

# Introuduction to Pluripotent Stem Cells

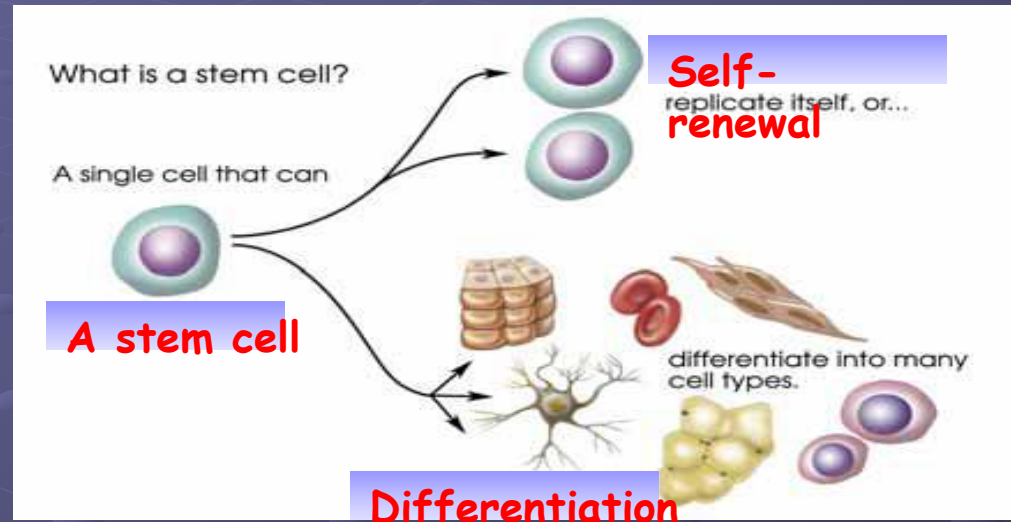
Prof. Abdullah Aldahmash





# Stem Cell – Definition

- A cell that has the ability to continuously divide and differentiate into various other kinds of cells



## Stem Cell – main function within the body

Continuous Repair of defective cell types and regeneration of tissues.

# Classifications of stem cells (1)

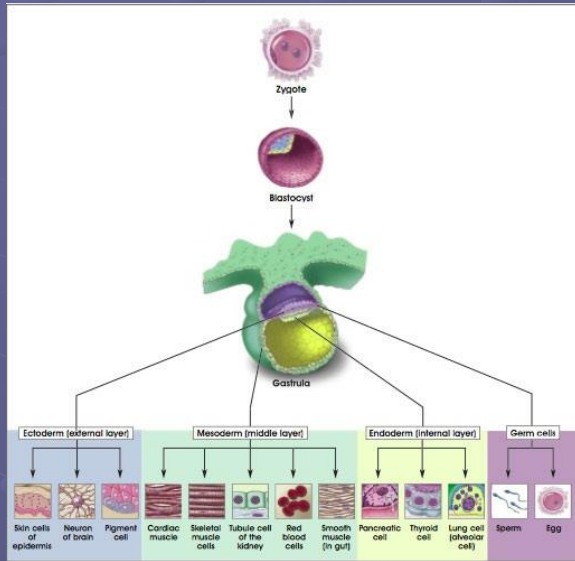
## Potency based

Potency	Description
Totipotent	1-3 days, differentiate into <b>embryonic</b> and <b>extraembryonic</b> cell types
Pluripotent	Descendants of totipotent cells and differentiate into cells of 3 <b>germ layers</b>
Multipotent	Produce cells of a closely <b>related</b> of cells (e.g. hematopoietic ) <b>family</b> stem cells
Oligopotent	Differentiate into <b>ONLY a few</b> cells, such as lymphoid or myeloid stem cells
Unipotent	Produce <b>ONLY</b> one cell type (e.g. muscle stem cells)
Nullpotent	The <b>terminal</b> cell

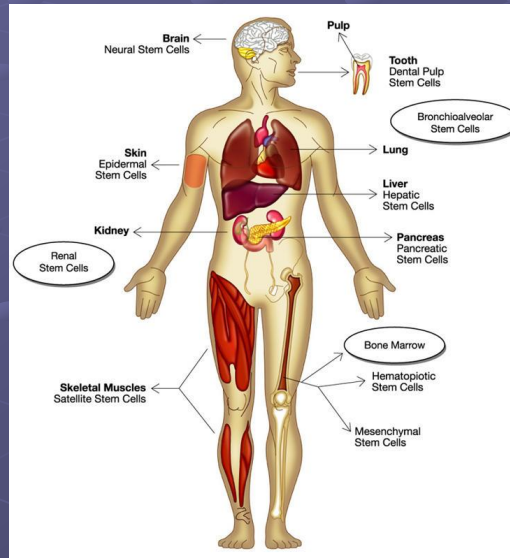
# Classifications of stem cells (2)

## Sourced based

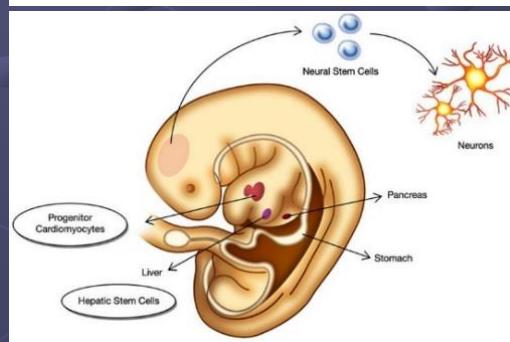
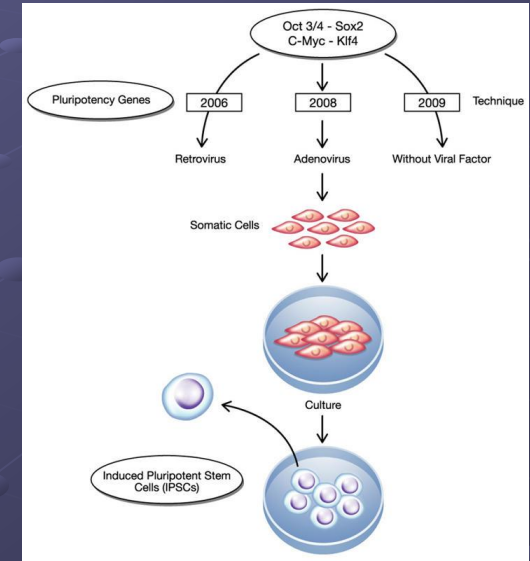
### Embryonic



