

### Overview

**Discover stem cells** is a 50 to 60-minute lesson introducing stem cells to students aged 12–14. It is designed to be delivered by two scientists or science communicators visiting a school, but a teacher could use the materials themselves too. The lesson is intended to be flexible and is made up of a set of short modules, mixing group activities with presentation and facilitator-led discussion.

This guide outlines how we have found the lesson to work best, but we hope you will adapt the details to suit your own needs. Please share your suggestions and experiences by posting your comments at [www.eurostemcell.org/resources](http://www.eurostemcell.org/resources). You can also email us at [www.eurostemcell.org/contact](http://www.eurostemcell.org/contact).

### Learning objectives

#### All students

- Know that a stem cell is a cell that can both self-renew and differentiate
- Know that there are different types of stem cells and be aware of where they are found
- Know why stem cells are important in the body

#### More able students

- Begin to think about why stem cells are interesting for scientists and how they may be used

### Required prior knowledge

This activity assumes that students know that the body is made up of cells, and that blood contains red and white blood cells. The lesson does not assume any prior knowledge of stem cells, or any detailed knowledge of cell structure or function.

### Materials and preparation

The lesson outline on page 3 provides a handy overview of the lesson. For detailed step-by-step guidance on delivering all aspects of **Discover stem cells**, see the facilitators notes in the PowerPoint presentation.

**Tip:** You will need to print, cut-out and fold some of these materials in advance – look at the materials checklist on the next page and plan time to prepare what you need.

Some things to think about when preparing for the lesson:

- **Speak to the contact teacher:** Explain what you will be covering and what facilities you need in the classroom. Make sure the teacher knows you need students to work in groups of 4; most teachers will put the students into groups if warned. Check timings, classroom setup and ability/prior knowledge of the students.
- **Prepare the materials:** Make sure you know how many students you will see and have printed and prepared enough copies of the resources. Use the materials checklist on the next page.
- **Practice:** Run through the presentation so you know what you want to say and how you will hand over between one facilitator and the other.
- **Arrive early:** Arrange to arrive at the school half an hour before the first lesson. Set up the classroom and test the presentation on the class computer in plenty of time.
- **Take a bottle of water:** Check with the teacher you can drink in the classroom or lab.
- **Get teacher feedback and note down your experiences:** Arrange time to see the teacher(s) at the end of the visit to get some verbal feedback. Perhaps you can arrange a follow-up visit to develop the topic further. Make your own notes straight away – they will help you next time.

### Materials checklist

### Ready?

#### Classroom equipment

- Computer with PowerPoint and ability to play film clip (no sound) ☐
- Internet connection (or stop clock if internet not available) ☐
- Projector and screen, or interactive whiteboard ☐
- Desks arranged for working in groups of 4 ☐

#### Presentation

- **Discover stem cells** PowerPoint slides and film clip or internet ☐

#### How many blood cells? game

- Internet connection or stop watch ☐
- Relevant slides from the **Discover stem cells** PowerPoint presentation ☐

#### Stem cell decisions game

- Per student – 1 decision maker ☐
- Per group of 4 students:
  - 1 dice ☐
  - 2 paper cups labelled red blood cells and white blood cells ☐
  - Approx 16 blood stem cell counters ☐
  - 1 instruction sheet ☐
- Facilitator – large decision maker (optional) ☐

#### Cell families card game

- Per group of 4 students:
  - Pack of cards ☐
  - 1 instruction sheet ☐
- Facilitator
  - Large (A1) **Cell families** body diagram ☐
  - Blue tak or other method for sticking cards on body diagram so they can be easily removed to use again ☐

#### Wrapping up: Feedback and leave-behind

- **Discover stem cells** feedback forms and leave-behind sheets ☐

# Discover stem cells

## Lesson plan

12–14

### Lesson outline

(See the **Discover stem cells** PowerPoint for detailed notes for facilitators)

### Time needed

### From...to...

(insert your timings, e.g 9am-9:05am)

**Start:** Students arrive and settle down.

5 mins

### Introduction (slides 2–4)

Facilitator 1: Introduce who you are and what the lesson will involve. Very briefly introduce the concept of a stem cell.

5 mins

### Stem cell decisions (slide 5)

Facilitator 2: Explain the **Stem cell decisions** game. Students work in groups to explore what a stem cell can do.  
Both facilitators: Circulate around the classroom making sure students understand the task and prompting them to think about what the decision maker tells them.

10 mins

### Class discussion (slide 6-7)

Facilitator 2: Lead a discussion on what the **Stem cell decisions** game shows. With the students' input, develop a diagram on the board showing that a stem cell can self-renew AND differentiate (see example in slides).

5 mins

### Presentation and How many blood cells? (slides 8–14)

Facilitator 1: Use the slides as a guide to help you introduce the concept of tissue stem cells and then lead the class through an interactive discussion focused on blood stem cells as an example. Includes some games to play as a class (instructions in the slide notes).

10 mins

### Stem cells in your body (slides 15–16)

Facilitator 2: Explain the **Cell families** card game, which introduces students to different types of stem cells.  
Both facilitators: Circulate around the classroom helping students. Prompt them to think about what the cells in each family have in common.

10 mins

### Class discussion (slides 17–18)

Facilitator 2: Use the large **Cell families** body diagram as the focus for a discussion to draw out the messages of the card game.

5 mins

### Plenary (slides 19–20)

Facilitator 1: Explain a little more about embryonic stem cells and then wrap up with a recap on what the lesson has covered. Ask the students to tell you what they have learnt before revealing the points on the slide.

5 mins

**Finish and feedback:** Thank participants and use feedback forms.  
Give the teacher the leave-behind student sheet for follow-up work.

5 mins

**Total time: 60 mins**

### Credits

**Funders:** The development of *Discover stem cells* was funded by the European Community's Seventh Framework Programme Project [EuroSyStem](#). EuroSyStem is a partner of EuroStemCell.

**Authors:** The *Discover stem cells* lesson was created and developed by **Emma Kemp and Ian Chambers, MRC Centre for Regenerative Medicine, University of Edinburgh.**

**Acknowledgements:** Ingrid Heersche, Scientific Communications Officer of the MRC Centre for Regenerative Medicine at the University of Edinburgh helped generate ideas and provided useful advice and support. Shona Reid, her colleagues and students at the James Young High School, Livingston, Scotland, participated in multiple pilots and offered helpful advice and feedback. Helen Wallace and Huw Jones of the University of Edinburgh delivered a pilot lesson. The Derby School High School (Bury, UK) and Tynecastle High School (Edinburgh, UK) provided opportunities to pilot early ideas with students.

**Picture credits:** Sources of illustrations and images used in *Discover stem cells* are given where the image appears.

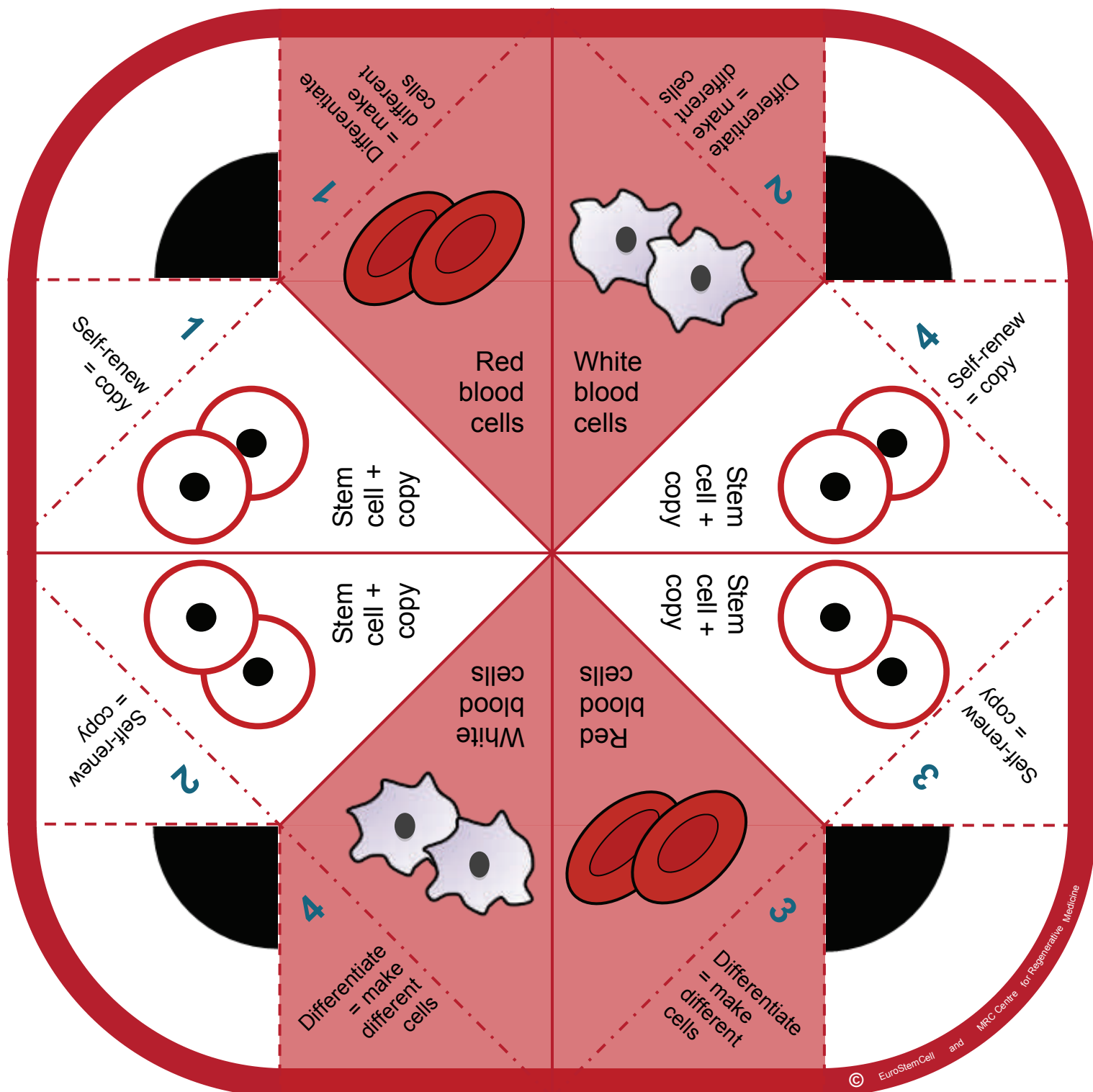
**Permissions:** This work is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/3.0/> or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA

# Discover stem cells

## Stem cell decisions game

## Stem Cell Decision Maker

1. Cut around the edge of the shape
2. Fold the four corners outwards at the line marked - . - . - . and tuck behind
3. Turnover
4. Fold the four corners inwards at the line marked - - - - - and tuck behind
5. You should have a square shape. Fold it in the middle (horizontally), and unfold again
6. Repeat, but now fold vertically
7. Work your fingers into the four corners and start your game!



## Stem Cell Decision Maker (Back)



Europe's stem cell hub: information, education, conversation

We're here to help European citizens make sense of stem cells. We provide reliable, independent information and road-tested educational resources on stem cells and their impact on society.

[www.eurostemcell.org](http://www.eurostemcell.org)



The MRC Centre for Regenerative Medicine at the University of Edinburgh brings together world leading basic stem cell research with established clinical excellence to deliver a “bench-to-bedside” approach.

