Introduction to Stem Cells

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Stem Cell History

1998 - Researchers first extract stem cells from human embryos

1999 - First Successful human transplant of insulin-making cells from cadavers

2001 - President Bush restricts federal funding for embryonic stem-cell research

2002 - Juvenile Diabetes Research Foundation International creates $20 million fund-raising effort to support stem-cell research

2002 - California ok stem cell research

2004 - Harvard researchers grow stem cells from embryos using private funding

2004 - Ballot measure for $3 Billion bond for stem cells

Stem Cells

- A cell that has the ability to continuously divide and differentiate (develop) into various other kind(s) of cells/tissues.
- ‘Blank cells’ (unspecialized)
- Capable of dividing and renewing themselves for long periods of time (proliferation and renewal)
- Have the potential to give rise to specialized cell types (differentiation)

Stem cells are the foundation for every organ, tissue, and cell in the human body.

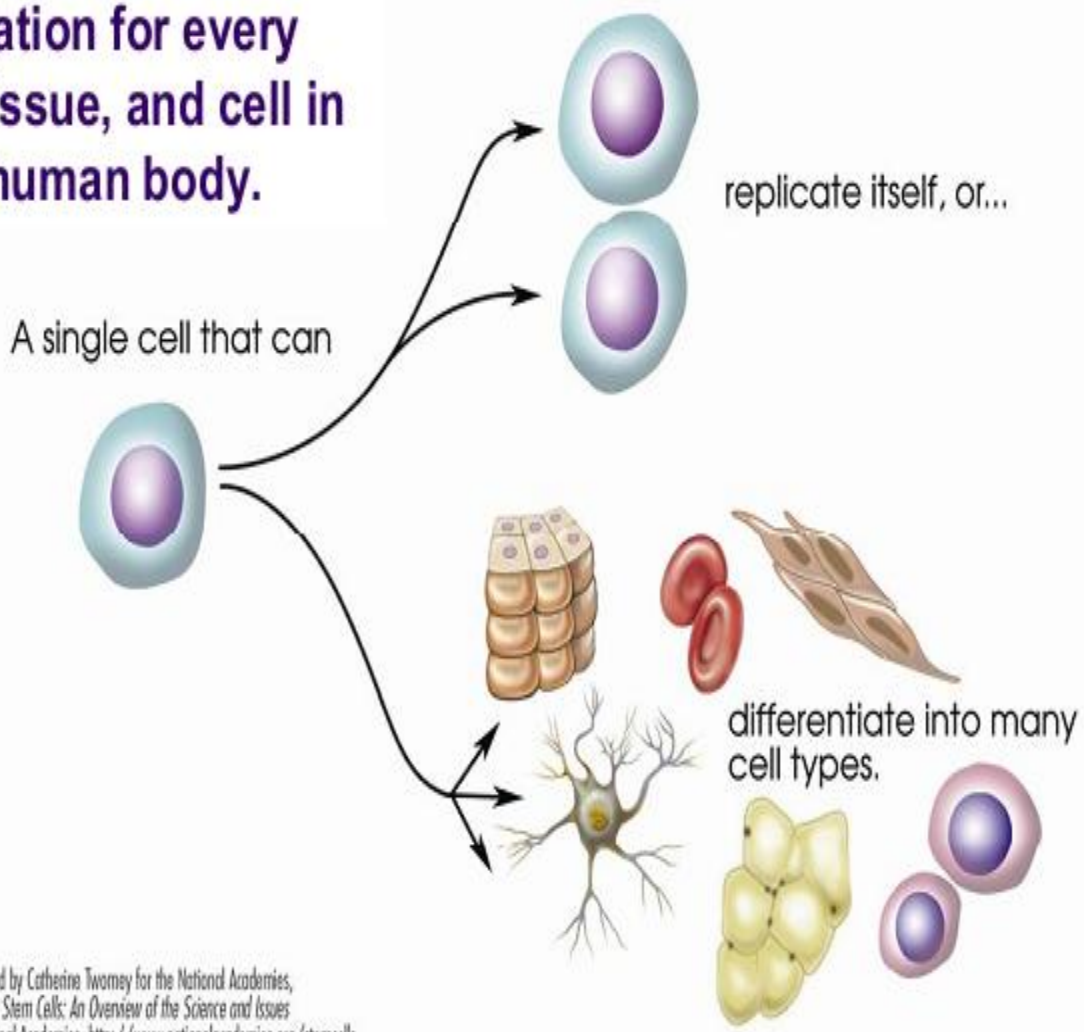
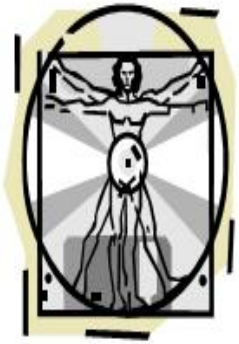


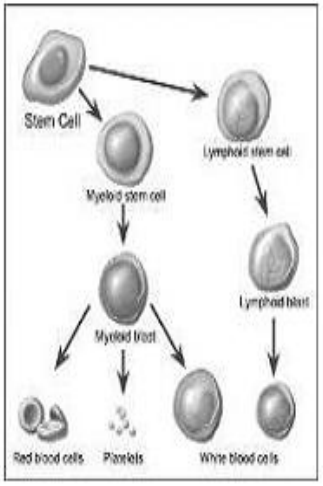
Image prepared by Catherine Twomey for the National Academies, *Understanding Stem Cells: An Overview of the Science and Issues* from the National Academies, http://www.nationalacademies.org/stemcells. Academic noncommercial use is permitted.

