Introducing stem cells

Stem cells in the news

Centre for Regenerative Medicine

MRC Medical Research Council

THE UNIVERSITY of EDINBURGH

EuroStemCell

www.eurostemcell.org

Objective: Understand the therapeutic value of stem cells

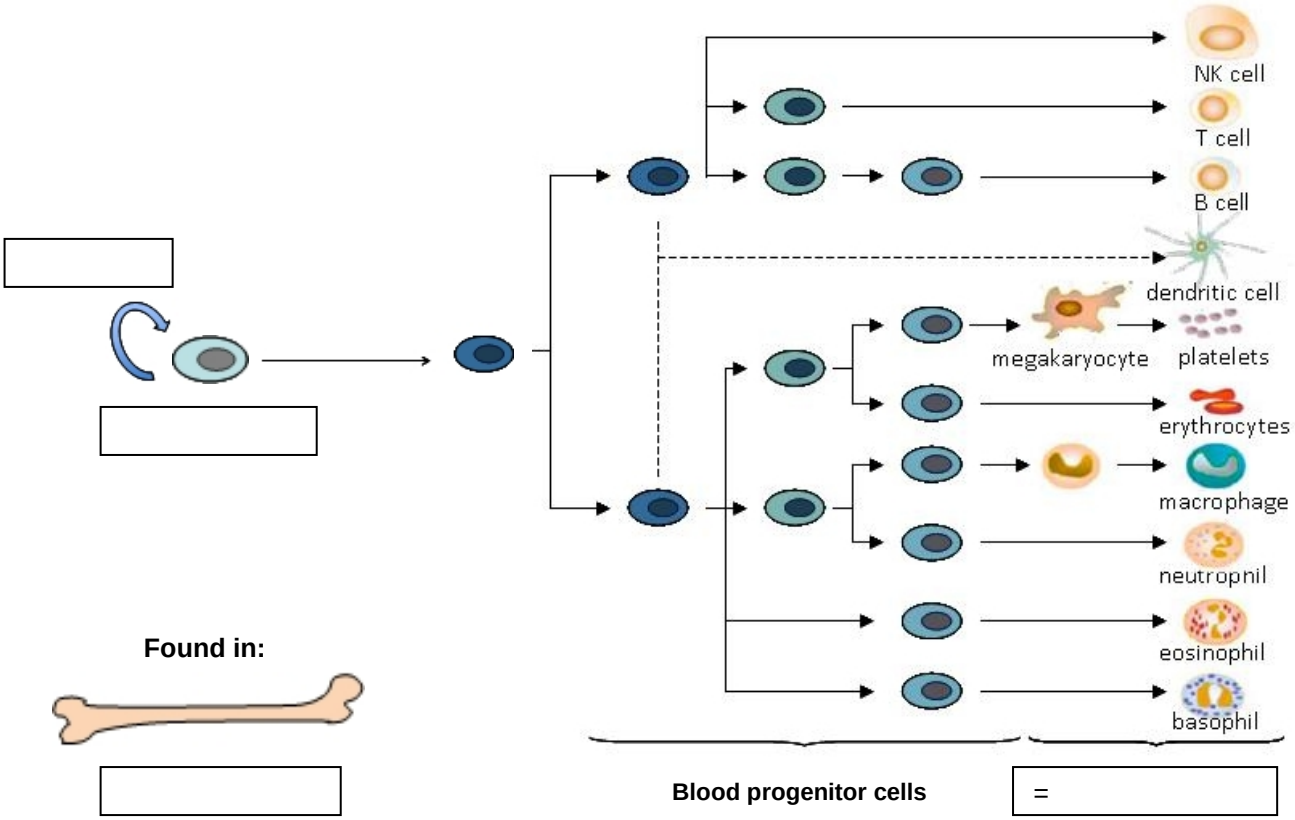
About tissue stem cells

Stem cells are one of the most amazing types of cells because they can (1) make copies of themselves and (2) make specialized cells like skin cells, red blood cells or liver cells.

1. We need stem cells in our body. What would happen to you if you didn't have stem cells?

Tissue stem cells have the potential to make several types of specialized cells, but not all. For example blood stem cells can make all the different types of cells in your blood, but they can't make skin cells.

2. Add the following labels to the diagram:
a. specialized cells in blood; b. blood stem cell; c. make copies; d. bone marrow.



