

# Title: Stem cells

## Learning objectives

1. Define what a stem cell is.
2. Describe where stem cells can be found.
3. Evaluate the use of stem cells.

# Starter – How Many...?

How many different types of cell can you list?

You have **2** minutes.

1 minute

Start

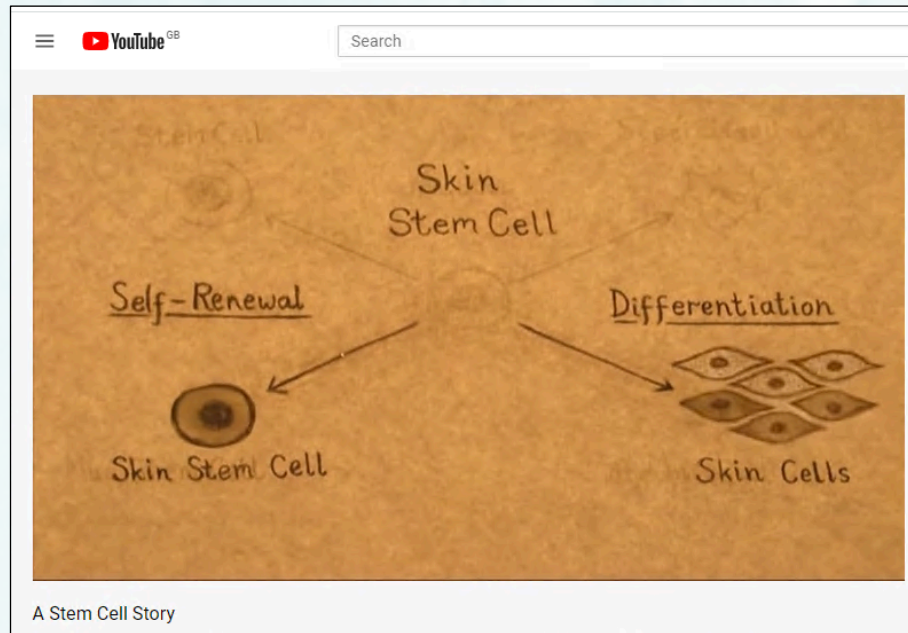
End

# Stem Cells

## What are stem cells?

Stem cells are undifferentiated cells; they are unspecialised.

Watch the [video](#) to learn more about stem cells.



# Stem Cells Continuum

Stem cells can be used in research and medical treatments. They can be sourced from some types of tissue in adults, but also from embryos and umbilical cord blood.

**Adult and embryonic stem cells should be used for medical treatment and research.**

What do you think so far?

What are your first thoughts and feelings?

agree

mixed feelings

disagree





# Stem Cells Continuum

Now, read through the information on the sheet and use it to answer the questions.

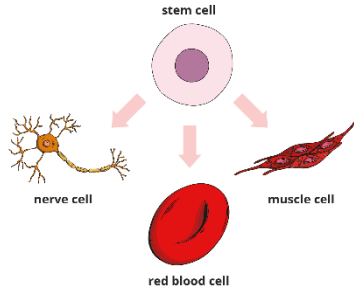
**B**

## Stem Cells

**What Are Stem Cells?**

All complex organisms are made up of a variety of different types of cells. These specialised cells all differentiate from one type of cell. This type of cell is called a stem cell.

Stem cells are undifferentiated cells that can give rise to many more cells of the same type and from which specialised cells, such as nerve cells or muscle cells, can arise through differentiation. Differentiation is the process of a cell becoming adapted to carry out a specific function.



stem cell

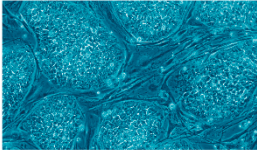
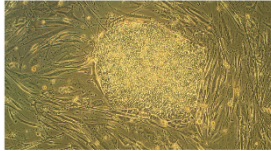
nerve cell

red blood cell

muscle cell

**Where Do Stem Cells Come From?**

There are two main types of stem cells: embryonic stem cells and adult stem cells.

Embryonic Stem Cells	Adult Stem Cells
	
<p>Embryonic stem cells are found in the blastocyst stage of early human embryos (around three to five days old). An embryo develops from an egg cell that has been fertilised by a sperm cell. Embryonic stem cells have the potential to differentiate into any type of cell.</p>	<p>Adult stem cells are the few cells which remain able to differentiate even once the organism is fully developed. They are found in small numbers in adult tissues such as bone marrow. Adult stem cells can only differentiate into a small number of different types of cells. For example, bone marrow stem cells give rise to blood cells.</p>

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# Ethical Debate

Embryonic stem cells have a wealth of potential for therapeutic uses because they can become specialised into any type of cell.

Some people support the use of embryonic stem cells.

Some people disagree with the use of embryonic stem cells.

## **Big Question**

Do you think all types of stem cells should be used for medical treatments?

## **Task**

Take a look at some opinions about stem cells and their use, then sort the opinions into two piles; agree with and disagree with.

Do you and your group always agree or disagree with the same opinions?

# Stem Cells Continuum

**Adult and embryonic stem cells should be used for medical treatment and research.**

What do you think now?

Has anything changed your position?

agree

mixed feelings

disagree



## Question:

Scientists can use stem cells for research and therapeutic treatment of diseases.

Adult stem cells have been used in therapeutic treatment of diseases and injuries. Leukaemia and skin grafts for severe burns are examples of conditions which are successfully treated with adult stem cell therapy, although not routinely available.

