Stem Cell Key Terms

En Español

The term “stem cell” by itself can be misleading. In fact, there are *many different types* of stem cells, each with very different potential to treat disease.

Stem Cell
Pluripotent
Embryonic Stem Cell
Adult Stem Cell
iPS Cell
Cancer Stem Cell

Stem Cell

By definition, all stem cells:

1. have the ability to divide and create an identical copy of themselves, a process called self-renewal; and
2. can also divide to form cells that mature into cells that make up every type of tissue and organ in the body.

Pluripotent

Pluripotent means many "potentials". In other words, these cells have the potential of taking on many fates in the body, including all of the more than 200 different cell types. Embryonic stem cells are pluripotent, as are induced pluripotent stem (iPS) cells that are reprogrammed from adult tissues. When scientists talk about pluripotent stem cells, they mostly mean either embryonic or iPS cells.

Embryonic Stem Cell

Embryonic stem cells come from pluripotent cells, which exist only at the earliest stages of embryonic development. In humans, these cells no longer exist after about five days of development.

When isolated from the embryo and grown in a lab dish, pluripotent cells can continue dividing indefinitely. *These cells are known as embryonic stem cells.*

James Thomson, a professor in the Department of Cell and Regenerative Biology at the University of Wisconsin, derived the first human embryonic stem cell lines in 1998. He now shares a joint appointment at the University of California, Santa Barbara, a CIRM-funded institution.

Adult Stem Cell

Adult stem cells are found in the various tissues and organs of the human body. They are thought to exist in most tissues and organs where they are the source of new cells throughout the life of the organism, replacing cells lost to natural turnover or to damage or disease.

Adult stem cells are committed to becoming a cell from their tissue of origin, and can’t form other cell types. They are therefore also called tissue-specific stem cells. They have the broad ability to become many of the cell types present in the organ they reside in. For example:

- Adult blood-forming stem cells in the bone marrow can give rise to any of the red or white cells of the blood system.
- Adult stem cells in the intestine can form all the cell types of the intestinal lining.

Unlike embryonic stem cells, researchers have not been able to grow adult stem cells indefinitely in the lab, but this is an area of active research.

Scientists have also found stem cells in the placenta and in the umbilical cord of newborn infants, and they can isolate stem cells from different fetal tissues. Although these cells come from an umbilical cord or a fetus, they more closely resemble adult stem cells than embryonic stem cells because they are tissue-specific. The cord blood cells that some people bank after the birth of a child are a form of adult blood-forming stem cells.

CIRM-grantee Irv Weissman of the Stanford University School of Medicine isolated the first blood-forming adult stem cell from bone marrow in 1988 in mice and later in humans.

Irv Weissman explains the difference between an adult stem cell and an embryonic stem cell (video)

iPS Cell

An induced pluripotent stem cell, or iPS cell, is a cell taken from any tissue (usually skin or blood) from a child or adult and is genetically modified to behave like an embryonic stem cell. As the name implies, these cells are pluripotent, which means that they have the ability to form all adult cell types.

Shinya Yamanaka, an investigator with joint appointments at Kyoto University in Japan and the Gladstone Institutes in San Francisco, created the first iPS cells from mouse skin cells in 2006. In 2007, several groups of researchers including Yamanaka and James Thomson from the University of Wisconsin and University of California, Santa Barbara generated iPS cells from human skin cells.

Cancer Stem Cell

Cancer stem cells are a subpopulation of cancer cells that, like stem cells, can self-renew. However, these cells—rather than growing into tissues and organs—propagate the cancer, maturing into the many types of cells that are found in a tumor.

Cancer stem cells are a relatively new concept, but they have generated a lot of interest among cancer researchers because they could lead to more effective cancer therapies that can treat tumors resistant to common cancer treatments.

However, there is still debate on which types of cancer are propelled by cancer stem cells. For those that do, cancer stem cells are thought to be the source of all cells that make up the cancer.

Conventional cancer treatments, such as chemotherapy, may only destroy cells that form the bulk of the tumor, leaving the cancer stem cells intact. Once treatment is complete, cancer stem cells that still reside within the patient can give rise to a recurring tumor. Based on this hypothesis, researchers are trying to find therapies that destroy the cancer stem cells in the hopes that it truly eradicates a patient's cancer.

John Dick from the University of Toronto first identified cancer stem cells in 1997. Michael Clarke, then at the University of Michigan, later found the first cancer stem cell in a solid tumor, in this case, breast cancer. Now at Stanford University School of Medicine, Clarke and his group have found cancer stem cells in colon cancer and head and neck cancers.

Find out More:

Catriona Jamieson talks about therapies based on cancer stem cells (4:32)

Stanford Publication: The true seeds of cancer

UCSD Publication: From Bench to Bedside in One Year: Stem Cell Research Leads to Potential New Therapy for Rare Blood Disorder

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