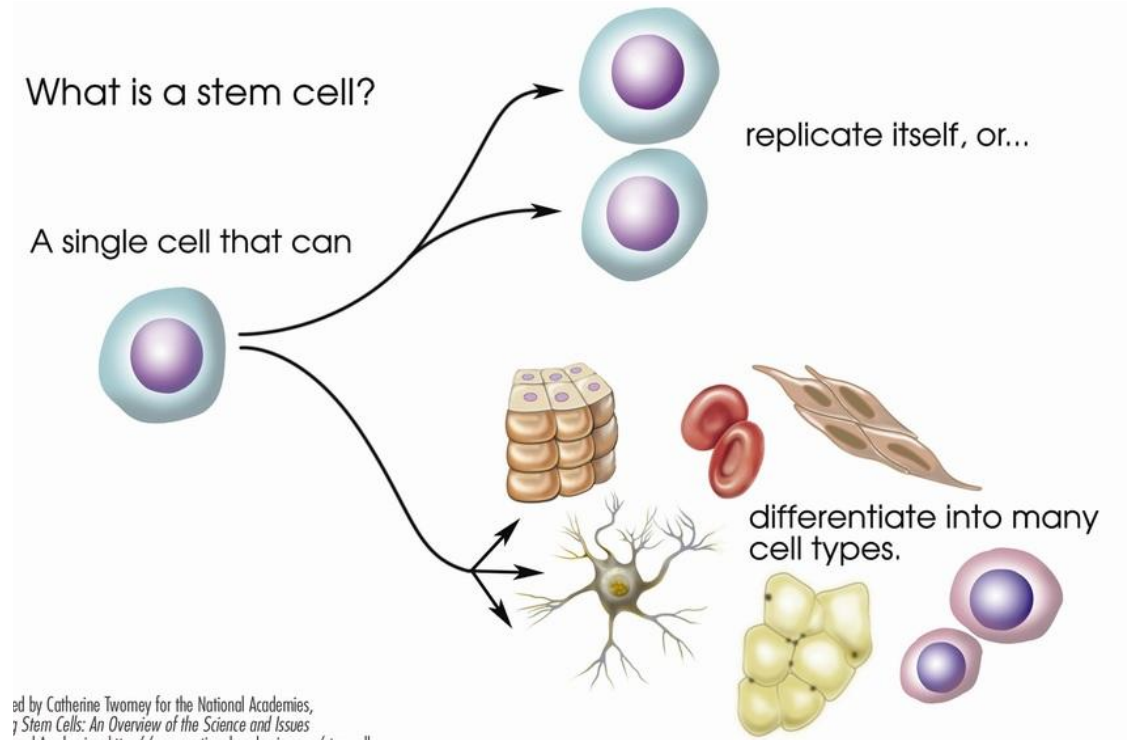




STEM CELLS & THEIR APPLICATIONS

What are Stem Cells

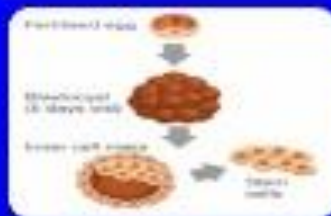
Stem cells are relatively ‘unspecialized’ cells that have the unique potential to develop into ‘specialized’ cell types in the body (for example, blood cells, muscle cells or nerve cells). They occur at all stages of human development, from embryo to adult, and in many tissues of the body.