### Adult (Tissue Specific)

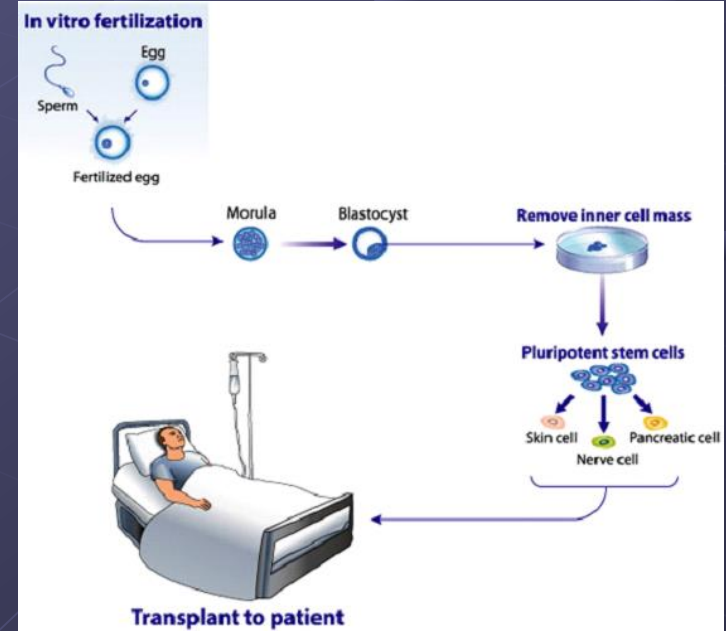
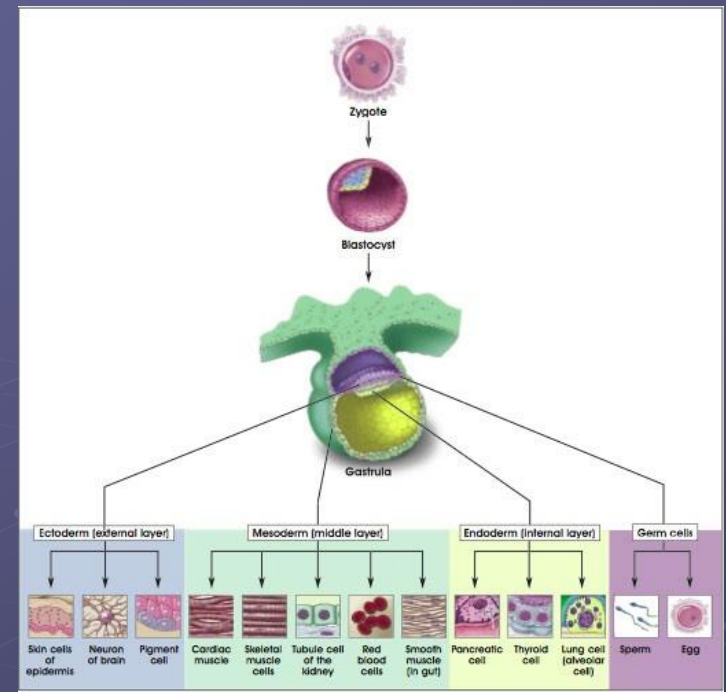


### Induced

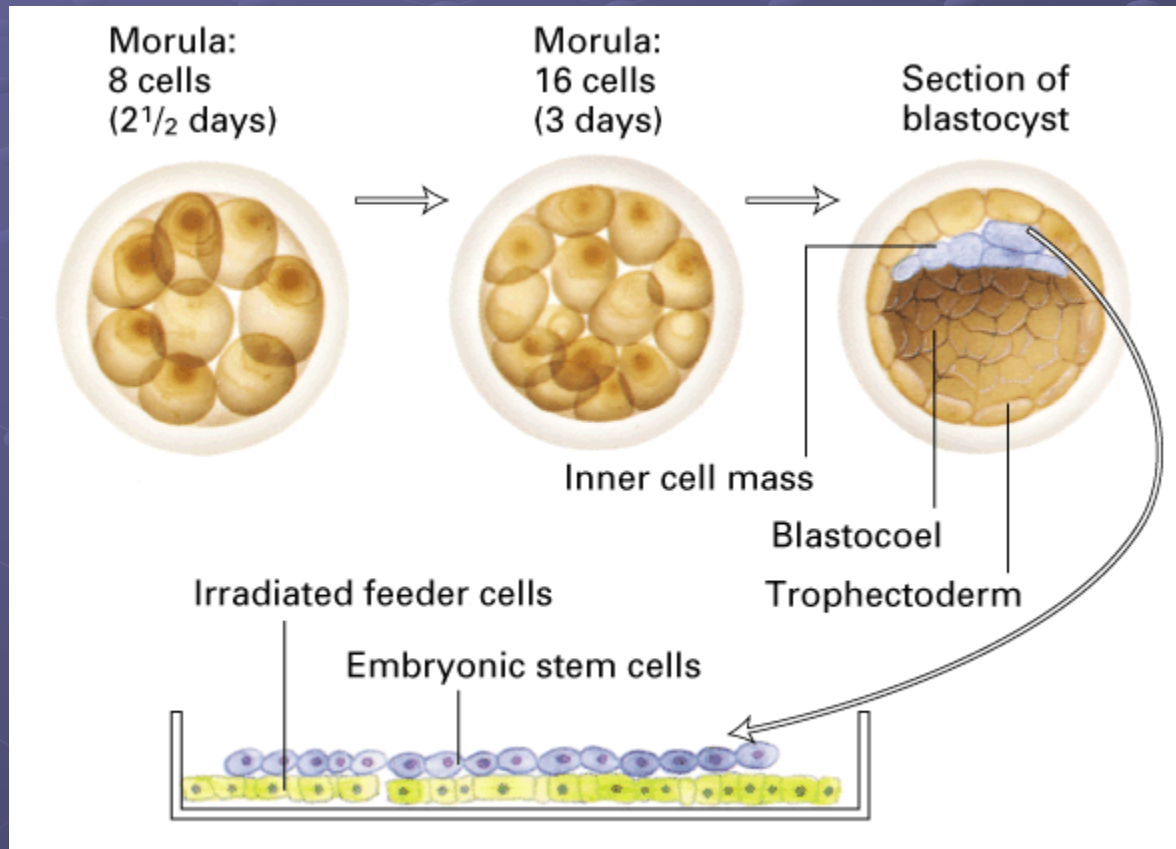


# Embryonic Stem Cell

- Embryonic human stem cells were first isolated in 1995 by Dr. James Thomson.
- Source of ESC is Blastocysts (IVF, SCNT)

