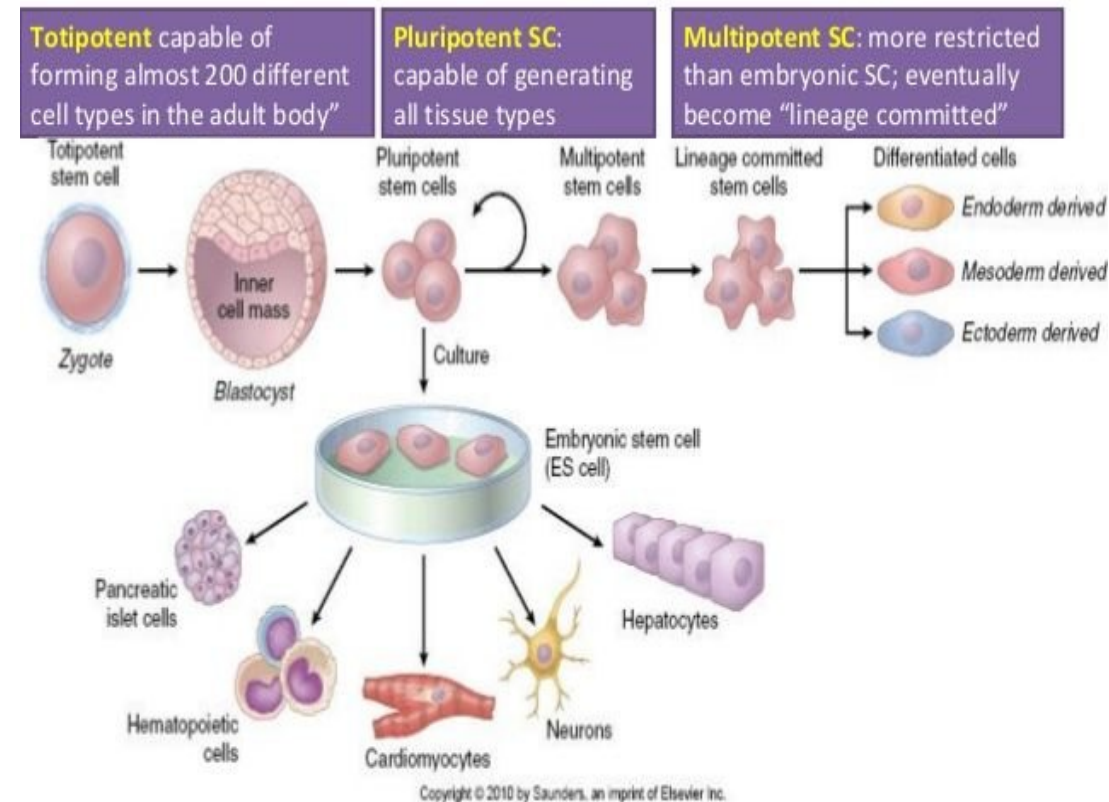
1-Totipotent stem cells

- They have the potential to generate all types of cells and construct a *complete organism*.
- They are derived from the cells produced by the first few divisions of the fertilized ovum (*morula* cells).



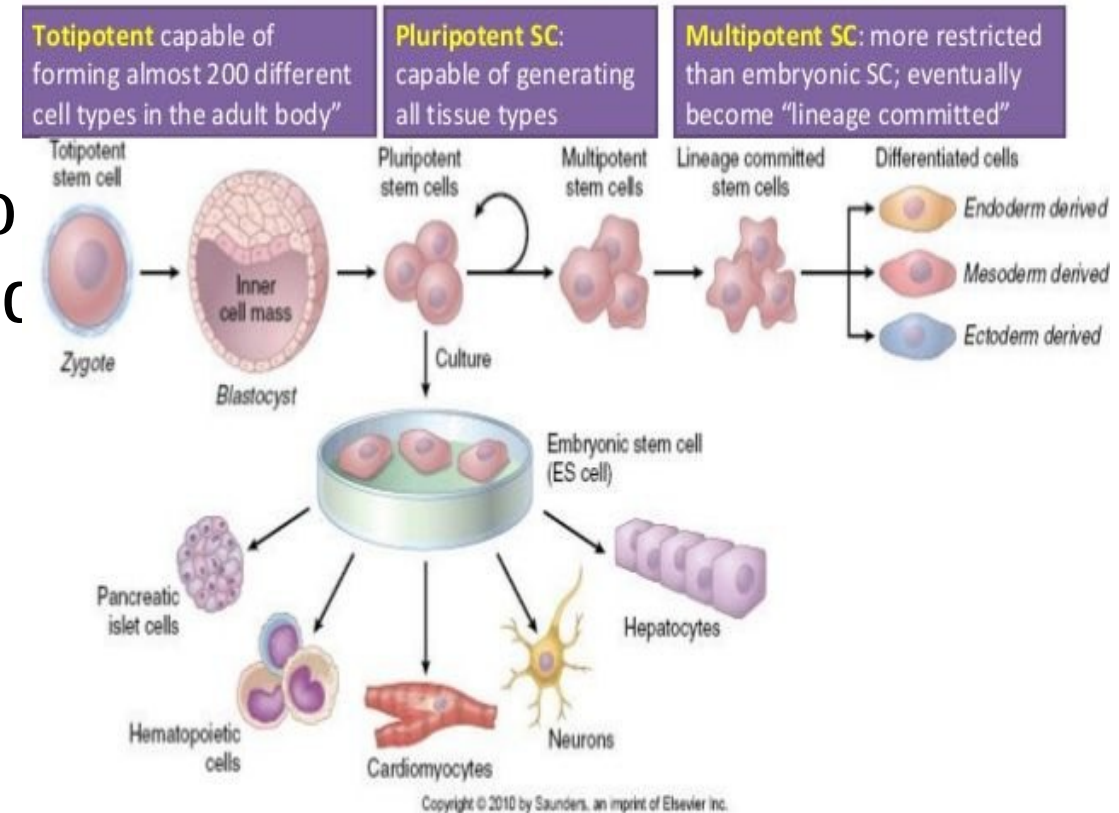
2-Pluripotent stem cells

- They can differentiate into the derivatives of *the three germ layers* = ectoderm, endoderm, and mesoderm.
- They are derived from *the inner cell mass* of the blastocyst