The Centre contributes to the development of new treatments for diseases like multiple sclerosis, liver failure and Parkinson's.

[www.crm.ed.ac.uk](http://www.crm.ed.ac.uk)

Stem cell decisions: Cup labels

**Red blood cells**

**White blood cells**

**Red blood cells**

**White blood cells**

**Red blood cells**

**White blood cells**

**Red blood cells**

**White blood cells**

**Red blood cells**

**White blood cells**

**Red blood cells**

**White blood cells**

**Red blood cells**

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**Red blood cells**

**White blood cells**

**Red blood cells**

**White blood cells**

**Red blood cells**

**White blood cells**

**Red blood cells**

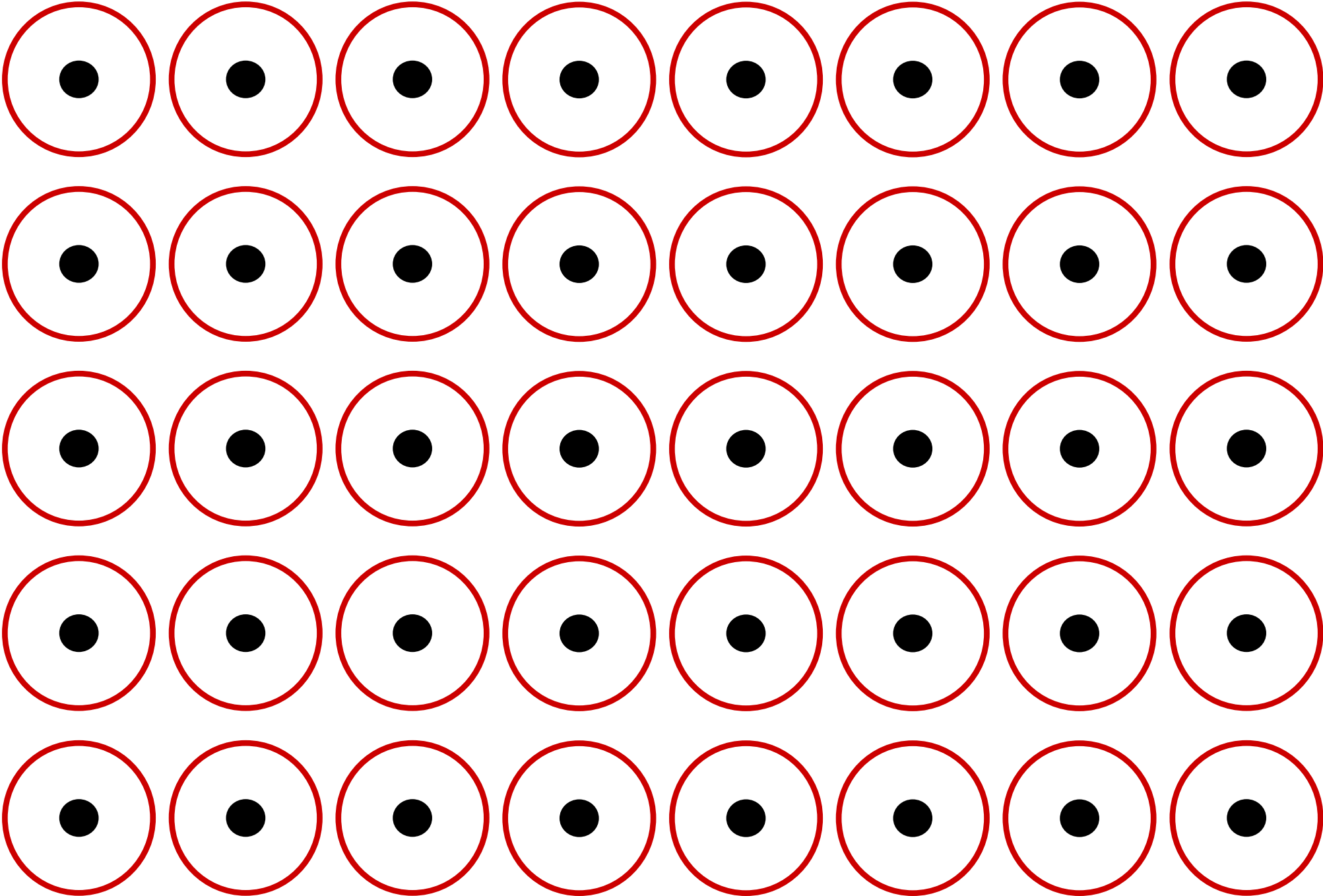
**White blood cells**

**Red blood cells**

**White blood cells**



Stem cell decisions: blood stem cell counters



### Your task

Find out what stem cells can do by playing this game.

### What you need

- A decision maker
- 2 blood stem cells each and a pile of spares
- A pot for red blood cells and a pot for white blood cells



### How to play

1. Start with two blood stem cells and one decision maker each.
2. You need to make some red blood cells and white blood cells, but you can only keep playing as long as you have a blood stem cell.
3. Put your fingers in your decision maker and hold it closed.
4. Take it in turns to roll the dice.
5. When it's your turn, roll the dice then open and close the decision maker the number of times shown on the dice.
6. Ask the person next to you to choose a number from 1 to 4. Open the flap with that number on it.
7. If you find a stem cell picture, take another blood stem cell. If you find a different kind of cell, put your token in the cup with that type of cell on it.
8. Play until everyone has run out of blood stem cells.
9. Now answer the questions below.

### Things to think about

- What TWO different things can the stem cell do?
- What happens when you run out of stem cell counters? What do you think would happen if your body ran out of blood stem cells?

# Discover stem cells

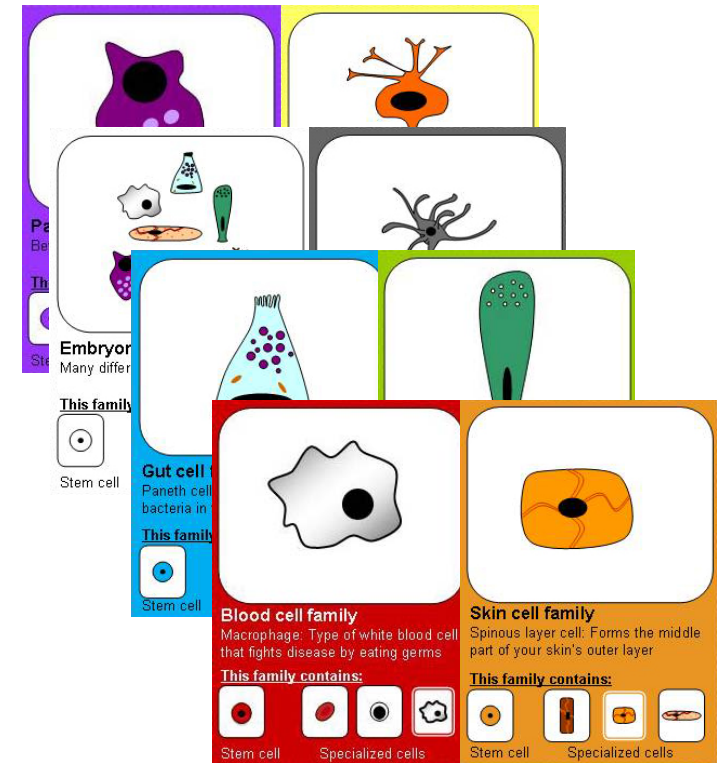
## Cell families card game

# Cell families

## Welcome to the Cell families card game

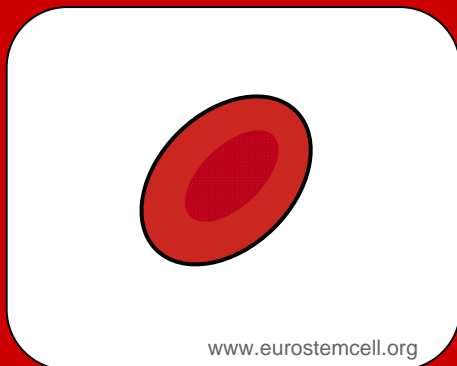
This game is designed for use with 12-14 year olds, as part of a discussion about types of stem cells. It introduces students to the concepts of multipotency in tissue stem cells, and pluripotency in embryonic stem cells.

1. Print the eight families of cards on pages 2 to 9 and use them to make two packs of cards. You will need one pack of cards per group of four students.
2. For older or high-ability students, you could include the additional cell families on pages 11 and 12. This introduces the idea that stem cells have a range of potencies: some can make many kinds of specialized cells, whilst others make only one specialized cell type.
3. The **Cell families** student instruction sheet explains how to play the game. Print one copy for each group of students.
4. We suggest you use this game as part of **Discover stem cells**, a 50- to 60-minute lesson that introduces basic stem cell concepts to 12–14 year olds. This lesson will be available in spring 2011.
5. Note on scientific content: The pancreatic stem cell is still controversial among scientists. The lung cell types illustrated here are well established in the mouse, but less so in humans.



Download **Discover stem cells** at [www.eurostemcell.org/resources](http://www.eurostemcell.org/resources)

(available Spring 2011)



### Blood cell family

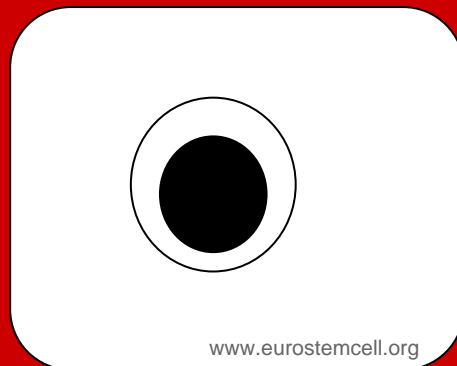
Red blood cell: Carries oxygen around the body

#### This family contains:



Stem cell

Specialized cells



### Blood cell family

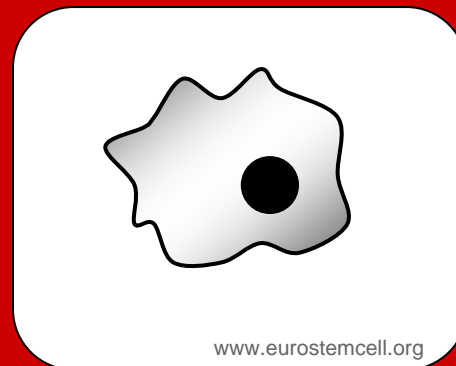
B cell: Type of white blood cell that makes antibodies to fight infection

#### This family contains:



Stem cell

Specialized cells



### Blood cell family

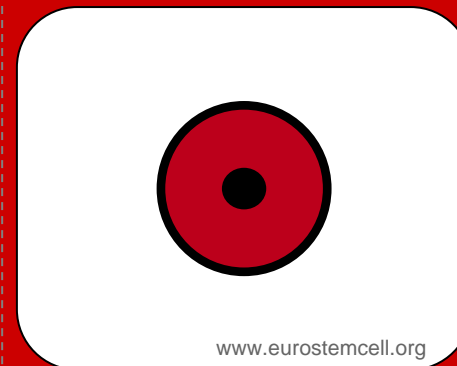
Macrophage: Type of white blood cell that fights disease by eating germs