Adult stem cells can be collected from adult bone marrow and although simple, the procedure can be painful. The stem cells collected have been trialled for use in treating diseases such as heart disease.

Embryonic stem cells are extremely useful for exploring the development and differentiation of cells. The use of embryonic stem cells as a therapeutic treatment for human diseases is new and still being trialled.

Evaluate the arguments for the use of stem cells in research and therapeutic treatment of diseases. You should discuss the use of adult and embryonic stem cells.

Give a conclusion in your evaluation.

**[6 marks]**



	Adult Stem Cells	Embryonic Stem Cells
Advantages	<ul style="list-style-type: none"> <li>• Less likely to be rejected when transferred to a patient.</li> <li>• Have shown evidence of success in clinical applications.</li> <li>• No major ethical concerns.</li> </ul>	<ul style="list-style-type: none"> <li>• Can be grown and maintained in cultures for a year or longer.</li> <li>• There are tried and tested methods for successfully maintaining cultures of embryonic stem cells.</li> <li>• Can differentiate to almost any cell type.</li> <li>• Studies of embryonic stem cells help scientists learn about the process of development.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Limited differentiation potential.</li> <li>• Can only be grown in cultures for short durations.</li> <li>• Only a small number remain in tissues, so they are difficult to locate and isolate.</li> <li>• Technology to produce and grow the stem cells on a mass scale does not exist.</li> <li>• It can be difficult to find suitable stem cell donors.</li> <li>• Bone marrow donation can be painful for donors.</li> </ul>	<ul style="list-style-type: none"> <li>• The process for generating cloned cells from embryonic stem cells is inefficient and does not always produce viable cells.</li> <li>• Cells may be rejected.</li> <li>• Therapies using embryonic stem cells are still in the research phase and require extensive testing.</li> <li>• Cells used in transplants that are taken directly from the culture can lead to the development of tumours or cancers in the patients, because of rapid cell division.</li> <li>• An embryo is destroyed to obtain the cells.</li> <li>• There are wellbeing risks to the embryo donor as the process is physically intrusive and can be emotionally stressful.</li> </ul>

Use the table below to help you structure your answer.

What are the command words? How will I structure my answer?	What keywords will I include in my answer?
What scientific points do I need to make?	How will I link my ideas to gain the full marks?

What are the command words? How will I structure my answer?	What keywords will I include in my answer?
<p><b>Evaluate - use the information supplied, as well as my own knowledge and understanding, to consider evidence for and against to make a judgement.</b></p> <p><b>Use full sentences with correct spelling, punctuation, and grammar.</b></p>	<p><b>embryo</b></p> <p><b>ethical, social, religious</b></p> <p><b>differentiation</b></p> <p><b>infection</b></p> <p><b>stem cells</b></p> <p><b>stem cell therapy</b></p> <p><b>research</b></p>
What scientific points do I need to make?	How will I link my ideas to gain the full marks?
<ul style="list-style-type: none"> <li>• <b>stem cell research can lead to treatments for diseases and injuries</b></li> <li>• <b>research can improve understanding of cell development/cell differentiation</b></li> <li>• <b>successes of adult stem cell therapy</b></li> <li>• <b>limitations of adult stem cell therapy</b></li> <li>• <b>potential success of embryonic stem cell therapy</b></li> <li>• <b>limitations of embryonic stem cell therapy</b></li> </ul>	<p><b>Include a balanced number of statements about each type of stem cell.</b></p> <p><b>Use information from the question to link to diseases successfully treated with adult stem cells.</b></p> <p><b>Link limitations of adult stem cells to treat only some diseases/injuries.</b></p> <p><b>Explain the potential of embryonic stem cells to treat more types of disease.</b></p> <p><b>Counter with limitations of embryonic stem cells use.</b></p>

# Home Learning

You should also know what plant stem cells are and where they are found. Complete the **Meristems Reading Comprehension Worksheet**.



## Meristems Reading Comprehension

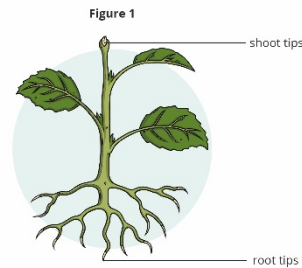
During plant growth and development, cells become specialised to carry out specific functions. This is called differentiation. Once differentiated, the cell is limited to carry out the function of its cell type.

Some examples of specialised cells in plants are:

- Phloem cells - specialised to transport dissolved sugars to parts of the plant where they are needed.
- Root hair cells - specialised for absorbing water and dissolved minerals.
- Xylem cells - specialised to transport water up the stem of a plant and into the leaves.

Unlike fully developed animals, most plants continue to grow throughout their entire life. However, most differentiated plant cells are unable to replicate themselves. Therefore, some undifferentiated cells must remain to produce new copies for growth and repair. These undifferentiated cells are called meristem cells. They can be found in meristem tissue throughout several parts of the plant.

**Figure 1** shows the location of meristem tissue in plants.



A clone of a plant can be produced by planting a cutting of the shoot tips from the plant you want to clone. The meristem cells in the cutting can produce copies of themselves and differentiate to form a new plant. The new plant will be identical to the parent plant. Rare species can be cloned using this method, preventing them from becoming extinct and ensuring continued biodiversity.

Cuttings can also be used to grow plants with desirable characteristics quickly and economically. Desirable characteristics of plants can include colourful petals, large fruit and disease or pest resistance. This could improve food security and increase crop yield.