

# Fact Sheet 1

## What are Stem Cells?

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Stem cells are stirring up great excitement in medical research. What are they and why are scientists so intrigued by them?

### What are stem cells?

The human body is made up of about 200 different kinds of specialised cells such as muscle cells, nerve cells, fat cells and skin cells. All specialised cells originate from stem cells. A stem cell is a cell that is not yet specialised. The process of specialisation is called differentiation and once the differentiation pathway of a stem cell has been decided, it can no longer become another type of cell.

Different types of stem cells have different levels of *potential*. A stem cell that can become every type of cell in the body is called **pluripotent** and a stem cell that can become only some types of cells is called **multipotent**.

### Where are stem cells found?

Stem cells are found in the early embryo, the foetus, amniotic fluid, the placenta and umbilical cord blood. After birth and for the rest of life, stem cells continue to reside in many sites of the body, including skin, hair follicles, bone marrow and blood, brain and spinal cord, the lining of the nose, gut, lung, joint fluid, muscle, fat, and menstrual blood, to name a few.

In the growing body, stem cells are responsible for generating new tissues, and once growth is complete, stem cells are responsible for repair and regeneration of damaged and ageing tissues.

Stem cells can be divided into two broad groups: **tissue specific stem cells** (also known as adult stem cells) and **pluripotent stem cells** (including embryonic stem cells and iPS cells). Tissue specific stem cells are derived from, or resident in, adult tissues, and can usually only give rise to the cells of that tissue, thus they are considered **multipotent**. Embryonic stem cells, derived from a small group of cells in the early embryo (5-7 days), are undifferentiated and are considered **pluripotent** as they can become every type of cell in the body. Recently, scientists discovered that a mature fully specialised cell, for example a human skin cell, in the right conditions could be induced to mimic the characteristics of an embryonic stem cell. These are known as induced pluripotent stem cells (iPS cells).

### Why are stem cells so different?

Stem cells are different from other cells in the body in three main ways:

1. **Stem cells are unspecialised.** They have not developed into cells that perform a specific function.
2. **Stem cells can differentiate.** This means they can divide and produce cells that have the potential to become other more specific cell types, tissues or organs. These new cells and tissues are used to repair or replace damaged or diseased cells in the body. Once cells have differentiated, they have less capacity to form multiple different cell types, and become 'committed' to becoming a particular cell type. Skin stem cells, for example, give rise to new skin cells when needed, to assist regeneration after damage and as part of the normal ageing process.

3. **Stem cells are capable of self-renewal.** Stem cells are able to divide and produce copies of themselves which leads to self-renewal. Once a cell has become specialised (has differentiated) to a particular tissue or organ, it has a very limited capacity to self-renew (produce new stem cells) but instead produces only cells relevant to that organ.

Image 1: Why are stem cells so special?