General properties of Stem Cells



Stem cells are unspecialized cells



Stem cells can divide and renew themselves for long periods of time

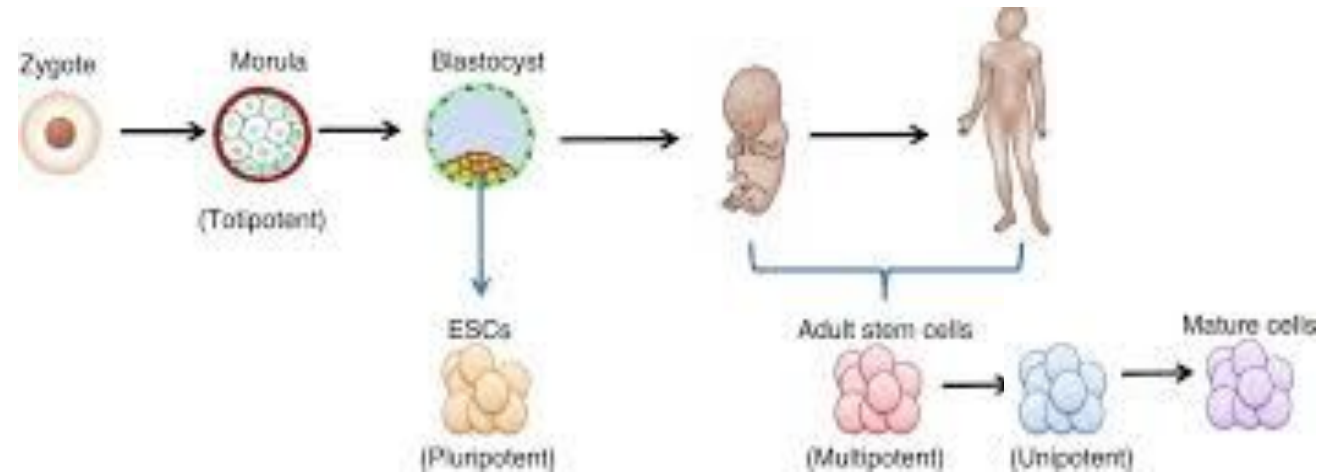


Stem cells can divide and become specific specialized cell types of the body



Stem cells can replace dying, old or damaged cells