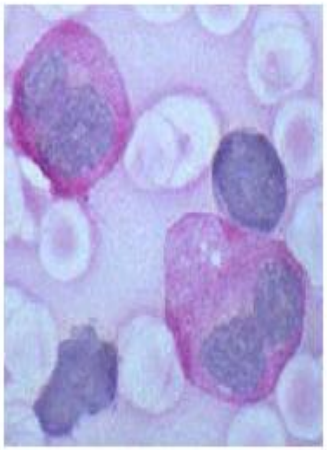
Types of Stem Cells

Sources of cells



Types of stem cells



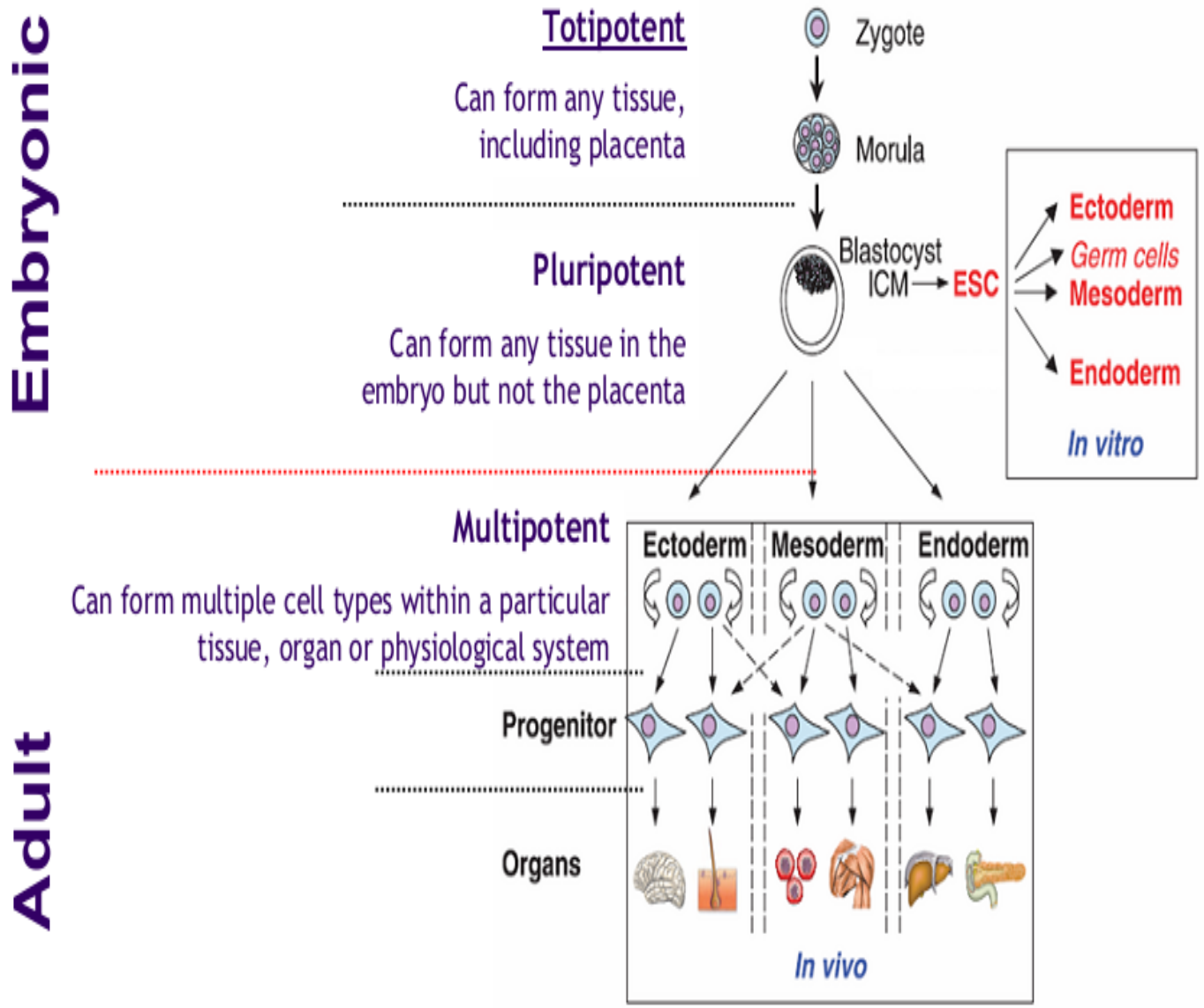


Embryonic
- self-renew
- differentiate into all tissue types

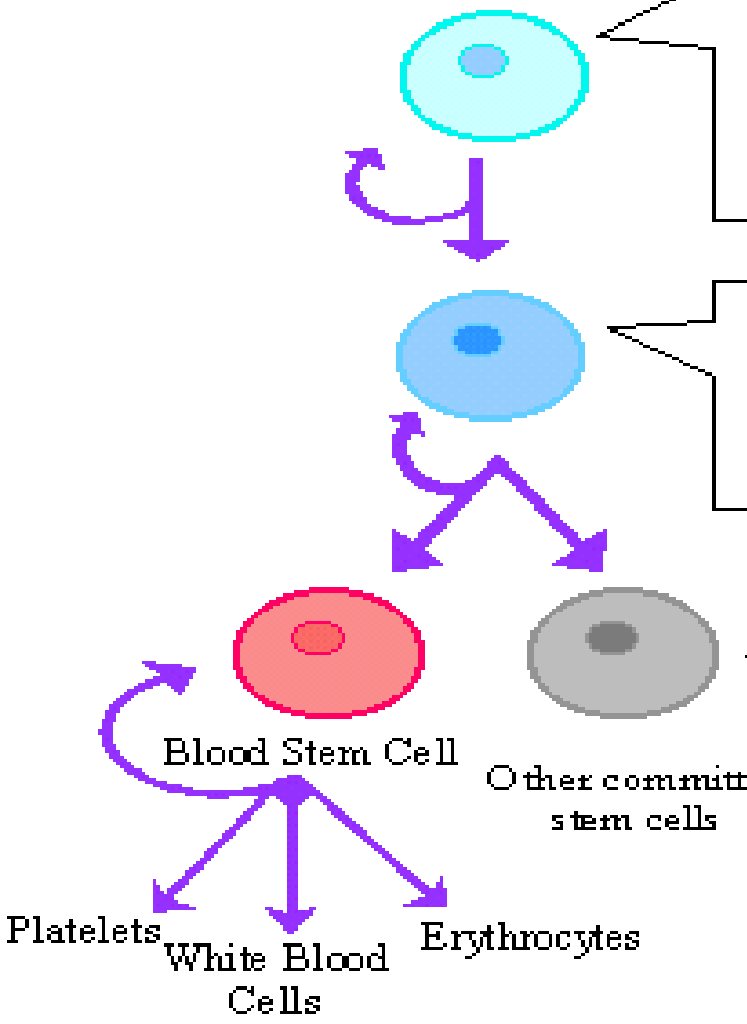
Adult
- found in tissue
- self- renew
- differentiate into cells of the same lineage

Progenitor
- derived from stem cells
- can not self-renew
- only differentiate into cells of the same lineage

Stem cell Nature	Description	Examples
Totipotent	Each cell can develop into a new individual	Cells from early (1-3 days) embryos
Pluripotent	Cells can form any (over 200) cell types	Some cells of blastocyst (5 to 14 days)
Multipotent	Cells differentiated, but can form a number of other tissues	Fetal tissue, cord blood, and adult stem cells


