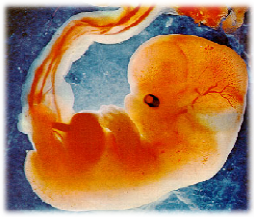
SNC2D BIOLOGY

TISSUES, ORGANS & SYSTEMS OF …

- ☞ Stem Cells & Meristematic Cells (P.40-41)

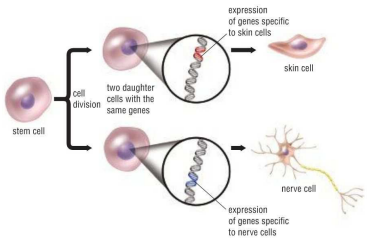
Specialized Cells

The cell theory states that all cells come from pre-existing cells. Every cell that makes up an animal's body comes from a single fertilized egg cell. The cells grow and divide in a repeating cycle: the cell cycle. You also know that cells die. In an adult human, the rate at which new cells are created is about the same as the rate at which old cells die.



Stem Cells

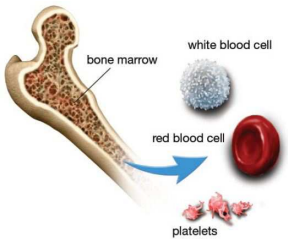
*Cells can become worn or damaged. Sometimes specialized cells can no longer divide. When this happens, unique cells called stem cells replace the damaged cells. A **stem cell** is different from other cells: it is **not** specialized and can divide repeatedly. The daughter cells it produces can become specialized (i.e. see diagram below).*



Stem Cells

NOTE!

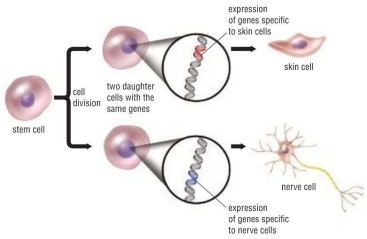
In some organs, such as bone marrow, stem cells regularly divide to replace worn out or damaged tissues. For example, stem cells from adult bone marrow can become red blood cells, white blood cells, or platelets. In other organs, such as the pancreas and the heart, stem cells only divide under special conditions.



Stem Cells

STEM CELL

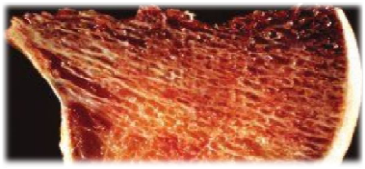
- cell that is not specialized
- can divide repeatedly to produce cells that become specialized



Stem Cells

NOTE!

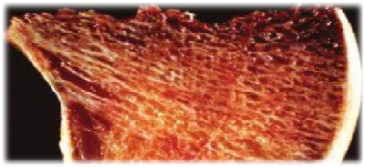
Human skin, bone marrow, and some other tissues contain stem cells. That helps explain how we can easily grow new skin cells, but not new nerve cells.



Stem Cells

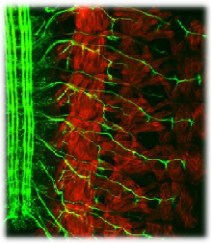
DYK?

If specialized nerve cells could "turn on" the segments of genetic information that allow them to divide, they could work like stem cells and once again begin dividing. This would mean that nerve cells could be restored or regenerated following a stroke or spinal cord injury.



Putting Stem Cells to Work

Thus, stem cells have the potential to repair specialized tissue cells in any organ. Many medical experts believe that stem cells can be used to treat a variety of illnesses and injuries, including wound healing, bone regeneration, and diseases such as cancer, heart disease, diabetes, and Parkinson's disease.



Putting Stem Cells to Work

In fact, in laboratories around the world, scientists are studying the superstar of regeneration – the salamander. ***Regeneration*** *is the process whereby a body part is replaced or regrown. The salamander has the unique ability to regrow not only limbs that have been amputated but also tails, lenses in eyes, and parts of the heart. In the salamander, the process of mitosis is responsible for regenerating the cells that will eventually specialize and create a newly formed limb.*

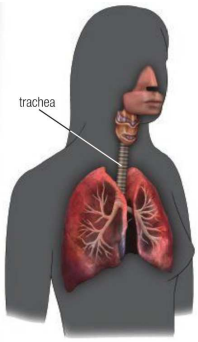
Putting Stem Cells to Work

In 2008, scientists reported that a powder, made from pigs' bladders, stimulated a human adult fingertip that had been severed to regrow. Another development in the field of regeneration was the growth of an artificial bladder using the patient's own bladder cells. In two months, the cells had formed a functioning bladder that was implanted into the patient. This technology has also been used to create functioning blood vessels and heart valves.