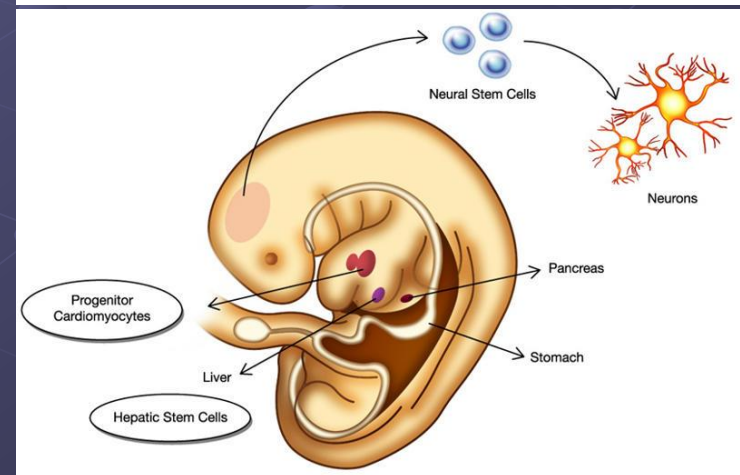
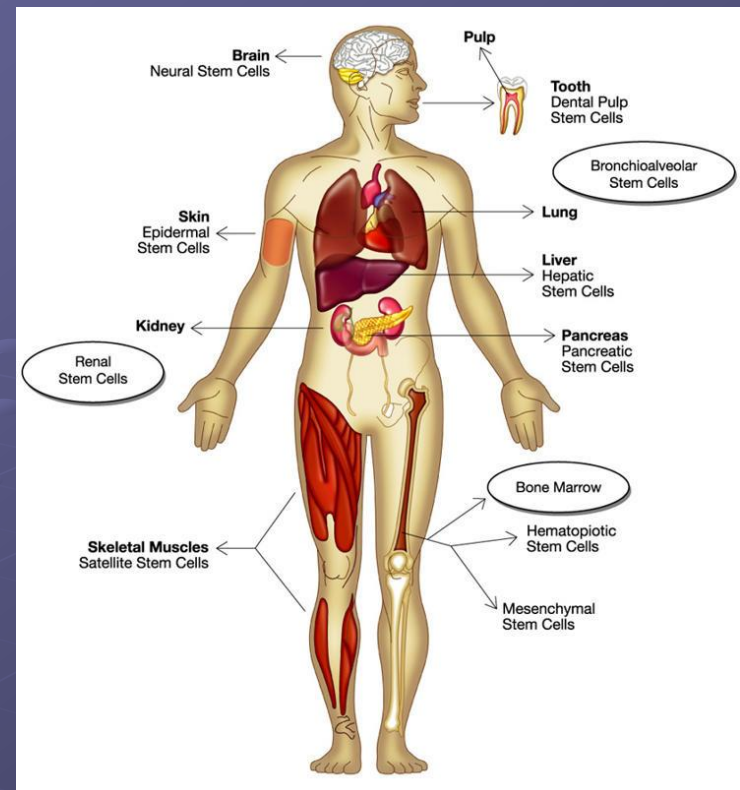


# Generation of Embryonic Stem Cells



# Adult stem cells (Tissue Specific Stem Cell)

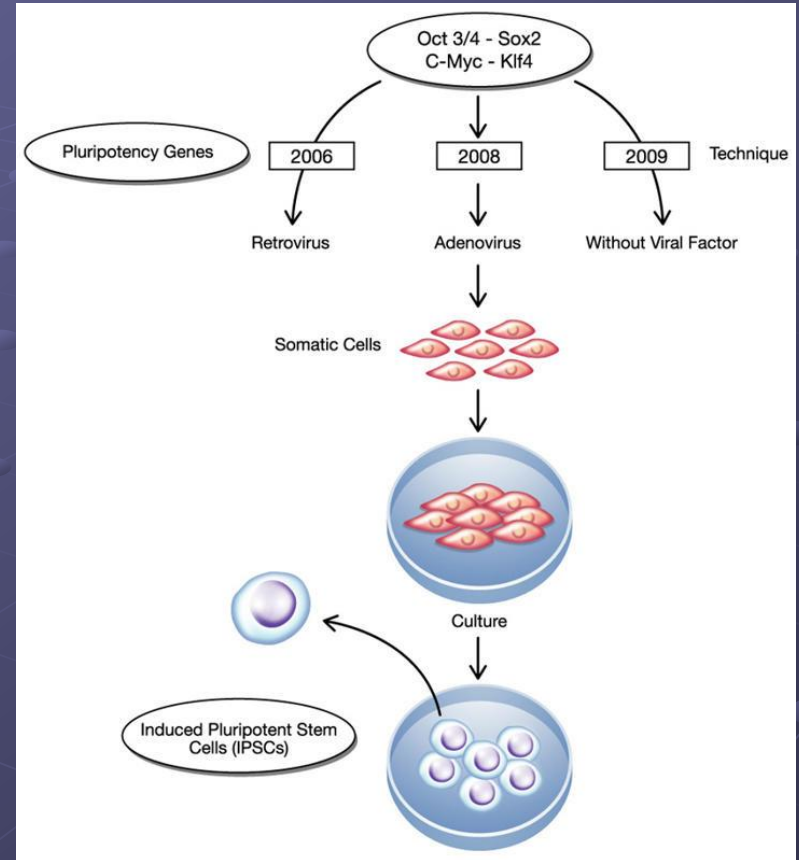
Found in specific mature body tissues as well as the umbilical cord and placenta after birth. They also can be isolated of developing embryos' different tissues





