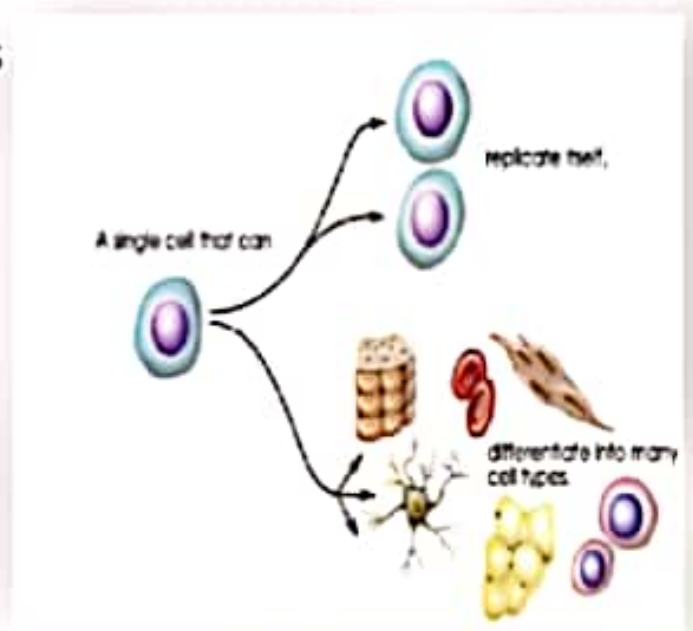


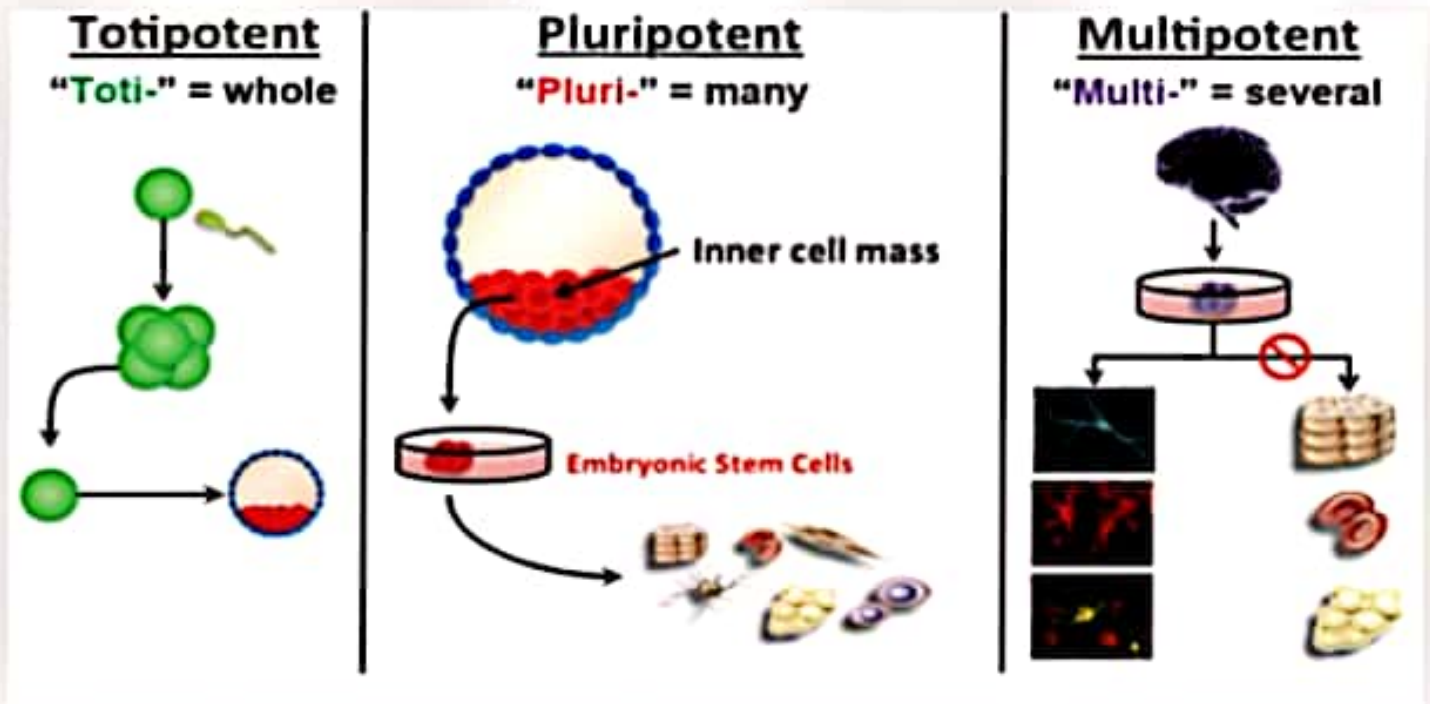
Introduction to stem cells

- Term given by William Sedgwick in 1886
- Undifferentiated autologous cells
- Self renewable capacity
- Differentiated
 - Cells
 - Tissue
 - Organ
- Show plasticity