Embryonic
Totipotent
Can form any tissue, including placenta
Zygote
Morula
Blastocyst
ICM
ESC
Pluripotent
Can form any tissue in the embryo but not the placenta
Ectoderm
Germ cells
Mesoderm
Endoderm
In vitro
Multipotent
Can form multiple cell types within a particular tissue, organ or physiological system
Ectoderm
Mesoderm
Endoderm
Progenitor
Organs
In vivo
Adult

Stem Cell Differentiation

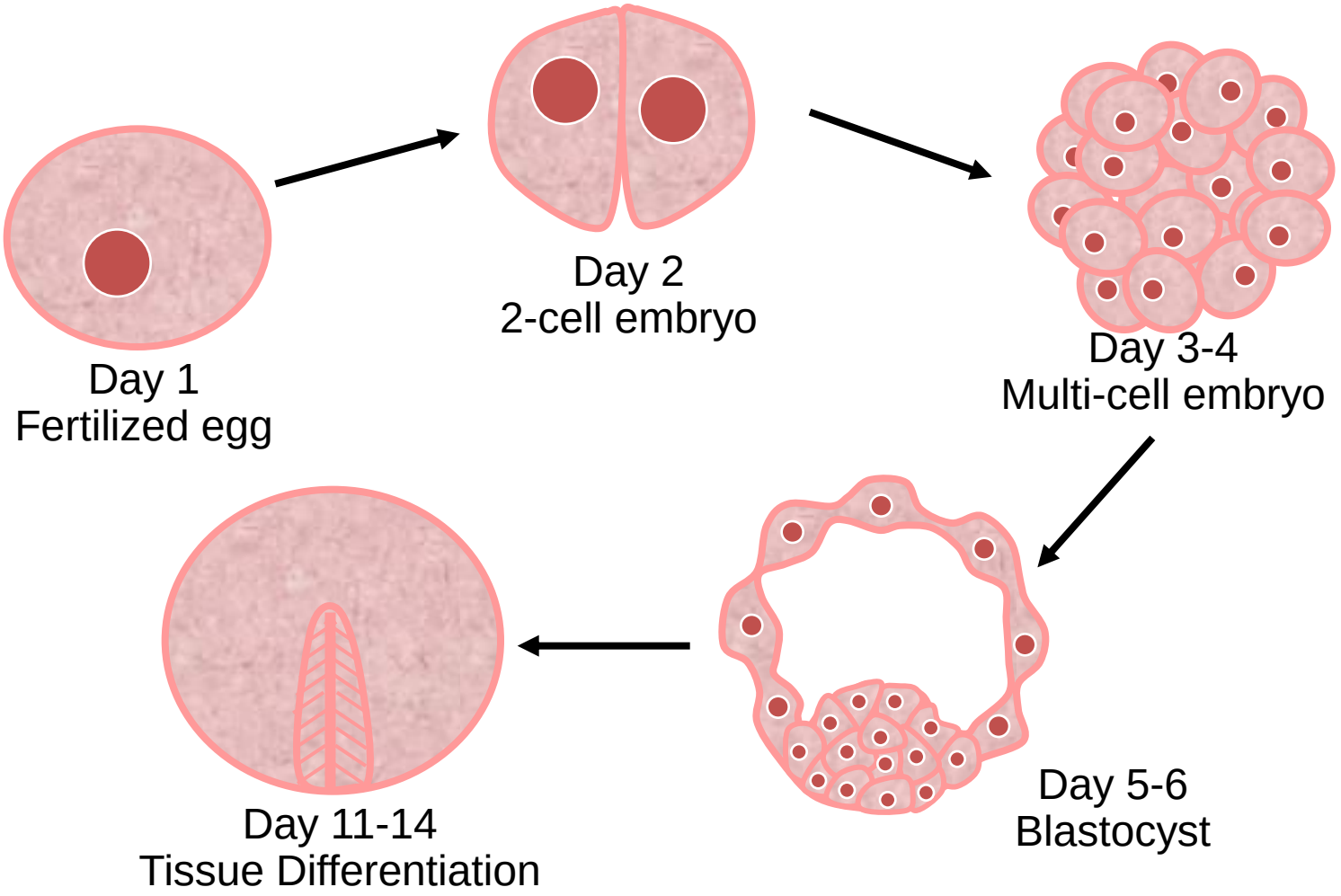


Totipotent Stem Cell
These cells have unlimited capability, and have the ability to form extraembryonic membranes and tissues, the embryo itself, and all postembryonic tissues and organs. An example is an embryo