Therapeutic value of stem cells

3. Read the article in the Scotland on Sunday.

SCOTLAND*on*SUNDAY

AUGUST 2, 2009
www.scotlandonsunday.com

Award-winning researcher's stem cell study offers hope for Parkinson's cure

Lyndsay Moss
Health Correspondent

A GROUND-BREAKING stem cell study being carried out in Scotland could finally lead to a cure for Parkinson's disease.

A researcher at Edinburgh University has been awarded £380,000 to create a special type of stem cell from patients with Parkinson's and their relatives.

It is hoped that cell lines created from just three families will help researchers around the world test new treatments for the disease.

And eventually the research could lead to patients receiving transplants of their own specially-treated cells to cure the condition.

Dr Tilo Kunath has been awarded a senior research fellowship by the Parkinson's Disease Society to push forward with his stem cell work.

In patients with Parkinson's, nerve cells in a particular part of the brain involved in co-ordinating movement die, leading to symptoms like tremors and problems walking.

In a UK first, Kunath and colleagues will create induced pluripotent stem cells (iPS cells) from people with Parkinson's to help understand why nerve cells die.

IPS cells are created by taking adult cells, such as from the skin, and reprogramming them in the lab to become cells which behave like embryonic stem cells – with the ability to transform into any type of cell, including nerve cells.

Scientists study stem cells for many reasons, for example to better understand the cell cycle and to develop and test new ways to treat patients.

4. Give one more reason why Dr Tilo Kunath is doing this research.

_____

In 2006, scientists discovered a new technique. They can now take a cell from a body, for example a skin cell, and turn it into a cell that behaves like stem cells from an embryo.

5. What are these special types of cells called?

_____

6. Why is Dr Tilo Kunath keen to use this technique to study Parkinson's?

_____

_____

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Points of view

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Teachers' notes

Objective

Discuss the ethical issues surrounding stem cell research and its regulation.

Required student knowledge

This activity assumes that students know:

- That a stem cell is a cell that can 1) make copies of itself; 2) make other types of cell
- That there are different kinds of stem cell: embryonic and adult stem cells
- That an embryo is an early stage in the development of a baby when it is still in the womb
- That IVF is a kind of fertility treatment in which embryos are made in the laboratory and then implanted into the mother's womb

Activity suggestion

Activity	Time needed
1. Introduction Option 1: Show the first 10 minutes of the film "Conversations: ethics, science, stem cells", at www.eurostemcell.org/films . You can order a DVD of this film from the website. Option 2: Use a teacher-guided discussion to remind students of the key scientific concepts listed above under 'required student knowledge'.	15 mins
2. Points of view Students work in groups to discuss the views of the six characters on the character cards. They then complete Part A of the policy worksheet provided in this resource.	15 mins
3. Embryonic stem cells and the law Students read and complete Part B of the policy worksheet. A brief teacher-led discussion about the stages of embryonic development may be helpful for some.	10-15 mins
4. Summary Teacher-guided discussion: Groups feed back to the class on their policies and opinions.	10-15 mins
Total time:	50-60 mins

Extension

Ask students to work in groups to discuss the scenario on the 'What if…?' scenario worksheet. Should Hannah's parents have the right to decide whether she can have the operation? What counts as a serious disease? Would students think differently about a similar operation for a different kind of disease?

Differentiation

Easier: Only use the characters Grant Cameron and Father O'Reilly and focus on one moral question – when does life begin? Students could use a simple timeline of embryonic development to discuss when they think life begins, then consider these two characters' opinions. An embryo development timeline is available as a card sort activity at www.sciberbrain.org

Harder: Ask students to think of additional issues not represented by the characters. Examples might include:

- Who should decide whether an embryo is donated for research? The mother, the father or both?
- Does it matter what kind of disease researchers are trying to treat?

Homework activity

Give students a recent news article about stem cells (e.g. from http://www.eurostemcell.org/news). Discuss the science in class then ask students to write a letter from one of the characters to the newspaper editor about the story, from the viewpoint of one of the characters.

Credits and acknowledgements

Stem cells: Points of view was developed by EuroStemCell (www.eurostemcell.org) and the MRC Centre for Regenerative Medicine in Edinburgh, UK (www.crm.ed.ac.uk).

