STEM CELL THERAPY

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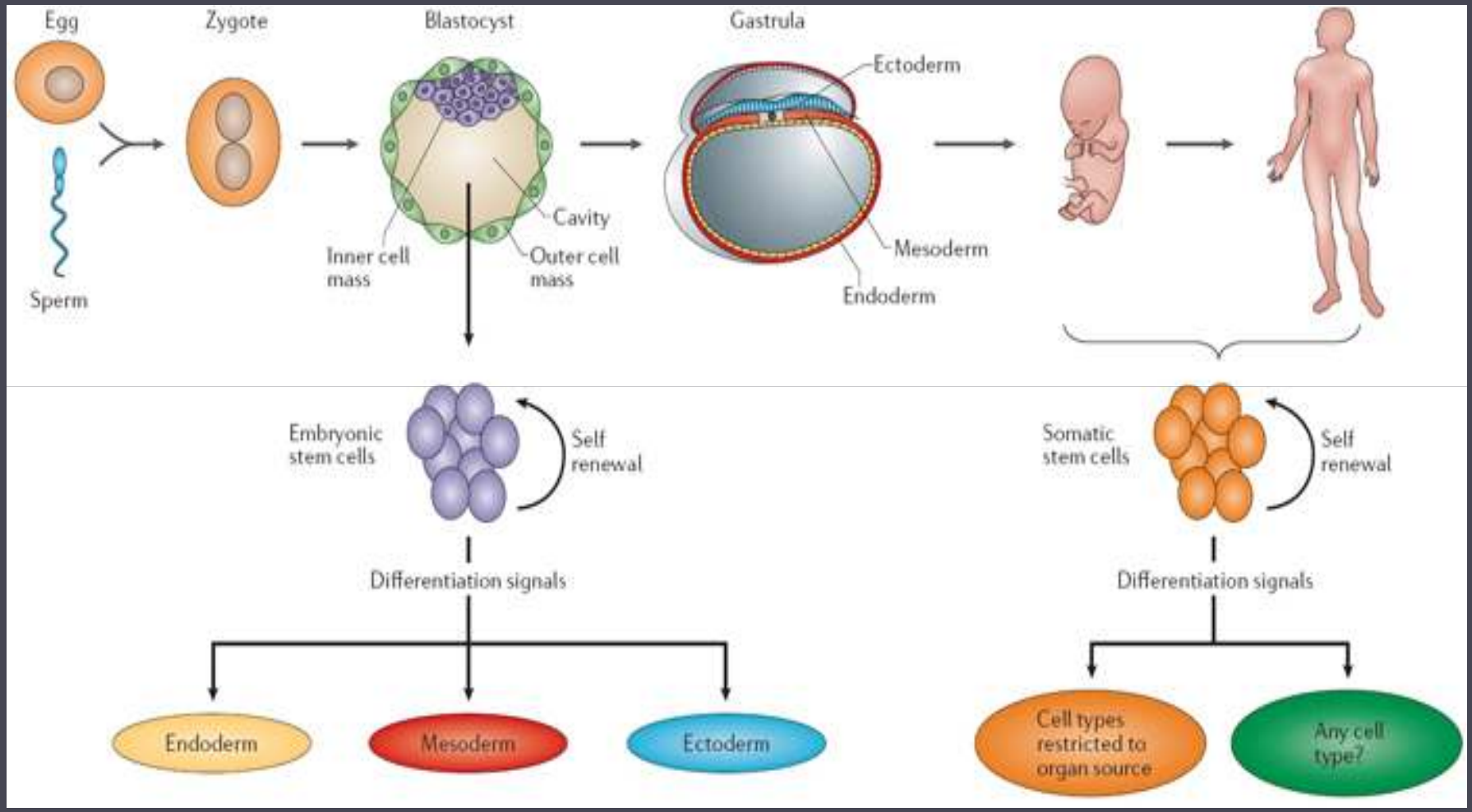
Introduction

- Stem cells are undifferentiated biological cells that can differentiate into specialized cells.
- In mammals, there are two broad types of stem cells: embryonic stem cells, which are isolated from the inner cell mass of blastocysts, and adult stem cells, which are found in various tissues.

