

What are stem cells?

Stem Cell & Regenerative Medicine Center University of Wisconsin-Madison



Stem cells are undifferentiated or “blank slate” cells from which other types of cells can arise. The defining characteristic of human stem cells is their ability to self-renew (provide an exact copy of themselves) while maintaining the potential to develop into other types of cells, such as blood, brain or heart. Although stem cells from different sources all share these general characteristics, there are also significant differences among them. There are three major types of stem cell.

Pluripotent Stem Cells (PS cells). Pluripotent stem cells have the capacity to divide for long periods while retaining the ability to make all cell types within the organism. The best known type of pluripotent stem cell is the embryonic stem cell. As the name implies, embryonic stem cells (or ES cells) are derived from embryos at what is known as the blastocyst stage of development. The stem cells originate from the inner cell mass inside a hollow ball of cells that is smaller than the period at the end of this sentence. The unique characteristic of embryonic stem cells is the ability, in theory, to replicate indefinitely in culture while retaining pluripotency. This makes them especially interesting to biomedical science as a potentially inexhaustible source of cells for both research applications and for potentially treating many different diseases. Very recently, pluripotent stem cells have been derived from adult skin cells and have been termed induced pluripotent stem cells or iPS cells.

Fetal stem cells. These are derived from specific tissues of a developing human fetus. Scientists can generate cells from different regions of the developing body and expand them in culture for long periods. These fetal stem cells seem to retain characteristics of the tissue from which they were taken. For example, fetal stem cells derived

from the brain have the capacity to make only nervous tissue, not blood or heart. Sometimes these are called progenitor cells, indicating that they have the potential to make only a limited range of tissue types.

Adult stem cells. These can be isolated from some tissues of the adult body. Bone marrow, for example, is a rich source of stem cells that can be used to treat some blood diseases. Adult stem cells have been found in many different tissues, but they are sometimes limited in their ability to expand in large numbers or differentiate into a wide variety of cell types.

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