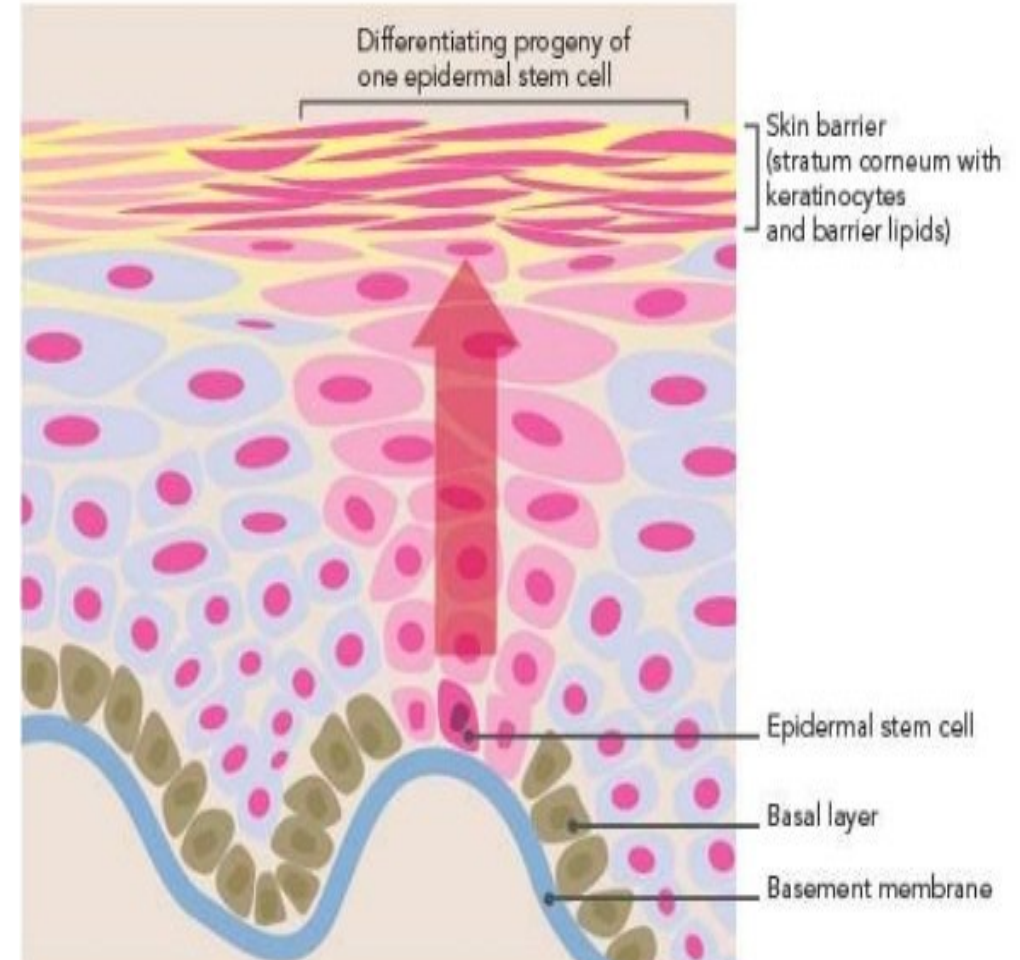
3-Multipotent stem cells

- They can produce cells of a *closely-related family*. e.g. hematopoietic stem cells that can differentiate into red blood cells, white blood cells and platelets.



4-Unipotent cells

- They can produce *a single type* of mature cell *but* still have the property of self renewal which distinguishes them from non-stem cells e.g. stem cells in the skin epidermis.

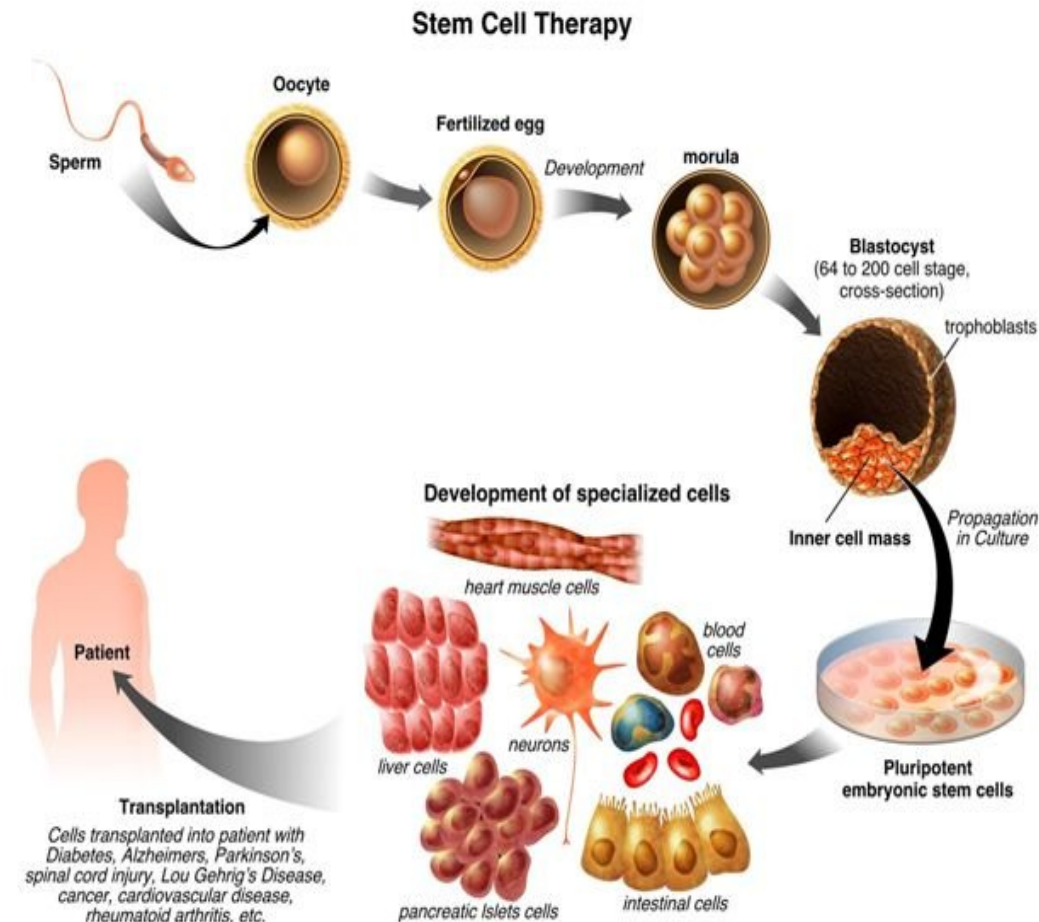


يَأْتِيهَا النَّاسُ إِنْ كُنْتُمْ فِي رَيْبٍ
مِنْ الْبَعْثِ فَإِنَّا خَلَقْنَاكُمْ مِنْ تُرَابٍ ثُمَّ مِنْ نُطْفَةٍ
ثُمَّ مِنْ عَلَقَةٍ ثُمَّ مِنْ مُضْغَةٍ مُخَلَّقَةٍ وَغَيْرِ مُخَلَّقَةٍ لِنَبِّينَ
لَكُمْ وَنُقِرُّ فِي الْأَرْحَامِ مَا نَشَاءُ إِلَى أَجَلٍ مُسَيَّءٍ ثُمَّ

Potential sources of stem cells for clinical application

1- Embryonic stem cells

- They are *pluripotent* stem cells derived from inner cell mass of blastocyst
- **Advantage:** They can specialize and become any type of body cells.
- **Disadvantage:** ethical restriction.