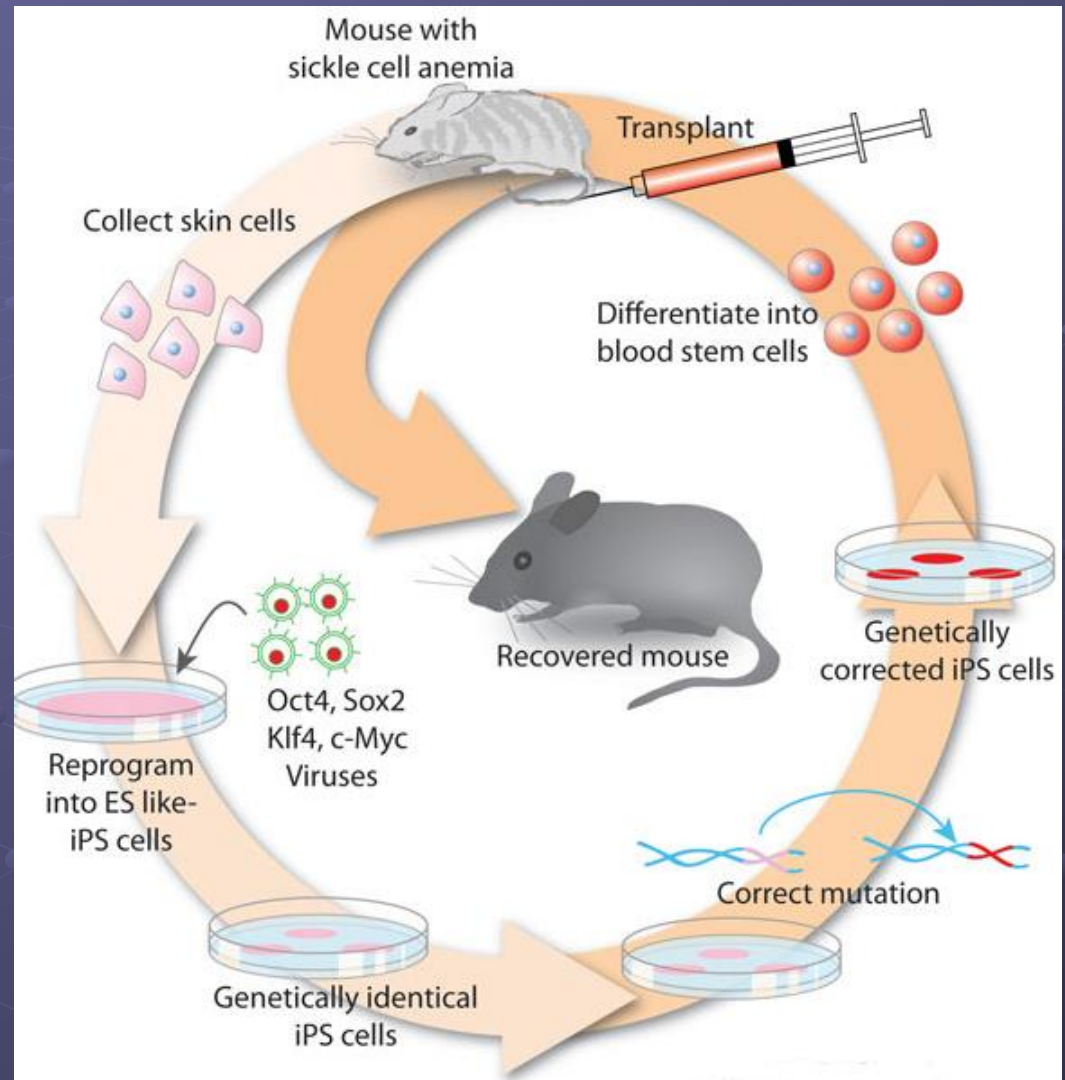
# Induced Pluripotent Stem Cell (iPS) cells

- The method was described by Yamanaka and Takahashi in which the skin cells of laboratory mice were genetically manipulated and returned back to their embryonic state.
- iPS are somatic cells that have been reprogrammed to a pluripotent state (embryonic stem cell like state).
- Several difficulties are to be overcome before iPS cells can be considered as a potential patient-specific cell therapy. It will be crucial to characterize the development potential of human iPS cell line in the future.