#### This family contains:



Stem cell

Specialized cells



### Blood cell family

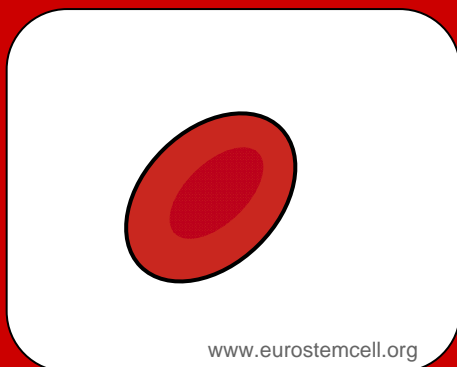
Blood stem cell: Self-renews and makes blood cells

#### This family contains:



Stem cell

Specialized cells



### Blood cell family

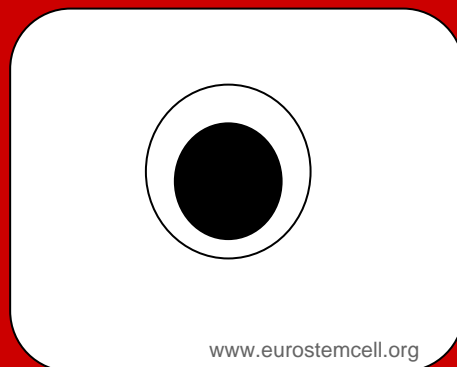
Red blood cell: Carries oxygen around the body

#### This family contains:



Stem cell

Specialized cells



### Blood cell family

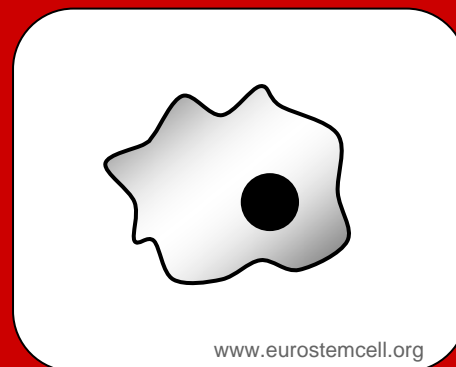
B Cell: Type of white blood cell that makes antibodies to fight infection

#### This family contains:



Stem cell

Specialized cells



### Blood cell family

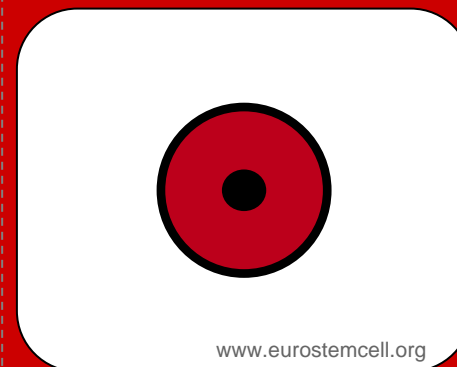
Macrophage: Type of white blood cell that fights disease by eating germs

#### This family contains:



Stem cell

Specialized cells



### Blood cell family

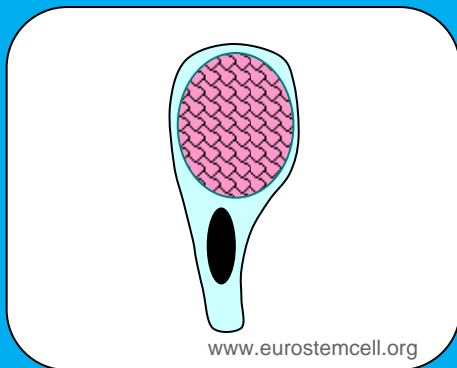
Blood stem cell: Self-renews and makes blood cells

#### This family contains:



Stem cell

Specialized cells



### Gut cell family

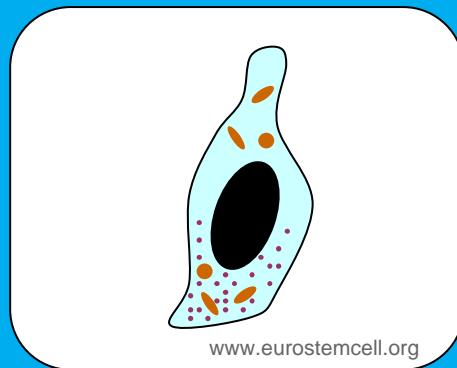
Goblet cell: Releases mucus to help food slide through your gut

#### This family contains:



Stem cell

Specialized cells



### Gut cell family

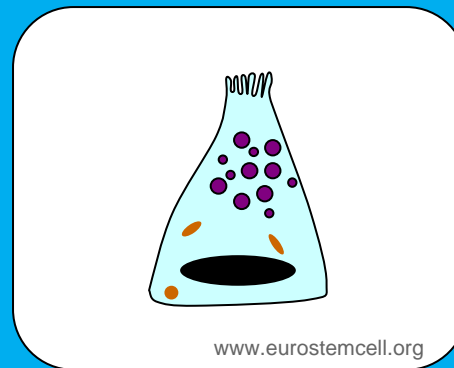
Endocrine cell: Makes hormones your gut needs

#### This family contains:



Stem cell

Specialized cells



### Gut cell family

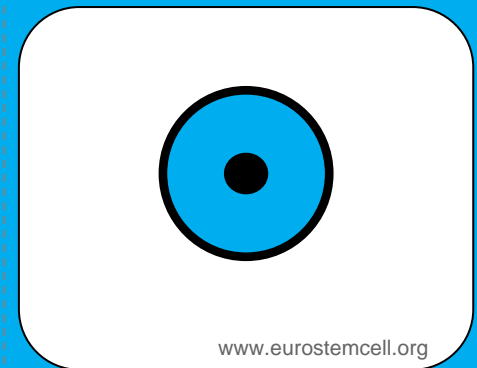
Paneth cell: Protects your gut from bacteria in food

#### This family contains:



Stem cell

Specialized cells



### Gut cell family

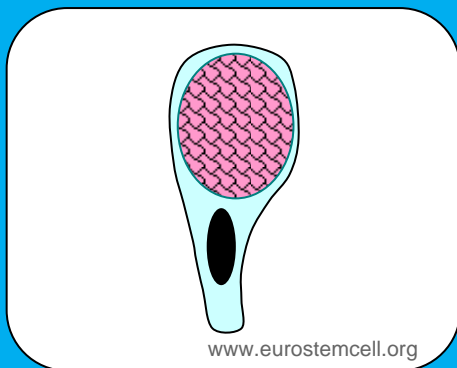
Gut stem cell: Self-renews and makes gut cells

#### This family contains:



Stem cell

Specialized cells



### Gut cell family

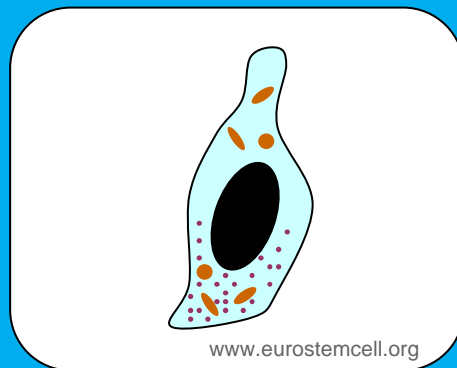
Goblet cell: Releases mucus to help food slide through your gut

#### This family contains:



Stem cell

Specialized cells



### Gut cell family

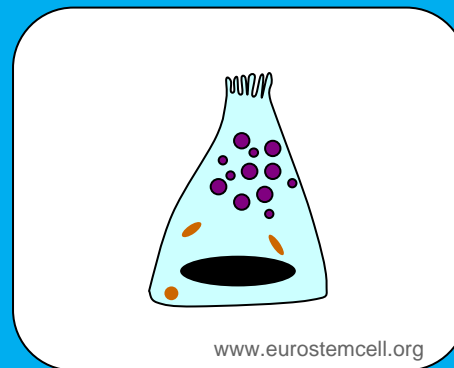
Endocrine cell: Makes hormones your gut needs

#### This family contains:



Stem cell

Specialized cells



### Gut cell family

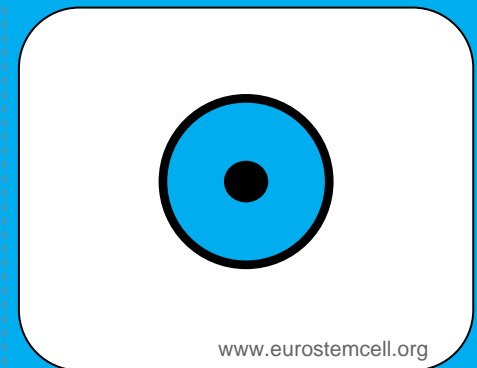
Paneth cell: Protects your gut from bacteria in food

#### This family contains:



Stem cell

Specialized cells



### Gut cell family

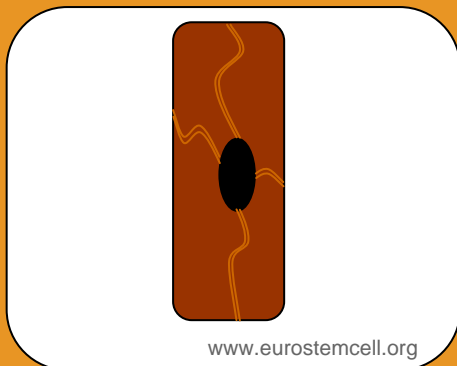
Gut stem cell: Self-renews and makes gut cells

#### This family contains:



Stem cell

Specialized cells



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### Skin cell family

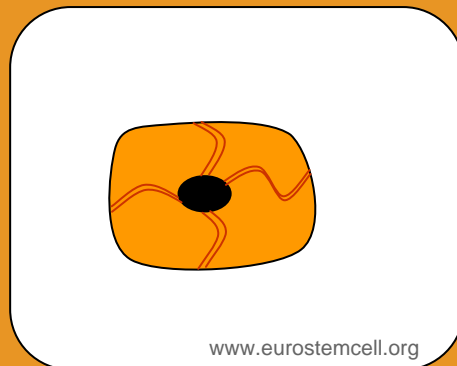
Basal layer cell: Forms the base of your skin's outer layer

#### This family contains:



Stem cell

Specialized cells



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### Skin cell family

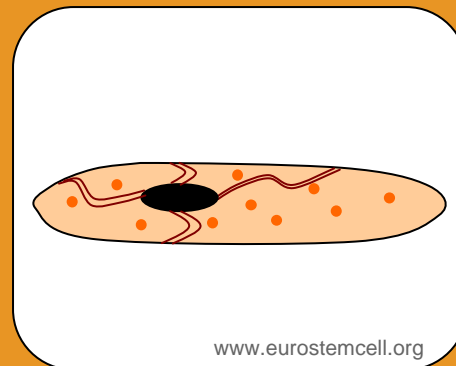
Spinous layer cell: Forms the middle part of your skin's outer layer

#### This family contains:



Stem cell

Specialized cells

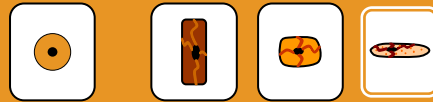


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### Skin cell family

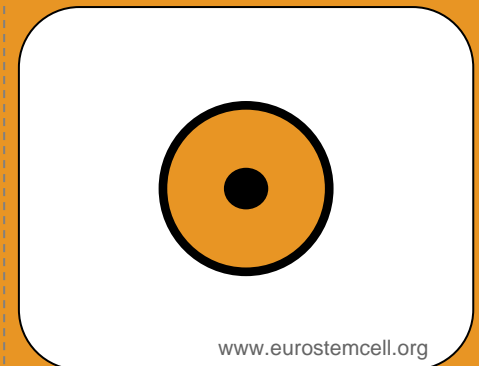
Granular layer cell: Lies very near the surface of your skin