Classification of stem cells



Source of origin

Embryonic

Adult

Differentiation potentials

Totipotent

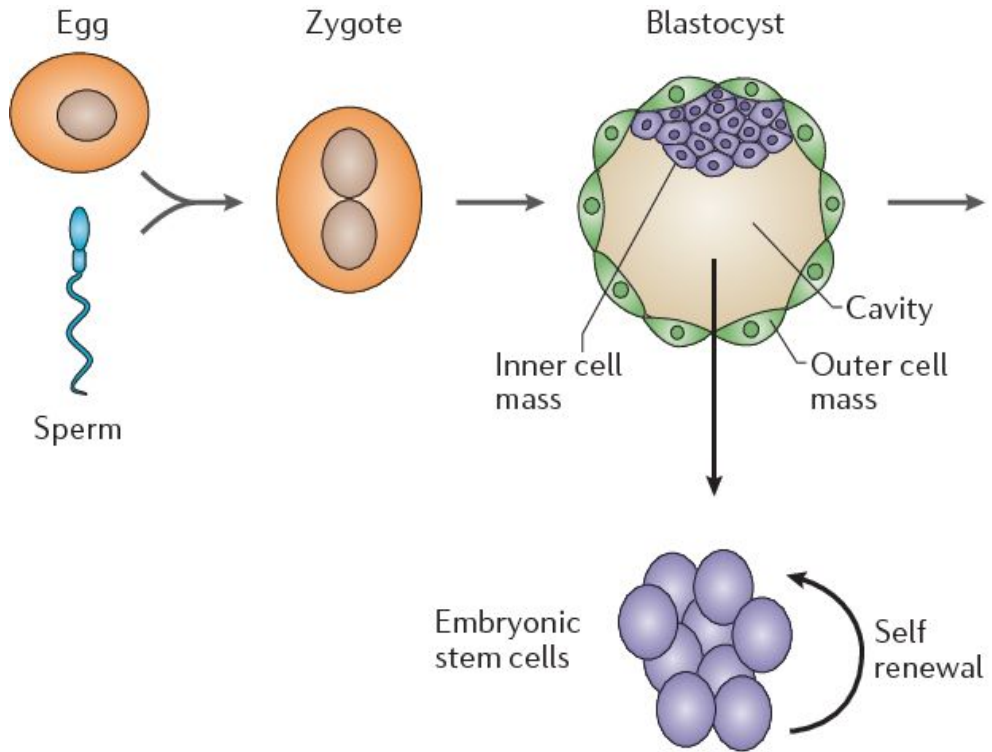
Pluripotent

Multipotent

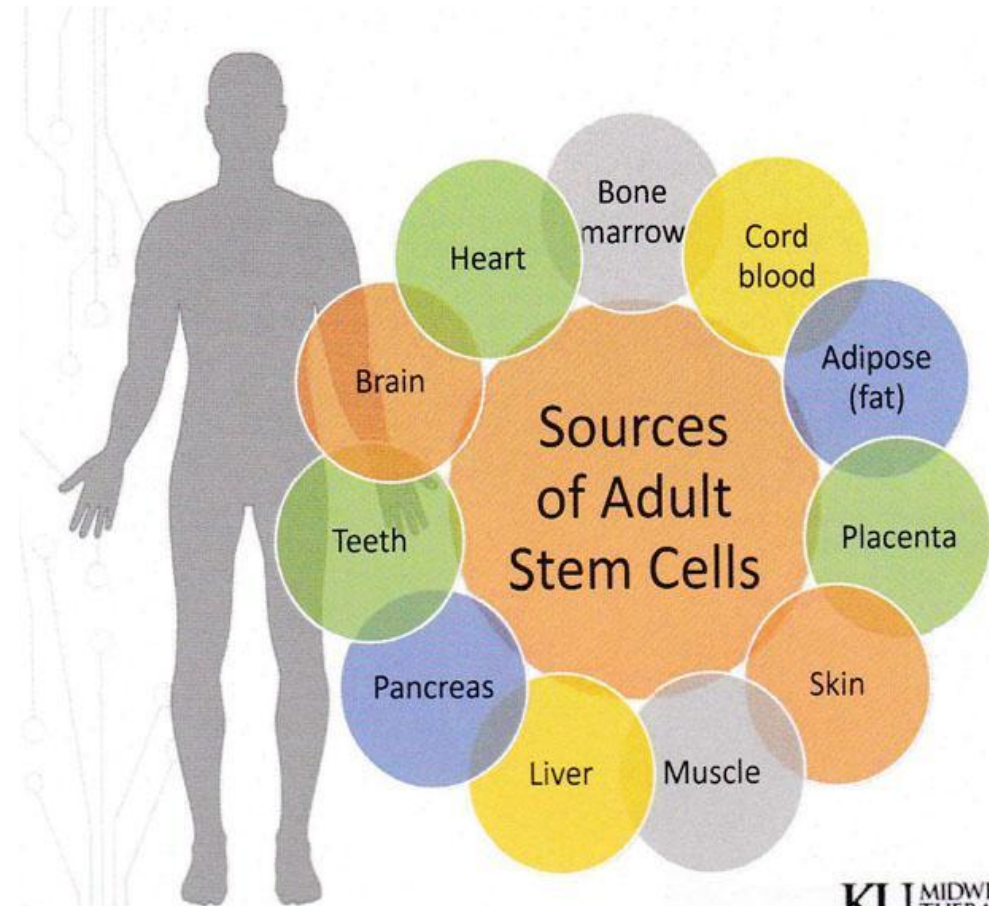
Unipotent

SOURCES OF STEM CELLS

Embryonic stem cells



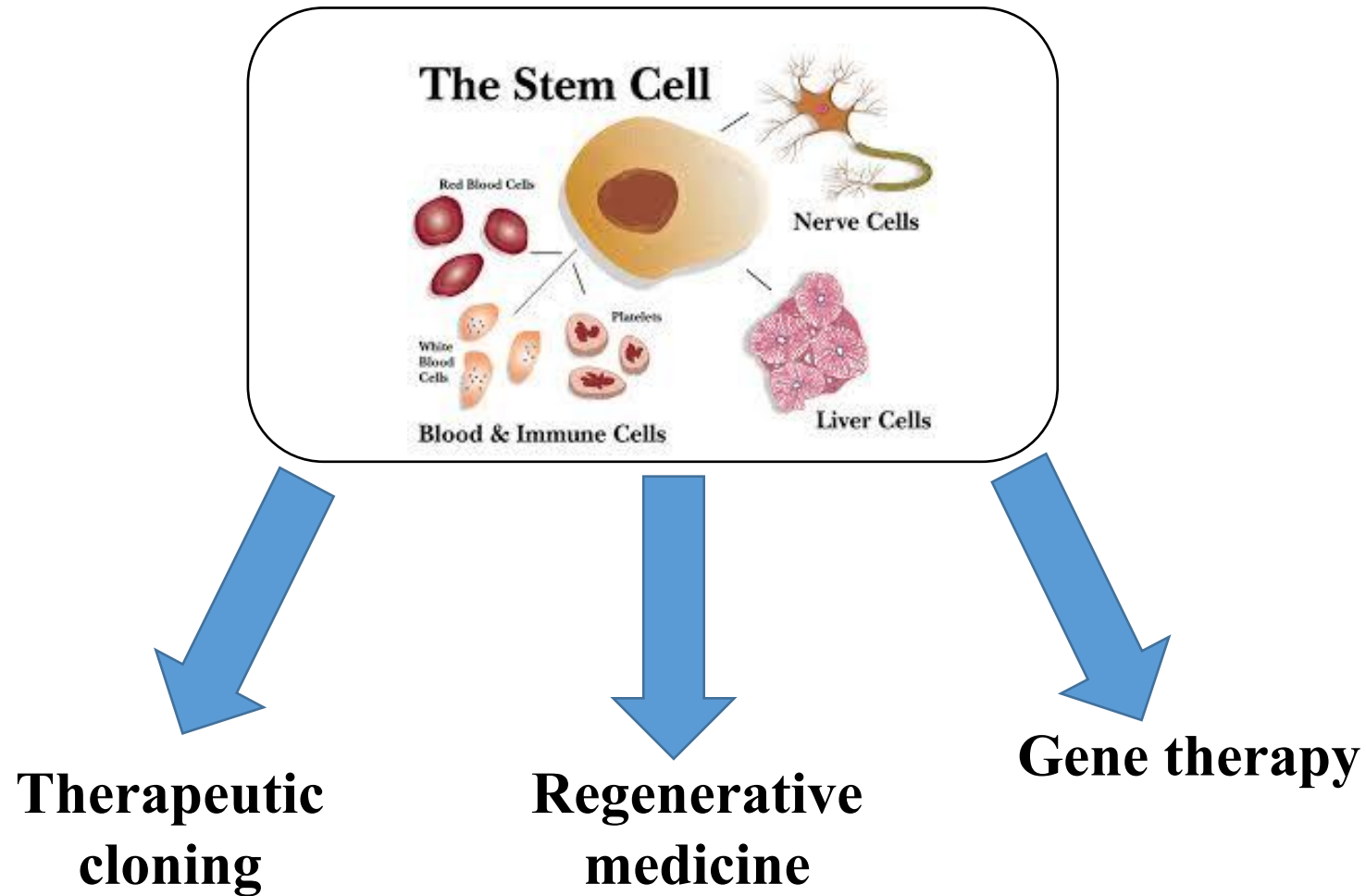