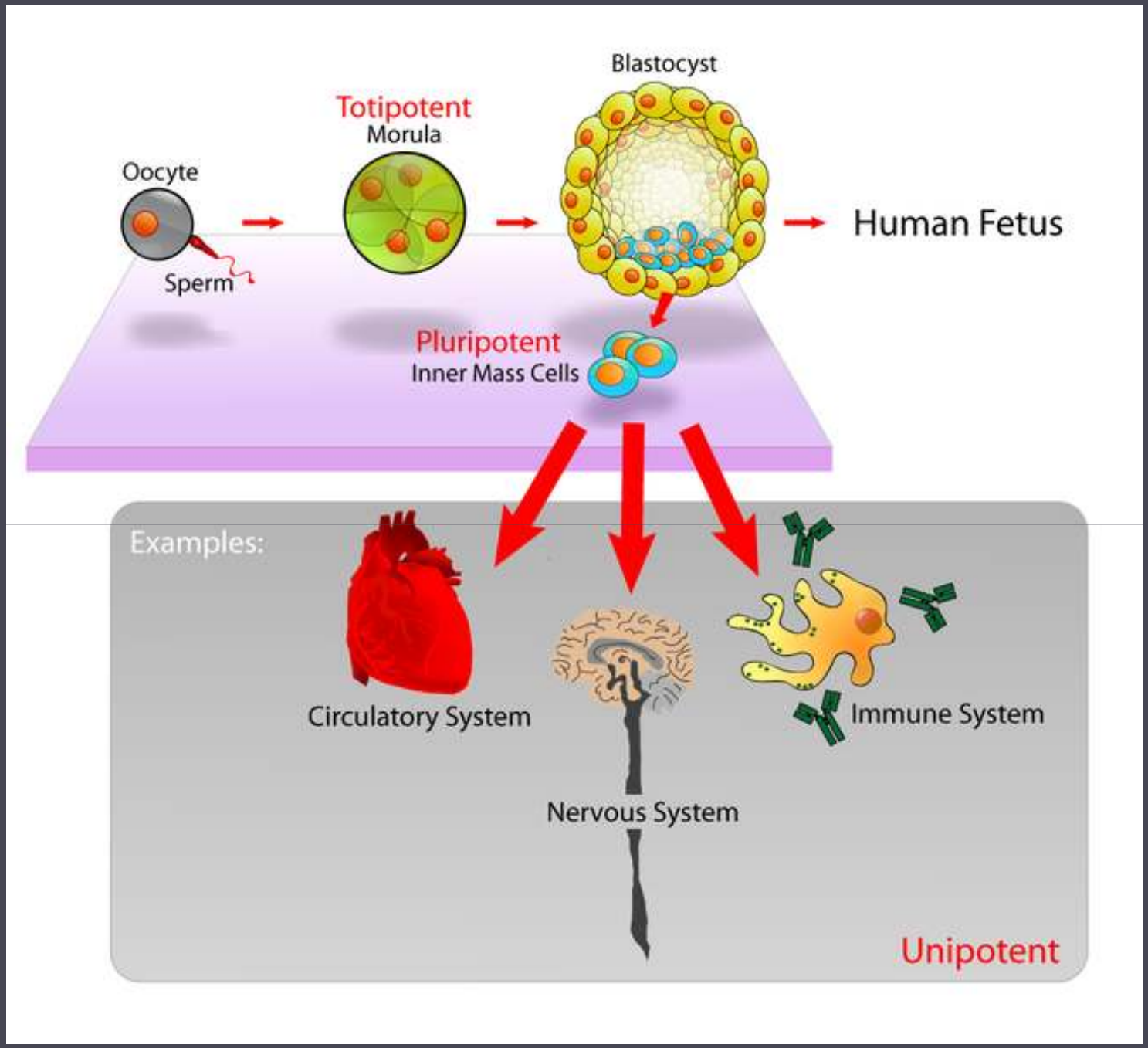

Egg
Zygote
Blastocyst
Gastrula
Sperm
Inner cell mass
Cavity
Outer cell mass
Ectoderm
Mesoderm
Endoderm
Embryonic stem cells
Self renewal
Differentiation signals
Endoderm
Mesoderm
Ectoderm
Somatic stem cells
Self renewal
Differentiation signals
Cell types restricted to organ source
Any cell type?

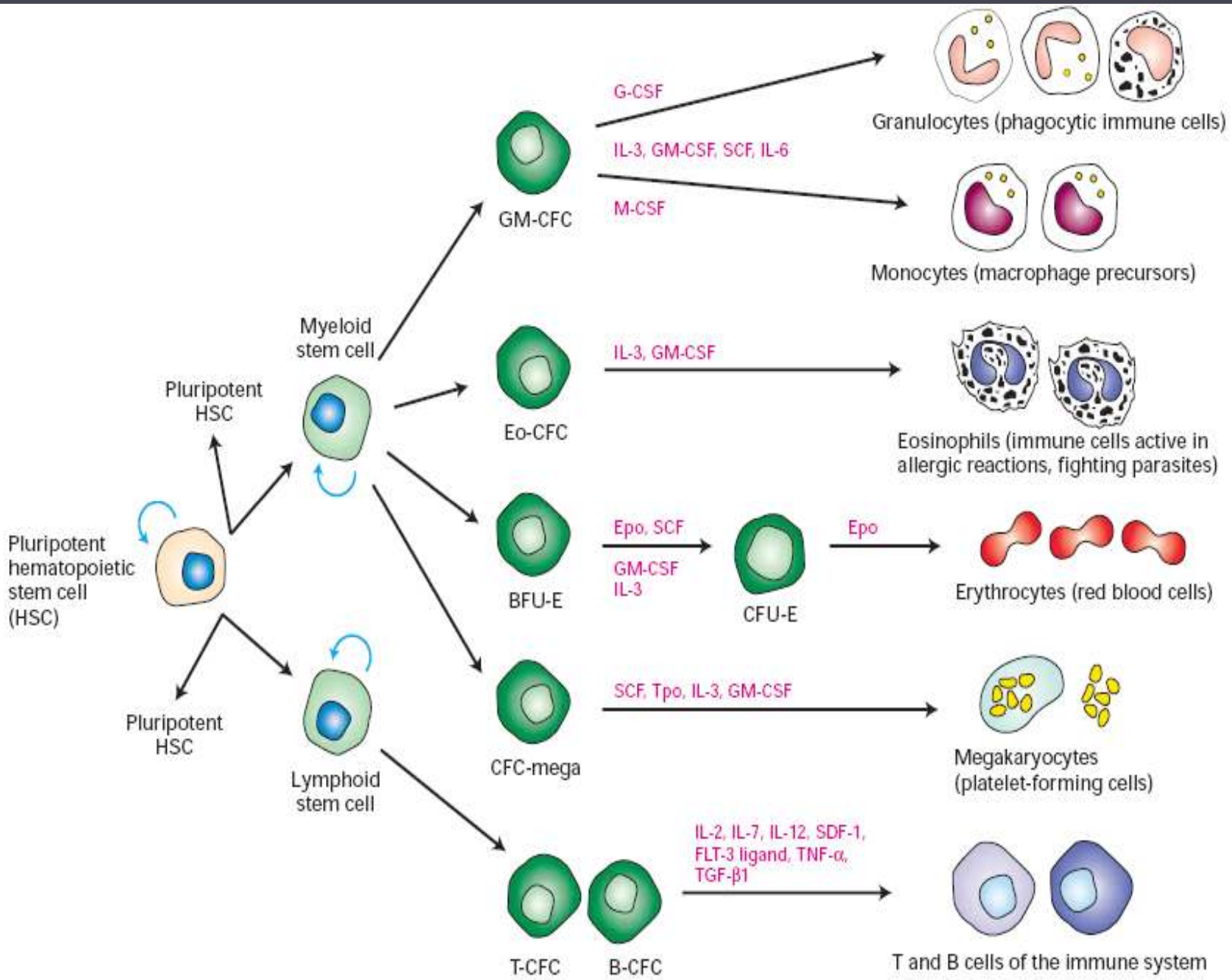
Properties

- Self-renewal:
  - the ability to go through numerous cycles of cell division.
- Potency:
  - the capacity to differentiate into specialized cell types.

