

Stem Cells

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INTRODUCTION

Stem cells are a type of cell that is known to differentiate, which means they specialize by turning into a specific type of cell. They can survive for several years if they are frozen, which makes them easy to work with. Stem cells could repair damaged tissues in living organisms.

STAGES OF DEVELOPMENT

Stem cells come in three stages of development. The first stage is embryonic stem cells. Embryonic stem cells have the ability to differentiate into any cell. They can also reproduce indefinitely. Embryonic stem cells are usually taken from the embryos of rodents, when they are about five days old. At that age, they are made up of a double-layered ball of cells which is called a blastocyst. Embryonic stem cells can be transplanted into other animals, even of another species, and the body's immune system won't reject them. They can also do human embryonic stem cells from in vitro fertilization, which is when they grow them in a test tube. Another stage is fetal stem cells. These stem cells can be taken from the blood in the placental end of the umbilical cord. There are a limited number of cells here, but scientists can make them multiply. The final stage is adult stem cells. These stem cells are more difficult to collect. One example of an adult stem cell is bone marrow stem cells. To get them, they will inject a growth factor so the cells spill out into the blood, and they can be collected. Bone marrow stem cells can transdifferentiate when they are injected into other tissues, like the brain and heart. When they are injected into the heart, it formed new muscle tissue, but the new muscle tissue did not electrically connect to the rest of the heart, so it caused irregular heartbeats. When the bone marrow stem cells were injected into the brain, they would not get rejected because the brain is immune privileged.

CELL POTENCY

Stem cells can be classified based on what types of cells they are able to differentiate into. Totipotency is when a cell divides and produces all the types of cells. Pluripotency is when a stem cell can differentiate into any of the three germ layers. The germ layers are endoderm, mesoderm and ectoderm. The endoderm makes up the interior stomach lining and lungs. The mesoderm makes up muscle, bone, and blood. The ectoderm makes up epidermal tissues and the nervous system. Induced Pluripotency is when a cell

originally nonpluripotent is modified through forced genes to make it pluripotent. Multipotency is when cells will differentiate into different types of cells within a group of cells. An example is blood cells that can turn into three types of blood cells, but cannot turn into brain cells.

POTENTIAL USES

Stem cells could be used to study how they specialize into a specific type of cell. They can also be used for cancer research, to figure out what causes cancer cells to form and divide. Stem cells could replace animal testing for some cases, because scientists could create human cell types to use instead. With enough research in the field, stem cells could eventually help cure many types of diseases and conditions.

STEM CELLS USED FOR BLINDNESS

Scientists have created an early stage retina from human embryonic stem cells. It is the first three-dimensional tissue structure to be made from stem cells. If they can successfully grow a retina from stem cells, they would be able to implant it into patients who have conditions like Retinitis Pigmentosa and Macular Degeneration. This early stage retina is being tested in animal models right now, and if they get positive results, they will do human clinical trials. Another experiment scientists have done is treating mice that are blind from light sensing photoreceptor cells dying. The scientists injected cells that were developing into retinas into their eyes, and after two weeks, it had reformed a light-detecting layer in the retina. They were able to tell it worked successfully due to pupil constriction in reaction to light.

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