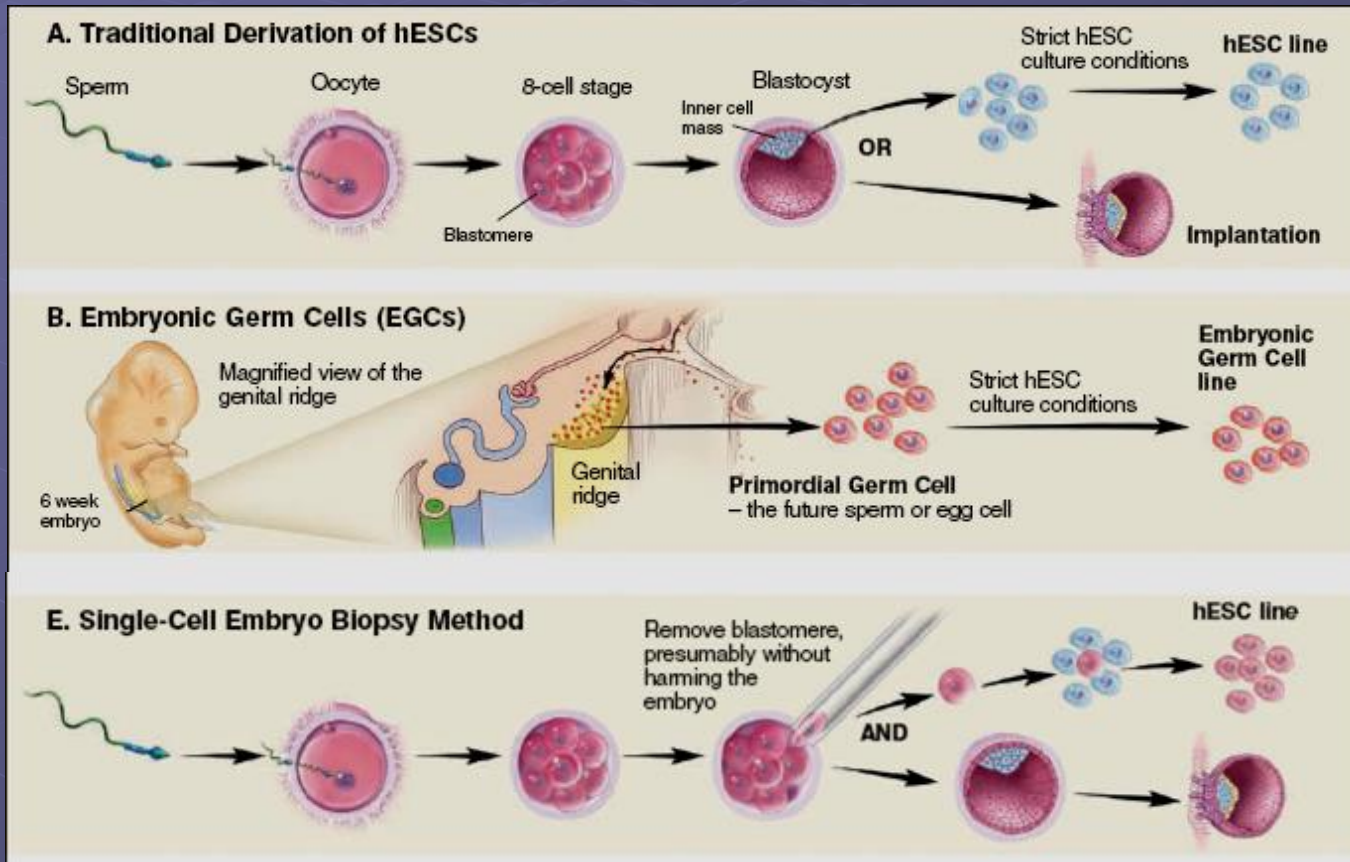
# iPS

- Skin cells were taken from the tail tip of a sickle-cell model mouse.
- The cells were differentiated into hematopoietic cells.
- The produced cells were transfused back into the sick mouse

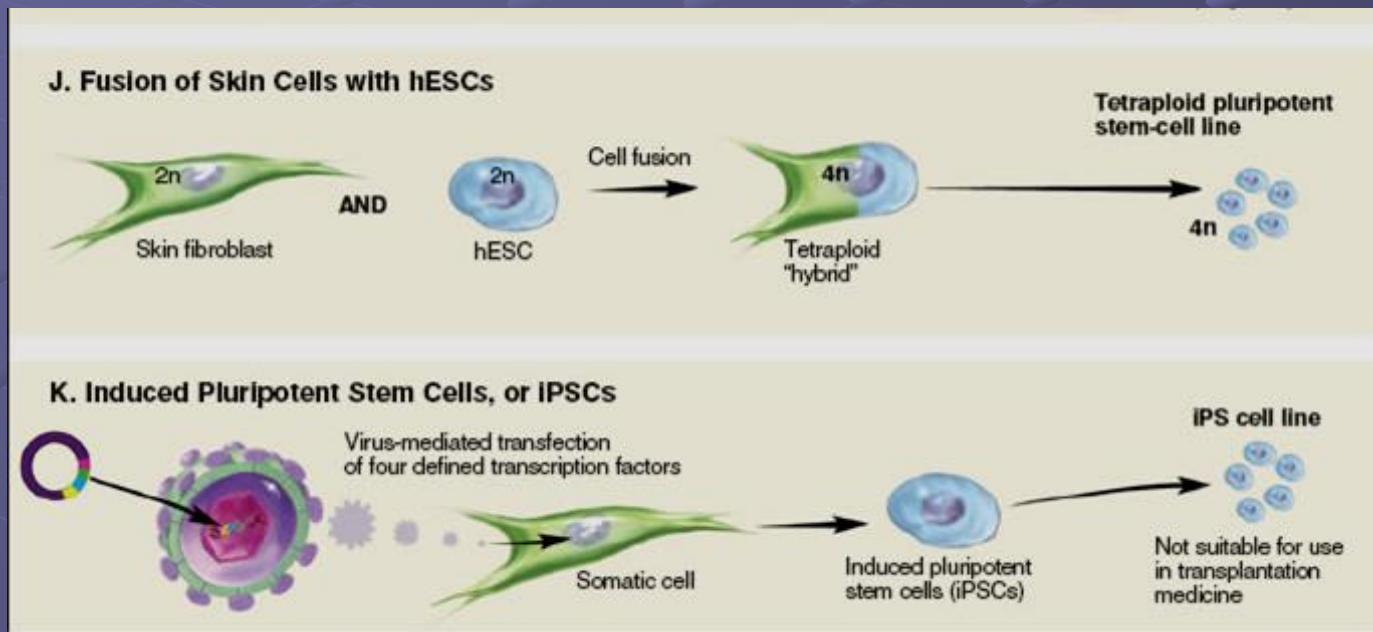


Hanna J. et.al., 2007

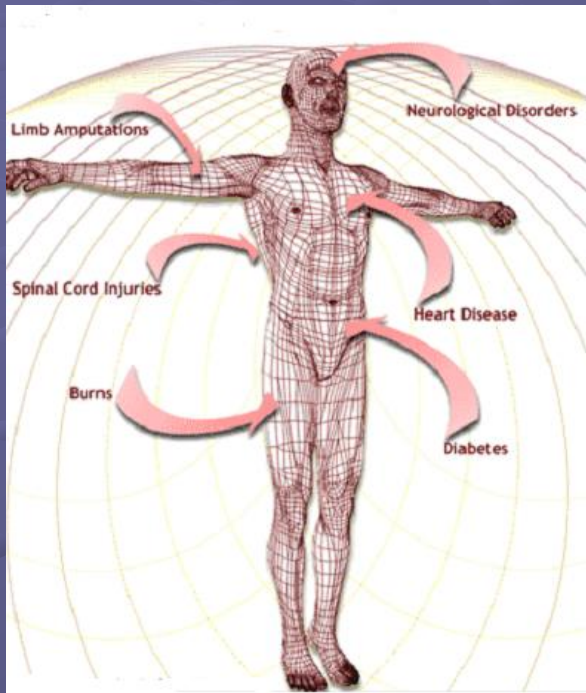
# Different Approaches for isolation of Pluripotent stem cells