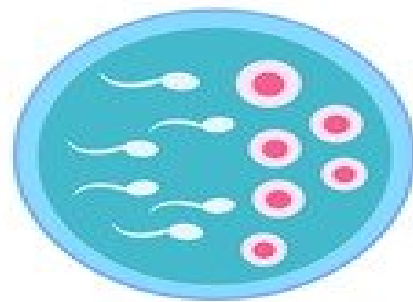
in Vitro Fertilization

2. Egg pick up



1. Ovarian stimulation hormone therapy

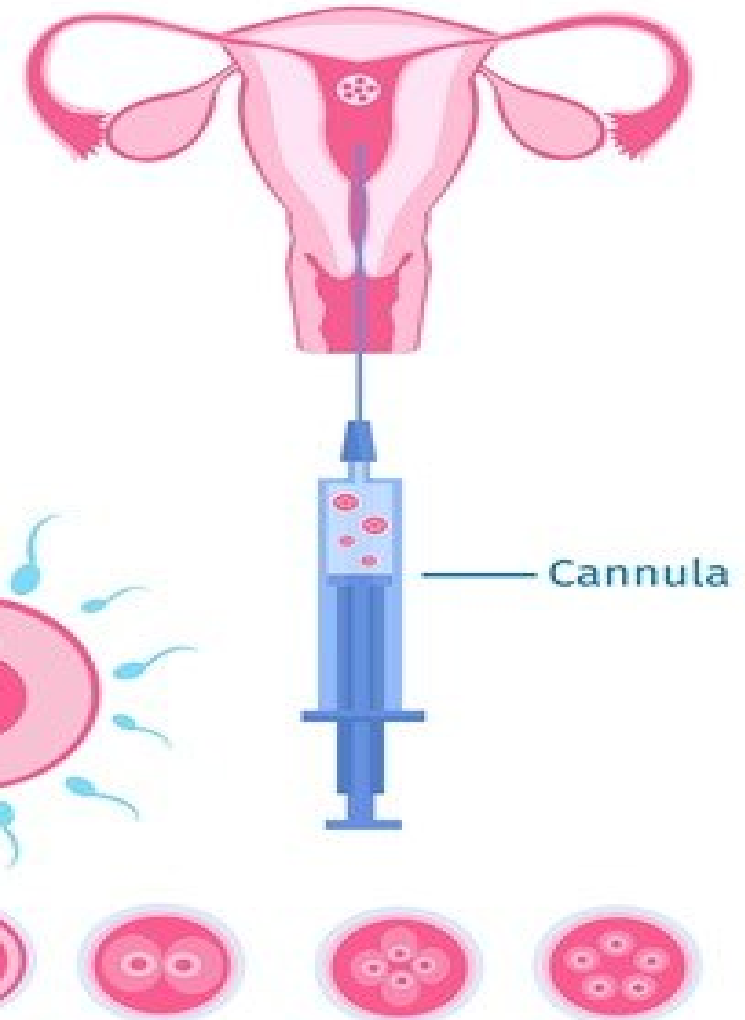
4. Egg fertilization



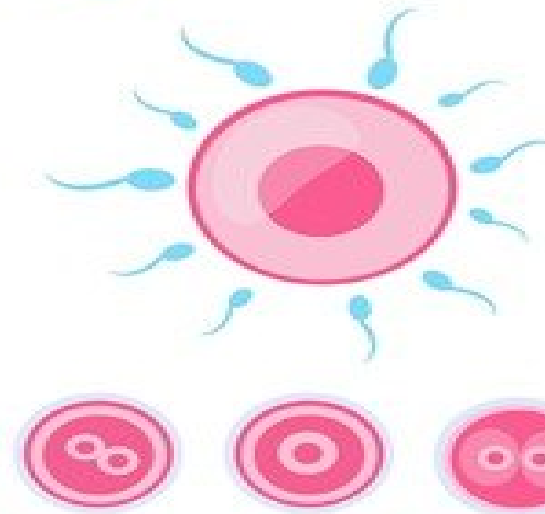
3. Sperm preparation



6. Embryo transfer



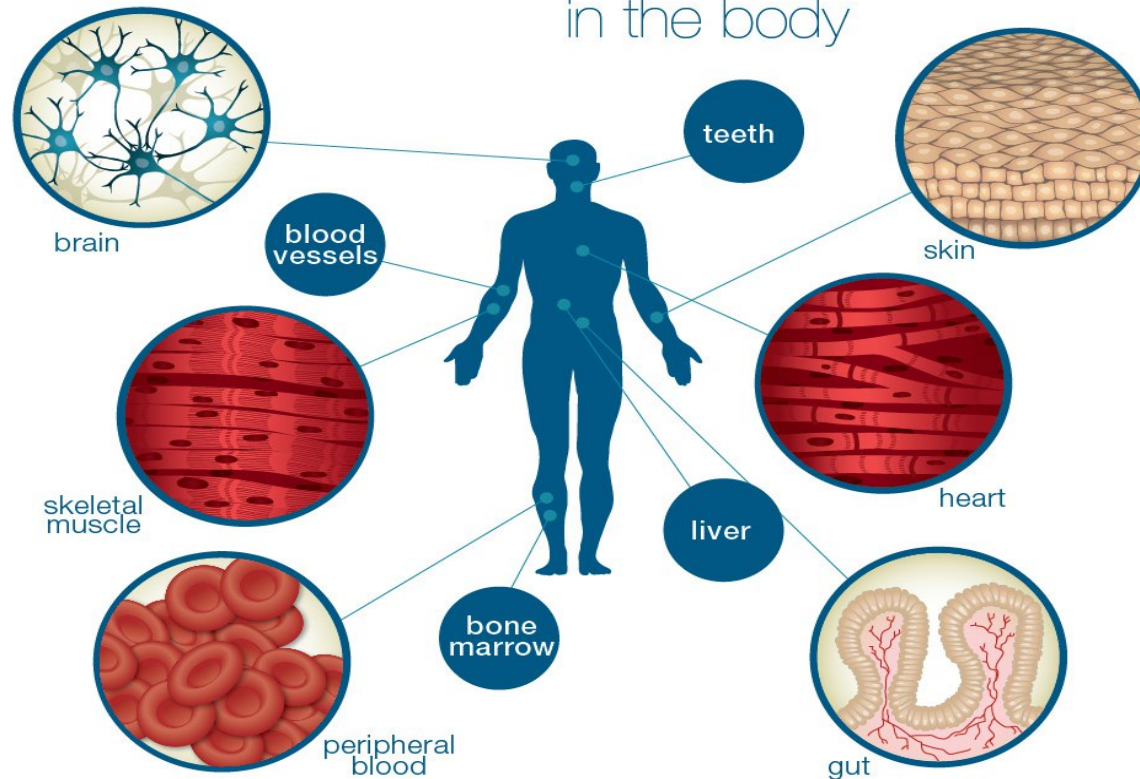
5. Embryo development



2- Adult stem cells

- Most of them are *multipotent*

Locations of **Somatic Stem Cells**
in the body



3-Amniotic fluid stem cells

- They are *multipotent*.