#### This family contains:



Stem cell

Specialized cells



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### Skin cell family

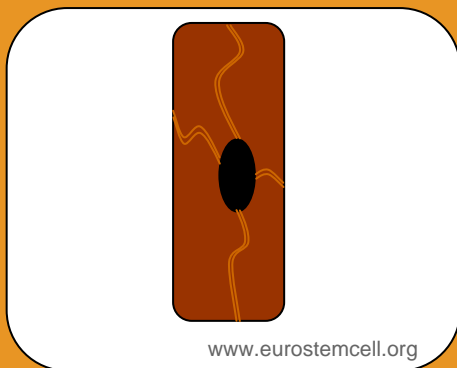
Skin stem cell: Self-renews and makes skin cells

#### This family contains:



Stem cell

Specialized cells



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### Skin cell family

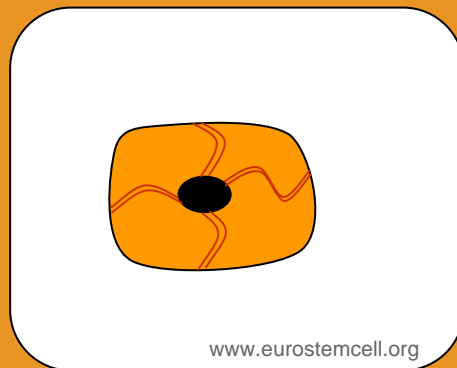
Basal layer cell: Forms the base of your skin's outer layer

#### This family contains:



Stem cell

Specialized cells



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### Skin cell family

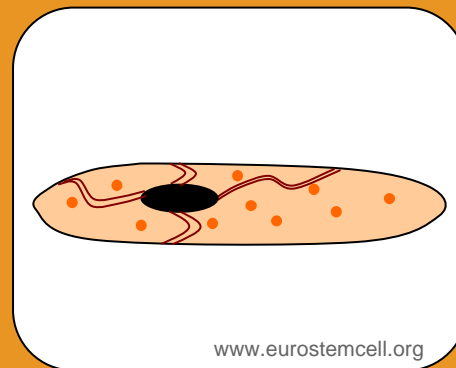
Spinous layer cell: Forms the middle part of your skin's outer layer

#### This family contains:



Stem cell

Specialized cells

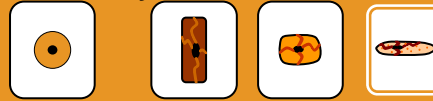


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### Skin cell family

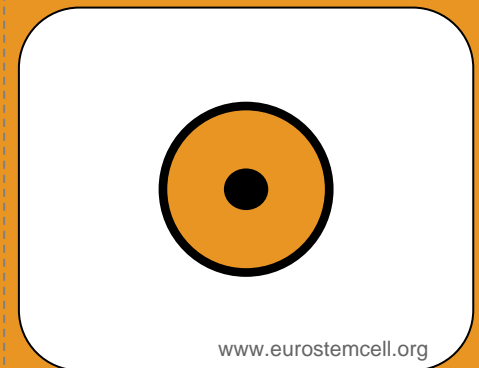
Granular layer cell: Lies very near the surface of your skin

#### This family contains:



Stem cell

Specialized cells



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### Skin cell family

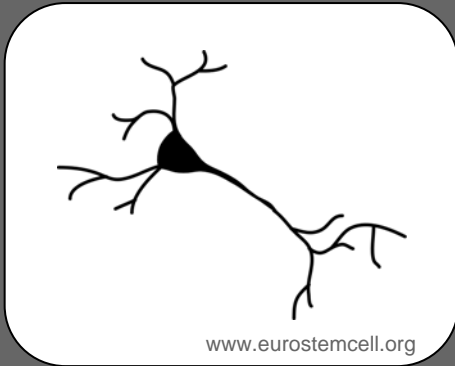
Skin stem cell: Self-renews and makes skin cells

#### This family contains:



Stem cell

Specialized cells



### Brain cell family

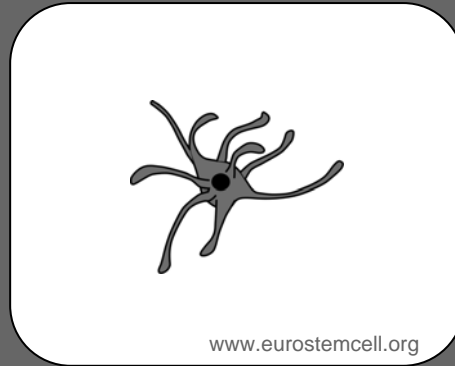
Neuron: Carries signals that help you touch, see, hear, smell or move

#### This family contains:



Stem cell

Specialized cells



### Brain cell family

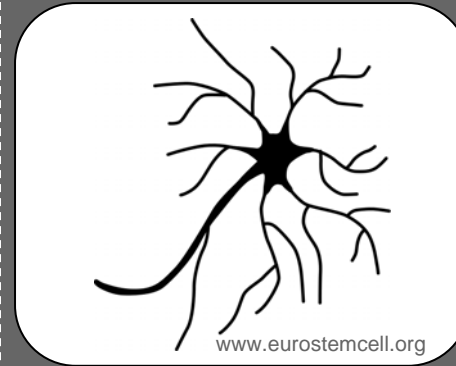
Oligodendrocyte: Wraps around other nerve cells to insulate them

#### This family contains:



Stem cell

Specialized cells



### Brain cell family

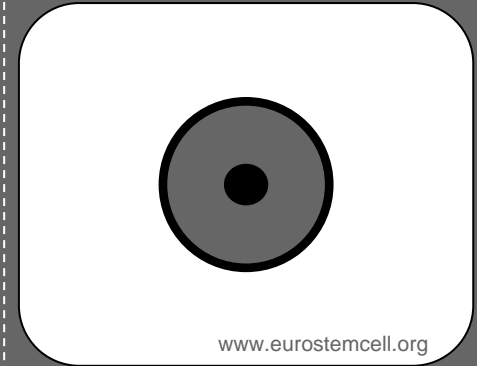
Astrocyte: Helps keep other nerve cells healthy or repair damage

#### This family contains:



Stem cell

Specialized cells



### Brain cell family

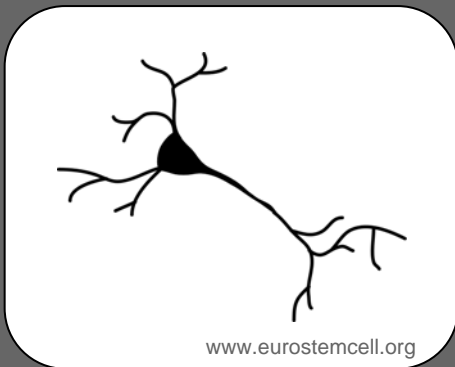
Brain stem cell: Self-renews and makes brain cells

#### This family contains:



Stem cell

Specialized cells



### Brain cell family

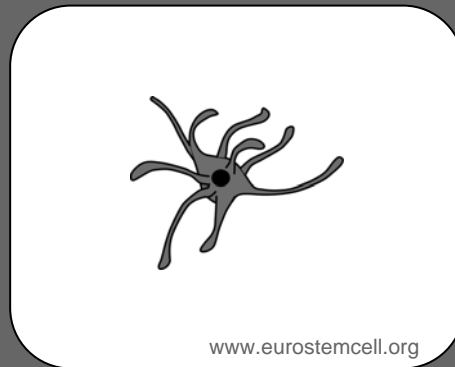
Neuron: Carries signals that help you touch, see, hear, smell or move

#### This family contains:



Stem cell

Specialized cells



### Brain cell family

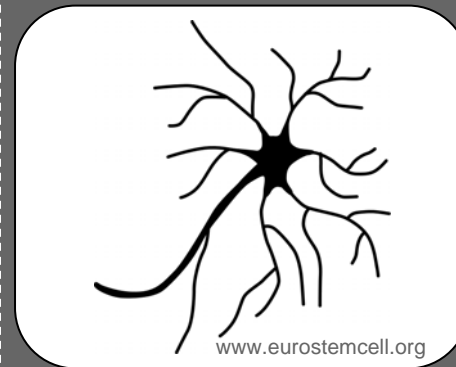
Oligodendrocyte: Wraps around other nerve cells to insulate them

#### This family contains:



Stem cell

Specialized cells



### Brain cell family

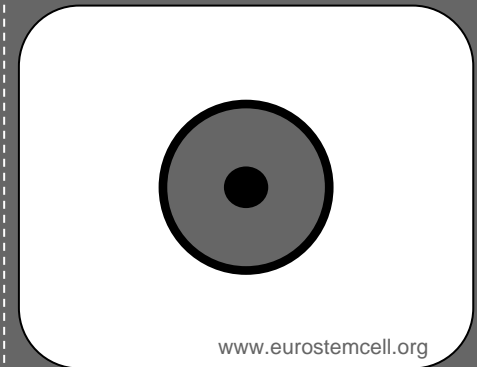
Astrocyte: Helps keep other nerve cells healthy or repair damage

#### This family contains:



Stem cell

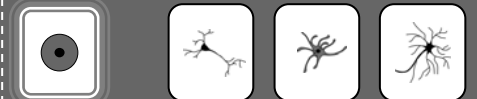
Specialized cells



### Brain cell family

Brain stem cell: Self-renews and makes brain cells

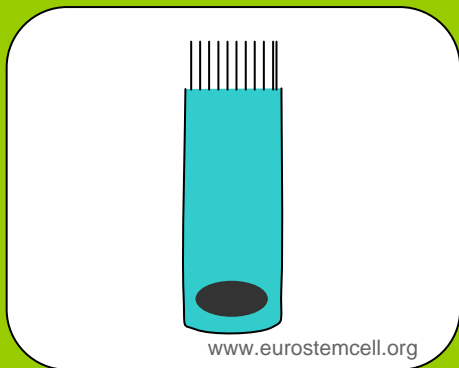
#### This family contains:



Stem cell

Specialized cells





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### Lung cell family

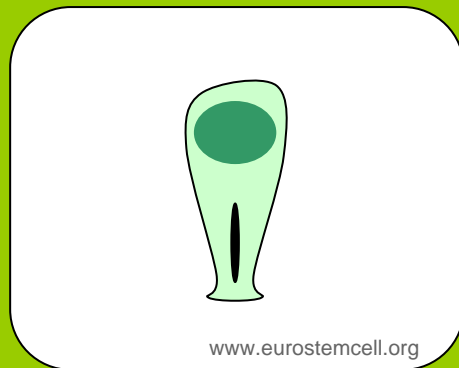
Ciliated cell: Helps clear mucous from your lung

**This family contains:**



Stem cell

Specialized cells



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### Lung cell family

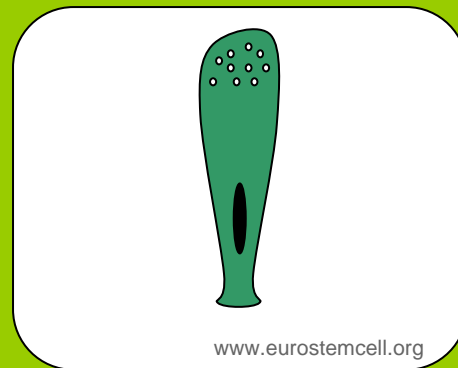
Goblet cell: Produces mucous and fights infection in your lung