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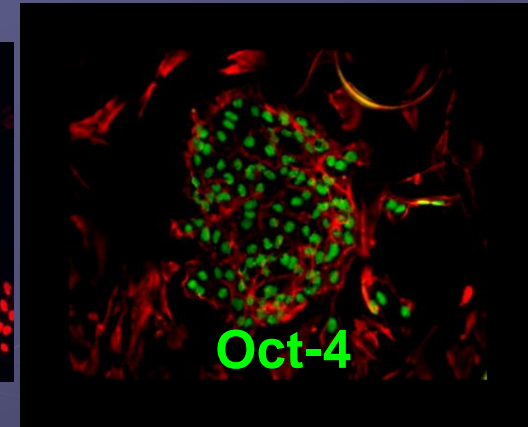
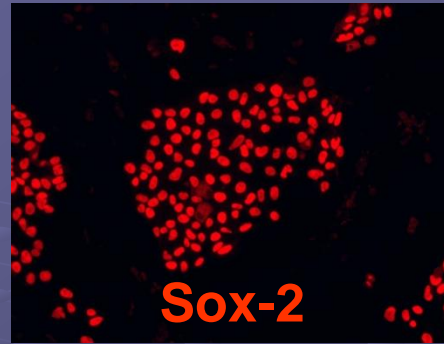
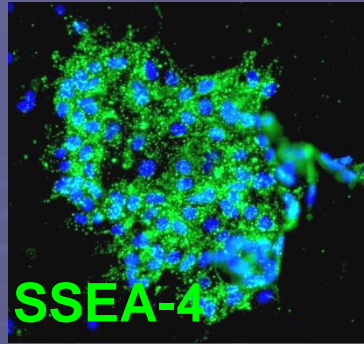
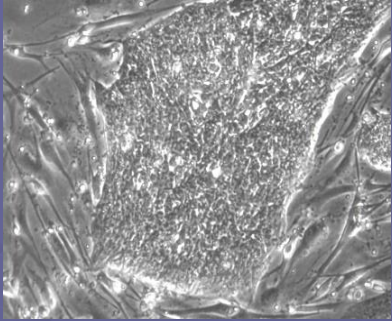
# The Promises of Stem Cell Technology



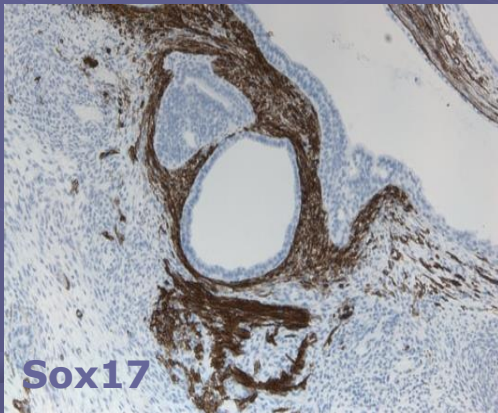
- Replacement of tissues/organs
- Study cell differentiation
- Toxicity testing.
- Understanding prevention and treatment of birth defects.
- Study of development and gene control.
- Study of drugs therapeutic potential.