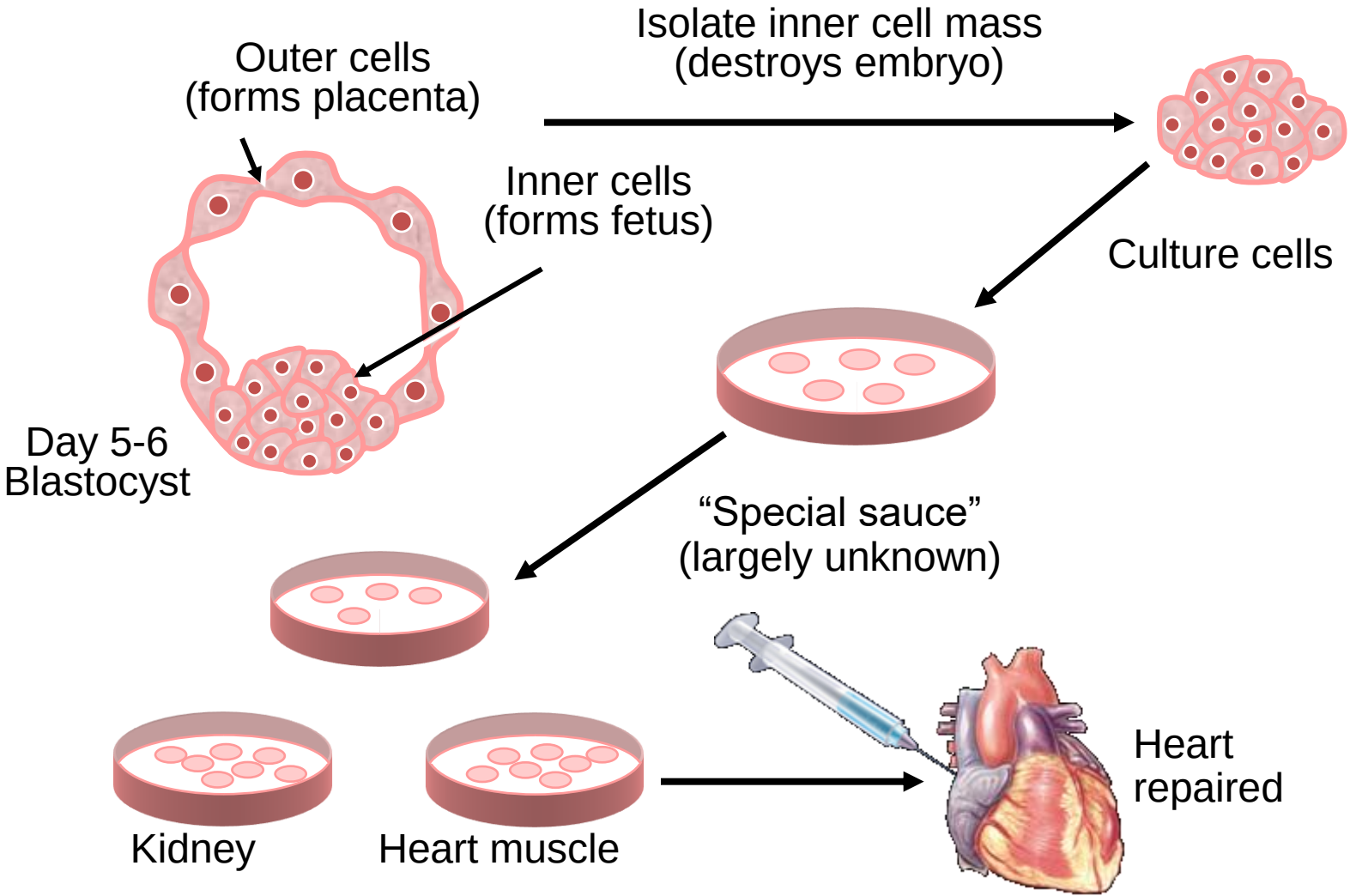
Pluripotent Stem Cell
These cells are capable of giving rise to most, but not all, tissues of an organism. An example is inner mass cells

Multipotent Stem Cell
These cells are committed to give rise to cells that have a specific function. An example is blood stem cells