The resource is partially based on "PlayDecide". Any opinions, views and findings expressed in this resource are those of the authors and do not necessarily reflect the views of PlayDecide. PlayDecide is available at: http://www.playdecide.org

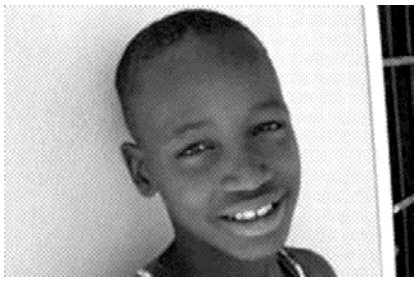
Further information

For further information, please contact EuroStemCell using the contact form at www.eurostemcell.org/contact

Janice Fortune
Doctor

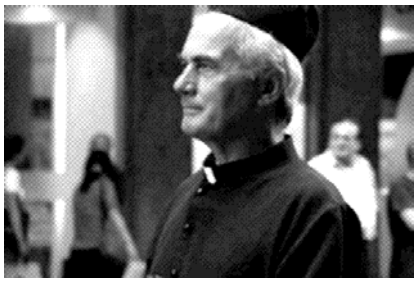
Janice is a doctor who treats people with back problems. Many of her patients have damaged their spines in accidents and cannot walk. Janice can treat pain, but she cannot make her patients walk again. Recently, some of her patients have travelled abroad and paid thousands of pounds for experimental stem cell treatment. Janice knows that scientists still have a lot to learn about stem cells. She is worried that patients are paying for treatments that don't work, or might even do them damage. She thinks we should stop arguing about whether to use embryos in research and concentrate on making sure patients are given proper advice. After all, isn't a patient's life worth more than a ball of cells?

Tomaini Minde
Boy from Tanzania



Tomaini is 12 years old. He lives in Tanzania, a very poor country. People he knows are dying from diseases like malaria and tuberculosis (TB). Tomaini knows that richer countries have medicines to treat these diseases. Everyone says there is not enough money to buy medicine for people in Tanzania. Tomaini's teacher told him about expensive stem cell research. The teacher said the research might find a cure for diseases like diabetes or heart disease. If researchers could cure these diseases, they might save some money in the long run. Patients would not need to take medicine all their lives or spend a lot of time in hospitals if they could be cured with a simple operation. Tomaini thinks this is too far in the future. It is more important to save lives now. Why are they putting so much money into this new research when there are not enough drugs for people in Tanzania right now?

Father O'Reilly
Catholic priest



Father O'Reilly is a Catholic priest. He believes that human life is sacred right from the beginning. When a sperm fertilizes an egg, a life is created and we must protect it from that moment on. Father O'Reilly thinks research on embryos should not be allowed at all. Experiments should only be done on stem cells from a baby's umbilical cord blood, or on adult stem cells. He has also heard that scientists have discovered how to turn normal skin cells into cells that behave just like embryonic stem cells in the lab. He hopes this new discovery will help stop experiments that use embryos. The Father knows there is a lot of suffering in the world and thinks we should help people as much as we can. But he believes that an embryo is a human life and nothing can ever make it right to end a life.

Grant Cameron
Scientist

Grant is a scientist. He is in charge of one of the top research teams working on embryonic stem cells. Grant often hears people saying that research on embryos is wrong because embryos have to be "killed". He thinks this kind of argument is emotional and unreasonable. The embryos used in research are at a very early stage of development. Each embryo is only 4 or 5 days old. It is just a ball of cells. Grant thinks it would be wrong to stop research on embryos when it could help us cure many terrible diseases. He knows that adult stem cells could also be very useful, but he believes that embryonic stem cells are important because they can form ANY kind of cell in the body. How can it be right to protect a ball of cells instead of trying to help millions of people with diseases like cancer, heart disease or diabetes?

Liz Hopeful
IVF patient

Liz Hopeful has been married for 5 years. She has a baby daughter called Lara. She couldn't get pregnant at first, so she and her husband had IVF treatment to have Lara. They still have 6 embryos left in cold storage. All of them have names. At the IVF clinic, Liz and her husband were asked if they would like to donate some of their embryos to stem cell research. Liz is horrified by the idea that her embryos could be experimented on. She thinks of them almost like babies that haven't had a chance to grow up. She can't understand how anyone could give their embryos to scientists for any kind of experiment. Liz's husband disagrees with her. He says that if they do not donate the embryos to research, they will be wasted. They will be frozen and stored for 5 to 10 years and then thrown away.

