

Stem cells

Buddhi Prakash Jain
Assistant Professor
Department of Zoology
Mahatma Gandhi Central University Motihari Bihar
Email: buddhiprakash@mgcub.ac.in

Followings are the objectives of the lecture:

- Definition and properties of stem cells.
- Types of stem cells.
- Applications of stem cells.

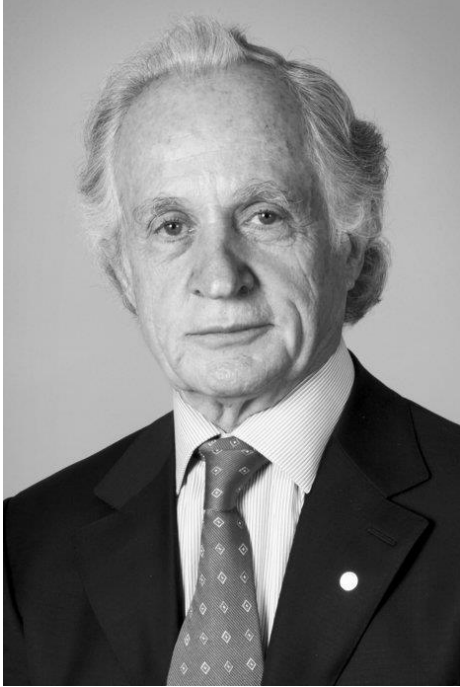
Stem cells: Undifferentiated cells in the multicellular organism which can differentiate into other cell types and also undergo self renewal.

Present in embryonic as well as in adult stage.

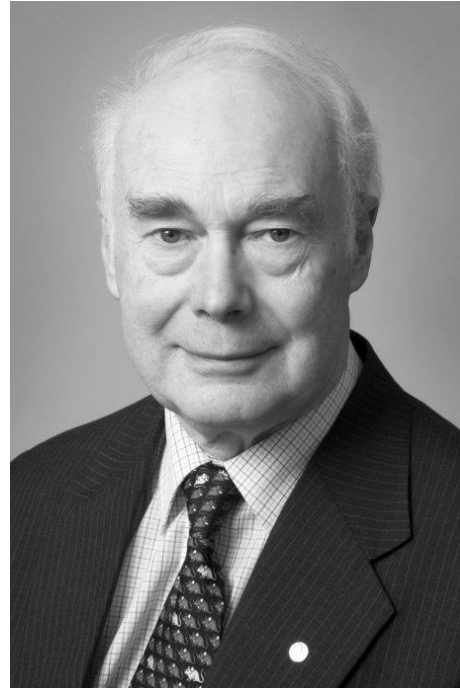
Example: Hematopoietic stem cells, Embryonic stem cells.

History of stem cells:

- 1960s: Ernest McCulloch and James Till: Define properties of stem cells, discover hematopoietic stem cells.
- 1981: Martin Evans and Matthew Kaufman: Isolate embryonic stem cells in mice.
- 1998: James Thomson: First isolate human embryonic stem cells.



Mario Capecchi



Martin J Evans



Oliver Smithies

The Nobel Prize in Physiology or Medicine 2007 was awarded jointly to Mario R. Capecchi, Sir Martin J. Evans and Oliver Smithies "for their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells."

<https://www.nobelprize.org/prizes/medicine/2007/summary/>

Properties of stem cells:

- Self-renewal: They divide and self renew themselves thus maintain undifferentiated state.
- Potency: They are undifferentiated and can divide and differentiate into one or many cell types.
- Unspecialized: They are unspecialized or uncommitted cells which can develop into specialized cells.

Types of stem cells:

Stem cells can be classified on two basis:

1. On the basis of origin.
2. On the basis of cell potency.

A. Classification of stem cells based on source or origin:

1. Embryonic stem cells: Blastocyst.
2. Adult stem cells: Hematopoietic stem cells.

B. Classification of stem cells based on cell potency:

1. Totipotent: Zygote.
2. Pluripotent: Embryonic stem cells.
3. Multipotent: Hematopoietic stem cells.
4. Unipotent: Spermatogonia.

*Cell potency: Ability of cells to differentiate into other cell types.

1. Embryonic stem cells (ESC):

- These stem cells derived from the embryo.
- These are pluripotent stem cells.
- Inner cell mass (ICM) from blastocyst.
- Embryonic germ cells (EGCs) are also derived from gonadal ridge region of embryo.

2. Adult stem cells (ASC):

These can be obtained from

- Umbilical cord stem cells.
- Placental stem cells.
- Adult tissue stem cells

These are multipotent or unipotent.