Types of Stem cell based on differentiation potential

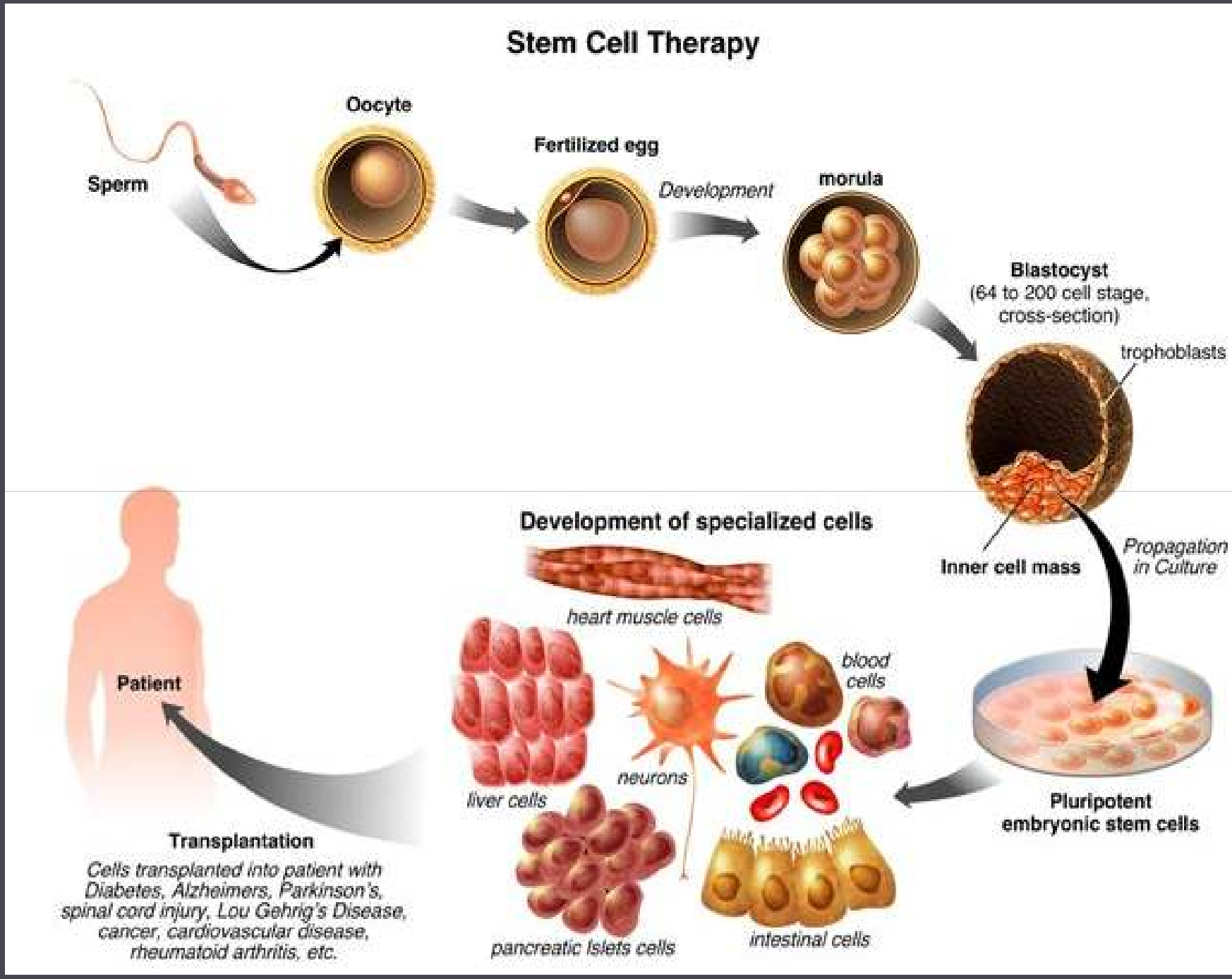
- **Totipotent** - Stem cells can differentiate into embryonic and extraembryonic cell types. Such cells can construct a complete, viable organism. These cells are produced from the fusion of an egg and sperm cell. Cells produced by the first few divisions of the fertilized egg are also totipotent.
- **Pluripotent** - stem cells are the descendants of totipotent cells and can differentiate into nearly all cells i.e. cells derived from any of the three germ layers.
- **Multipotent** - stem cells can differentiate into a number of cell types, but only those of a closely related family of cells.
- **Unipotent** - cells can produce only one cell type, their own, but have the property of self-renewal, which distinguishes them from non-stem cells (e.g. progenitor cells, muscle stem cells).