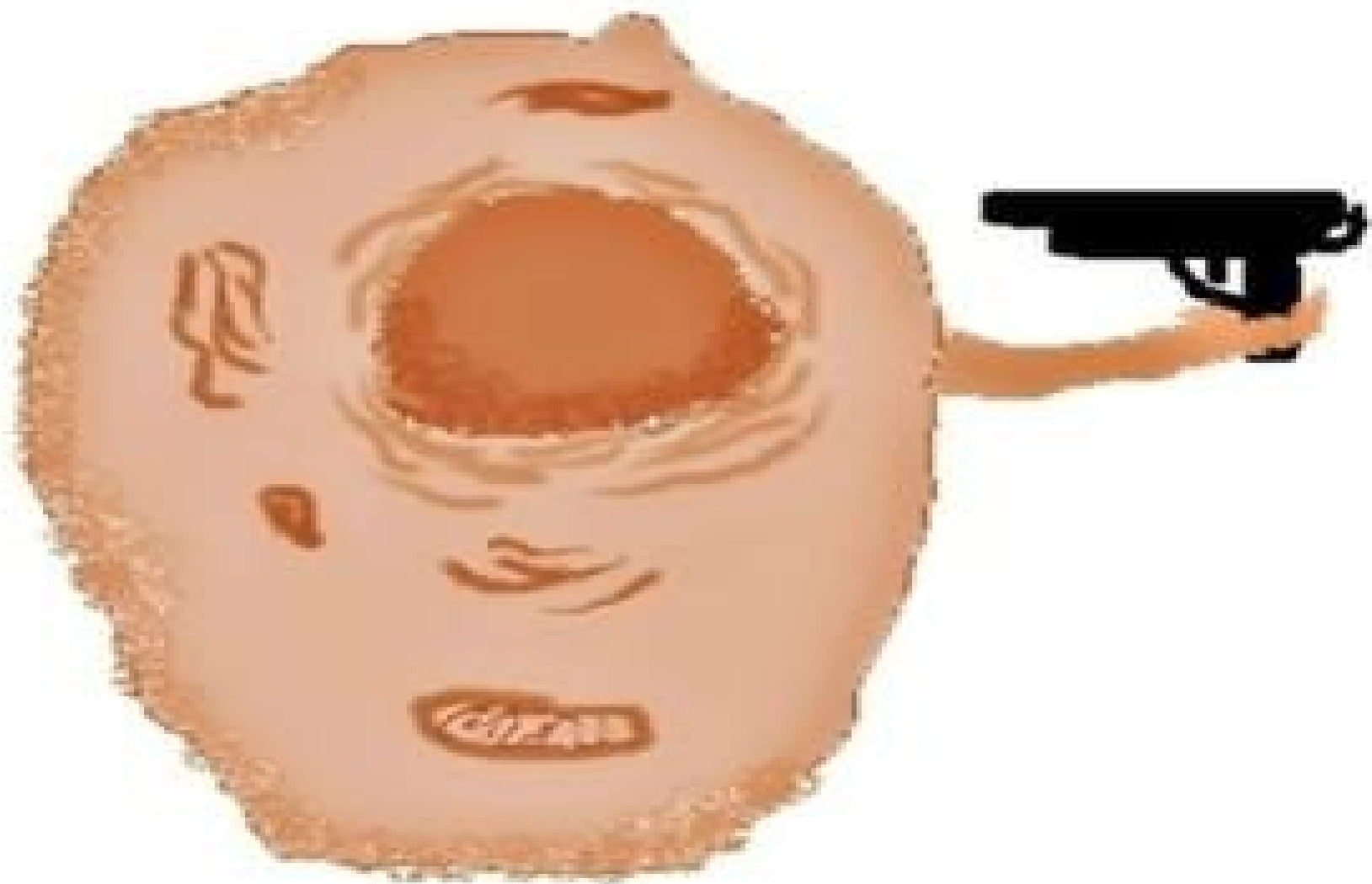


4-Umbilicalcord blood stemcells

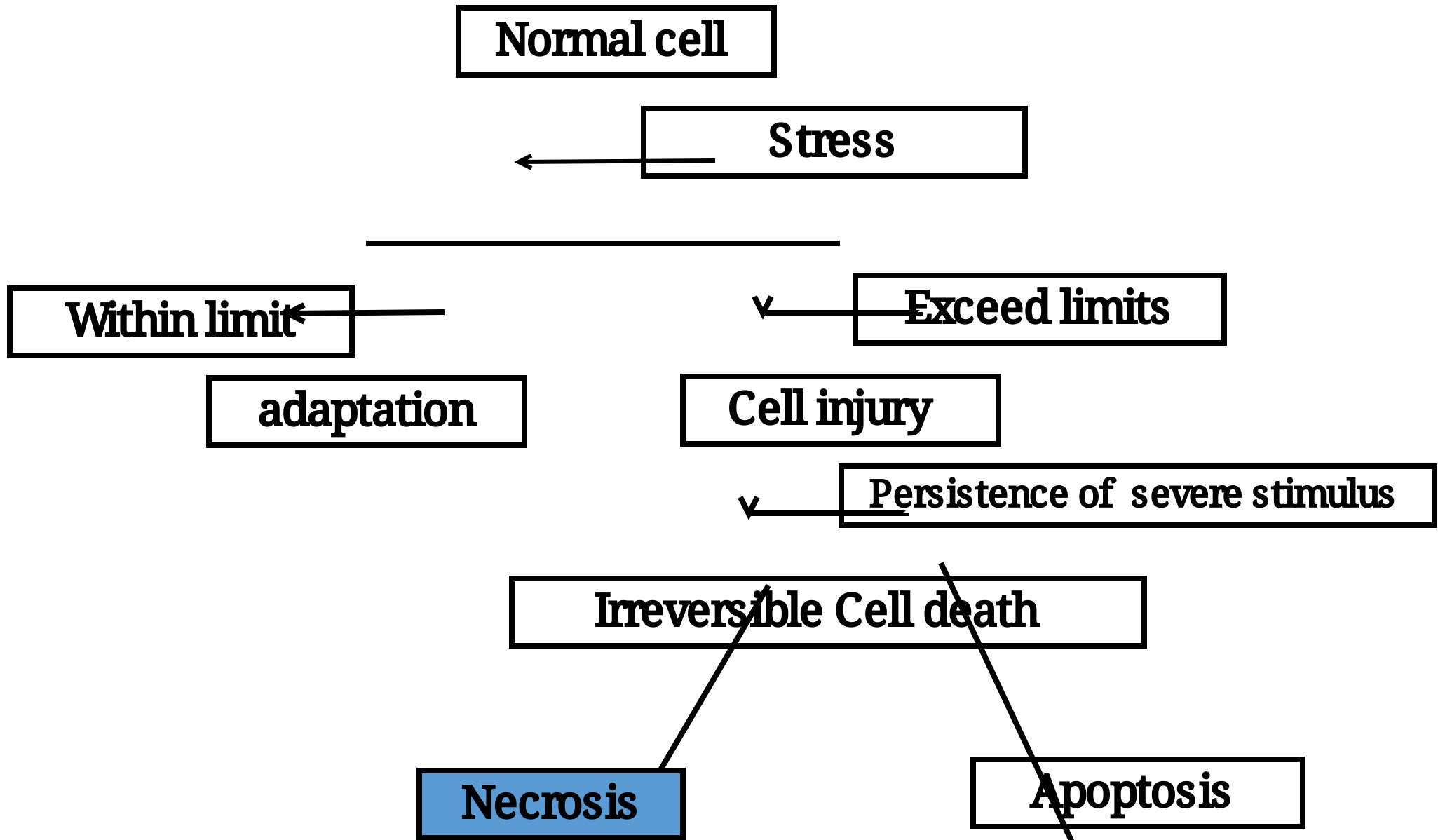
- They are *pluripotent*



Cell death



When a cell want to die...