Adult stem cells



DIFFERENCES BETWEEN EMBRYONIC AND ADULT STEM CELLS

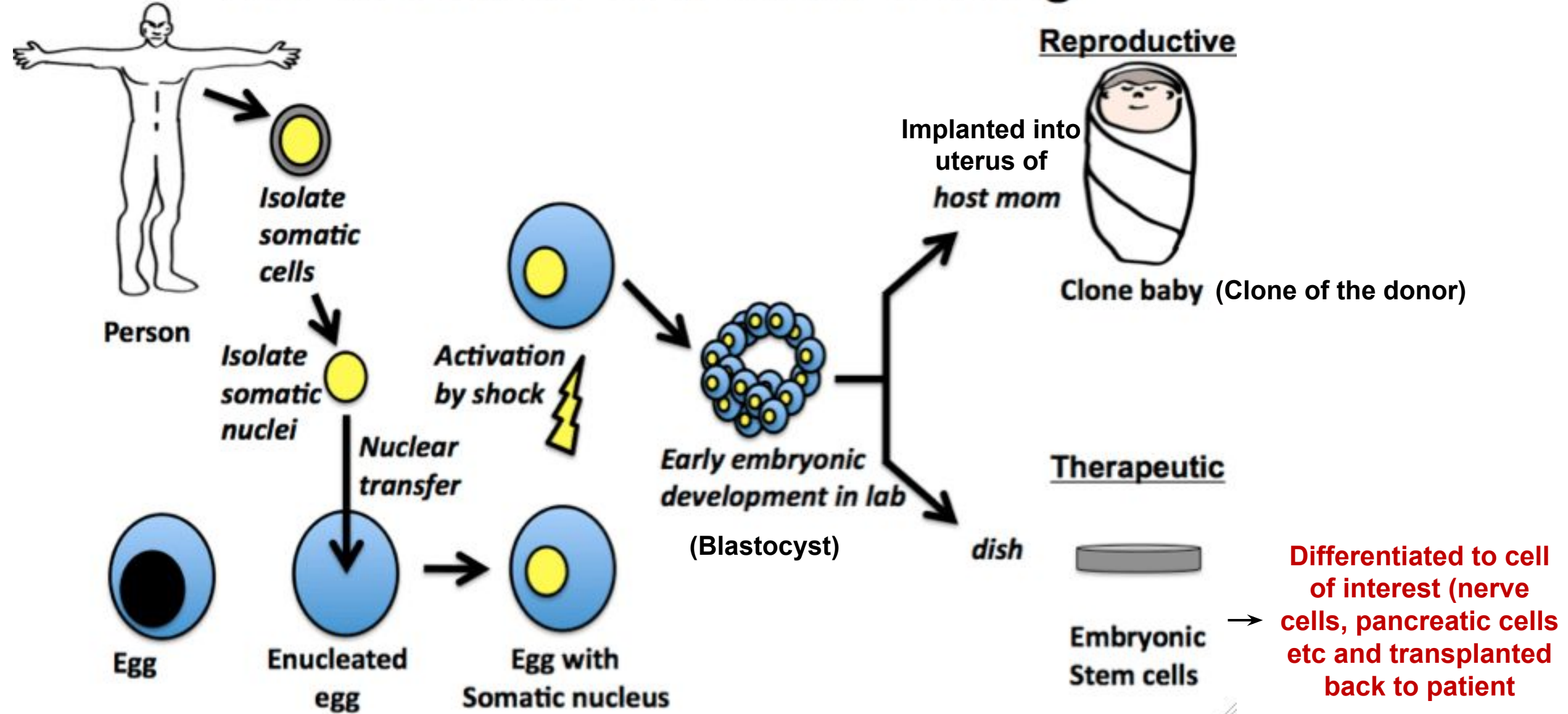
	EMBRYONIC STEM CELLS	ADULT STEM CELLS
SOURCE	EMBRYO	ADULT TISSUE
POTENCY	TOTIPOTENT / PLURIPOTENT	MOSTLY MULTIPOTENT
CELL CULTURE	EASY	CHALLENGING
	FLEXIBLE	LESS FLEXIBLE
	IMMORTAL	MORTAL WITH FINITE LIFE TIME
	AVAILABILITY	LIMITED QUANTITY
	DIFFICULT TO DIFFERENTIATE UNIFORMLY INTO TARGET TISSUE	INDUCEMENT IS SIMPLER
	ALWAYS IMMUNOGENIC	NON IMMUNOGENIC
	TUMORIGENIC	NON TUMORIGENIC
	ISOLATION LEADS TO DESTRUCTION OF EMBRYO, HIGH ETHICAL CONTROVERSY	RELATIVE EASE OF PROCUREMENT, LESS MORAL & LEGAL CONTROVERSY