Figure 1.39 An artificial bladder held by gloved hands. The bladder was grown from cultured bladder cells.

Putting Stem Cells to Work

In another case doctors in Barcelona, Spain, used a trachea from a donor to help a patient grow a new trachea. Doctors first stripped the living cells from the donor trachea, leaving behind non-living cartilage. Stem cells from the patient's bone marrow were then grafted over the cartilage, creating a hybrid trachea. Since there were no living cells remaining on the donor trachea, there was less chance of it being rejected. In the future, scientists believe it may be possible to grow all body parts including the human heart.



Putting Stem Cells to Work

REGENERATION

- process whereby a body part is replaced or regrown
- uses mitosis

STEM-CELL THERAPY

- process whereby stem cells are used to treat injuries and diseases and regenerate organs that typically do not regenerate (known as "tissue engineering")
- stroke victims, spinal injuries, …

Putting Stem Cells to Work

NOTE!

Current research involves the use of stem cells in the treatment of such diseases as cancer, Parkinson's disease, Alzheimer's disease, stroke, heart disease, diabetes, and rheumatoid arthritis. However, there is much public debate about the use of embryonic stem cells. It is possible to harvest a few embryonic stem cells from the umbilical cord or placenta, but to collect larger amounts of embryonic stem cells, it is necessary to destroy the embryo.

STEM-CELL RESEARCH

- much debate re ethical issues – embryo must be destroyed

Specialized Plant Cells – Meristematic Cells

Just as animals contain some unspecialized cells called stem cells, plants have unspecialized cells that are called ***meristematic cells****. They are found in the growing tips of roots and stems and also in a layer in the stem known as the cambium. Plant meristematic cells are active throughout the life of a plant, which means that they continually produce new cells of various types.*

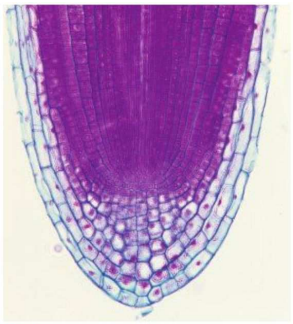


Figure 2 There are regions in all plant roots and stems, near the tips where rapid growth occurs, that contain meristematic cells.

Specialized Plant Cells – Meristematic Cells

MERISTEMATIC CELLS

- plant stem cells
- located in the tips of roots and shoots
- continually produce new cells

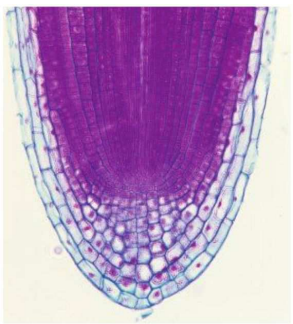


Figure 2 There are regions in all plant roots and stems, near the tips where rapid growth occurs, that contain meristematic cells.

✔ Check Your Learning

1. What obstacles stand in the way of stem cell therapy?

stem cell therapy has many obstacles including:

- scientists have not yet identified the stem cells that will produce the different types of specialized cell in the human body
- there are very few stem cells in the human body and the stem cells we have may have damaged DNA due to aging, exposure to toxins, or other reasons

✔ Check Your Learning

2. Describe how stem cell therapy might help a patient with lung disease.

stem cell therapy would allow the doctors to grow the patient a new set of lungs from the patient's own cells reducing the risk of rejection

✔ Check Your Learning

3. Predict some implications that would result if organ regeneration were possible for every organ in your body? Explain your choices.

answers will vary (social, political, economic, …)

✔ Check Your Learning

WIKI (BIOLOGY)

✎.... 2DBIOL - QUIZ2 (Chapter 1)