Example: hematopoietic stem cells, neural stem cells, mesenchymal stem cells.

1. Totipotent stem cells:

- These stem cells have the ability to form whole organism.
- Capable to develop and differentiate any cell type of an organism including placenta.
- Example: Fertilized egg i.e. Zygote, blastomeres after early cleavage.

2. Pluripotent stem cells:

- These stem cells can differentiate or develop into any or several kind of cells but can not develop the whole organism.
- Can't differentiate into extraembryonic tissues as placenta.

Example: Inner cell mass from the blastocyst.

3. Multipotent stem cells:

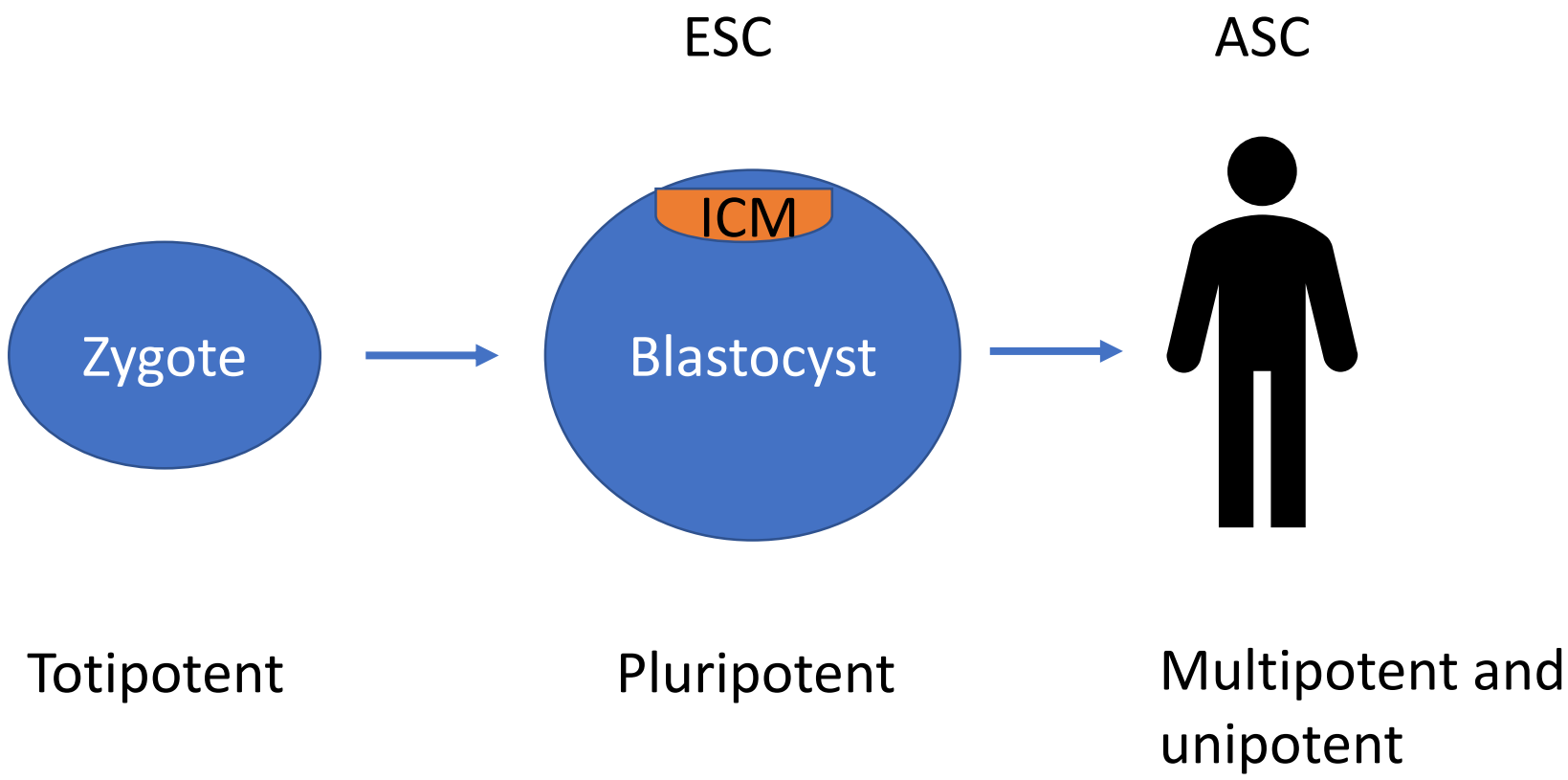
- These stem cells can differentiate into many cell types but not all.
- These stem cells can form many cell types of one germ layer not all three.

