

Stem Cells

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Raul Duarte

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Introduction

☞ Why do Research on Stem Cells?

To learn how organisms develop from single cells.

To learn how healthy cells replace damaged cells.

What will Stem Cell Research Provide

Cell-based therapies to treat disease:

Regenerative Medicine

Reparative Medicine

What are Stem Cells?

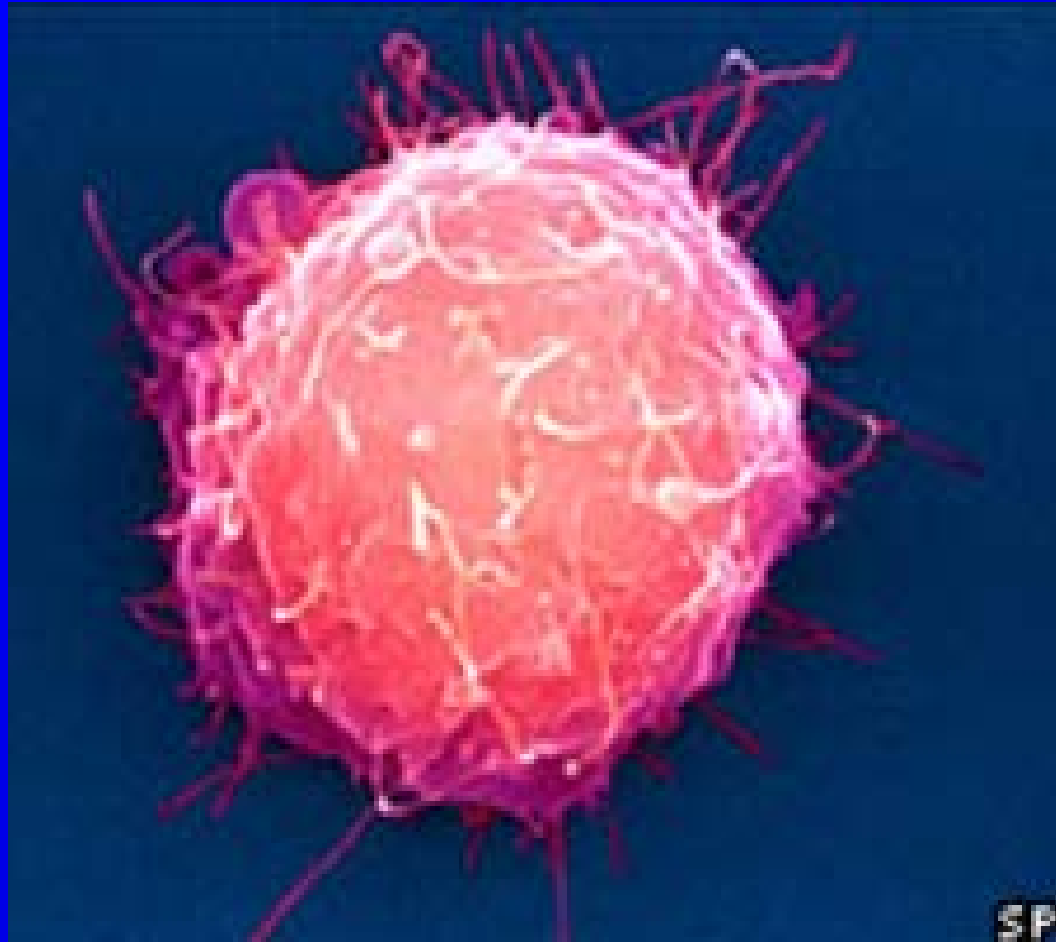
They are unspecialized cells that can self-renew through cell division.

They are cells that can be induced to become cells with special functions, for instance, beating cells of the heart muscle or insulin-producing cells of the pancreas.