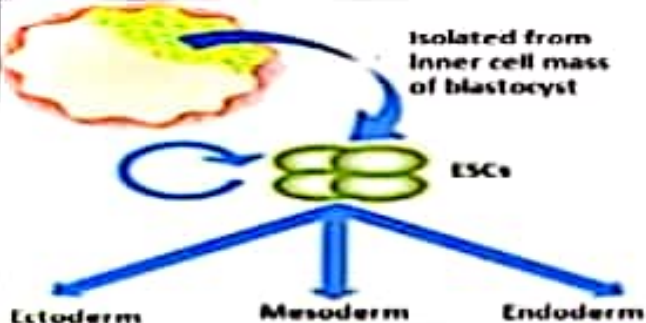
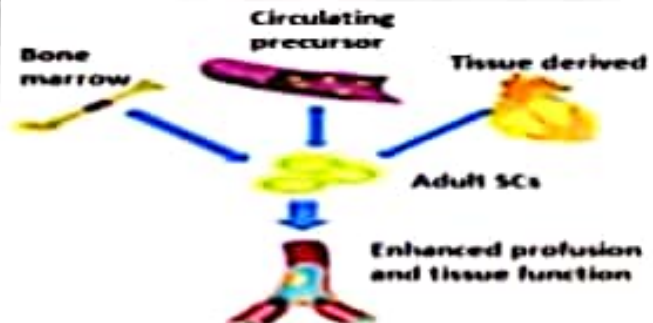


Types of stem cells

➤ Based on their ability

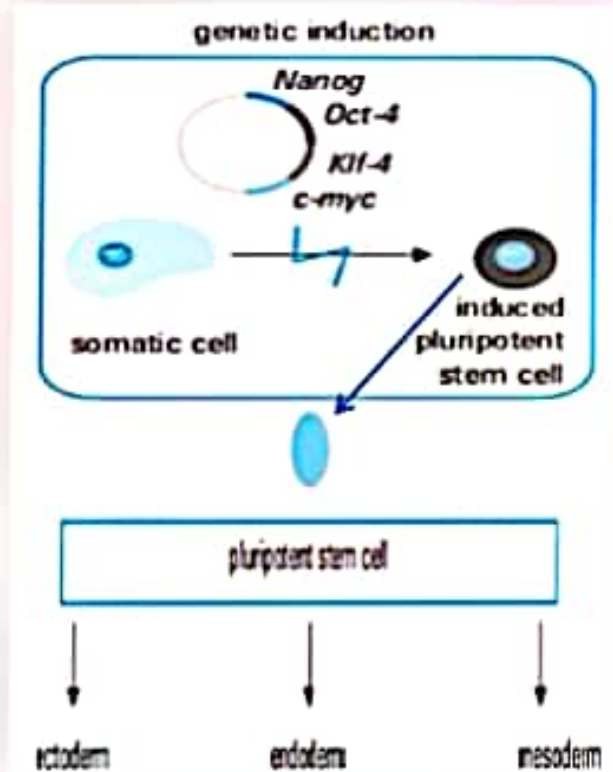


Types of human stem cells

Embryonic stem cells (ESCs)	Adult stem cells (ASCs)
 <p>Isolated from inner cell mass of blastocyst</p> <p>ESCs</p> <p>Ectoderm Mesoderm Endoderm</p>	 <p>Bone marrow Circulating precursor Tissue derived</p> <p>Adult SCs</p> <p>Enhanced proliferation and tissue function</p>
<p>Strengths</p> <ul style="list-style-type: none"> ➤ Pluripotent ➤ High replicative capacity <p>Weakness</p> <ul style="list-style-type: none"> ➤ Immunological concerns ➤ Subjected to ethical debate 	<p>Strengths</p> <ul style="list-style-type: none"> ➤ Multipotent and autologous ➤ Clinical safety <p>Weakness</p> <ul style="list-style-type: none"> ➤ Limited number ➤ Limited replicative capacity

Induced pluripotent stem cells (iPSCs)

- Recently developed stem cells
- Genetic modification of adult somatic cells
- Similar as embryonic stem cells
- Differentiated into 3 germ layers
- Noncontroversial