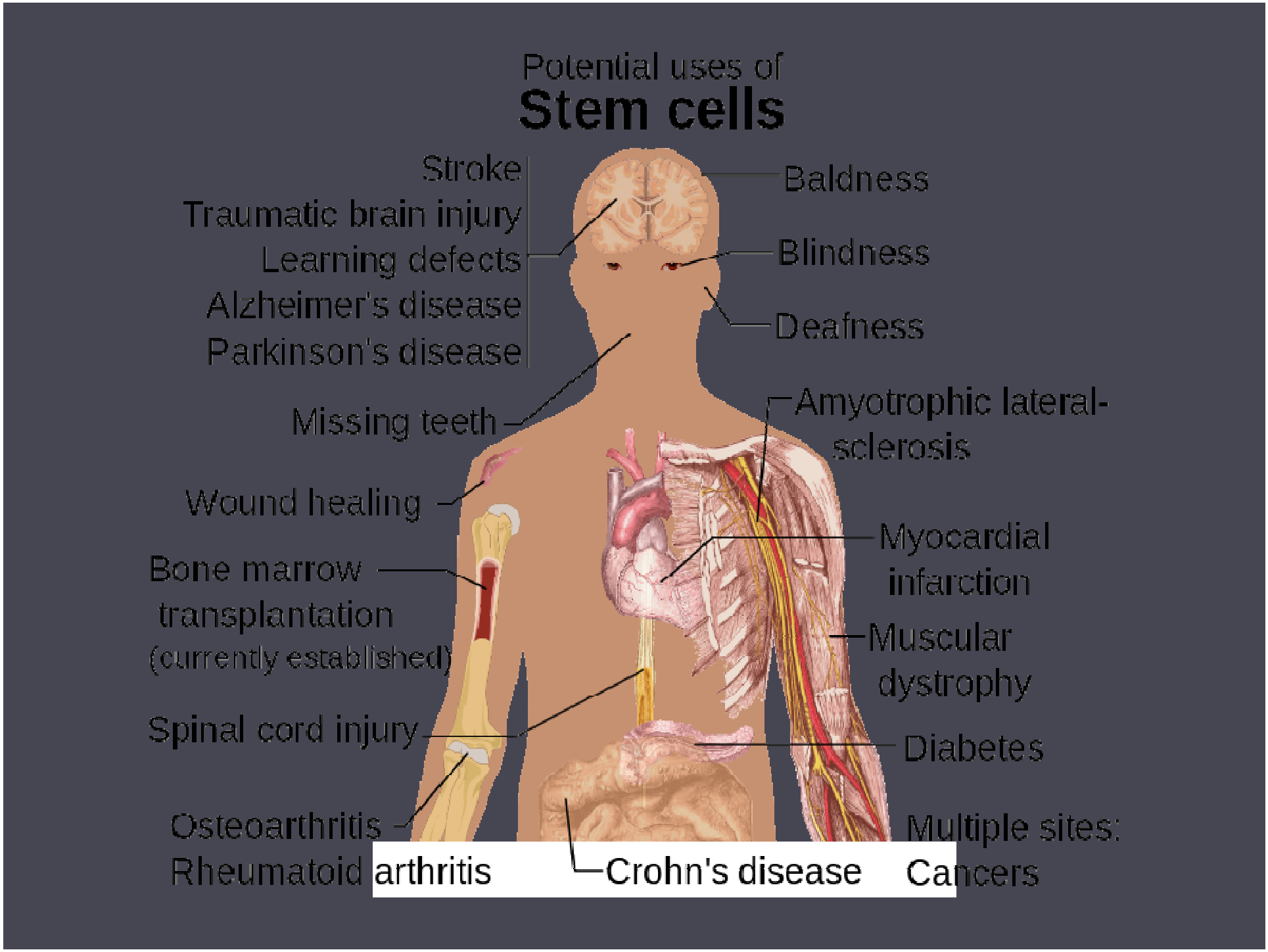

Blastocyst
Totipotent
Morula
Oocyte
Sperm
Human Fetus
Pluripotent
Inner Mass Cells
Examples:
Circulatory System
Nervous System
Immune System
Unipotent