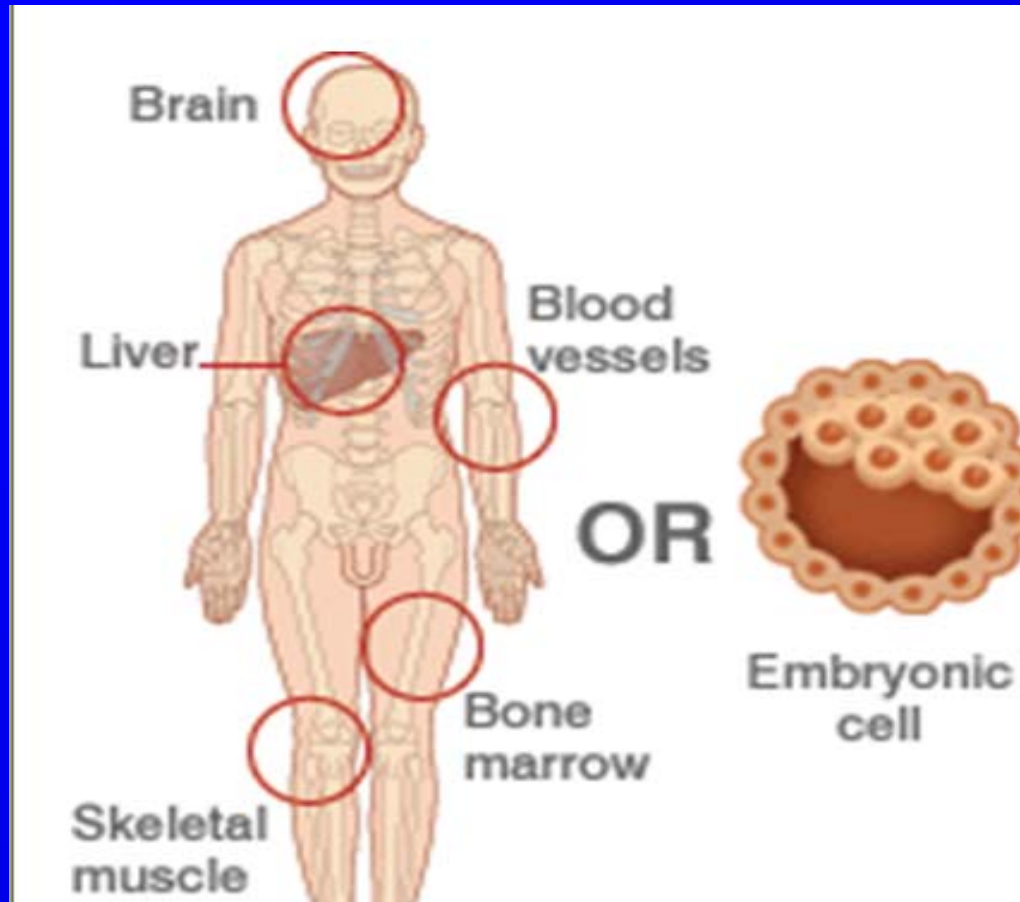
Source: National Institute of Health – NIH

What are Stem Cells

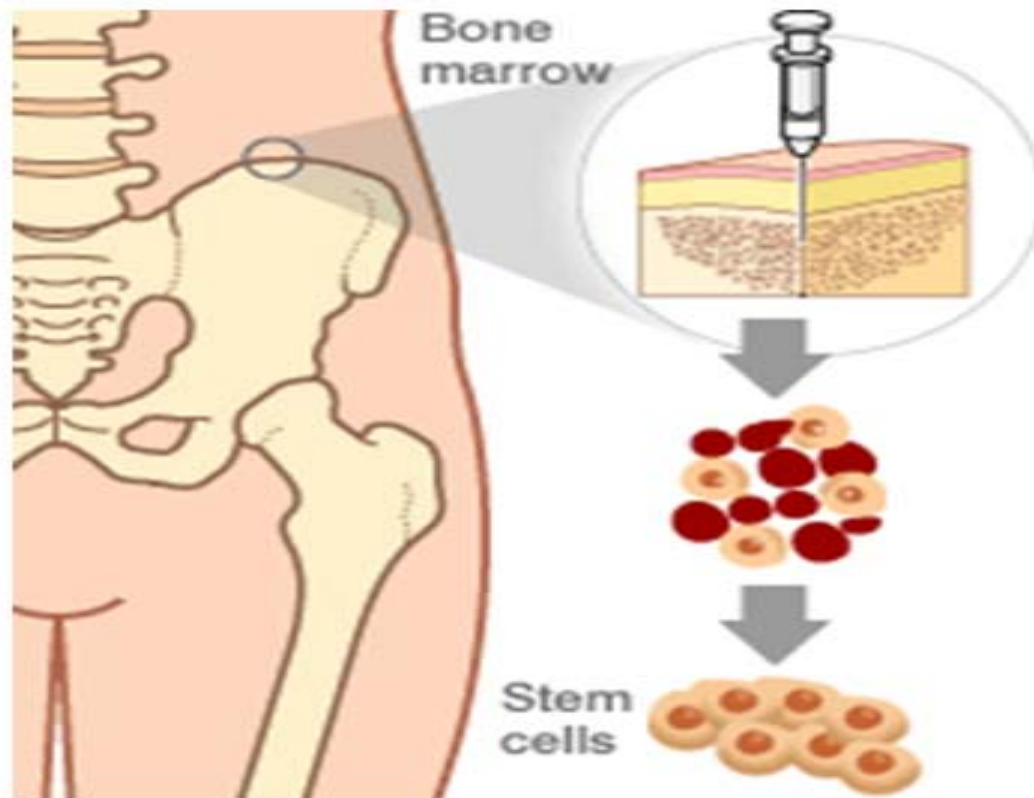
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Stem cell Technology