Example: hematopoietic stem cells which can differentiate into different blood cells as RBC, WBC, platelets etc but they can not form other cell types as neural cells, kidney cells.

4. Unipotent stem cells:

- These stem cells can develop into one type of cells while maintaining their undifferentiated form.

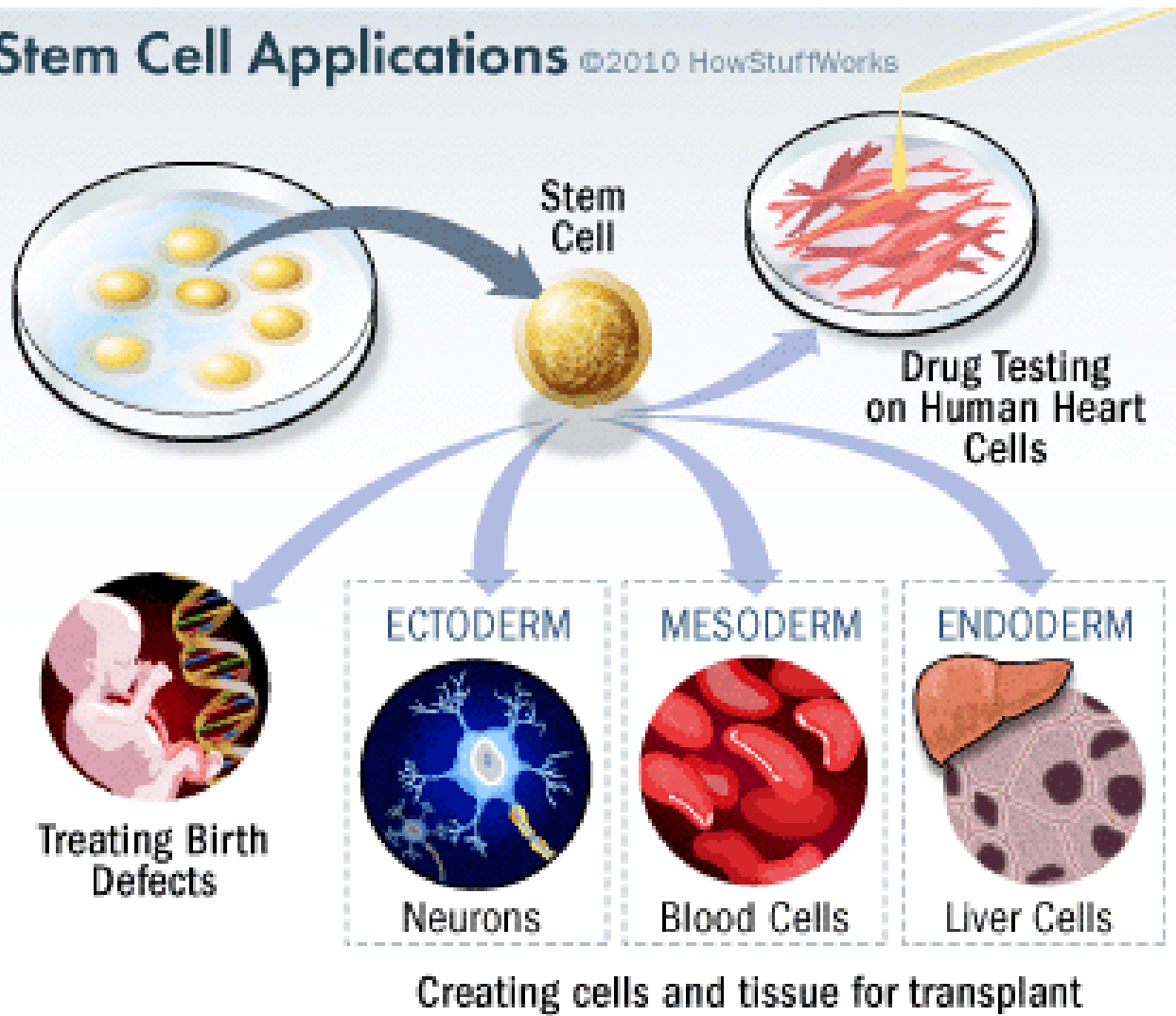
Example: Spermatogonia differentiate into sperm cells.
Epidermal stem cells.



Application of stem cells:

- Stem cells therapy for repair of damaged tissues.
- Used for the study of development of an organism.
- Used for the study and treatment of many diseases as cancer, neurodegenerative disease, diabetes etc.
- Drug target validation.

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References:

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THANK
you