**This family contains:**



Stem cell

Specialized cells



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### Lung cell family

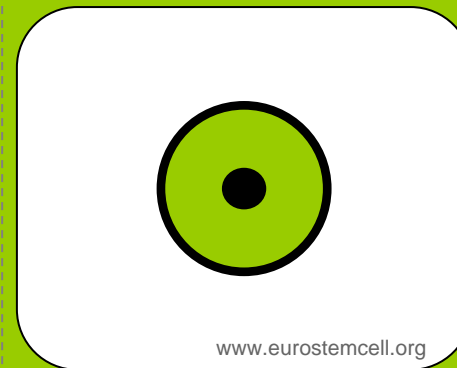
Clara cell: Helps fight infection in your lung

**This family contains:**



Stem cell

Specialized cells



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### Lung cell family

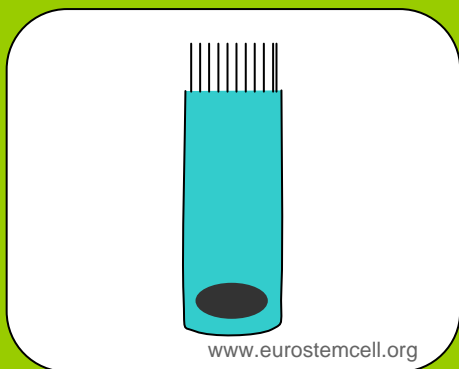
Lung stem cell: Self-renews and makes lung cells

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Lung cell family

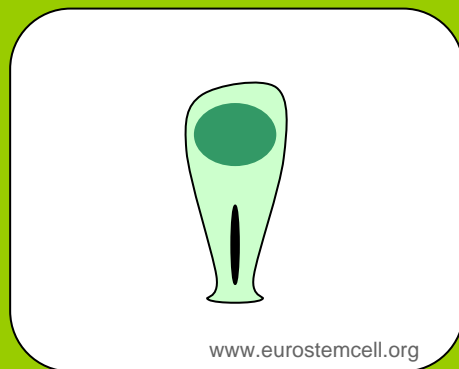
Ciliated cell: Helps clear mucous from your lung

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Lung cell family

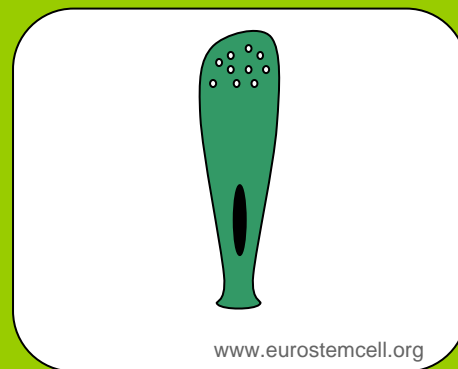
Goblet cell: Produces mucous and fights infection in your lung

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Lung cell family

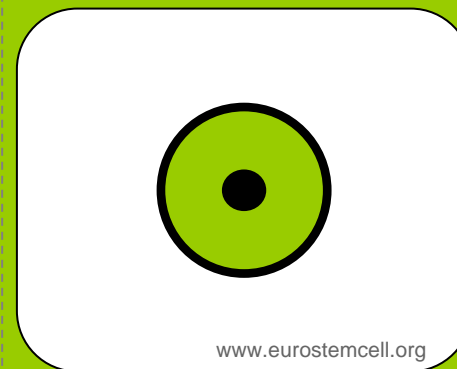
Clara cell: Helps fight infection in your lung

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Lung cell family

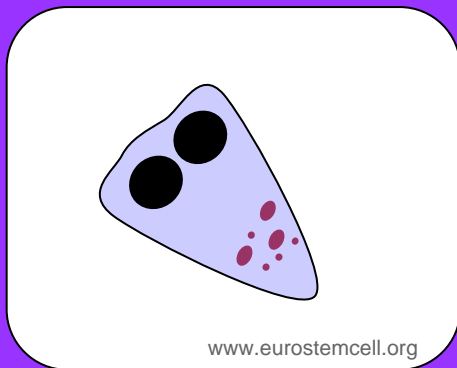
Lung stem cell: Self-renews and makes lung cells

**This family contains:**



Stem cell

Specialized cells



### Pancreas cell family

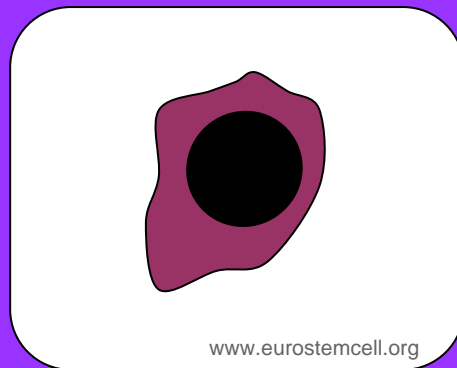
Acinar cell: Makes enzymes to help digest food

**This family contains:**



Stem cell

Specialized cells



### Pancreas cell family

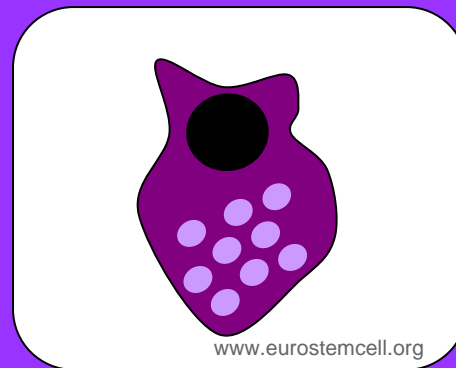
Duct cell: Helps carry enzymes to the gut

**This family contains:**



Stem cell

Specialized cells



### Pancreas cell family

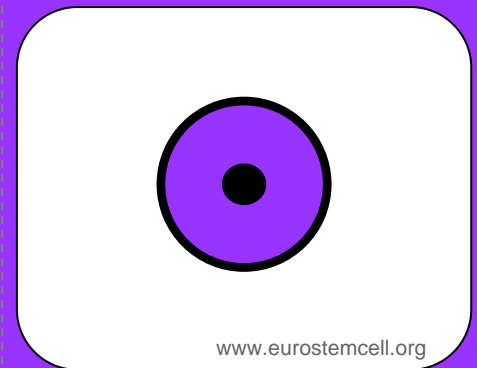
Beta cell: Makes insulin

**This family contains:**



Stem cell

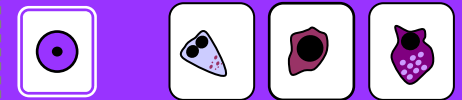
Specialized cells



### Pancreas cell family

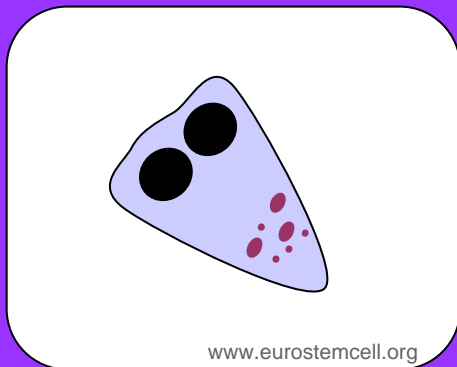
Pancreatic stem cell: Self-renews and makes pancreas cells

**This family contains:**



Stem cell

Specialized cells



### Pancreas cell family

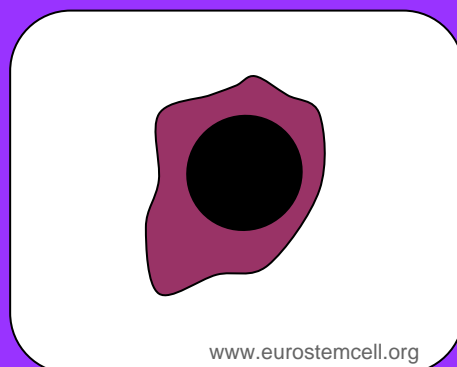
Acinar cell: Makes enzymes to help digest food

**This family contains:**



Stem cell

Specialized cells



### Pancreas cell family

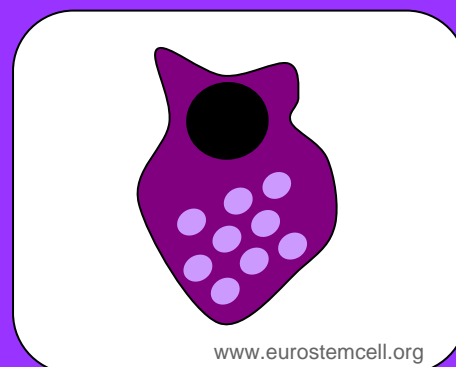
Duct cell: Helps carry enzymes to the gut

**This family contains:**



Stem cell

Specialized cells



### Pancreas cell family

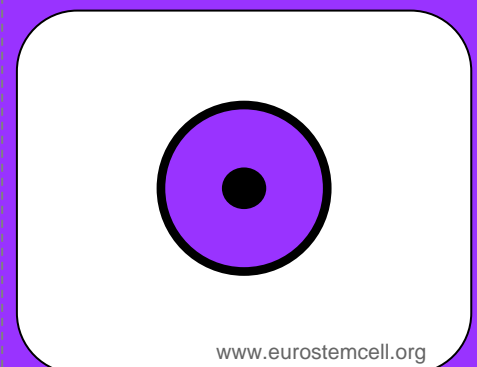
Beta cell: Makes insulin

**This family contains:**



Stem cell

Specialized cells



### Pancreas cell family

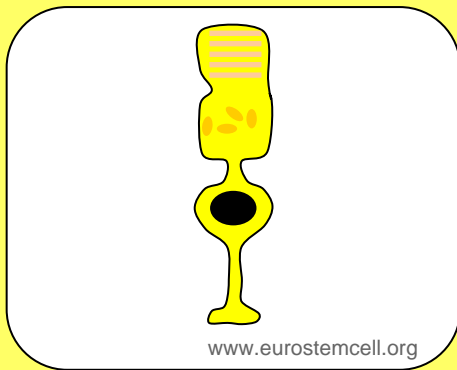
Pancreatic stem cell: Self-renews and makes pancreas cells