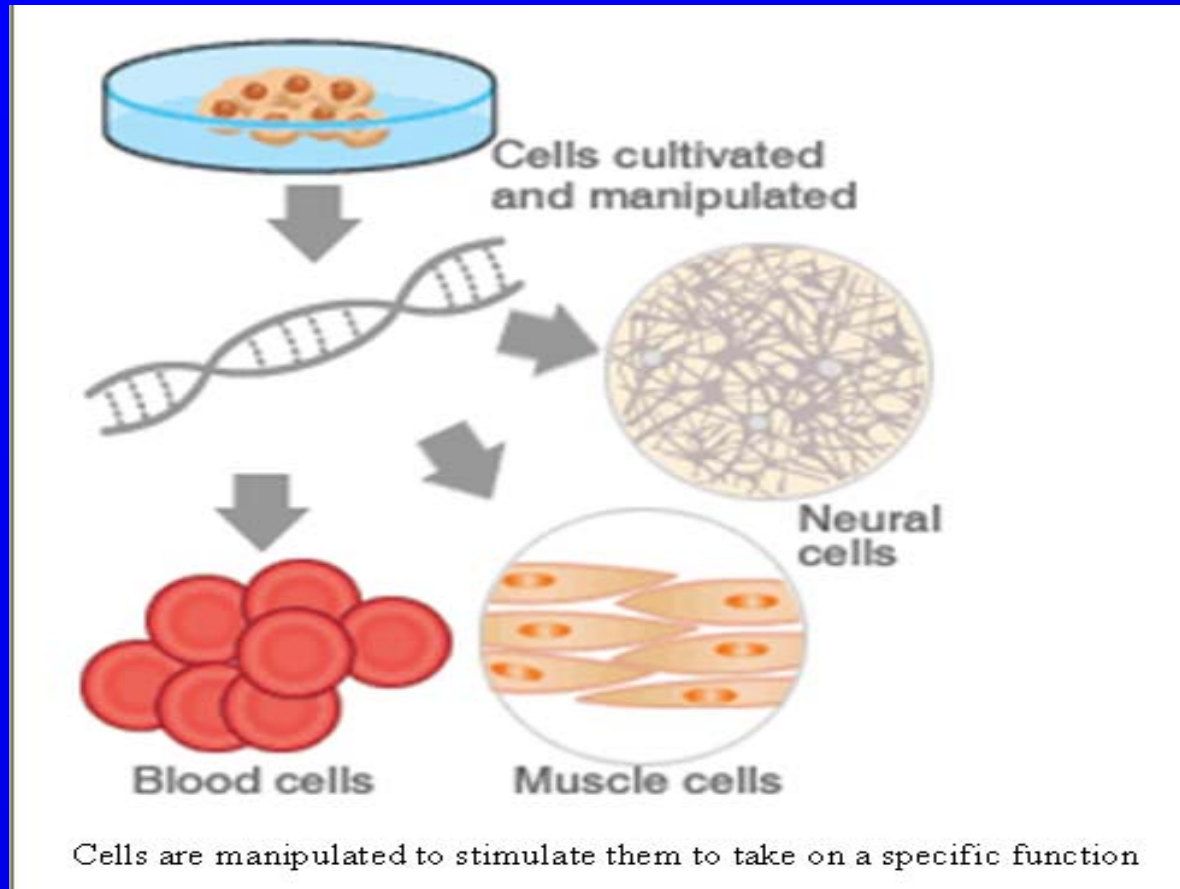


Stem Cell Technology

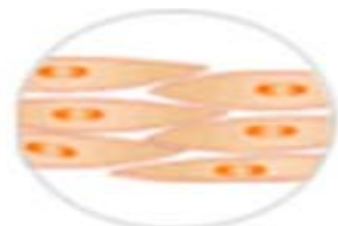


Adult stem cells are identified and separated from other cells

Stem Cell Technology



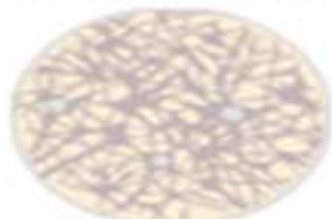
Stem Cell Technology



Muscle cells



Heart



Neural cells



Spinal cord



Blood cells



Bone marrow

Specialized cells may then be used to treat unhealthy areas

Stem cells differ from other cells in the body.

All stem cells regardless, of their source have three general properties:

They are capable of dividing and renewing themselves.

They are unspecialized.

They can give rise to specialized cell types.

Stem Cells are Capable of Dividing and Renewing Themselves

Mature cells (muscle cells, red blood cells, or nerve cells),
do not normally replicate.

- Stem cells can replicate many times.

Stem Cells are Capable of Dividing and Renewing Themselves

Proliferation is when cells replicate many times over.

A starting population of stem cells that proliferates for many months in the laboratory can yield millions of cells.

If the resulting cells continue to be unspecialized, like the parent stem cells, the cells are said to be capable of long-term self renewal.

Stem Cells are Unspecialized

A stem cell does not have any tissue-specific structures:

- A stem cell cannot work with its neighbors to pump blood through the body (like a heart muscle cell);
- It cannot carry molecules of oxygen through the blood stream (like a red blood cell);
- It cannot fire electrochemical signals to other cells that allow the body to move or speak (like a nerve cell).

Stem Cells are Unspecialized

However:

Unspecialized cells (Stem Cells) can give rise to specialized cells,

Including: Heart muscle,
Blood cells, or
Nerve cells.

Stem Cells Can Give Rise to Specialized Cells

Differentiation is when unspecialized stem cells give rise to specialized cells.

Signals inside and outside the cells trigger stem cell differentiation.

- Internal signals are controlled by a cell's genes.

Genes are interspersed across long strands of DNA and carry coded instructions for all the structures and functions of a cell.