# Characterization of Human Pluripotent Stem cells (ESCs)

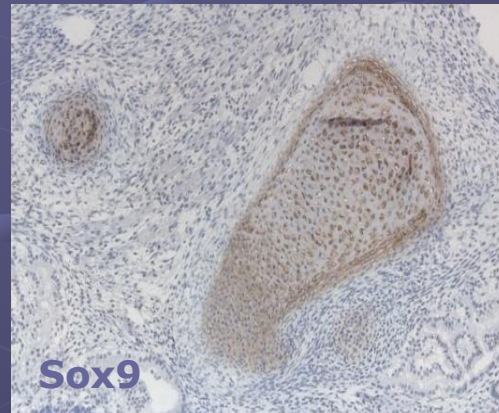




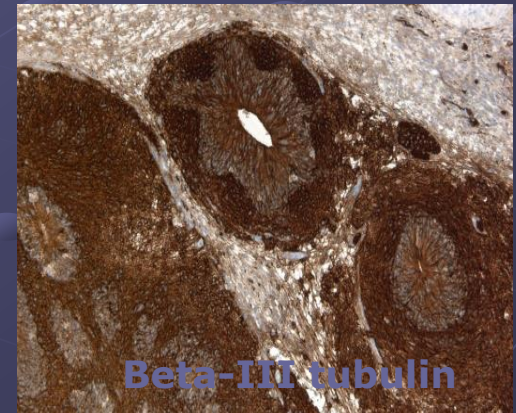
## ENDODERM

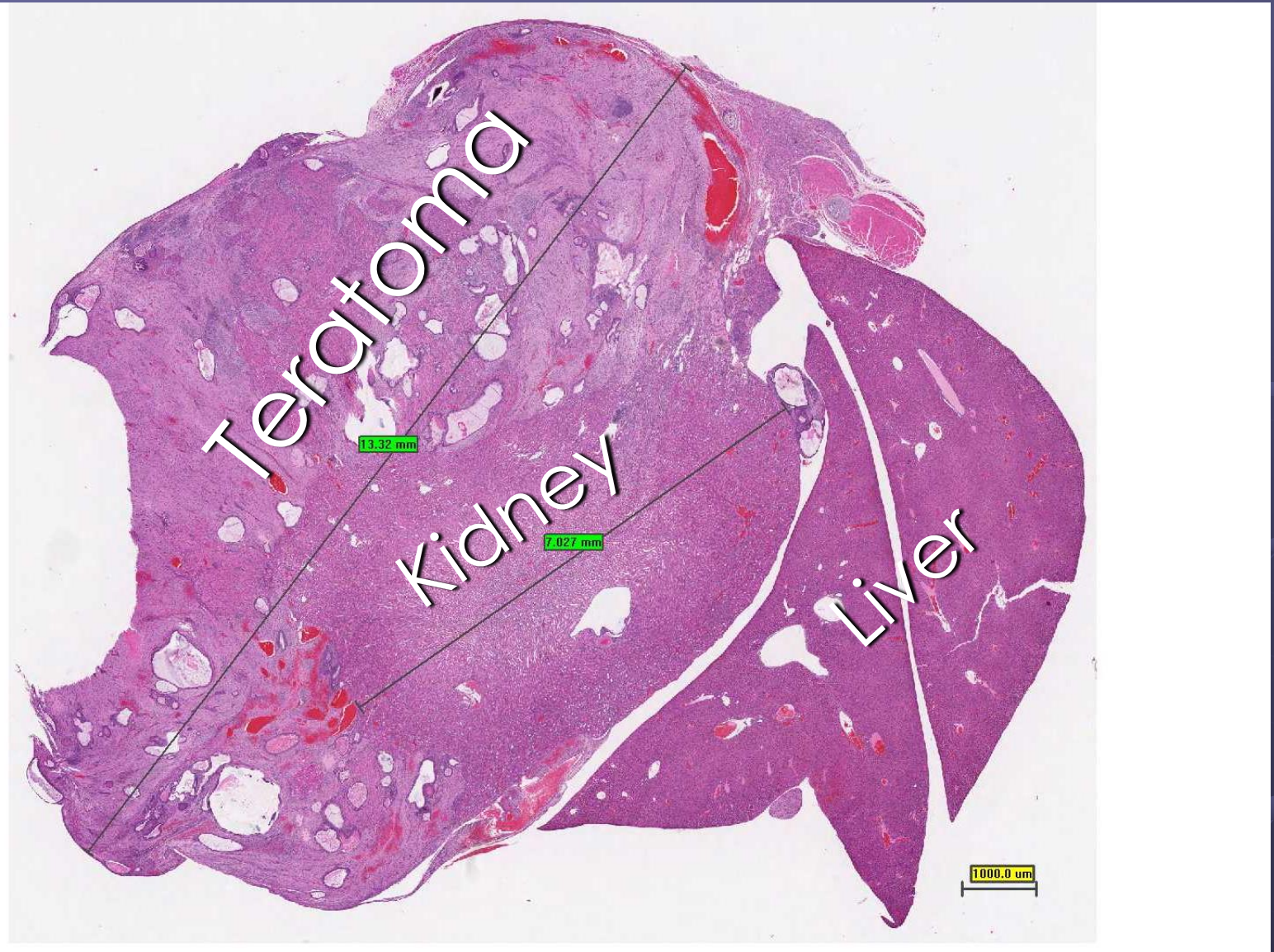


## MESODERM



## ECTODERM

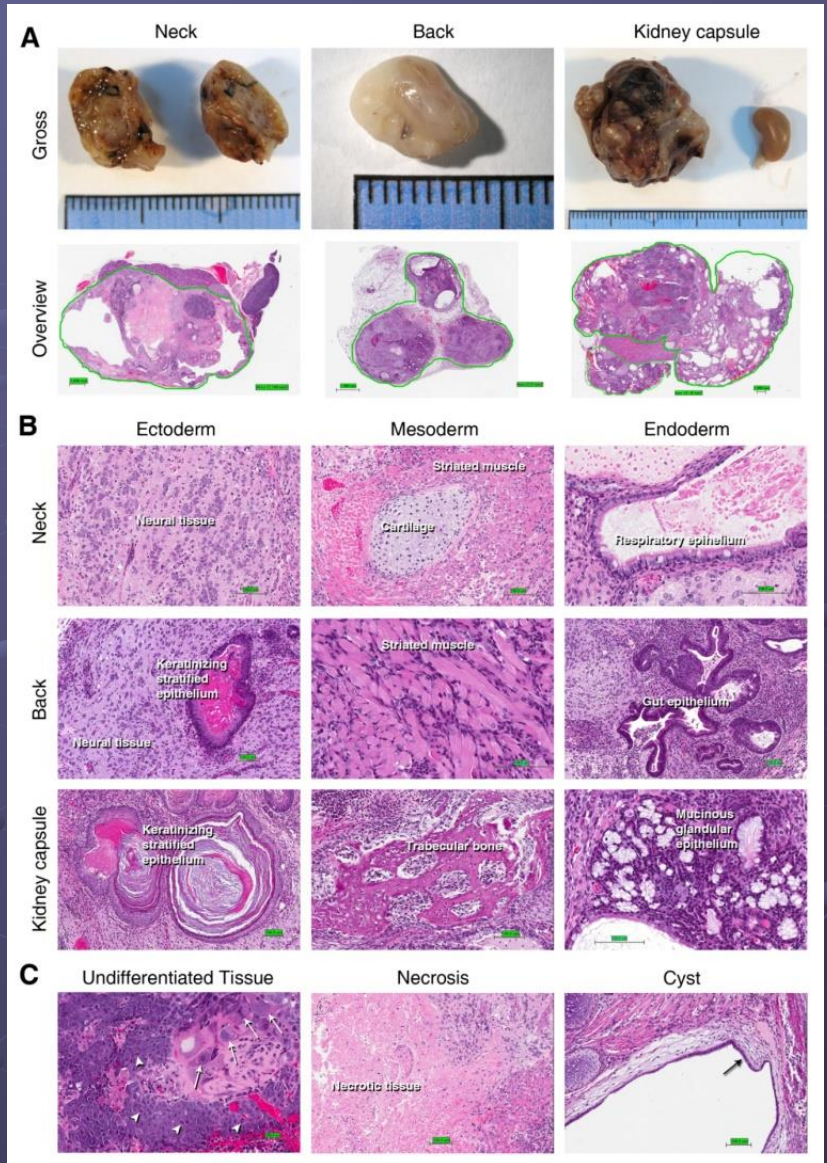
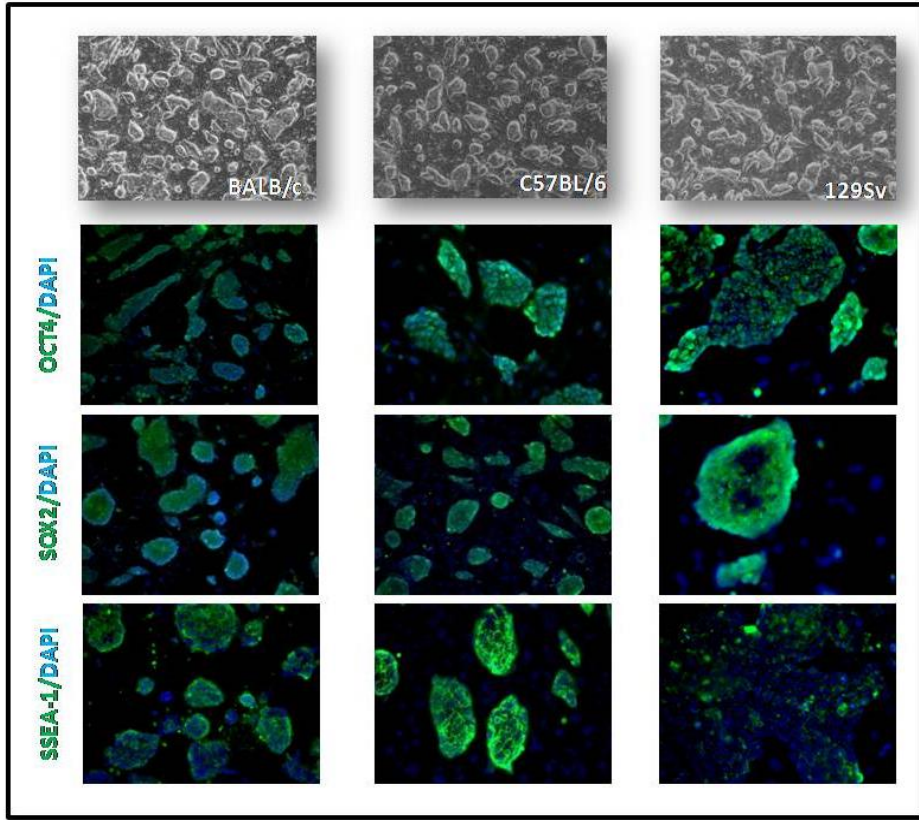