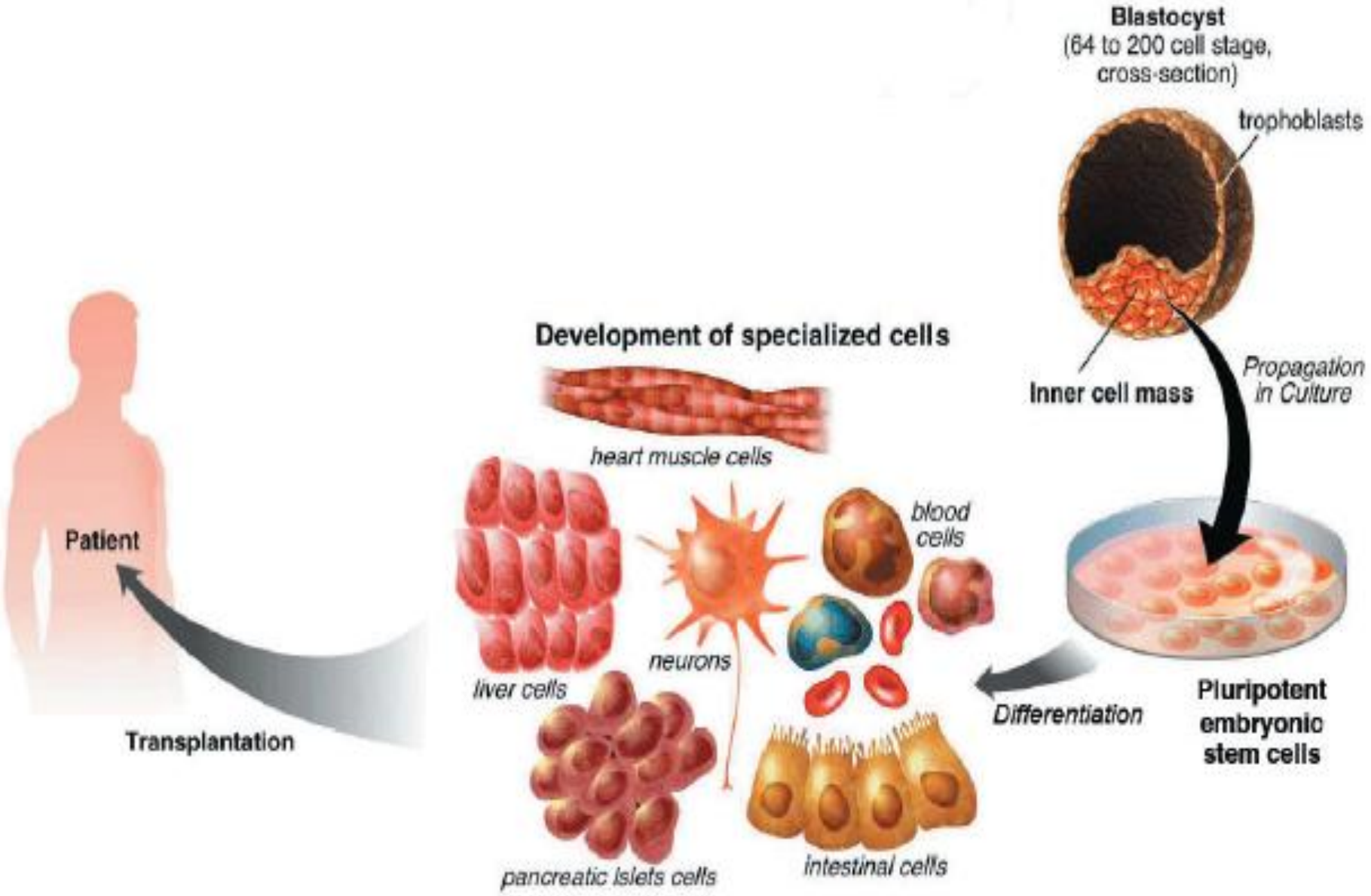
Stages of Embryogenesis



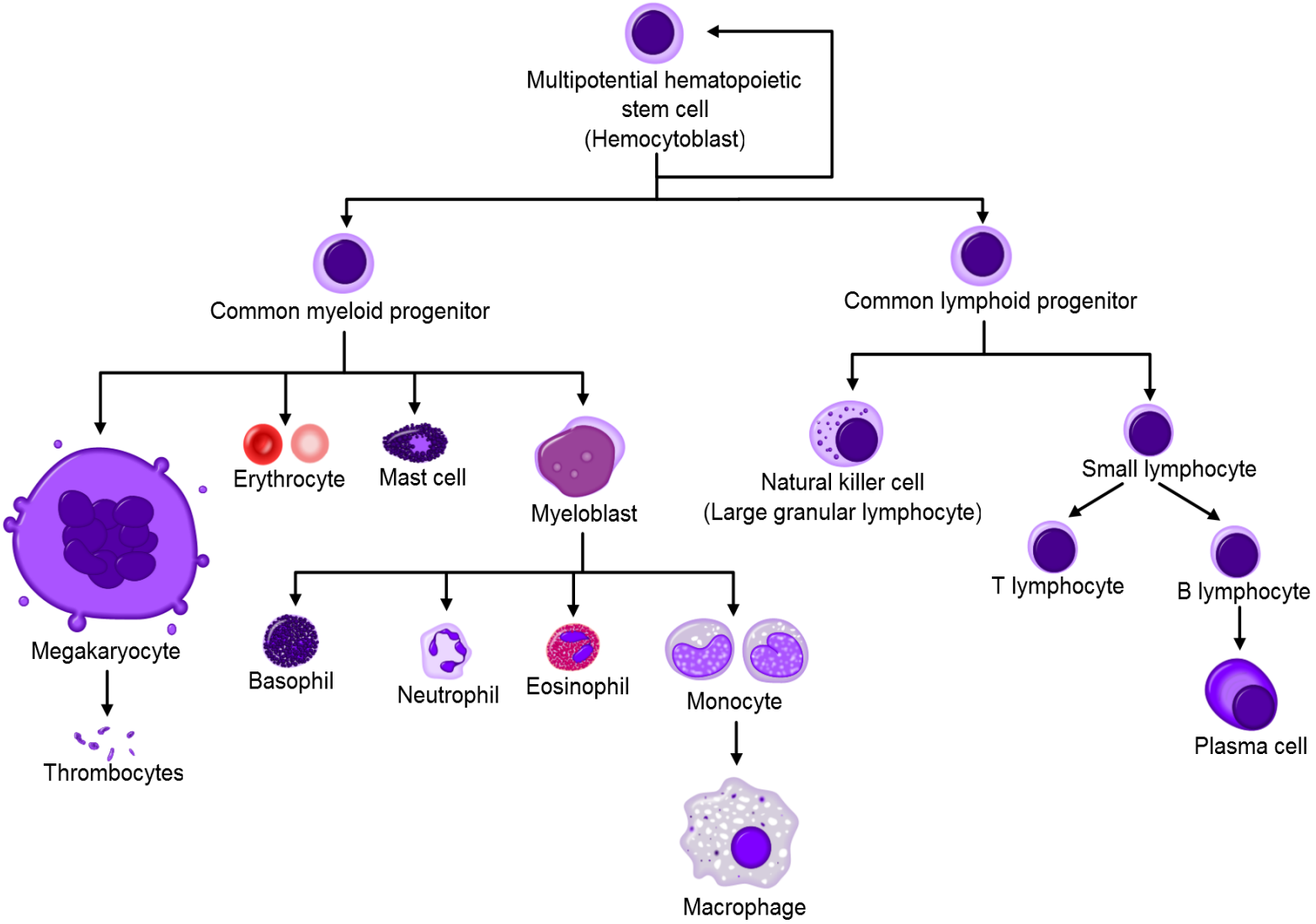
Derivation and Use of Embryonic Stem Cell Lines