- External signals for cell differentiation include chemicals secreted by other cells, physical contact with neighboring cells, and certain molecules in the microenvironment.

Types of Stem Cells

Adult Stem Cells or Somatic Stem Cells.

Embryonic Stem Cells.

What are Adult Stem Cells

- An adult stem cell is an undifferentiated cell found among differentiated cells in a tissue or organ.
- Adult stem cells can self-renew, and can differentiate into progenitor cells to yield the specialized cell types of the tissue or organ.
- The primary role of adult stem cells in a living organism is to maintain and repair the tissue in which they are found.

Potential Uses of Human Stem Cells

The most important potential application:

- The generation of cells and tissues that could be used for cell-based therapies.

Potential Uses of Human Stem Cells

Today, donated organs and tissues are used to replace ailing or destroyed tissue.

The need for transplantable tissues and organs far outweighs the available supply.

Potential Uses of Human Stem Cells

Stem cells, directed to differentiate into specific cell types, offer a renewable source of replacement cells and tissues to treat diseases such as:

- Parkinson's and Alzheimer's diseases,
- spinal cord injury,
- stroke,
- burns,
- heart disease,
- diabetes,
- osteoarthritis, and
- rheumatoid arthritis.

The Ideal Stem Cell Research Laboratory

- A GMP facility that will house a multi-use laboratory utilizing six separate manufacturing laboratories, all completely separate from the other.
- Each lab has its own HEPA filtered HVAC unit, that operates independently, providing Class 10,000 certified air.
- Each is equipped with a biological safety cabinet and dual chamber incubators.
- The laboratories will adhere to current Good Manufacturing Practice (cGMP) standards (FDA guidelines) and will operate in a BSL2 environment.
- Access to these labs consists of two gowning rooms, two intermediate entry rooms, one intermediate exit room, and one degowning area.

Thank You



P.O. Box 23952

Belleville, IL 62223

Phone: (618) 235-2849

Fax: (618) 235-3050

E-mail: rduarte@ddkscientific.com

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