**This family contains:**



Stem cell

Specialized cells

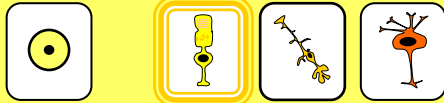


www.eurostemcell.org

### Retina cell family

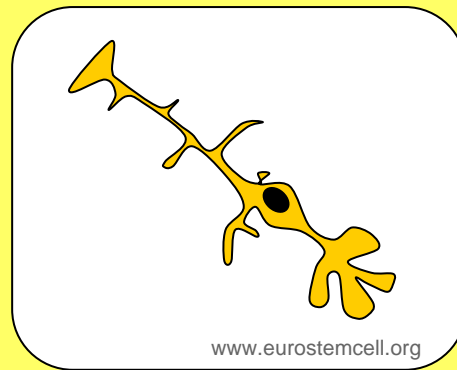
Photoreceptor: Catches light

#### This family contains:



Stem cell

Specialized cells

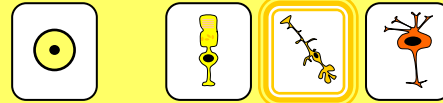


www.eurostemcell.org

### Retina cell family

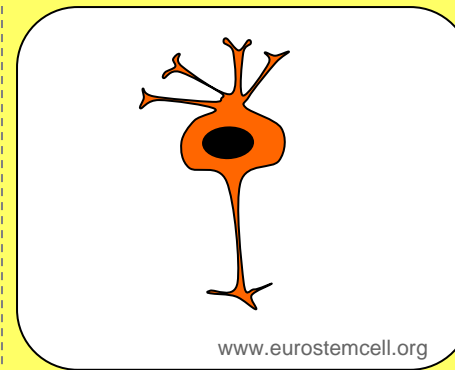
Müller cell: Helps keep nerve cells in the eye healthy and working properly

#### This family contains:



Stem cell

Specialized cells

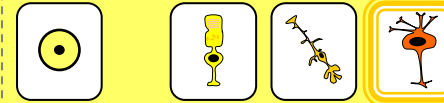


www.eurostemcell.org

### Retina cell family

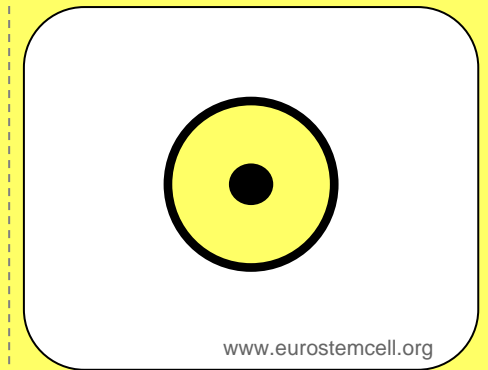
Retinal ganglion cell: Sends a signal from the eye to the brain

#### This family contains:



Stem cell

Specialized cells

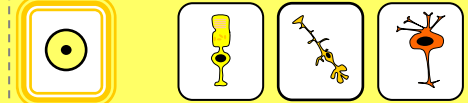


www.eurostemcell.org

### Retina cell family

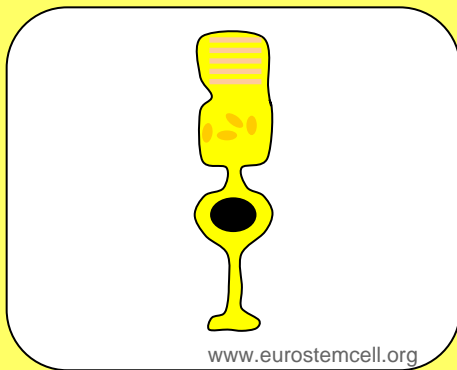
Retinal stem cell: Self-renews and makes retina cells

#### This family contains:



Stem cell

Specialized cells

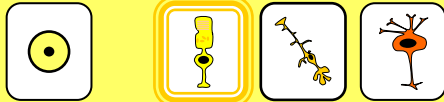


www.eurostemcell.org

### Retina cell family

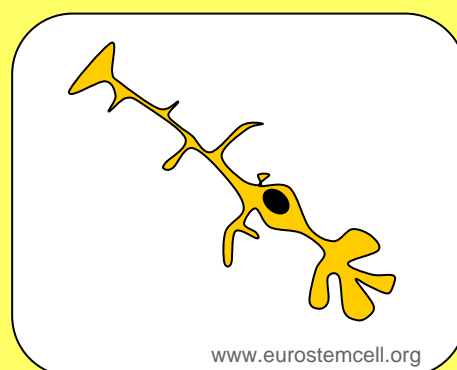
Photoreceptor: Catches light

#### This family contains:



Stem cell

Specialized cells

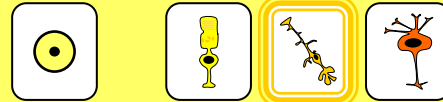


www.eurostemcell.org

### Retina cell family

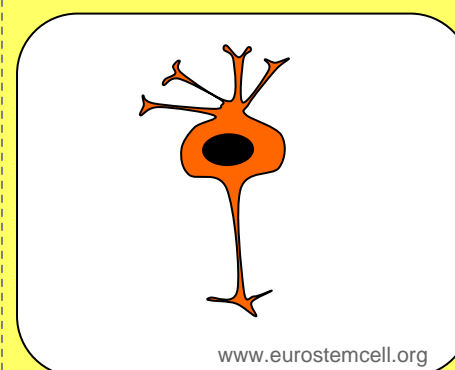
Müller cell: Helps keep nerve cells in the eye healthy and working properly

#### This family contains:



Stem cell

Specialized cells

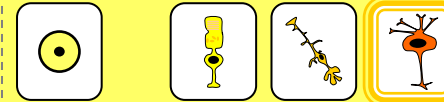


www.eurostemcell.org

### Retina cell family

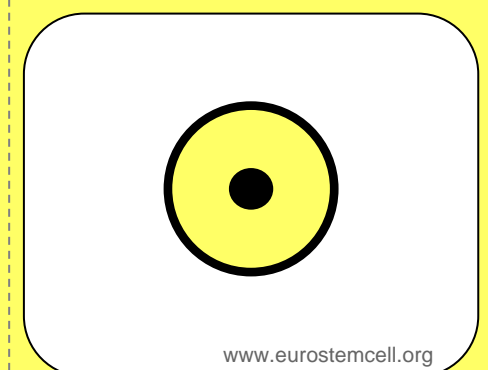
Retinal ganglion cell: Sends a signal from the eye to the brain

#### This family contains:



Stem cell

Specialized cells

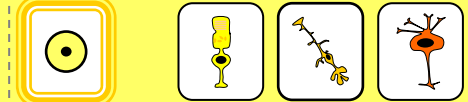


www.eurostemcell.org

### Retina cell family

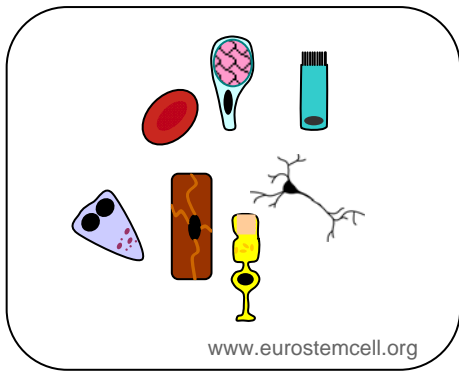
Retinal stem cell: Self-renews and makes retina cells

#### This family contains:



Stem cell

Specialized cells



www.eurostemcell.org

### Embryonic stem cell family

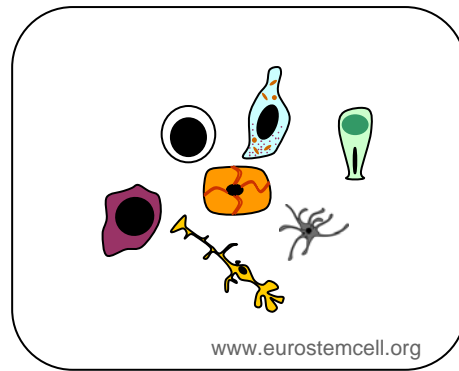
Many different specialized cells

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Embryonic stem cell family

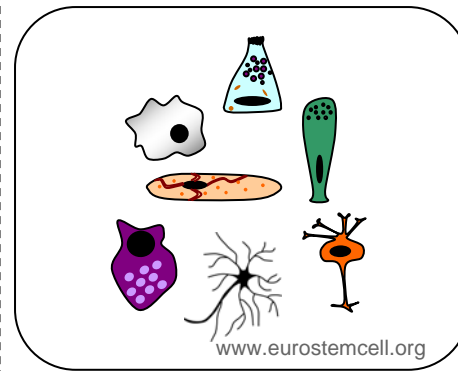
Many different specialized cells

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Embryonic stem cell family

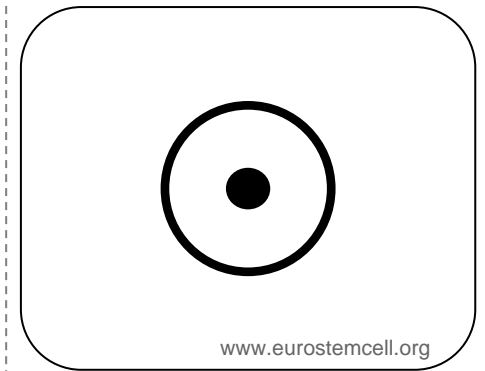
Many different specialized cells

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Embryonic stem cell family

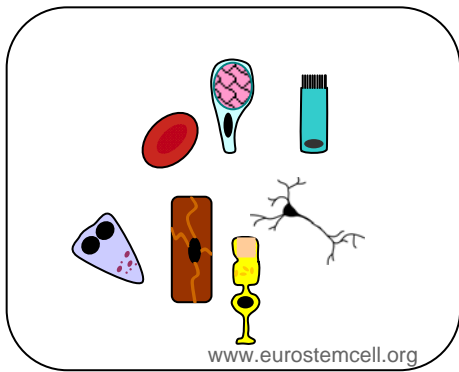
Embryonic stem cell: Can make all the different cells of the body