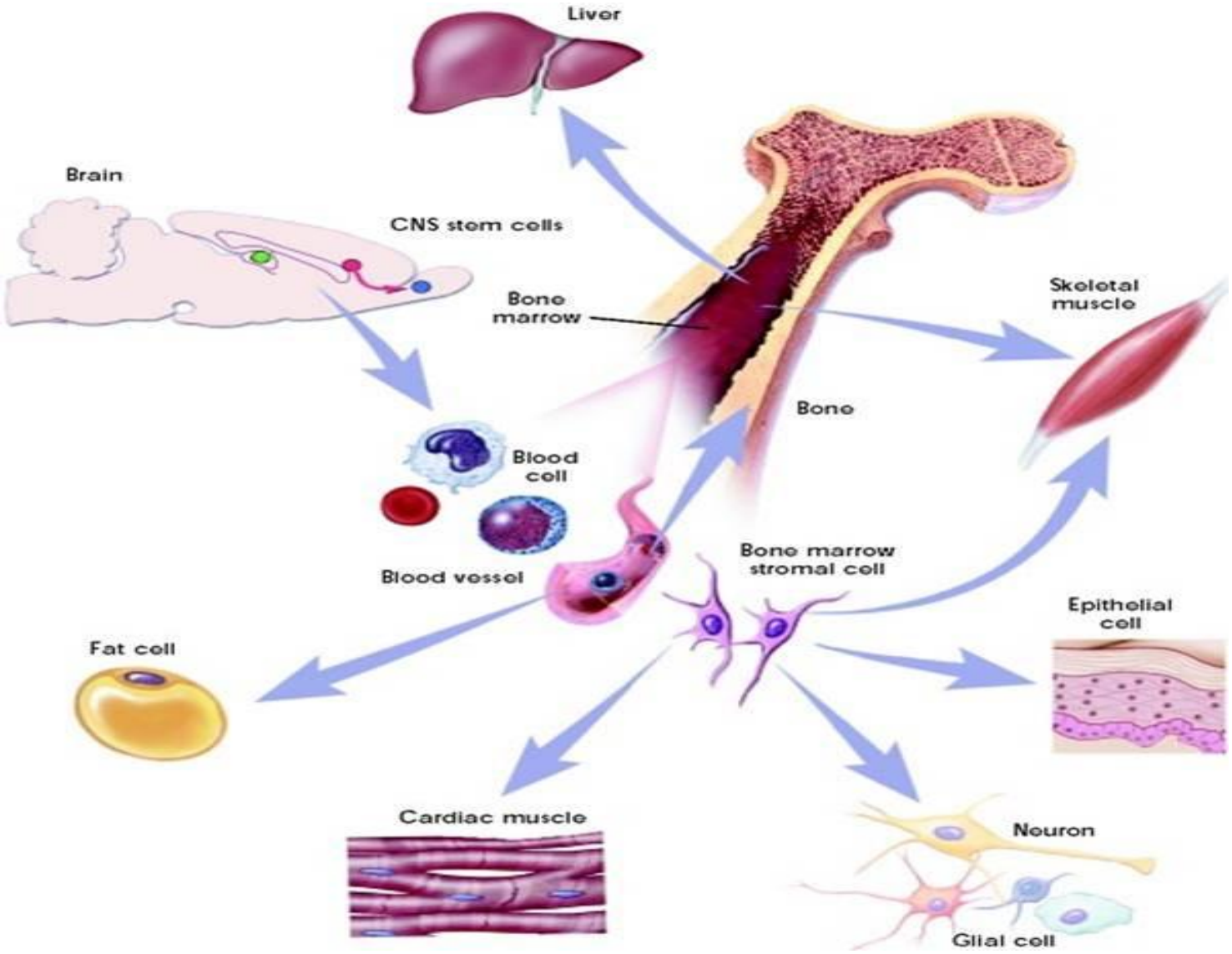
Embryonic Stem cells Potency



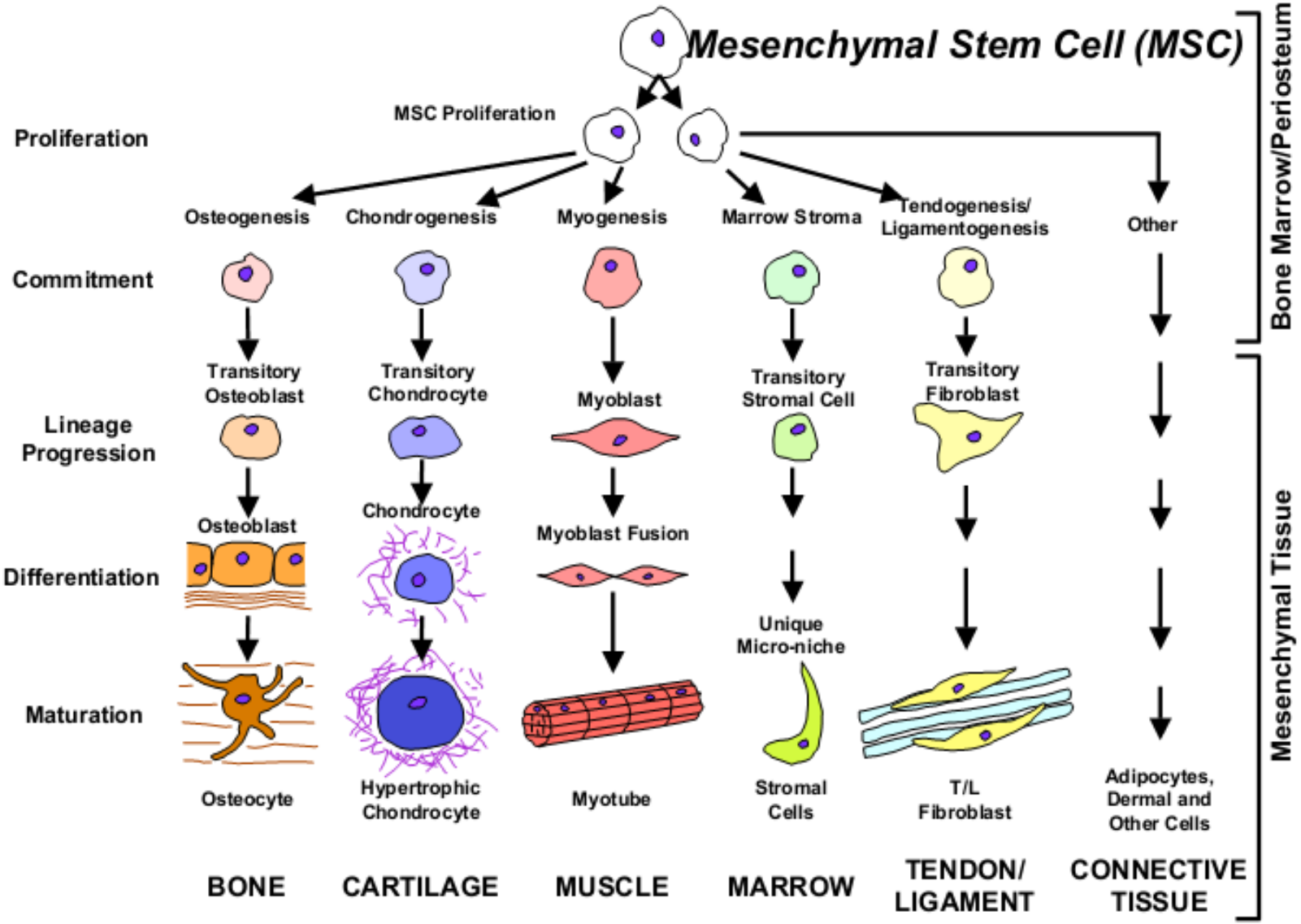
Hematopoietic Stem Cell Differentiation



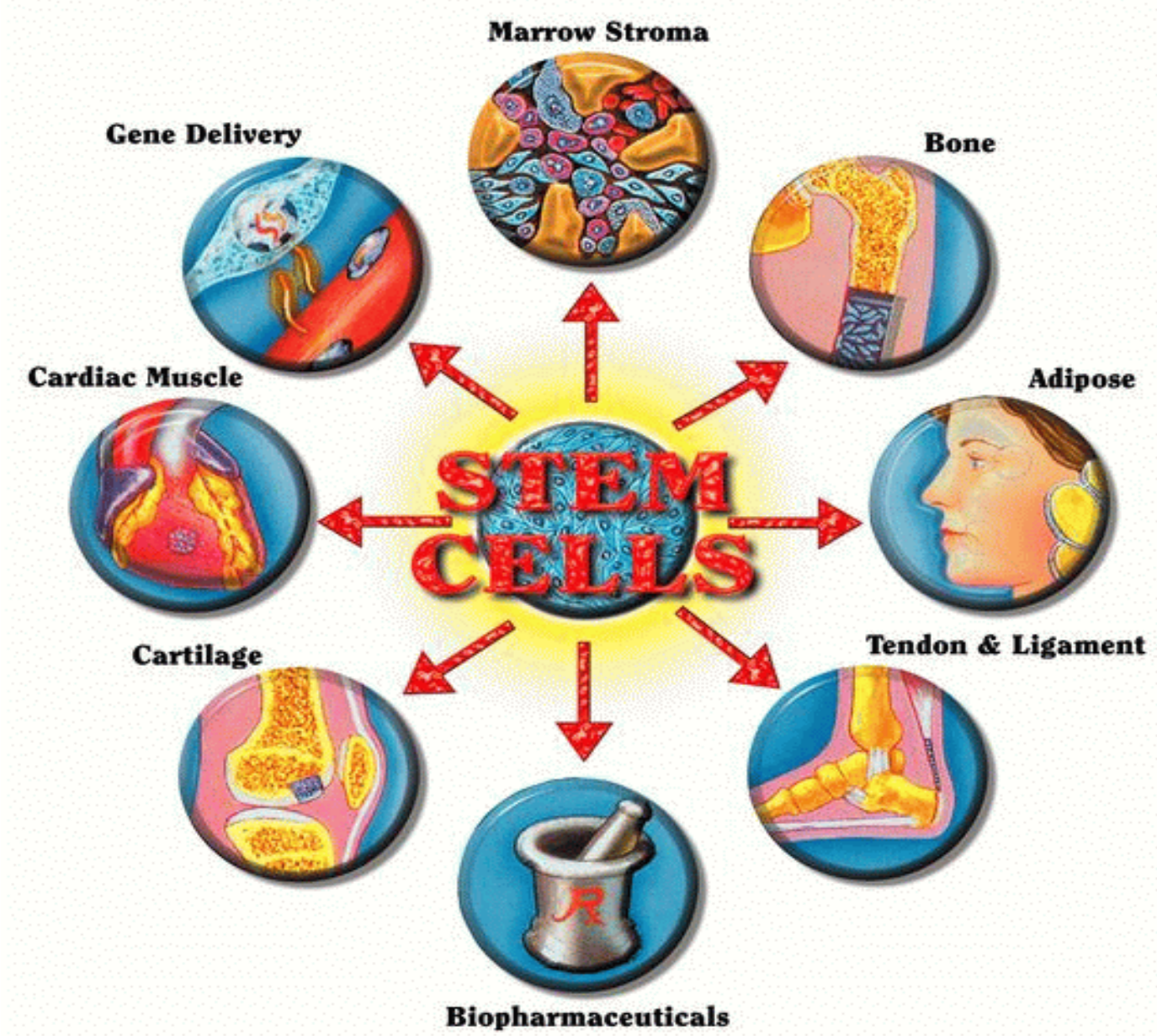