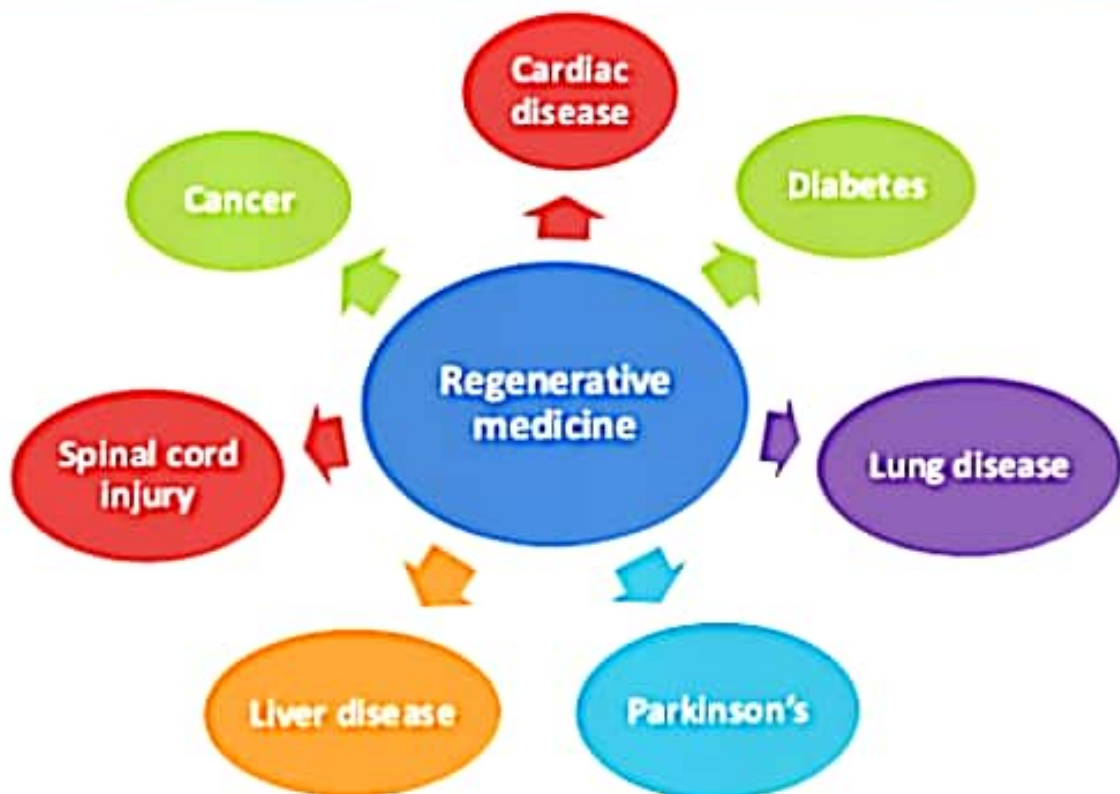


Regenerative medicine

"Process of replacing, engineering or regenerating human cells, tissues or organs to restore or establish normal function"

- iPSCs are mostly used
- Tissues and organs grown in the laboratory
- Solves the problem of organ shortage

...regenerative medicine



(Barnett, 2011)

Other developed regenerative medicine

Tissue or organ developed	Stem cells used	Uses	Reference
Liver	iPSCs	Acute liver failure	Chen <i>et al.</i> , 2015
Kidney organoid	iPSCs	Nephrotoxicity screening, disease modeling	Takasato <i>et al.</i> , 2015
Dopamine neuron	ESC	Parkinson's disease	Kriks <i>et al.</i> , 2014
Cerebral organoid (model human brain)	iPSCs	Disease modeling and treatment of brain diseases	Lancaster <i>et al.</i> , 2013
Neurons	iPSCs	Neural disorder	Corti <i>et al.</i> , 2012

Stem cells based gene therapy

- Genetic engineering technology for treatment of human diseases dates to 1989
- Gene therapy has side effects
- iPSCs - new upgraded cellular vehicle or vector
- Homing effect

Drug screening and development

- iPSCs technology revolutionizing medical science

(Jered *et al.*, 2014)

- Mechanisms and novel therapeutic molecular targets
- Opportunities for drug discovery
- Large chemical libraries to a list of candidate compounds

(Inoue and Yamanaka, 2011)

Success stories

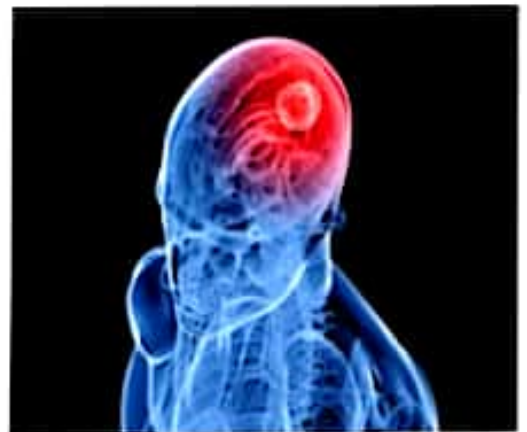
- Red blood cells created from iPSCs
- In Britain- multimillion pound project

(Hough, 2010)

- American company **City of Hope**
- FAD approval for human trial for Treatment of HIV and diabetes

Disadvantage of iPSCs

- Use of viral vector for gene delivery
- Genetic abnormality in the cells
- Formation of tumor-tumorigenesis
- Very low efficiency of reprogramming



(Miyoshi and Shimizu, 2012)

Stem cell banking

- Stores stem cells at very low temperature
- Regenerative medicine- develops **bioeconomy**
- Destined as pillar of the bioeconomy

(Diecke *et al.*, 2014)



Steps in cord blood banking

1



Umbilical cord cut

2



Cord blood collected

3



Test are conducted
for maximum safety

4



Processed to yield
maximum stem cells

5



Stored in liquid nitrogen

(Knoppers and Isasi, 2010)