

Stem Cells and Regenerative Medicine

The term stem cell refers to any cell which is found in a developed organism that has two properties: the ability to divide and create another cell like itself and also divide and create a cell more differentiated than itself.

Stem cells have the ability for:

- self-renewal capacity
- long-term viability, and multilineage potential

Until recently, differentiation was thought to be the primary function of regenerative cells. However, the functions of regenerative cells are now known to be much more diverse and are implicated in a highly integrated and complex network.

[!\[\]\(d66ff64371a51729ac8c1cdaa685ba6f_img.jpg\)A microscopic image showing a single stem cell, which is a small, round cell with a prominent nucleus and a thin layer of cytoplasm.](http://www.istockphoto.com/stock-photo-14442543-stem-cell.php)

Stem cells have the remarkable potential to develop into many different cell types in the body during early life and growth. In addition, in many tissues they serve as a sort of internal repair system, dividing essentially without limit to replenish other cells as long as the person or animal is still alive.

When a stem cell divides, each new cell has the potential either to remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, a red blood cell, or a brain cell.

Stem Cells are multipotent and can differentiate into tendon, ligament, bone, cartilage, cardiac, nerve, muscle, blood vessels, fat, and liver tissue (see figure below). Thus, treatment using stem cells is termed "regenerative medicine" and has many potential uses for a wide variety of diseases and injuries.

Stem cells are important for living organisms for many reasons. In the 3- to 5-day-old embryo, called a blastocyst, the inner cells give rise to the entire body of the organism, including all of the many specialized cell types and organs such as the heart, lung, skin, sperm, eggs and other tissues. In many adult tissues, such as bone marrow, adipose, muscle, and brain, discrete populations of adult stem cells generate replacements for cells that are lost through normal wear and tear, injury, or disease.

[!\[\]\(cf531ed27e91483460120fcc057b3901_img.jpg\)A microscopic image showing a cluster of stem cells, which are small, round cells with a prominent nucleus and a thin layer of cytoplasm.](http://www.istockphoto.com/stock-photo-9199737-stem-cell.php)

Unlike traditional medicine, in which one drug targets one receptor, stem cell based regenerative medicine, including AVSC therapies, can be applied in a wide variety of traumatic and developmental diseases.

[!\[\]\(4b7a79268f6ba26c1471d4232fffa85a_img.jpg\)A microscopic image showing a cell in the process of division, with a prominent nucleus and a thin layer of cytoplasm.](http://www.istockphoto.com/stock-photo-6300680-cell-biology.php)

A significant potential application of stem cells is making cells and tissues for medical therapies.

The use of stem cells offer the possibility of a renewable source of replacement cells and tissues to treat a myriad of diseases, conditions, and disabilities including Parkinson's disease, amyotrophic lateral sclerosis, spinal cord injury, burns, heart disease, diabetes, and arthritis.

[!\[\]\(4f6bf54ae7e4144a72d78316053e412d_img.jpg\)A microscopic image showing a single stem cell, which is a small, round cell with a prominent nucleus and a thin layer of cytoplasm.](http://www.istockphoto.com/stock-photo-14442532-stem-cell.php)

Given both the clinical and ethical issues surrounding the use of embryonic stem cells, Australian Veterinary Stem Cells has been pursuing the use of adult stem cells from the stroma (i.e., mesenchymal stem cells (MSCs)) in the treatment of a number of conditions in the veterinary setting.

Adult stem cells are found throughout

the body and are present in all of us at all ages.

Adult stem cells have been used internationally for the treatment of horses and dogs for many years. Most of the work has been focused on the treatment of arthritis and dermatitis in dogs as well as tendon, ligament and muscle injuries in horses.

Initial results have been extremely promising. For instance, in approximately 90% of cases of dogs treated with stem cells for arthritic conditions, veterinarians and owners of dogs have reported an average improvement in quality of life of 75%.

[</p> <p>AVSC regenerative medicine uses adult stem cells to treat traumatic, inflammatory and degenerative diseases, including osteoarthritis, atopic dermatitis, bowed tendons, ligament injuries, and osteochondral defects in dogs and horses.</p> <p>AVSC technology delivers a functionally diverse cell population able to communicate with other cells in their local environment. AVSC technology should be viewed as a complex, yet balanced, approach to a therapeutic goal.</p>](http://www.istockphoto.com/stock-photo-2306186-girl-smiling-with-dog.php)