

# Understanding Stem Cell Research

## What are stem cells?

Stem cells are the foundation cells for every organ, tissue and cell in the body. They are like a blank microchip that can ultimately be programmed to perform particular tasks. Stem cells are undifferentiated or "blank" cells that have not yet fully specialized. Under proper conditions, stem cells begin to develop into specialized tissues and organs. Additionally, stem cells can self-renew, that is they can divide and give rise to more stem cells.

## What is an embryonic stem cell?

Embryonic stem cells exist only at the earliest stages of embryonic development and are capable of making any cell type in the body. Under the right conditions, these cells retain the ability to divide and make copies of themselves indefinitely. Scientists are beginning to understand how to make these cells develop into any of the more than 200 different types of cells in the human body.

## What is an adult stem cell?

Adult stem cells, also known as tissue-specific stem cells, are present in adults, children, newborn infants and developing fetuses. Adult stem cells are more limited and specialized than embryonic stem cells. They have the ability to make just one or two kinds of tissue, such as blood and immune system cells, brain or muscle cells. Adult stem cells also have a more limited capacity to replace themselves than do embryonic stem cells.

## What is an iPS (induced pluripotent stem) cell?

iPS cells are adult cells reprogrammed to behave like embryonic stem cells. While iPS cells are an exciting discovery, these cells could never be used in patients because the use of viruses to reprogram these adult cells predisposes the cells to cancer. As a result, these cells cannot replace the use of embryonic stem cells. There is widespread agreement among leading stem cell researchers, including the scientists that developed iPS cells, that research must continue on all types of stem cells including those derived from embryos.

## What is Somatic Cell Nuclear Transfer (SCNT)?

Somatic cell nuclear transfer (SCNT) is a technique in which the nucleus of a somatic cell, that is any cell of the body apart from the sperm or egg, is transferred into an egg that has had its original nucleus removed. The egg now has the same DNA, or genetic material, as the donor somatic cell. Given the right signals, the egg can be coaxed into developing as if it had been fertilized. The egg would divide to form 2 cells, then 4 cells, then 8 cells and so on until the blastocyst is formed. Embryonic stem cells can be derived from this blastocyst to create cell lines that are genetically identical to the donor somatic cell.

## Where do stem cells come from?

Embryonic stem cells are derived from the inner cell mass of a blastocyst: the fertilized egg, called the zygote, divides and forms two cells; each of these cells divides again, and so on. Soon there is a hollow ball of about 150 cells called the blastocyst that contains two types of cells, the trophoblast and the inner cell mass. Embryonic stem cells are obtained from the inner cell mass.

Stem cells can also be found in small numbers in various tissues in the fetal and adult body. For example, blood stem cells are found in the bone marrow that give rise to all specialized blood cell types. Such tissue-specific stem cells have not yet been identified in all

vital organs, and in some tissues like the brain, although stem cells exist, they are not very active, and thus do not readily respond to cell injury or damage.

Stem cells can also be obtained from other sources, for example, the umbilical cord of a newborn baby is a source of blood stem cells. Recently, scientists have also discovered the existence of cells in baby teeth and in amniotic fluid that may also have the potential to form multiple cell types. Research on these cells is at a very early stage.

Recently, cells with properties similar to embryonic stem cells, referred to as induced pluripotent stem cells (iPS cells) have been engineered from somatic cells (see ‘What is are induced pluripotent stem cells?’).

### **What is a stem cell line?**

A stem cell line is a population of cells that can replicate themselves for long periods of time in vitro, meaning outside of the body. These cell lines are grown in incubators with specialized growth factor-containing media (liquid food source), at a temperature and oxygen/carbon dioxide mixture resembling that found in the mammalian body.

Also see:

[\*Stem Cell Comparison Chart \(.pdf\)\*](#)