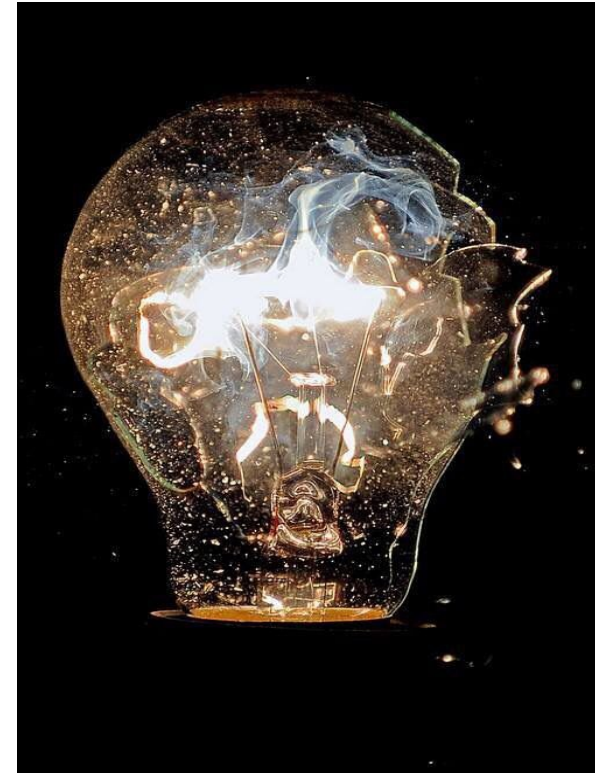


Types of cell death

Apoptosis

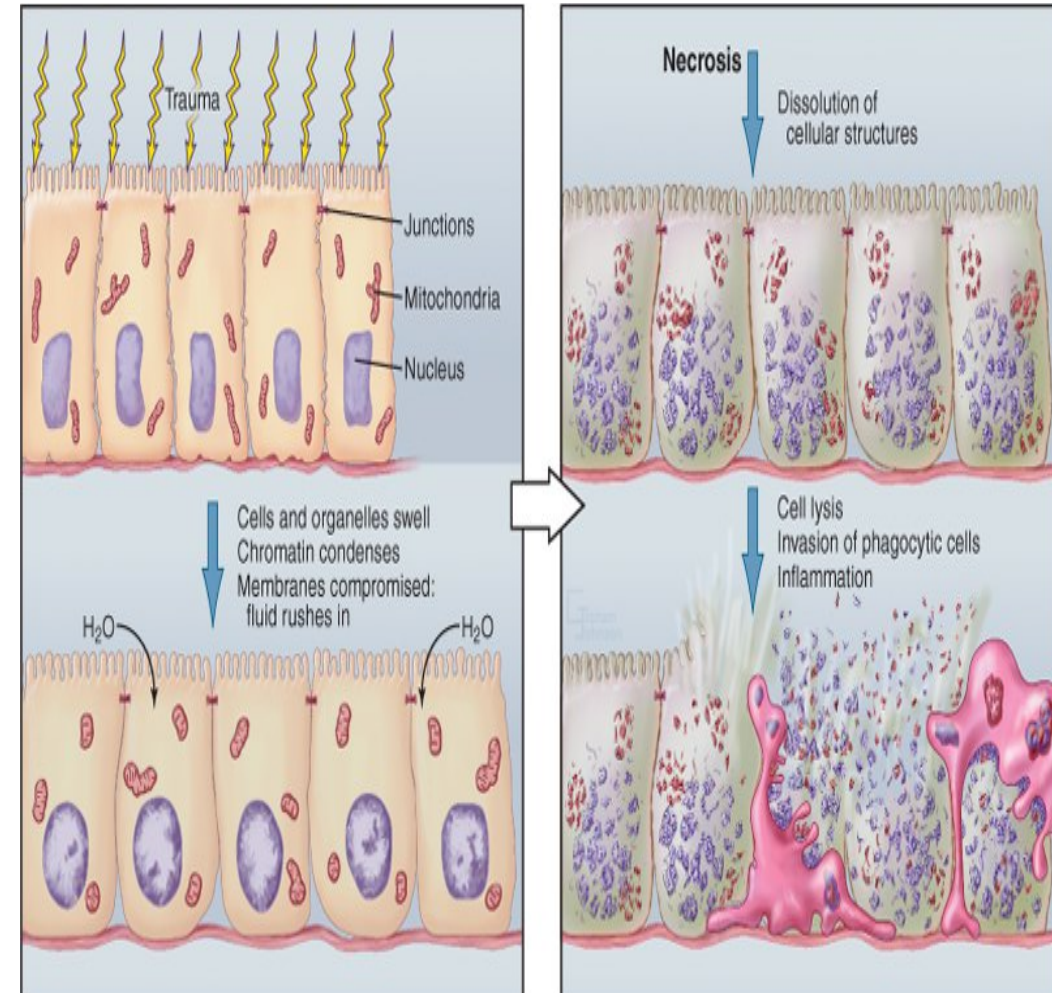


Necrosis



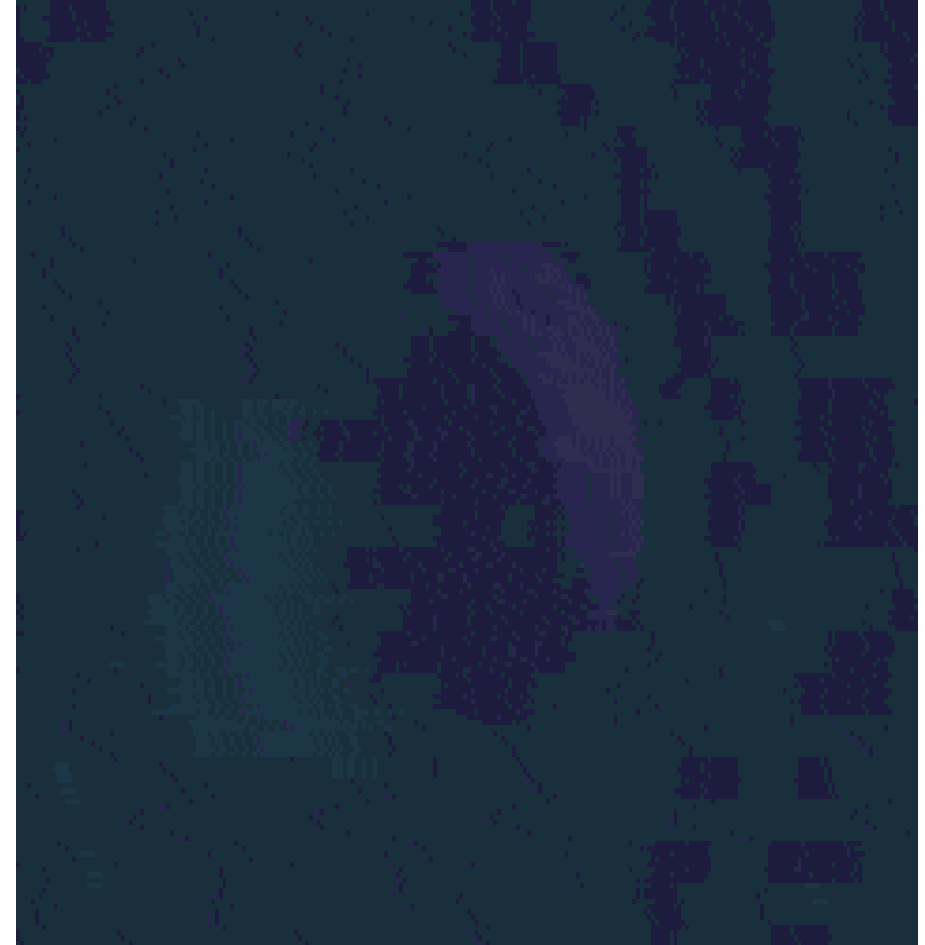
Necrosis = accidental cell death

- **Causes:** It is a *pathological process* due to e.g. hypoxia, radiation or pathogens such as viruses.
- **Morphological features:**
 - 1- *Damage of the cell membrane* with cell swelling & rupture.
 - 2- Breakdown of cell organelles.
 - 3- Denaturation or coagulation of cytoplasmic proteins.
 - 4- Inflammation with extensive damage of the surrounding tissue.



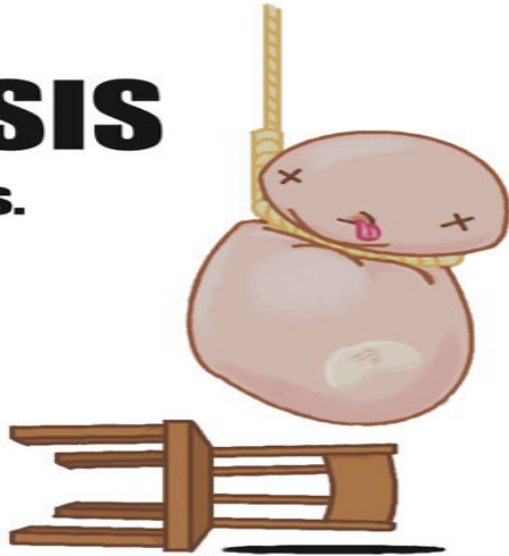
Apoptosis = programmed cell death