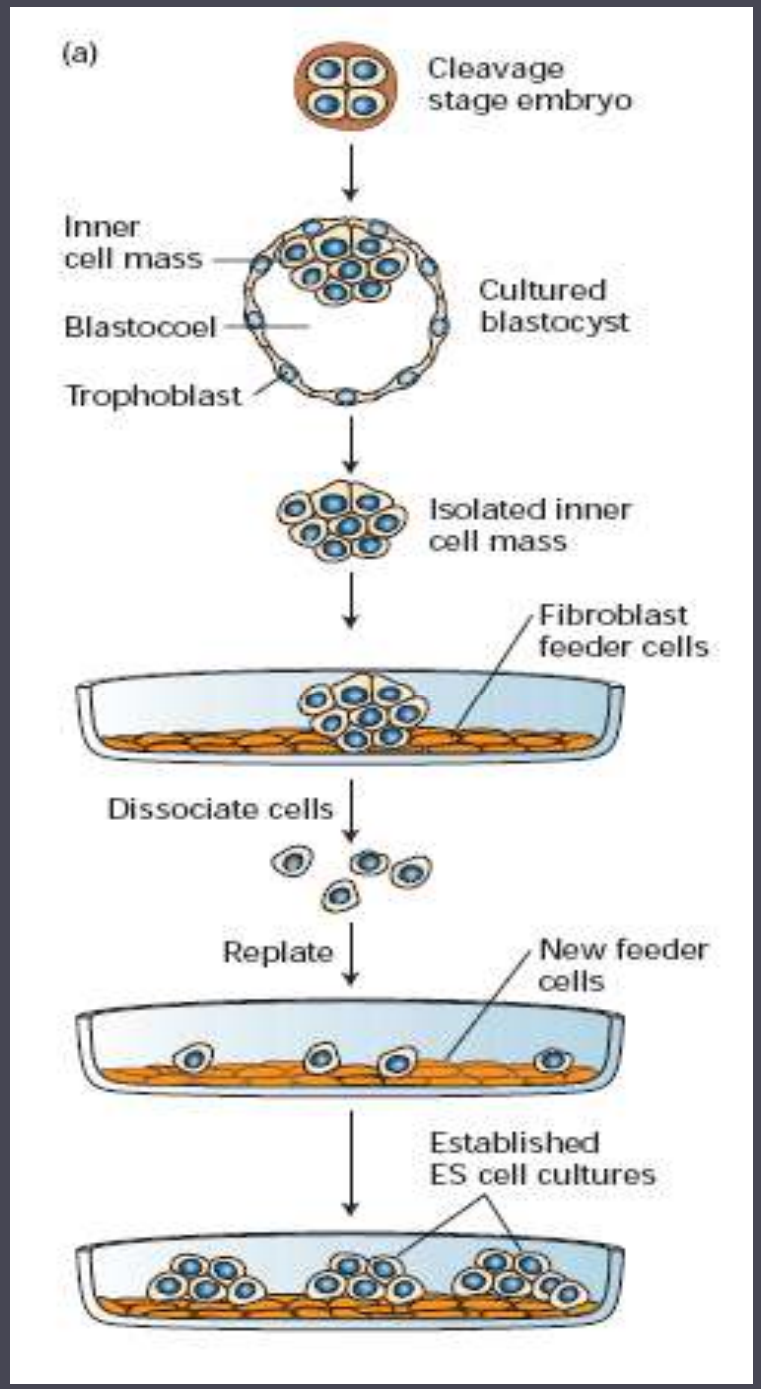

Pluripotent hematopoietic stem cell (HSC)
Pluripotent HSC
Pluripotent HSC
Myeloid stem cell
Lymphoid stem cell
GM-CFC
Eo-CFC
BFU-E
CFC-mega
T-CFC
B-CFC
G-CSF
IL-3, GM-CSF, SCF, IL-6
M-CSF
IL-3, GM-CSF
Epo, SCF
GM-CSF
IL-3
Epo
SCF, Tpo, IL-3, GM-CSF
IL-2, IL-7, IL-12, SDF-1, FLT-3 ligand, TNF-α, TGF-β1
CFU-E
Granulocytes (phagocytic immune cells)
Monocytes (macrophage precursors)
Eosinophils (immune cells active in allergic reactions, fighting parasites)
Erythrocytes (red blood cells)
Megakaryocytes (platelet-forming cells)
T and B cells of the immune system

Stem Cell Therapy

- Stem cell therapy is to introduce new adult stem cells into damaged tissue in order to treat disease or injury.
- The ability of stem cells to self-renew and give rise to subsequent generations with variable degrees of differentiation capacities, offers significant potential for generation of tissues that can potentially replace diseased and damaged areas in the body, with minimal risk of rejection and side effects.
- Medical researchers anticipate that adult and embryonic stem cells will soon be able to treat cancer, Type 1 diabetes mellitus, Parkinson's disease, Huntington's disease, Celiac disease, cardiac failure, muscle damage and neurological disorders, and many others.

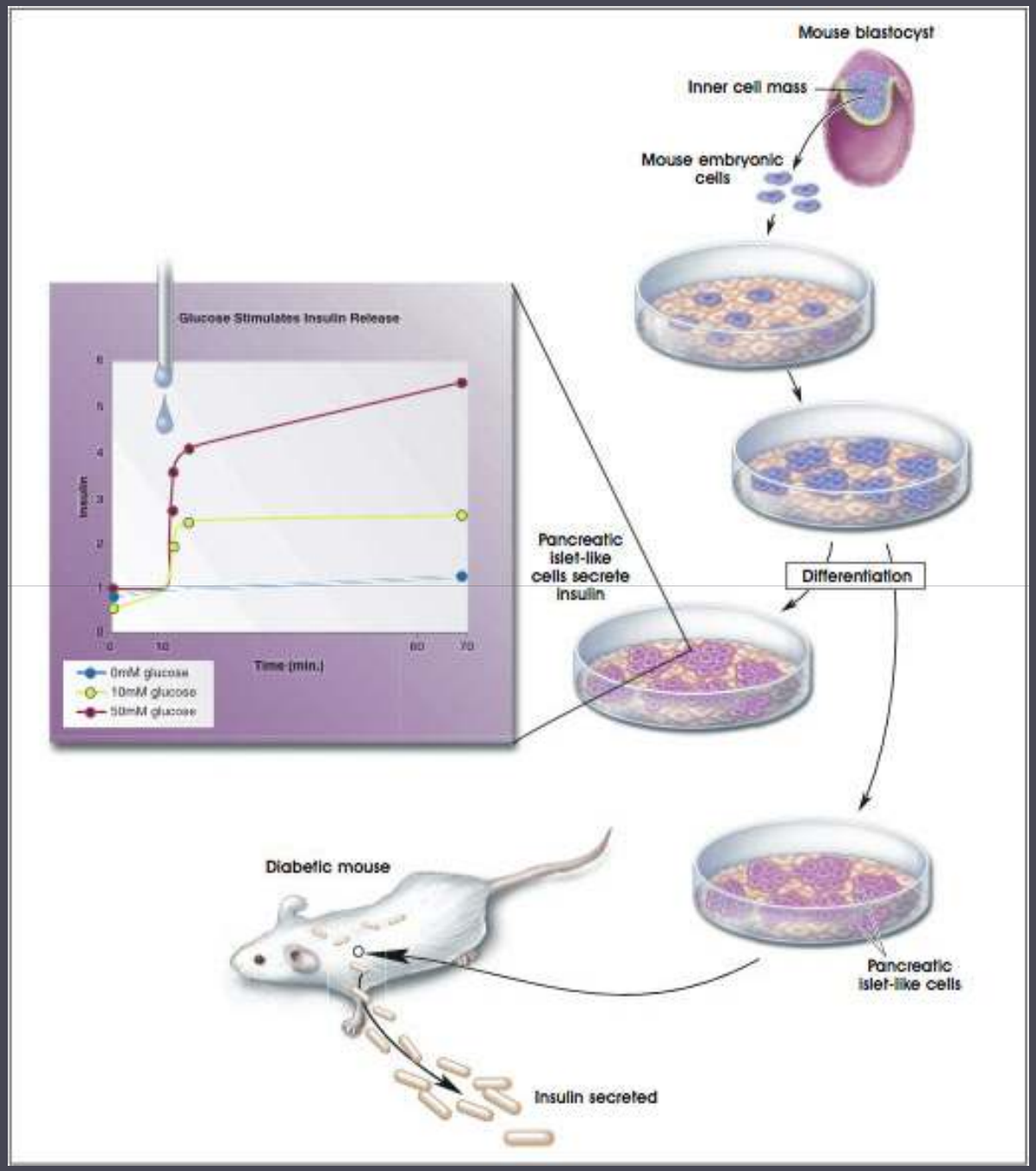

Stem Cell Therapy
Oocyte
Sperm
Fertilized egg
Development
morula
Blastocyst
(64 to 200 cell stage,
cross-section)
trophoblasts
Inner cell mass
Propagation
in Culture
Development of specialized cells
heart muscle cells
blood
cells
neurons
liver cells
Pluripotent
embryonic stem cells
Patient
Transplantation
Cells transplanted into patient with
Diabetes, Alzheimers, Parkinson's,
spinal cord injury, Lou Gehrig's Disease,
cancer, cardiovascular disease,
rheumatoid arthritis, etc.
pancreatic Islets cells
intestinal cells