APPLICATION OF STEM CELLS



THERAPEUTIC CLONING (Somatic Cell Nuclear Transfer)

The two kinds of human cloning



THERAPEUTIC CLONING - ADVANTAGES & DISADVANTAGES

Advantages

- 1) SCNT can be used in **regenerative medicine applications** (produce patient-specific stem cells to **develop organs** (rather than entire bodies) **for transplantation** thereby reducing, or **preventing, organ rejection**. Potential clinical applications include the treatment of end-stage kidney disease, neurodegenerative diseases, and diabetes, conditions for which there is limited availability of immunocompatible tissue transplants)
- 2) Since, SCNT products have histological compatibility with the nuclear donor, the **use of immunosuppressive drugs with heavy side-effects can be prevented**.
- 3) SCNT can be used in gene therapy, **as a vector for gene-delivery**.

Disadvantages

- 1) This technique has **not yet been shown to work in humans**.
- 2) Some cell lines generated by SCNT have **contained chromosomal abnormalities**.
- 3) **Low success rate** of SCNT as only 0.7% of the nuclear transfers result in a viable blastocyst
- 4) **Low oocyte availability**
- 5) Many **ethical concerns** surrounding such practices. (Reproductive cloning has been banned in most countries. Therapeutic cloning is also often tied to ethical considerations concerning the source, destruction and moral status of IVF embryos.)

PRACTICE QUESTIONS

Short questions

- 1) Give any two differences between adult and embryonic stem cells.
- 2) What is the major source of adult and embryonic stem cells?
- 3) How are totipotent cells different from multipotent cells?
- 4) Why are embryonic stem cells considered “immunogenic” in nature?
- 5) What is the basic difference between a unipotent stem cell and a differentiated cell?

Long questions

- 1) What are stem cells and their properties?
- 2) How are stem cells classified on the basis of sources and potency?
- 3) How stem cells are used for therapeutic cloning? Explain with a diagram.
- 4) What is regenerative medicine and how stem cells can be used in it? Brief with examples. (Not in course)
- 5) What is gene therapy? Explain the ex-vivo gene therapy with suitable diagrams. (Not in course)

REGENERATIVE MEDICINE (NOT IN COURSE)

What is "REGENERATIVE MEDICINE"??

Regenerative medicine is the "process of replacing or regenerating human cells, tissues or organs to restore or establish normal function".



First cells are isolated.

Then the isolated cells are manipulated expanded and or organs are generated from reprogrammed cells.

The modified cells are transplanted into patients.