It is a *physiological process* controlled by several genes (loss of mitochondrial function initiates several reactions that lead to cell death).



What makes a cell decide to commit suicide?

APOPTOSIS Know the signs.



Don't Stop Me! I
want to Die!

Each cell receives

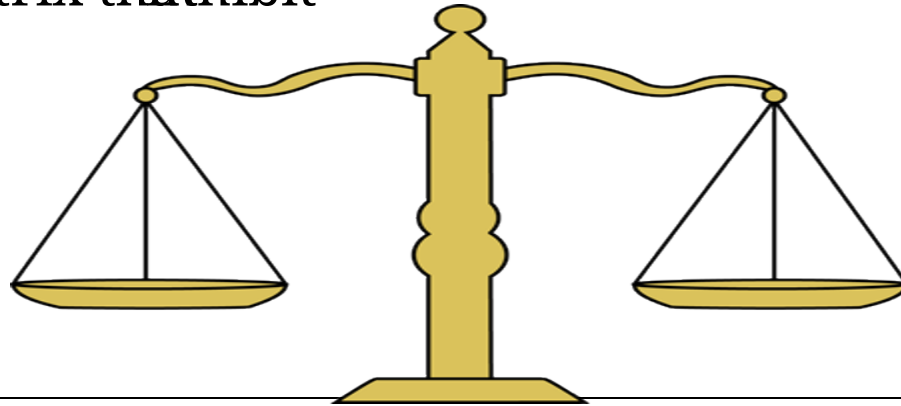


Positive signals

From other cells and extracellular matrix that inhibit apoptosis

Negative signals

Promote apoptosis



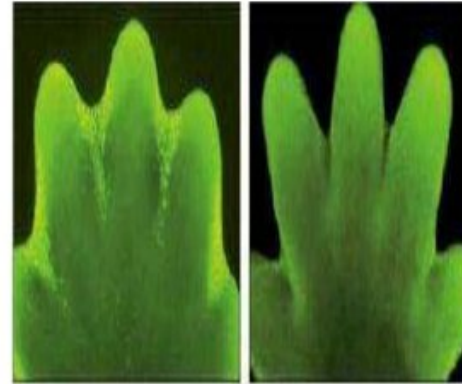
There is a Balance Between them

Receiving of negative signals **OR** Withdrawal of positive signals →

Apoptosis

I-During embryonic development

- Removal of excess cells that have no function e.g. during morphogenesis and for determination of organ size.