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Embryonic stem cell family

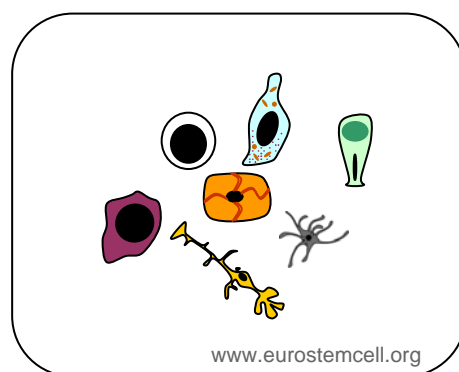
Many different specialized cells

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Embryonic stem cell family

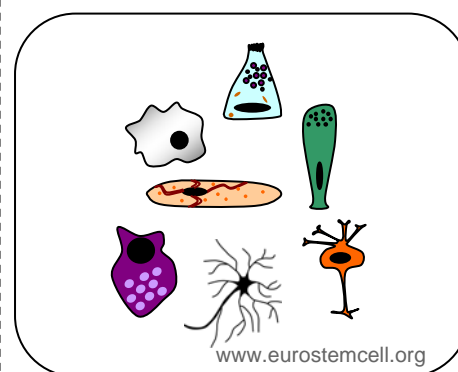
Many different specialized cells

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Embryonic stem cell family

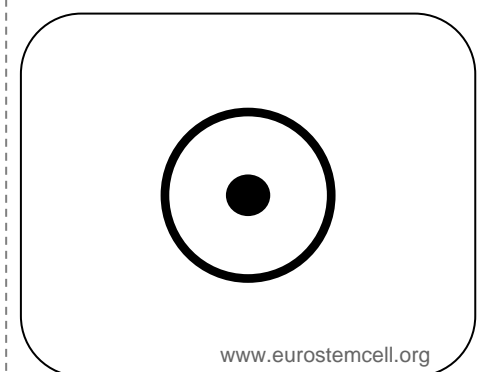
Many different specialized cells

**This family contains:**



Stem cell

Specialized cells



www.eurostemcell.org

### Embryonic stem cell family

Embryonic stem cell: Can make all the different cells of the body

**This family contains:**



Stem cell

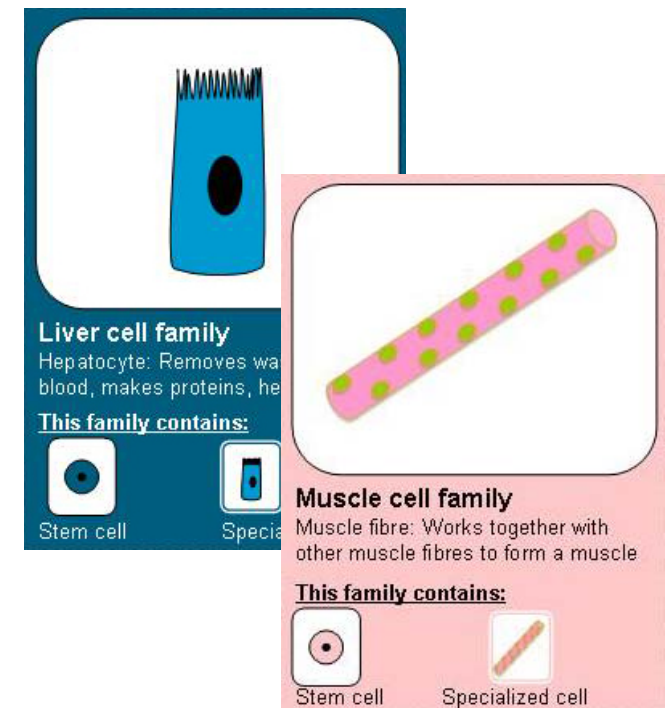
Specialized cells

# Cell families: extension

## A challenge for older or high-ability students

The two cell families on the following pages – muscle and liver – offer a chance to extend this game for older students. Multipotent stem cells can't in reality always make exactly three kinds of specialized cells. We have made families of four cards for simplicity, but in fact the potency of stem cells varies – some multipotent stem cells can make more kinds of specialized cells than others. Unipotent stem cells also exist: stem cells that only make one type of specialized cell.

For older or very able pupils, add the muscle and liver families to allow discussion of the range of potencies of stem cells.





### **Muscle cell family**

Muscle fibre: Works together with other muscle fibres to form a muscle

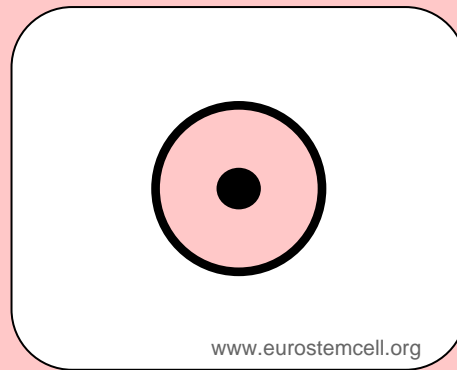
#### **This family contains:**



Stem cell



Specialized cell



### **Muscle cell family**

Muscle stem cell: Self-renews and makes muscle cells

#### **This family contains:**



Stem cell



Specialized cell



### **Muscle cell family**

Muscle fibre: Works together with other muscle fibres to form a muscle

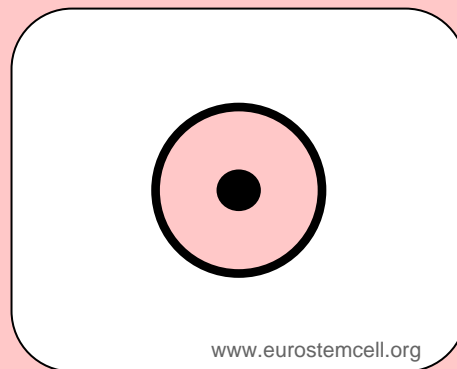
#### **This family contains:**



Stem cell



Specialized cell



### **Muscle cell family**

Muscle stem cell: Self-renews and makes muscle cells

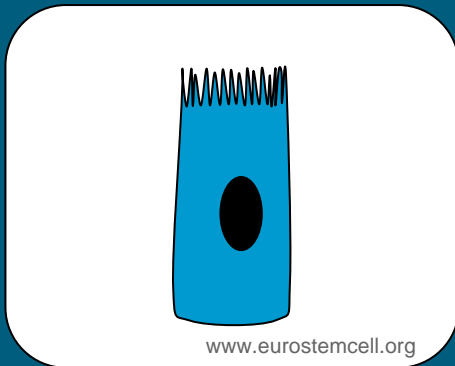
#### **This family contains:**



Stem cell



Specialized cell



### Liver cell family

Hepatocyte: Removes waste from the blood, makes proteins, helps digestion

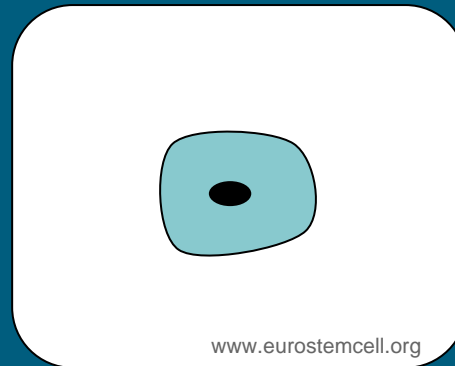
#### This family contains:



Stem cell



Specialized cells



### Liver cell family

Biliary cell: Helps carry bile from the liver to the gut, to digest fats in food

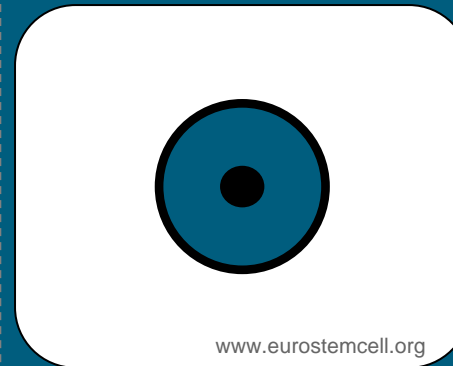
#### This family contains:



Stem cell



Specialized cells



### Liver cell family

Liver stem cell: Self-renews and makes liver cells

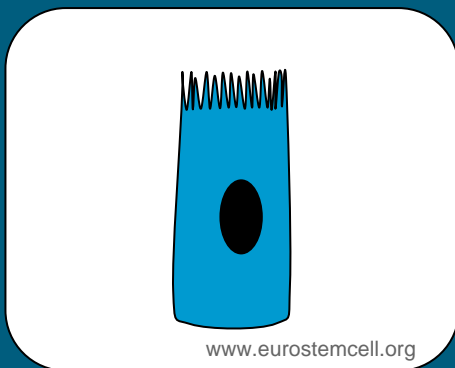
#### This family contains:



Stem cell



Specialized cells



### Liver cell family

Hepatocyte: Removes waste from the blood, makes proteins, helps digestion

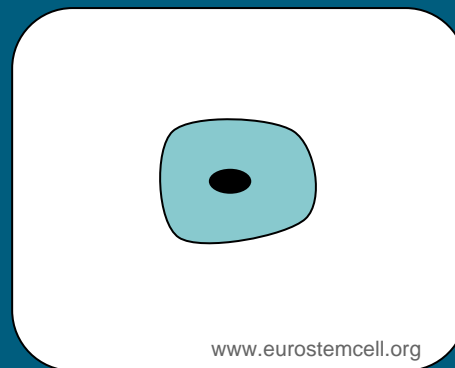
#### This family contains:



Stem cell



Specialized cells



### Liver cell family

Biliary cell: Helps carry bile from the liver to the gut, to digest fats in food

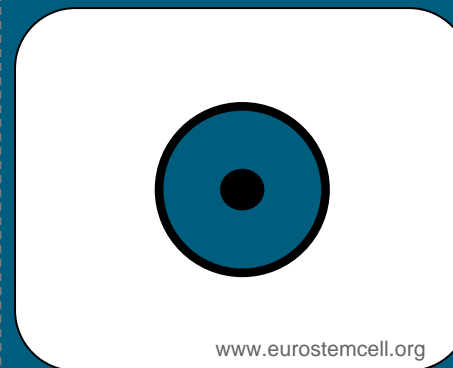
#### This family contains:



Stem cell



Specialized cells



### Liver cell family

Liver stem cell: Self-renews and makes liver cells

#### This family contains:



Stem cell



Specialized cells



# Cell families: Card list

## Blood cell family

Blood stem cell  
Red blood cell  
B cell  
Macrophage

## Gut cell family

Gut stem cell  
Goblet cell  
Endocrine cell  
Paneth cell

## Skin cell family

Skin stem cell  
Basal layer cell  
Spinous layer cell  
Granular layer cell

## Brain cell family

Brain stem cell  
Neuron  
Oligodendrocyte  
Astrocyte

## Lung cell family

Lung stem cell  
Ciliated cell  
Goblet cell  
Clara cell

## Pancreas cell family

Pancreatic stem cell  
Acinar cell  
Duct cell  
Beta cell

## Retina cell family

Retinal stem cell  
Photoreceptor  
Müller cell  
Retinal ganglion cell

## Embryonic stem cell family

Embryonic stem cell  
Many different specialized cells  
(3 different cards)

## Muscle cell family

Muscle stem cell  
Muscle fibre

## Liver cell family

Liver stem cell  
Hepatocyte  
Biliary cell

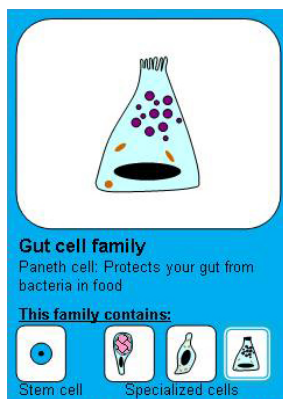


### Aim of the game

Collect as many families of cards as you can. Each family has four members – 1 stem cell and 3 specialized cells.