Adult Stem Cells Potency



THE MESENGENIC PROCESS

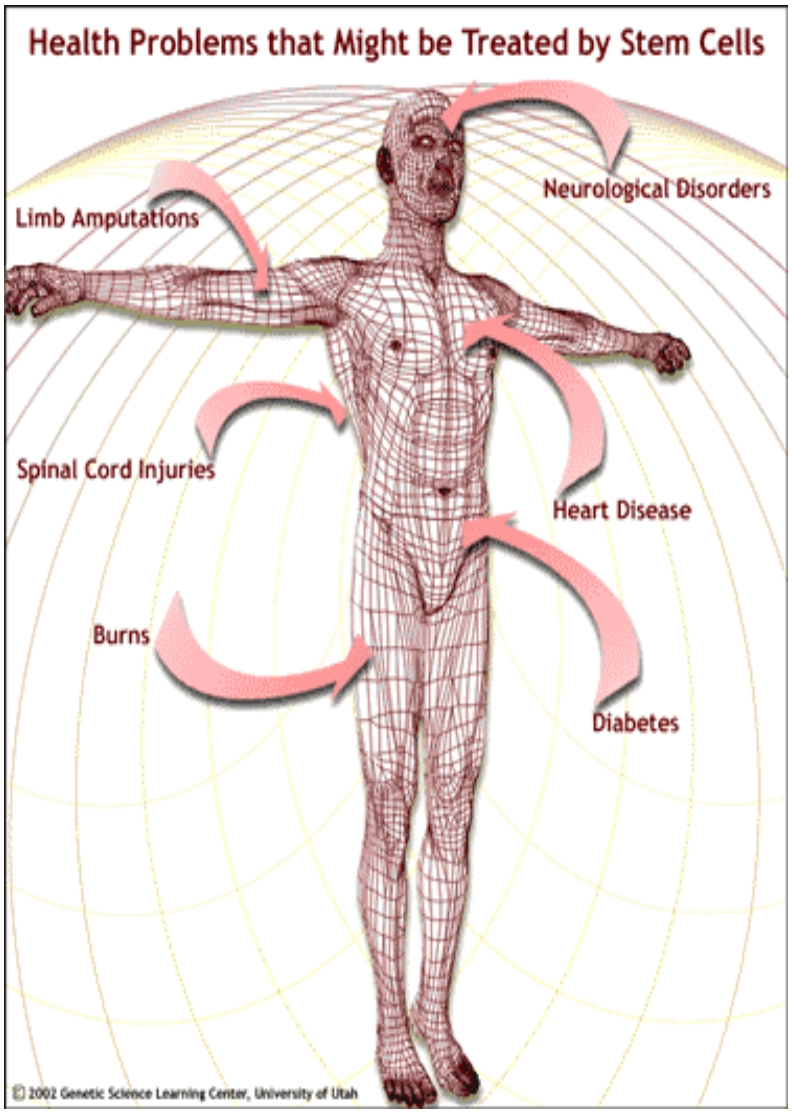
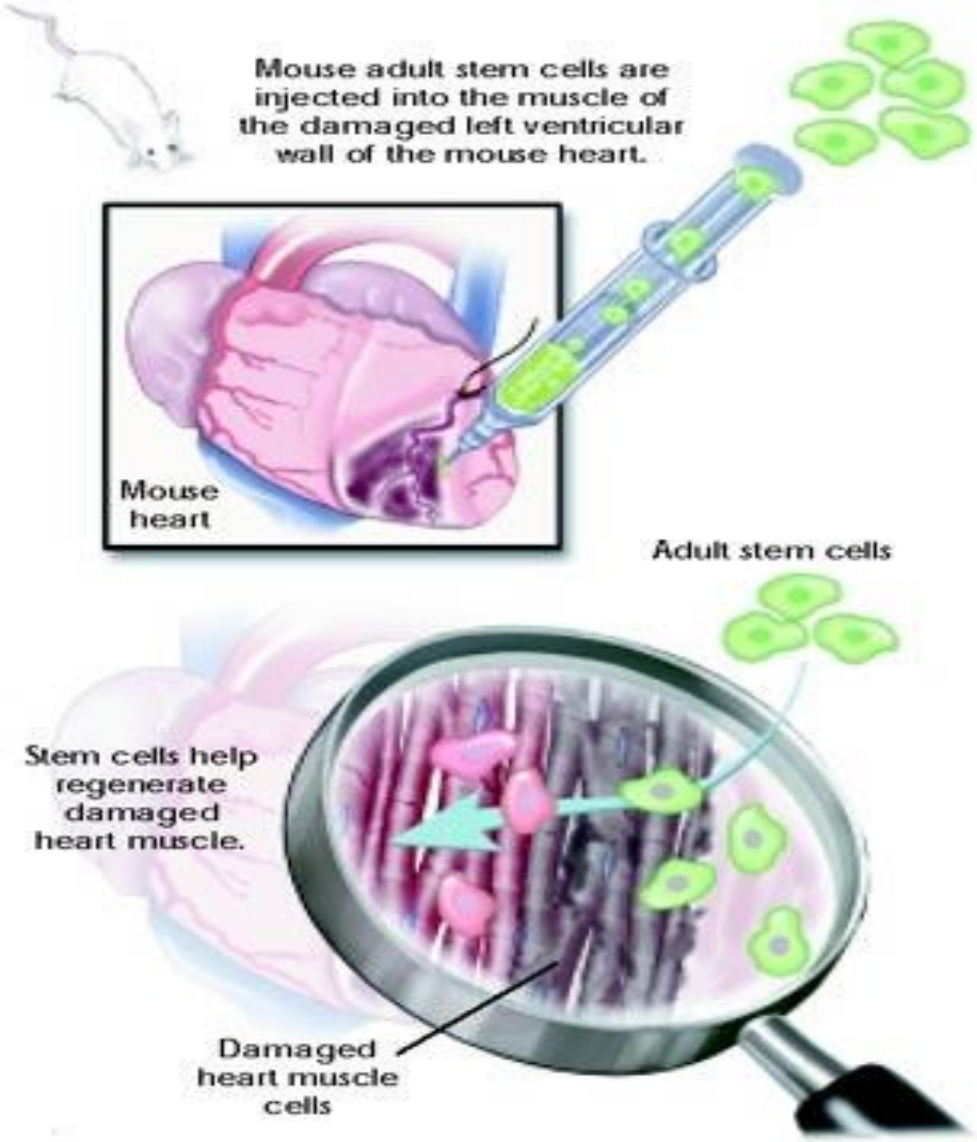
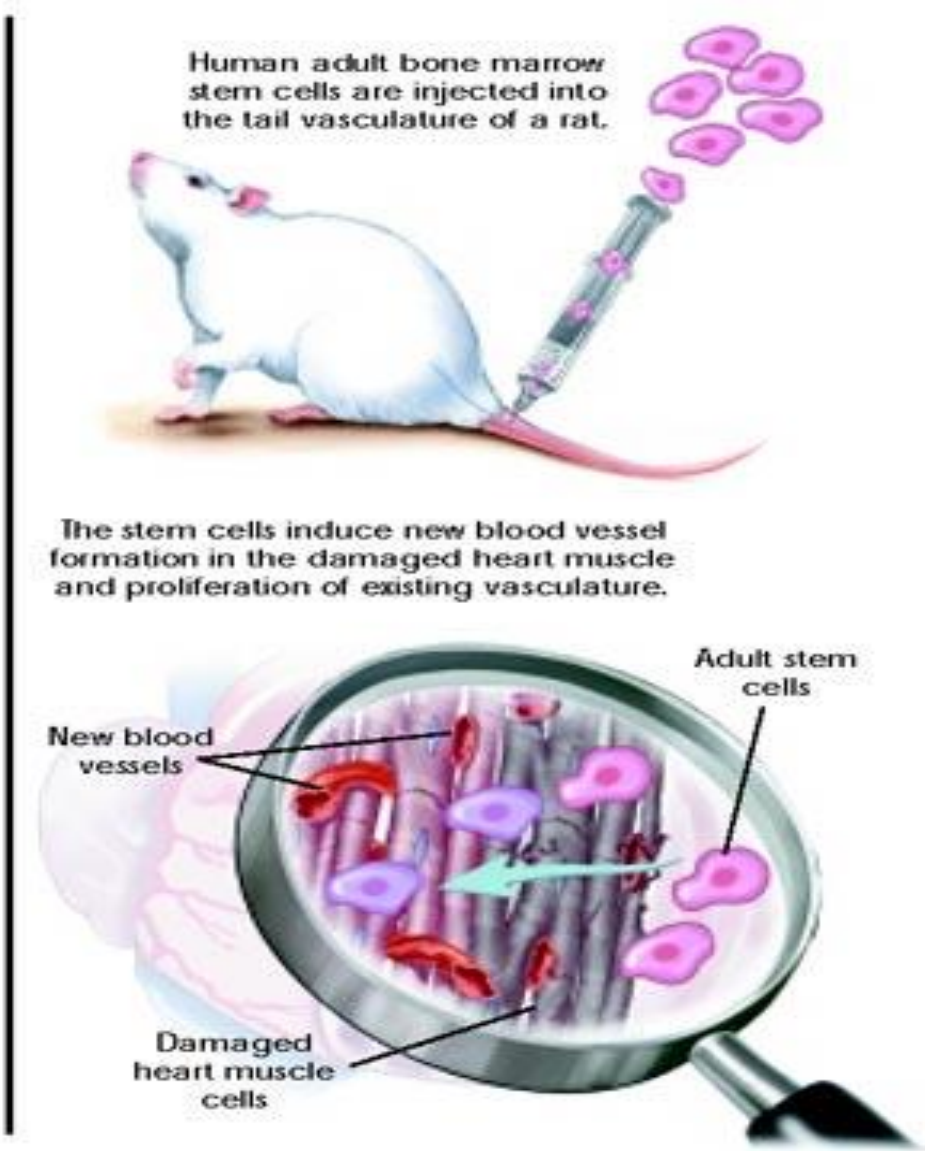


Potential of Adult Stem Cells



Applications of Stem cells

- Disease
  - Diabetes, Spinal cord injury, Parkinson's disease, heart disease
- Genetic based Disease
  - Cystic fibrosis, Huntington's



Stem cells to treat Heart Disease