Development of toes

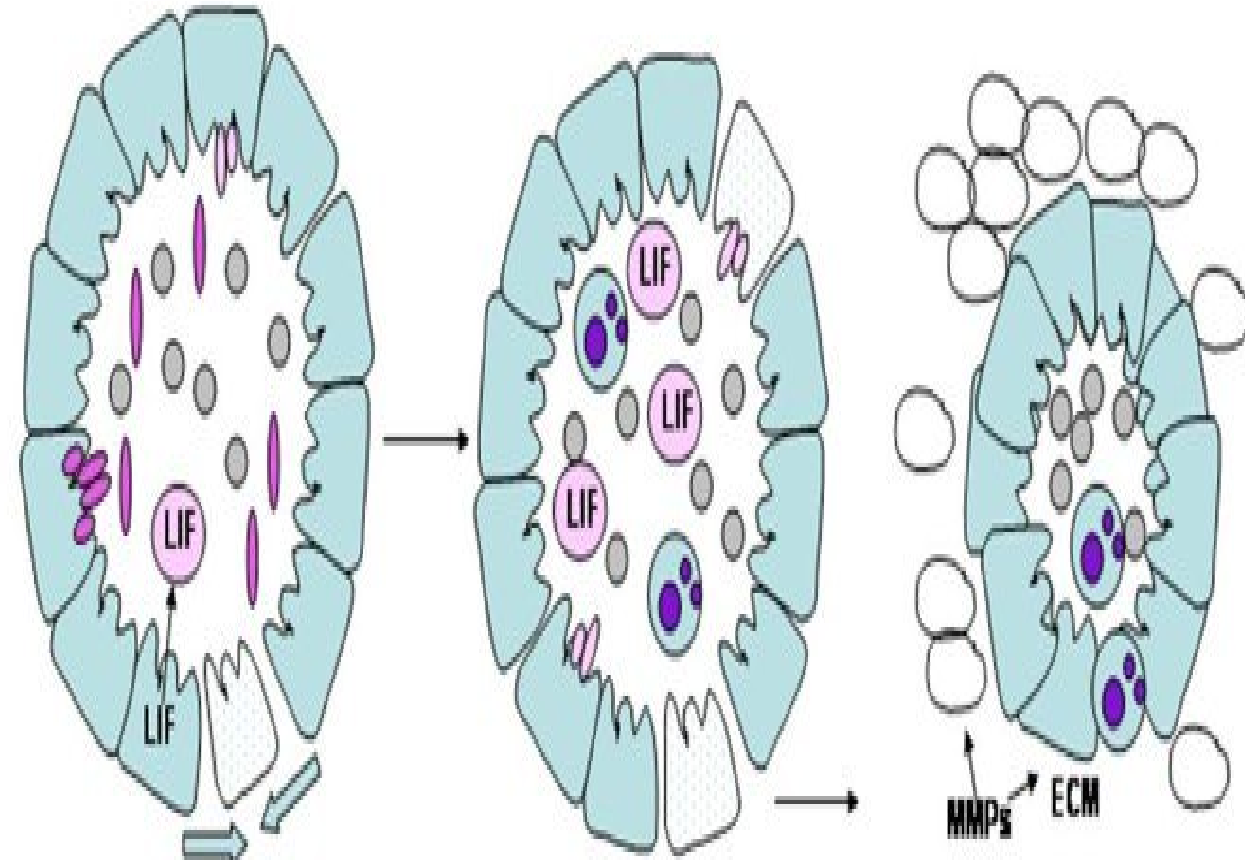


Incomplete apoptosis

II-In adult

1- Hormone-dependent:

- ★ Involution of the endometrium during the menstrual cycle.
- ★ Regression of lactating mammary gland after weaning.
- ★ Regression of prostate in old males.



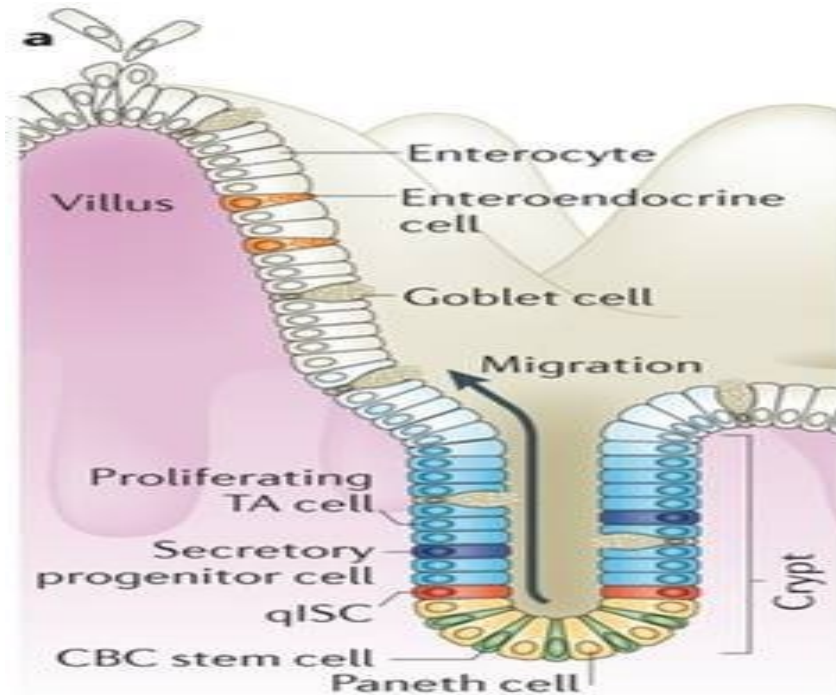
II-Inadult

2- Elimination of cells during cell cycle when their DNA damage is not repaired.



II-In adult

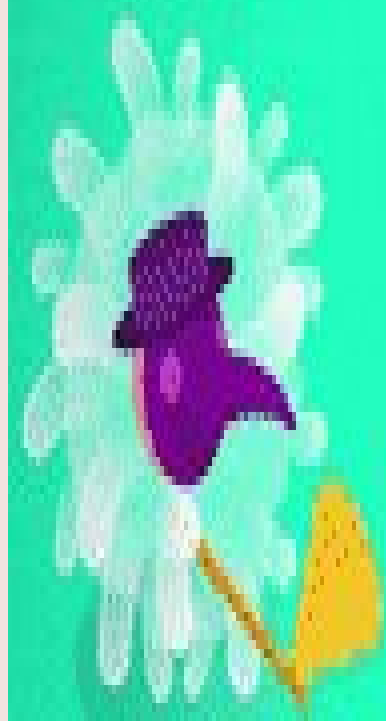
3- Maintaining a constant number of cells in proliferating cell populations, e.g. intestinal epithelium





I am done with my
role here. It's time
for me to die now.

I will miss you my
altruistic brother.

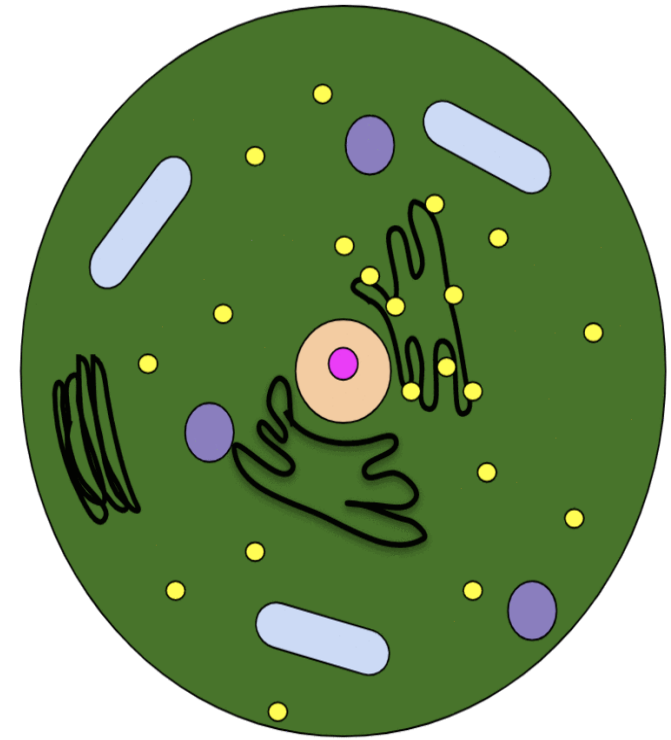






Morphological features of apoptosis

- 1- Loss of microvilli and intercellular junctions.
- 2- Shrinkage of the cell with membrane blebbing
- 3- Breakdown of DNA with hypercondensation of chromatin and its collapse against the nuclear periphery.
- 4- Change of cell membrane characters *without loss of its integrity*
- 5- Cell organelles remain apparently normal but become clumped inside the cytoplasm.
- 6- Fragmentation of the cell into *apoptotic bodies* that contain fragments of the nucleus, mitochondria and other organelles
- 7- The apoptotic bodies are removed by the phagocytic cells.