Potential uses of
Stem cells
Stroke
Traumatic brain injury
Learning defects
Alzheimer's disease
Parkinson's disease
Baldness
Blindness
Deafness
Missing teeth
Amyotrophic lateral-sclerosis
Wound healing
Myocardial infarction
Bone marrow transplantation
(currently established)
Muscular dystrophy
Spinal cord injury
Diabetes
Osteoarthritis
Rheumatoid arthritis
Crohn's disease
Multiple sites: Cancers


(a)
Cleavage stage embryo
Inner cell mass
Blastocoel
Trophoblast
Cultured blastocyst
Isolated inner cell mass
Fibroblast feeder cells
Dissociate cells
Replate
New feeder cells
Established ES cell cultures

Diabetes

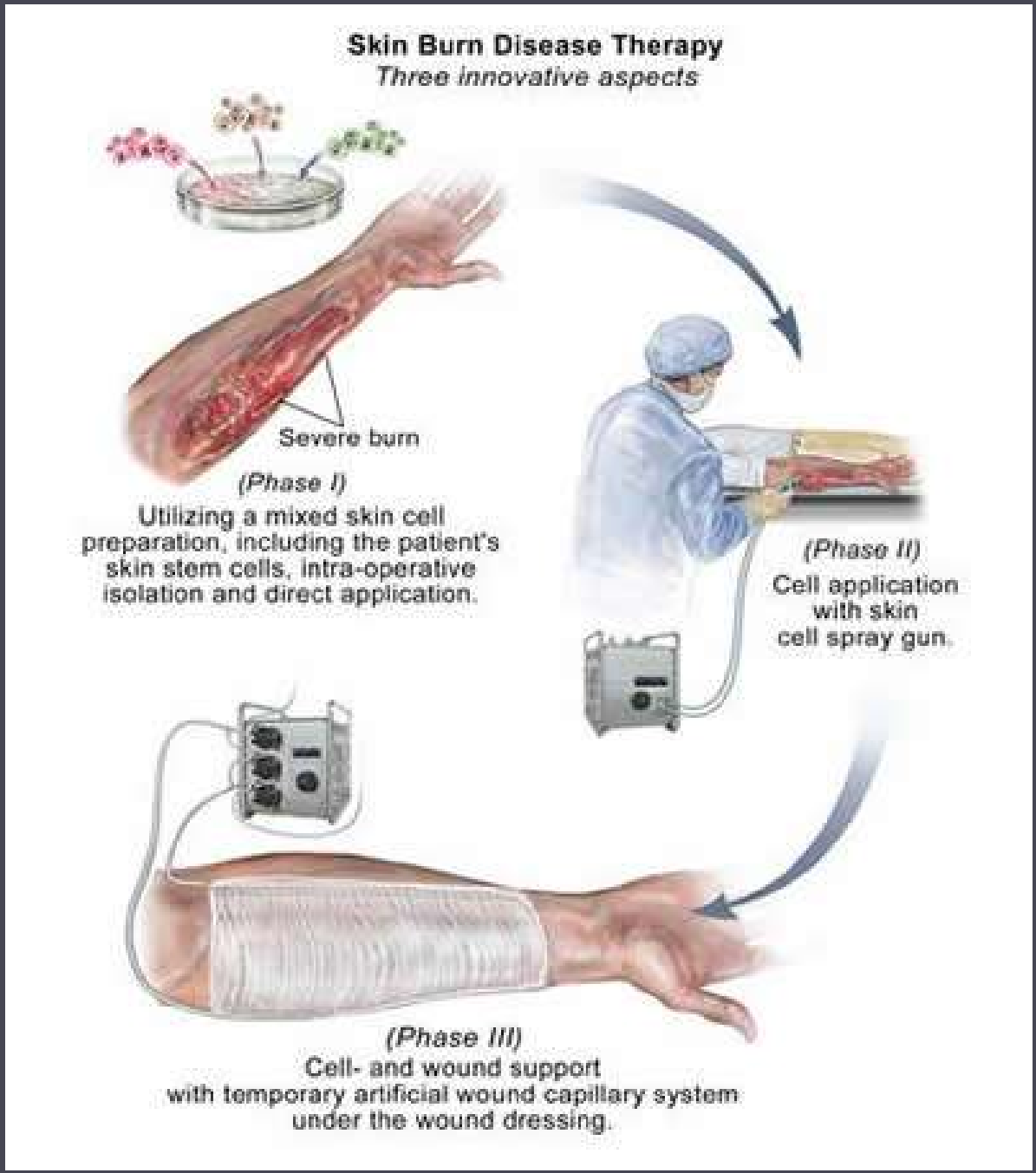
- Diabetes patients lose the function of insulin-producing beta cells within the pancreas.
- Human embryonic stem cells may be grown in cell culture and stimulated to form insulin-producing cells that can be transplanted into the patient.