spinal cord injury

heart disease

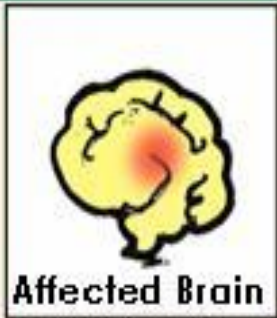
stroke

REGENERATIVE MEDICINE

Parkinson's disease

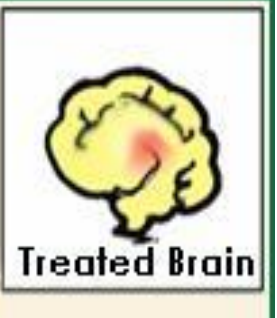
liver disease





Affected Brain

Stem cell Treatment For Parkinson's



Treated Brain



1. Dead nerve cells not producing dopamine

2. Implanted Stem Cells

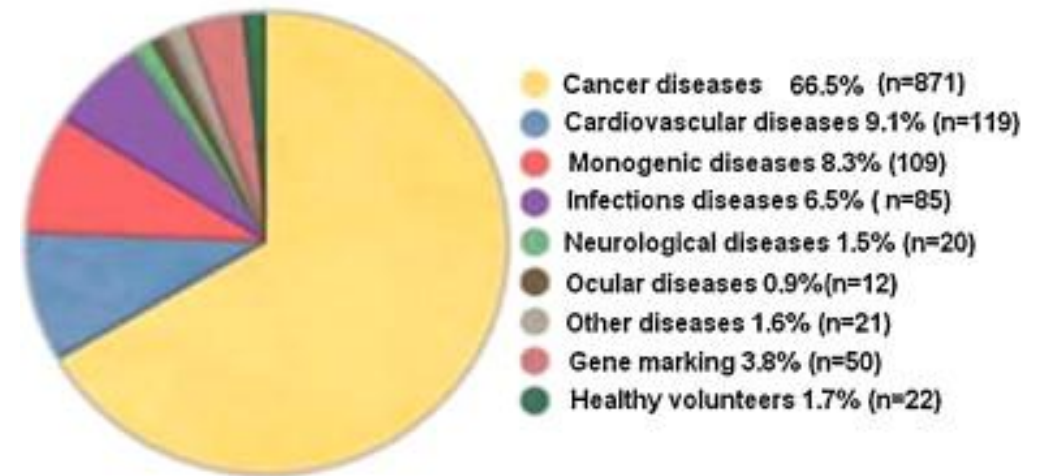
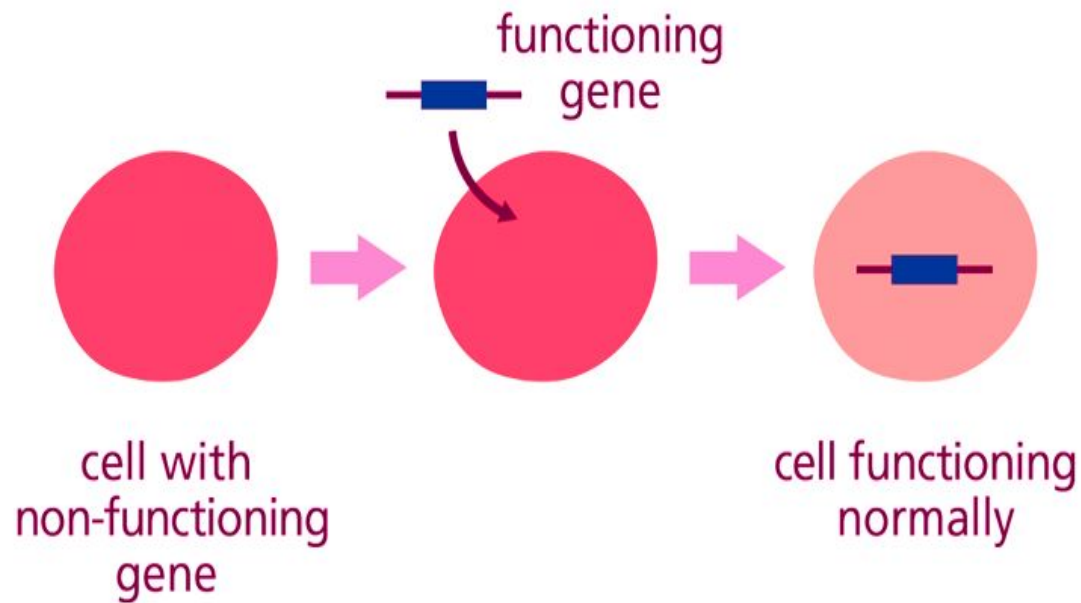
3. New nerve cells producing dopamine

4. Dopamine transmits nerve signal



GENE THERAPY (NOT IN COURSE)

- Gene therapy is insertion of genes into an individual's cells and tissue to treat a disease
- Mostly is being used to treat cancer, infectious diseases, heart diseases, arthritis, Alzheimer's disease etc.



STRATEGIES FOR GENE THERAPY

