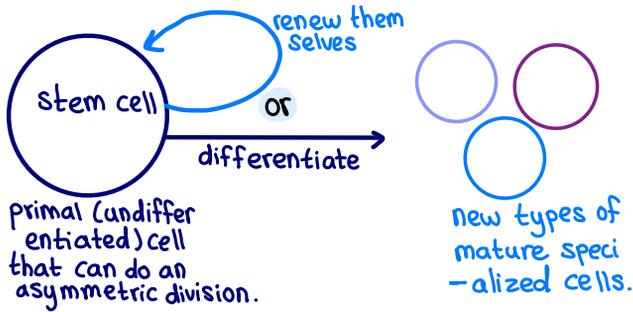


# Stem cells



Note: during this asymmetric division differential segregation of cell membrane proteins occurs, which means → proteins that are imp to keep the "stemness" of the cell are located on the cell that is going to be used to renew stem cell population, while proteins that are imp for driving differentiation go to the cell that goes to differentiation pathway.

\* Stem cells go through several steps before they become mature & during these steps they produce intermediate cells → progenitor cells.

Stem cell niche : suitable environment for stem cell division.

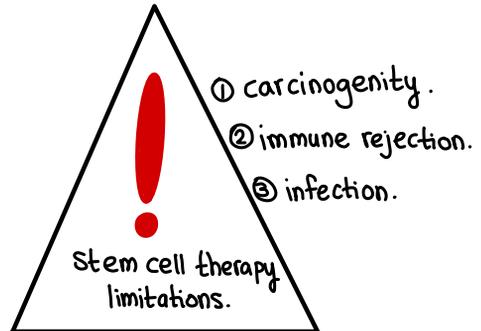
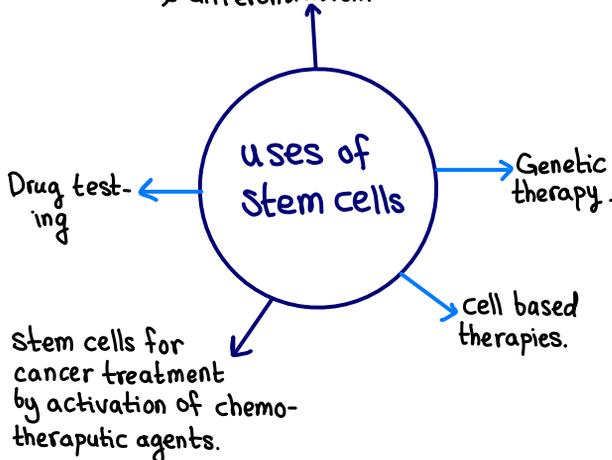
- functions:

- ① support for viability.
  - ② nutritive.
  - ③ feedback control of stem cell pool size.
  - ④ co-ordination among tissue compartments
  - ⑤ hubs of inter-lineage co-ordination.
- ↳ differentiation paths.

- its components?

- ① cells only : single type / a whole host of cells.
- or
- ② cells & ECM : proteins & sugars ....
- or
- ③ secreted / cell surface (soluble) factors : Notch, Wnt, FGF, EGF, TGF- $\beta$ , SCF & chemokine families

To study specific signals & differentiation.



# types of stem cells

according to

potency (ability to differentiate).

time of presence

## Totipotent

- can diff. to all types of tissues + extra - embryonic tissue (placental).

## pluripotent

- all tissues, but not extr. a embryonic.   
 \* can produce the 3 germ layer tissue cells.

## multipotent

Several types of cells.

## unipotent

Single type.

## Embryonic (ESCs)

- pluripotent  
- derived from inner cell mass of blastocytes.  
- Develop before implantation in the uterus.

## Adult (ASCs)

- multi/uni potent.  
- Act as repair system of the body.  
- undifferentiated cells.

## Embryonic stem cells

\* Pluripotency of ESCs:

depends on expression factors:

Oct4	Nanog
wnt-β-catenin signaling	others.

\* In order to use them for treatment we need to isolate them from an embryo = killing the embryo after it has developed which can be unethical according to morals & religion. Also, using them may cause immune rxns.

\* That's why we found another source of pluripotent cells → Induced pluripotent stem cells (iPSCs). their idea depends on reversing the differentiation of the patient's own cells in lab.

\* iPSCs are safer, Ethical, Autologous & patient specific.

• iPSCs were obtained by transducing embryonic and adult fibroblasts with defined transcription factors.

• OCT3/4, SOX2, c-Myc, KLF4

\* Yamanaka, (the scientist that discovered iPSCs) tested their features & they were all indistinguishable from ES cells.

## Adult stem cells.

types of adult stem cells:

<p>① Bone marrow (ASCs)</p> <p>Hematopoietic.</p> <p>somatic</p> <p>mesenchymal.</p> <p>osteoblasts, chondrocytes, myocytes, adipocytes &amp; neuronal cells.</p> <p>mammary</p>	<p>② Neuronal (ASCs):</p> <p>- found in neurospheres in subventricular zone, which lines the lat. ventricles of brain &amp; the dentate gyrus of the hippocampal formations.</p>
<p>③ Adipose (ASCs):</p> <p>obtained from liposuction.</p>	<p>④ Umbilical Stem cells:</p> <p>Hematopoietic or mesenchymal.</p>
<p>⑤ Olfactory (ASCs).</p> <p>to regenerate olfactory sensory cells.</p>	<p>⑥ Tissue stem cells in cornea</p> <p>&amp; in trabecular meshwork in insect region.</p>

limitations of using them:

- 1-Lack of stem cell markers resulting in difficulties to separate and identify cells.
- 2-In vitro systems for manipulating adult stem cell populations are often not well defined (we don't know how to make them diff. to the type we want).
- 3-In vivo :our understanding of how adult stem cells are regulated within their niche is in its infancy.
- 4-Multipotency of ASCs (limited in comp. to pluri).