### How to play

1. Shuffle the cards and deal them out face down.
2. Each look at your own cards and decide which family to collect. You can see all the members of the family on the bottom of each card:



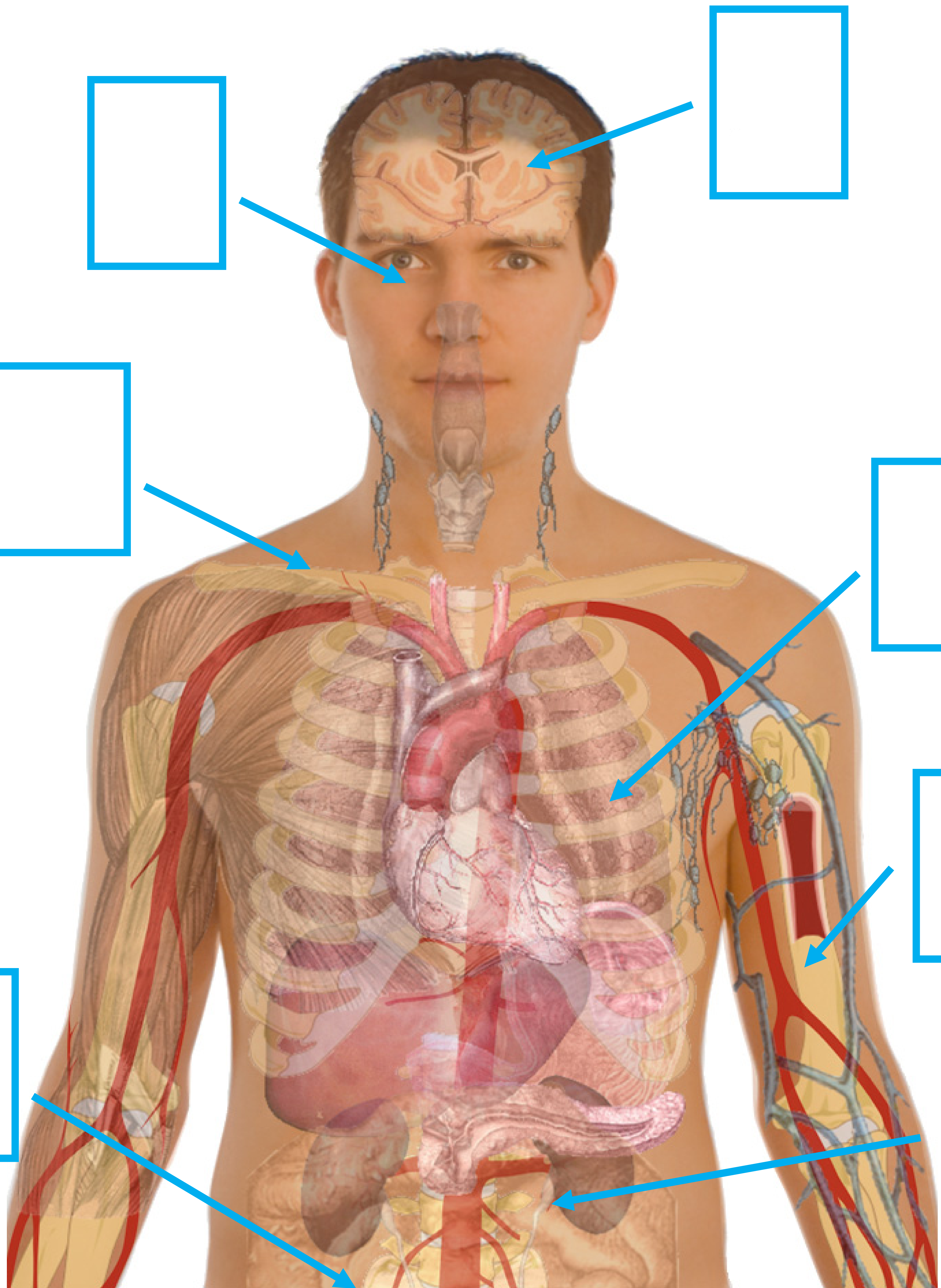
← Members of this cell family

3. The player to the left of the dealer starts: Choose a card you don't want. Give it to the person on your left, without letting anyone else see what it is.
4. Now the person who has just got a new card can play: If you've got 4 cards that make up a family, put them down on the table for everyone to see. Now choose a card to pass to the person on your left.
5. Keep playing until all the cards are used up or you are told to stop.

### Things to think about

- Where in your body would you find the cells shown on the cards? Are there any cells that don't belong in your body? If so, where do you think they belong instead?
- What do you think would happen if the stem cells in your body stopped working?
- Why might it be useful to learn more about stem cells?

# Tissue stem cells



# Cell families: Credits

## Funders

The development of **Cell families** was funded by the European Community's Seventh Framework Programme Project [EuroSyStem](#).

## Authors

**Cell families** was designed by Emma Kemp on behalf of [EuroSyStem](#), and was developed and piloted in close collaboration with Ian Chambers of the MRC Centre for Regenerative Medicine at the University of Edinburgh. It is part of **Discover stem cells**, a lesson for 12-14 year olds created by Ian Chambers and Emma Kemp.

## Acknowledgements

- Ingrid Heersche, Scientific Communications Officer of the MRC Centre for Regenerative Medicine at the University of Edinburgh helped generate ideas and provided useful advice and support.
- Shona Reid, her colleagues and students at the James Young High School, Livingston, Scotland, participated in pilots and offered helpful advice and feedback.
- Helen Wallace and Huw Jones of the University of Edinburgh helped pilot the materials.
- Many scientists and colleagues offered advice on the scientific content of this game: Yvan Arsenijevic, Yann Barrandon, Nick Barker, Valentina Castiglioni, Elena Cattaneo, Michele De Luca, Adam Giangreco, Christèle Gonneau, David Hay, Harry Heimberg, Valentina Lo Sardo, Melissa Maggioni, Didier Montarras, Gianni Munizza, Emmanuelle Savioz-Dayer, Shahragim Tajbakhsh.
- Melissa Magionni translated the content into Italian.

## Picture credits

Thanks to Shahragim Tajbakhsh, Institut Pasteur, France for permission to reproduce the muscle cell drawing.

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# Discover stem cells

Feedback and leave-behind

1. Did you enjoy the lesson?

- ☐ I enjoyed it a lot
- ☐ I enjoyed most bits of it
- ☐ I did not like some of it
- ☐ I did not like any of it

2. Which part(s) of the lesson did you LIKE? Why?

3. Which part(s) of the lesson did you DISLIKE? Why?

4. How much did you learn in the lesson?

- ☐ I learned a lot of new things
- ☐ I learned quite a few new things
- ☐ I did not learn much
- ☐ I did not learn anything

5. Try to write down 2 things you learnt during the lesson.

6. What should we change to make the lesson more interesting?

Now please turn over and answer the questions on the back of this sheet.

## 1. What is a stem cell?

- A cell that can make copies of itself AND make different types of cell
- A cell that helps to fight against infections
- A cell that is specialized
- A cell that can produce all the cell types of the body

A
B
C
D

## 2. Where are stem cells found?

- Only in the early embryo
- Only in adults
- Only in the brain
- In our bodies all our lives AND in the early embryo

A
B
C
D

## 3. Which types of specialized cells can blood stem cells make?

- Only different types of blood cells
- Different types of blood cells and skin cells
- All types of cells in the body
- They can only copy themselves

A
B
C
D

## 4. Our bodies need stem cells to...

- Fight infections
- Digest food
- Replace cells that die or get damaged
- We don't have stem cells in our bodies

A
B
C
D

## 5. Which types of specialized cells can embryonic stem cells make?

- Only skin cells
- All types of cells in the body
- Only cells that babies need
- They can't make any new cells

A
B
C
D

## 6. Where are embryonic stem cells found?

- In the blood
- In our bodies after we are born
- Only in the early embryo
- In the early embryo and in our bodies all our lives

A
B
C
D

Thank you for your help. We hope you enjoyed the lesson.

# Stem cell decisions

## Feedback form: Teachers

1. Which class(es) did you observe?

2. How would you describe the level of engagement of the students in comparison to their usual engagement level in lessons?

- ☐ Majority of students more engaged than usual
- ☐ A few students more engaged than usual
- ☐ Students all at their usual engagement level
- ☐ A few students less engaged than usual
- ☐ Majority of students less engaged than usual

3. Was the content pitched appropriately for the age and ability of the students?

If some parts of the lesson were more appropriate than others, please explain which parts were problematic and why.

4. We combined different formats of delivery. Was the balance of activity types appropriate? If not, what should be changed?

5. Was the content well matched to curriculum goals? If not, what should be changed?

**Please turn over**

# Stem cell decisions

## Feedback form: Teachers

6. Would you consider repeating the visit, or suggesting to colleagues that they organise a similar event? Why/Why not?

7. Any other comments or suggestions for improvement of today's activities?

8. We want to make some downloadable educational resources on stem cells and regenerative medicine. What specific aspects of the topic would you like resources on and why?

9. Do you look for teaching resources online, and if so, are there any particular sites or resources that you like ? (on any topic, not only stem cells)

**Thank you for your time. Your comments will help us develop our activities and provide guidance for other scientists who wish to visit schools.**



### What are stem cells?

Use these words to fill in the gaps:

**differentiation**

**skin**

**self-renewal**

**copies**

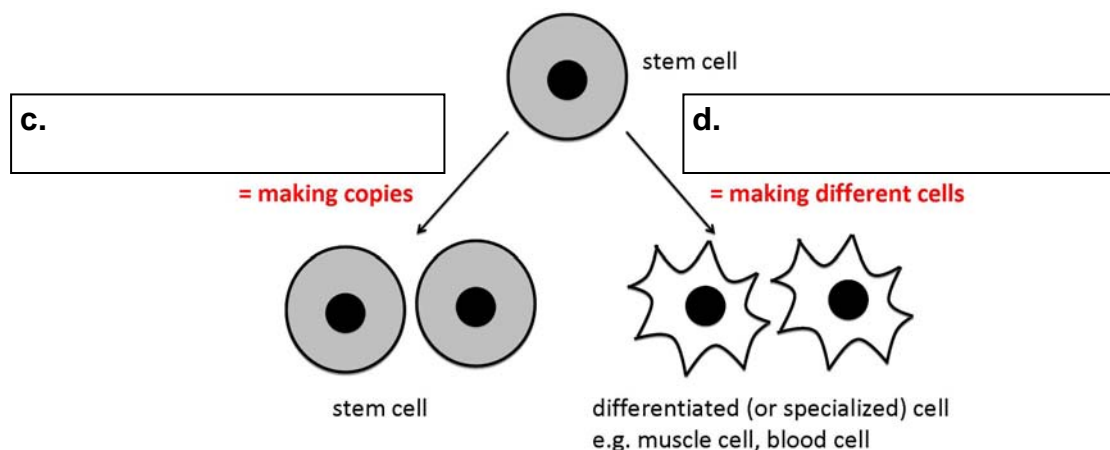
Cells are the building blocks of all living things. Your body is made up of 210 different kinds of cells – blood cells, **a.** cells, muscle cells, nerve cells and many more.

Stem cells are one of the most amazing types of cell in your body. You can't survive without them. In fact, you would never have developed from a fertilized egg into a baby without stem cells. Stem cells are special because they can do two things:

1. Make **b.** of themselves = **self-renewal**.

2. Make different types of cells that do particular jobs in the body, e.g. skin cells, nerve cells or blood cells = **differentiation**.

The new cells are called 'differentiated', or 'specialized' cells. That's because they can only do the particular job they were made for – they are specialists at their jobs.



### Not all stem cells are the same!

Use these words to fill in the gaps:

brain

embryo

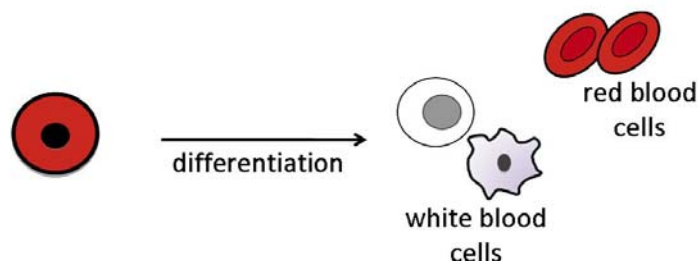
blood

You need two kinds of stem cells: **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 damaged or die. There are blood stem cells making blood cells, muscle stem cells making muscle cells, **a.**  stem cells making the different types of cells 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 **tissue stem cells**. Each kind of tissue stem cell can only make a few other types of cells. Your skin stem cells can only make skin cells; they can't make muscle.



**b.**  stem cell

**Different types of blood cell**

### Embryonic stem cells

When you were still just 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 a baby when it is just a ball of around 100 to 150 cells. This ball of cells is called a blastocyst – it is a very young **c.** .