Death with Dignity
Gently and Painlessly



This is not a matter
of life versus death,
but about the timing
and manner of an
inevitable death.

Unknown

motherofimperfection.com

THE END

1- Type

Pathological.

Physiological.

2- Cell membrane

Damage with loss of its integrity.

Change of some characters without loss of its integrity.

3- Organelles

Broken down.

Intact.

4- Proteins

Denatured or coagulated.

Broken down of DNA with hypercondensation of chromatin.

5- Apoptotic bodies

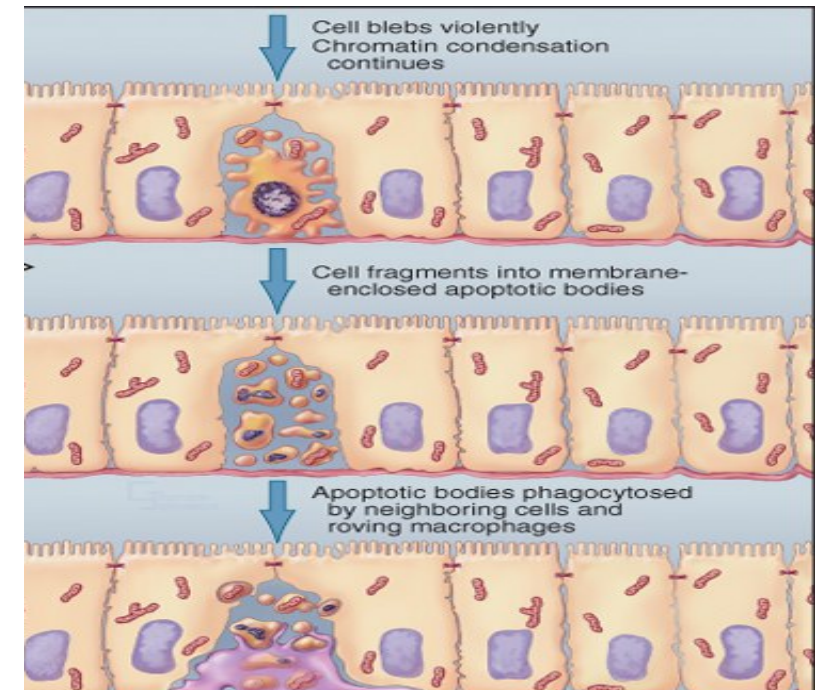
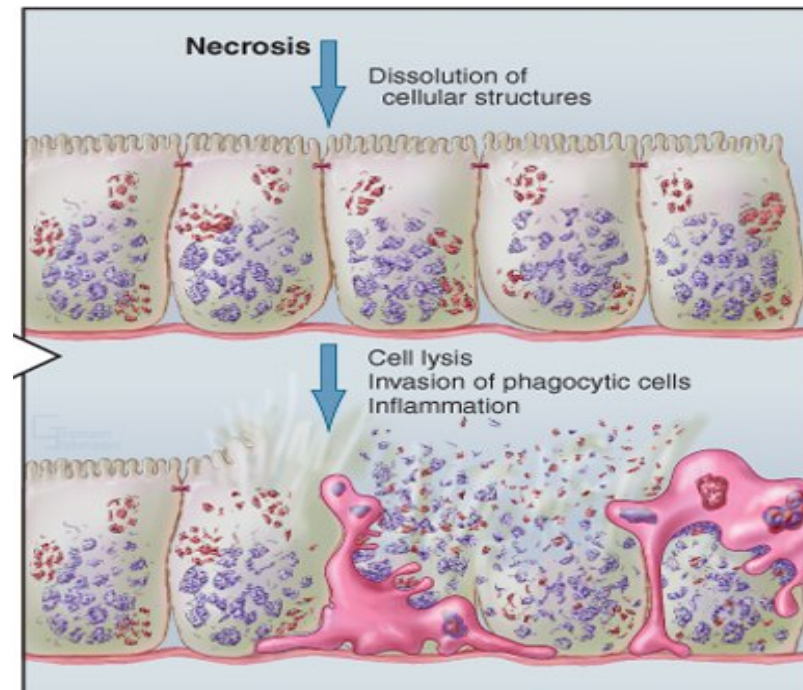
Absent

Present

6- inflammation

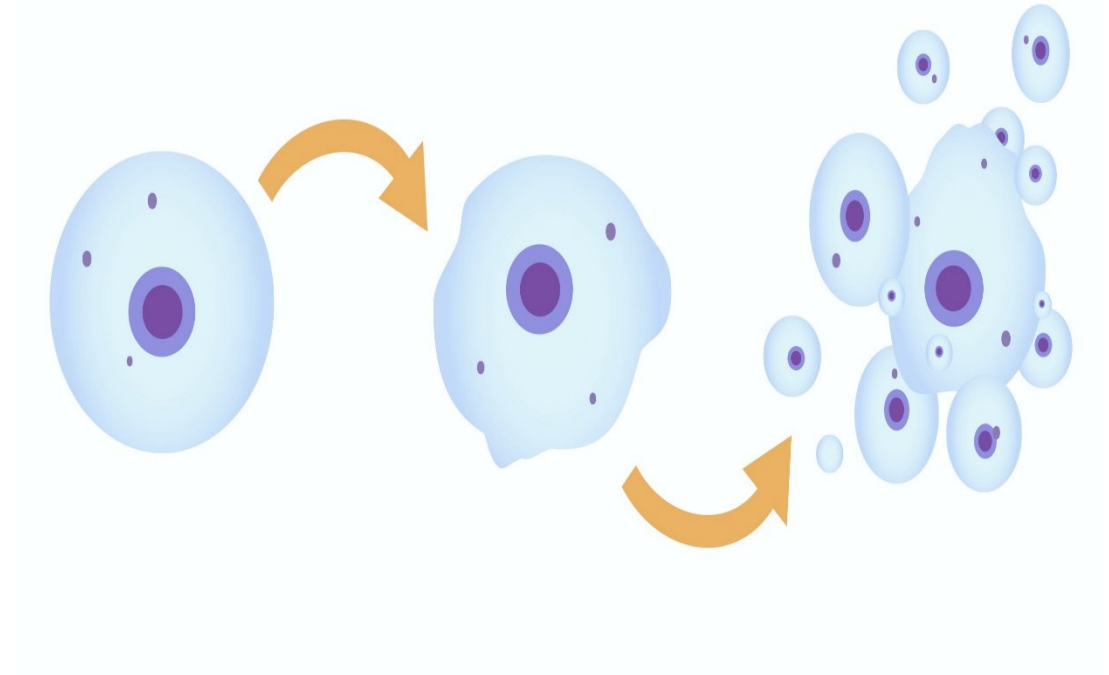
Present

Absent



What is the correct feature of this process?

- 1-The cell can proliferate & differentiate into many cell types.
- 2- The cell organelles are broken down.
- 3- The cell can replicate its DNA.
- 4- Shrinkage of the cell with membrane blebbing



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