Amanda Prentice
Scientist

Amanda is a young stem cell scientist. She is studying adult stem cells. She got interested in stem cells when she heard how they can be used to save lives. For example, skin stem cells are used to grow new skin for people who have been very badly burned. Doctors take stem cells from a tiny unburned part of the patient's body and use them to grow new skin in the laboratory. The patients would die without this skin, but it is not perfect: it has no hair or sweat glands. Amanda wants to solve this problem. She thinks adult stem cells will be very useful for treating other injuries and diseases too. She knows another scientist who is already using adult stem cells to repair people's eyes after accidents. And that's just one example. Amanda thinks everyone talks about embryonic stem cells too much. Adult stem cells are just as important.

Objective: Discuss the ethical issues surrounding stem cell research and its regulation.

Stem cell research: What's the right policy?

Look at the characters you have been given. What do they think about stem cell research? Why? Decide which policy each character would support. Write their names in the boxes below.

Policy	People who agree with this policy
Policy 1 All stem cell research should stop. Money should be spent on other things instead.	
Policy 2 Embryos should NOT be used for research. Other kinds of stem cell research should carry on.	
Policy 3 Research on spare embryos that are donated by couples after IVF treatment should be allowed.	

Part A: Our group policy

What do YOU think? Which character do you agree with most? Discuss your opinions in your group.

Our group thinks the right policy is…
(Choose one of the policies above, or make up your own).

We think this because…

Part B: More things to think about

When does an embryo become a person? What does this mean for research? Different countries around the world have different laws about how embryos must be treated. In the UK:

- Embryos up to 14 days old can be used in research. At 14 days old, the embryo starts to develop a nervous system.
- Abortion is allowed until 24 weeks into pregnancy. After 24 weeks, a foetus has developed that can begin to respond to light and sound.

Do you agree with the UK's laws? Why / why not?

What if…?

Hannah is 15 and she has diabetes. She has to inject herself with insulin three times a day to control the amount of sugar in her blood. She has to be careful about what she eats and drinks too. If she doesn't inject herself regularly, she could get very ill or even die.

Image ©iStockphoto.com/Andrzej Tokarski

Hannah could have health problems when she's older too. For example, she might start to go blind or have kidney problems. Her life could also be up to 10 years shorter because of her diabetes.

Could Hannah's life change?
It is 2030 and stem cell researchers have discovered a way to cure diabetes. But Hannah's parents won't let her have the operation. When scientists started to develop the treatment 20 years ago, they used embryos in their research. Hannah's parents think that is wrong.

What should Hannah do?

When she is older, Hannah could choose to have the operation. She would never have to inject herself with insulin again. Should she do it? What about her parents' opinions?

Reasons Hannah SHOULD have the operation	Reasons she should NOT have the operation

Our group thinks that Hannah should…

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What's missing?

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Objective: Understand what different types of stem cells there are, and what they can do

Not all stem cells are the same!

Use these words to fill in the gaps:

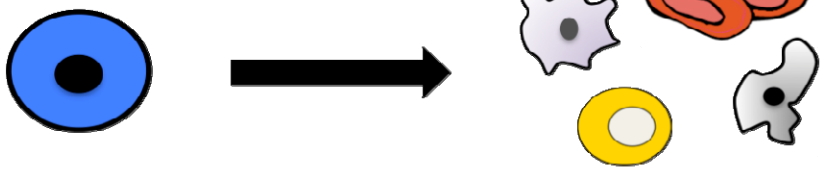
embryonic	**brain**	**adult**	**embryo**	**blood**

You need two kinds of stem cell: **embryonic stem cells** to help you grow from a fertilized egg into a baby, and **tissue stem cells** to stay healthy once you are born.

Tissue stem cells

You have lots of different stem cells in your body. They are hard at work every day, replacing cells that get used up, damaged or die. There are blood stem cells making blood cells, muscle stem cells making muscle cells, **a.** stem cells making all the different types of cell in your brain, and other kinds of stem cells in the rest of your body.

The stem cells you have in your body now are called **b.** or **tissue stem cells**. Each type stem cell in your body can only make a few other types of cell. Your brain stem cells can only make brain cells; they can't make muscle.



c. _____ stem cell

Different types of blood cell

Embryonic stem cells

Way back when you were still a ball of cells inside your mother's womb, you needed a very special kind of stem cell: **embryonic stem cells**. These amazing cells can make ALL the different types of cell in the body. They are only found in the very early stages of development of an **d.**, when it is just a ball of around 100 cells.

A new kind of stem cell

Recently, scientists have discovered a way to make stem cells from normal skin or brain cells. These artificially created stem cells are called induced pluripotent stem cells, or iPS cells. They are just like **e.** stem cells and can make all the different kinds of cell in the body.