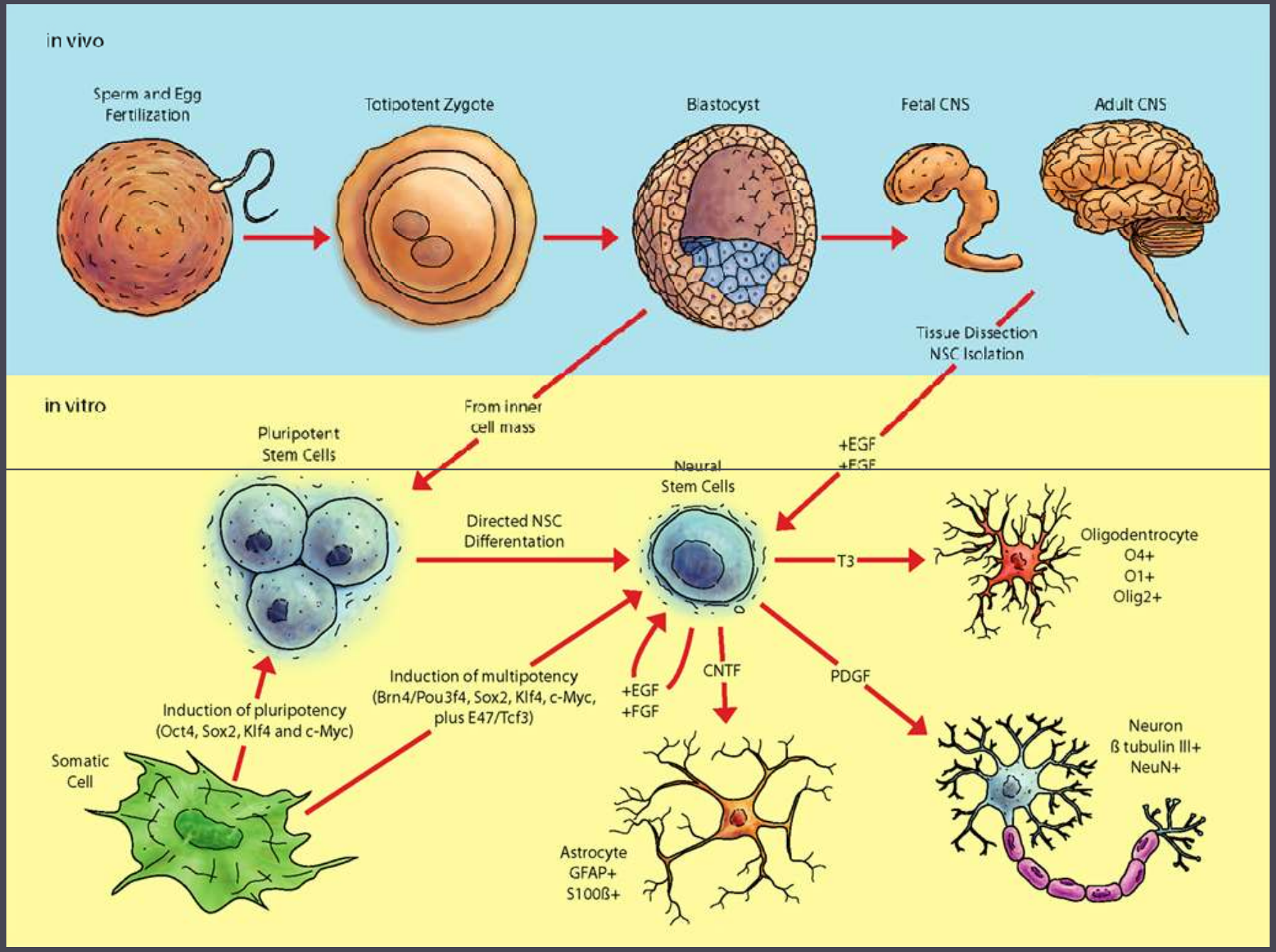


University of Missouri scientist Habib Zaghouani, PhD, is developing a potential cure for type 1 diabetes by combining adult stem cells with a promising new drug he developed at MU.

Stem cell in Skin Grafting

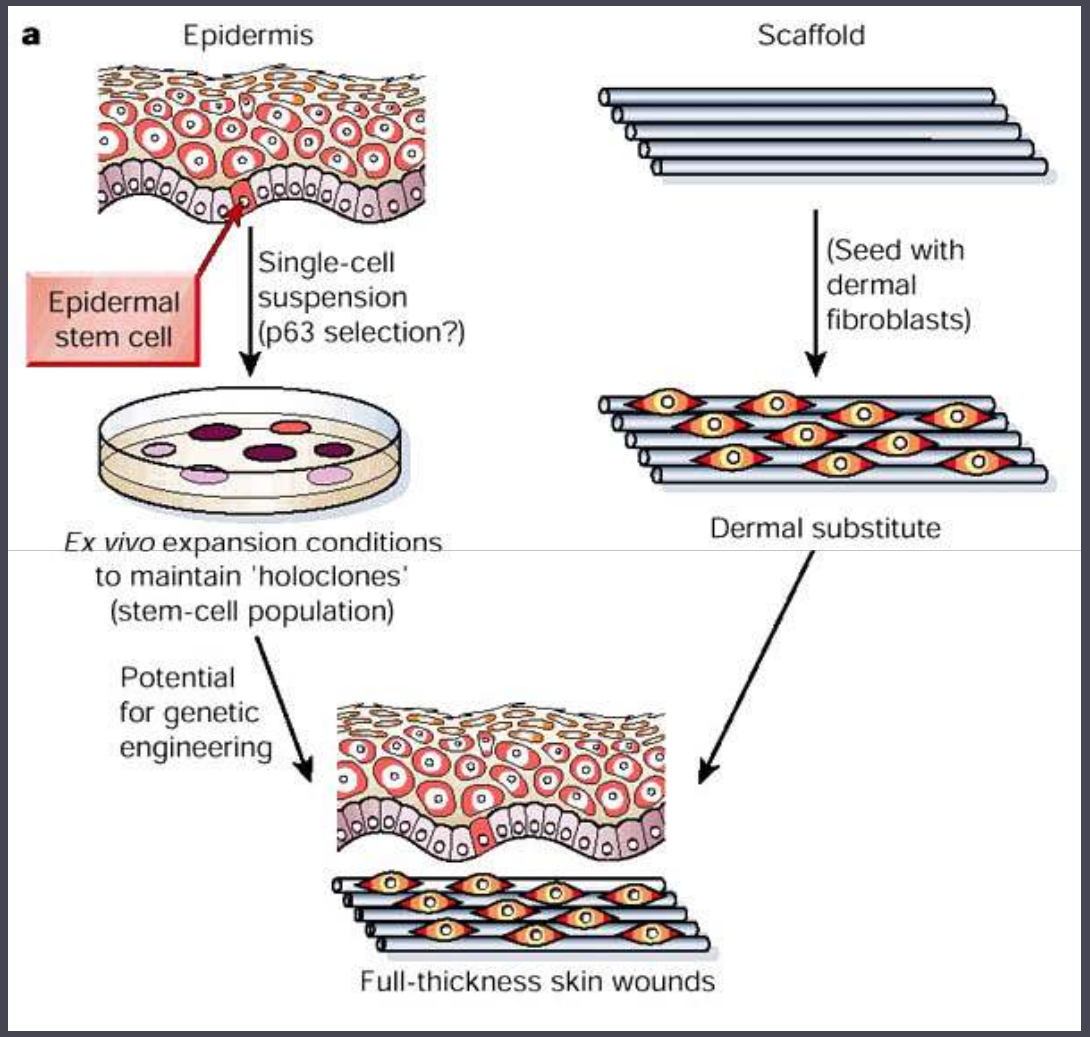
keratinocytes can be derived from hESCs... Growing human epidermis from hESCs could have clinical relevance as an unlimited resource for temporary skin replacement in patients