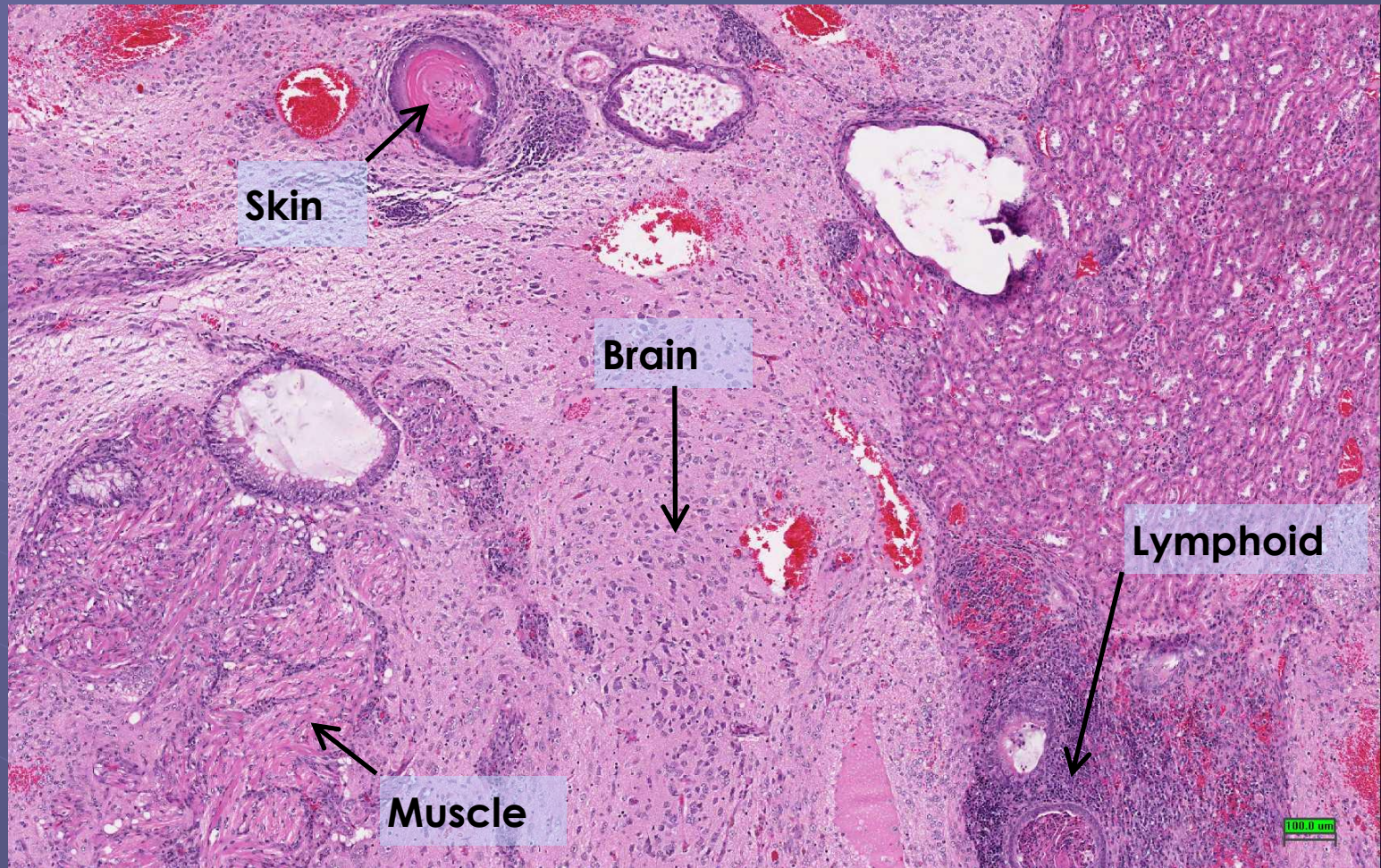


A large tumor mass measuring twice as the kidney is compressing it.



Figure 1





The teratoma was composed of mixed tissue patterns: skin with keratin, brain tissue, striated and smooth muscle, lymphoid tissue .....

# Challenges to Stem Cell Research

- Stem cells need to be differentiated to the appropriate cell types *before* they can be used clinically.
- Recently, abnormalities in chromosome number and structure were found in three human ESC lines.
- Stem cell development or proliferation must be controlled once placed into patients.
- Possibility of rejection of stem cell transplants as foreign tissues is very high.
- The use of mouse “feeder” cells to grow ESC could result in problems due to xenotransplantation.