in vivo
Sperm and Egg Fertilization
Totipotent Zygote
Blastocyst
Fetal CNS
Adult CNS
Tissue Dissection
NSC Isolation
in vitro
From inner cell mass
Pluripotent Stem Cells
+EGF
+FGF
Neural Stem Cells
Directed NSC Differentation
T3
Oligodentrocyte
O4+
O1+
Olig2+
Induction of multipotency
(Brn4/Pou3f4, Sox2, Klf4, c-Myc, plus E47/Tcf3)
+EGF
+FGF
CNTF
PDGF
Induction of pluripotency
(Oct4, Sox2, Klf4 and c-Myc)
Somatic Cell
Astrocyte
GFAP+
S100ß+
Neuron
ß tubulin III+
NeuN+

Stem cell in Wound healing

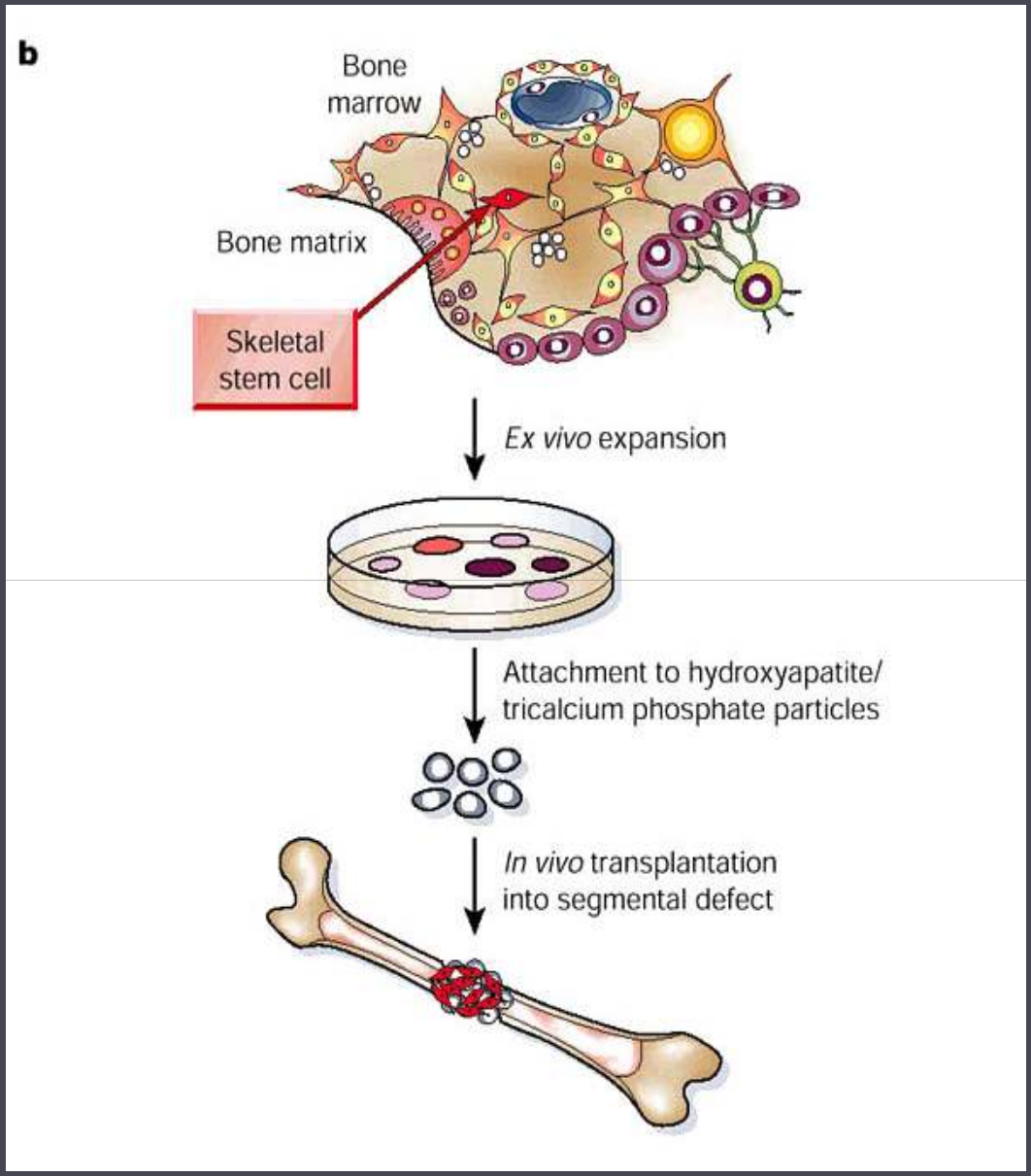
Skin autografts are produced by culturing keratinocytes (which may be sorted for p63, the recently described, epidermal stem cell marker) under appropriate conditions not only to generate an epidermal sheet, but also to maintain the stem cell population (holoclones).
The epidermal sheet is then placed on top of a dermal substitute comprising devitalized dermis or bioengineered dermal substitutes seeded with dermal fibroblasts. Such two-dimensional composites, generated *ex vivo*, completely regenerate full-thickness wounds.



Stem cell in Skeletal repair

Bone regeneration requires ex *vivo* expansion of marrow-derived skeletal stem cells and their attachment to three-dimensional scaffolds, such as particles of a hydroxyapatite/tricalcium phosphate ceramic.

This composite can be transplanted into segmental defects and will subsequently regenerate an appropriate three-dimensional structure *in vivo*.



Thankyou