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# Introduction for teachers

Many Australian science curricula, including the new National Science Curriculum, aims to 'provide students with a solid foundation in science knowledge, understanding, skills and values on which further learning can be built'<sup>1</sup>. As lifelong learners, our students are encouraged to become global thinkers who are aware of the environment and community around them. With new technologies developing so fast, it is difficult for students and teachers alike, to keep up to date. See appendix 2 for a complete summary of the Stem Cell Teachers' Kit Curriculum Guide for Science, Religion Education, Philosophy and English, and which activities correspond to individual state requirements.

Research into stem cells and their applications advances rapidly and is of high interest to the general public. Articles about stem cells regularly feature in Australian and global media. The science behind stem cell acquisition and use is commonly poorly understood by students and adults alike. **This kit enables teachers to introduce and incorporate the concepts of stem cell science into their class rooms.**

**What this kit contains:** The kit consists of six chapters (see contents below), each chapter containing a number of activities varying in length and difficulty (to cater to different levels, age groups, depth of knowledge required and time). The activities provide useful information, links and activities related to stem cells and also to a variety of other areas of biology. Use some of the activities as a tuning exercise, or as background information about stem cells for students who are to complete an issues based essay, debate or presentation. Many of the activities are interchangeable and do not necessarily need to be followed sequentially. So that activities work as standalone sections, relevant information on student outcomes, references and resources has been captured and repeated in the information boxes at the beginning of each activity. Teachers can mix and match activities to consolidate a particular area of stem cell science or biology they wish to address. Teachers can also combine a number of activities to make a lesson plan and even a number of activities to make up an entire unit of work.

Activities can be used to develop one or more key learning or thinking skills. Each activity consolidates a number of key scientific skills including comprehending and understanding new concepts and knowledge, applying knowledge, problem solving, thinking critically and evaluating. Activities mostly contain one or more higher order thinking tasks and incorporate a number of different skills. A number of activities also describe how tasks can be adapted to cater for the individual learning styles of different students (i.e. basic or more advanced concepts).

**How to use the kit:** Throughout the kit there are suggested activities which teachers can use or modify to suit their students level and ability. Many activities contain handouts which can be photocopied or printed and distributed to students. Many handouts contain information and diagrams that may be useful for students to understand new concepts when they are first presented and also act as a reference for concept consolidation during and at the end of a teaching unit. Most handouts have review questions or student response sections. All of these handouts are supported with suggested answers on subsequent pages.

**This kit has been designed to be of assistance to teachers in the following key learning areas:**

- Year 10 Science
- Year 11 and 12 Biology
- Year 10, 11 and 12 English
- Religious education, in particular ethics
- Year 11 and 12 Philosophy

<sup>1</sup> 1. Shape of the Australian Curriculum: Science, May 2009 [http://www.acara.edu.au/verve/\\_resources/Australian\\_Curriculum\\_-\\_Science.pdf](http://www.acara.edu.au/verve/_resources/Australian_Curriculum_-_Science.pdf)

# Teachers' Kit overview

Chapter	Synopsis
1. What are these things called stem cells?	Stem cells feature heavily in the media, but many students do not know what a stem cell actually is. In this chapter, stem cells are defined and introduced through a series of short activities.
2. The different types of stem cells	Stem cells can be categorised into two broad categories: pluripotent stem cells and tissue based stem cells (also referred to as adult stem cells). This chapter introduces these two broad types of cells and helps students to understand the versatility and limitations of the two types.
3. Techniques for obtaining and specialising stem cells	This chapter explores how stem cells are isolated and manipulated so that they differentiate into cell types. Activities include: <ul style="list-style-type: none"><li>■ an outline of how a fertilised egg develops into an embryo</li><li>■ how the IVF process works</li><li>■ how embryonic stem cell are obtained.</li></ul> Difficult concepts are introduced that deal with: <ul style="list-style-type: none"><li>■ advances in induced pluripotent stem cells</li><li>■ cloning.</li></ul>
4. Stem cell use now and in the future	This chapter explores not only the current and potential uses of stem cells in clinical applications; but all other significant areas of stem cell research including potential drug screening.
5. Stem cells – fact and fiction	With stem cells featured frequently in the media, it is important to distinguish fact from fiction. This chapter outlines and resolves many of the misconceptions.
6. It's stem cells – the issues	Stem cell use and research is a hot topic! This chapter outlines a variety of way for students to explore, discuss, present and reflect on stem cells.
Glossary	Common words used in stem cell research.

# How to use the Stem Cell Teacher Kit – A guide for teachers

**The aim of this kit is to enable teachers to easily introduce and incorporate the concepts of stem cell science into their class rooms.**

This Kit contains a number of activities varying in length and difficulty (to cater to different levels, age groups, depth of knowledge required, different key learning areas and time).

The activities in this kit:

- Can be adapted by teachers. I.e. shortened or extended to cater for differences in teacher/student time and resources.
- Can mostly be used as standalone activities.
- Can be joined together to make a whole lesson plan or even a unit plan.
- Range from tuning in exercises and background information about stem cells to activities that can be used to consolidate deeper understanding about a particular area of stem cell science or biology.
- Can be readily interchanged and do not need to be followed sequentially.
- Have masters to photocopy or print that can be distributed to students. Most handouts have review questions or student response sections.
- Are supported with suggested answers on subsequent pages.
- Incorporate the use of ICT where applicable.
- Provide links to useful information, links and activities related to stem cells and also to a variety of other areas of biology.
- Can be used to develop one or more key learning or thinking skills. Such as comprehending and understanding new concepts and knowledge, applying knowledge, problem solving, thinking critically and evaluating.
- Can be used to cater for higher order thinking.
- Can be used to cater for a number of different learning styles.

# Suggested teaching plan – Scenario 1: Year 10 science

'I want to introduce stem cells to year 10s. The unit is on genetics and I want to highlight a number of gene technologies, such as GM, stem cells, cloning, etc. I have about 2–3 lessons (45 minutes each) that I can devote to stem cells. Students only need to understand the basic concept behind stem cells, general uses and a general idea of ethical issues'

## 1. Tuning in

Activity 1.1 Brainstorm  
5–10min, whole class

Use the whole class brainstorm activity to grab student attention and get them thinking about where they have seen 'stem cells' before.

Activity 1.1 KWL  
2–5min, individual

In their workbooks, ask students to write what they already know and what they want to know about stem cells. At the end of the lessons, have them write what they have learned, as a quick self reflection task.

Activity 1.3 What are stem cells?  
10–15min, individual

This activity is a good introduction to stem cells and their general properties.

## 2. Developing understanding about stem cells

Handout 2.1.2 Types of stem cells – jumbled task (basic)  
10–20min, individual/pairs

Use this cut and paste activity to introduce the types of stem cells. All the information is there, it's just jumbled up. Students can stick the finished table in their books and refer back to it. (Want to make it more inquiry based – swap this task with 'research' version 2.2.1.)

Activity 2.3 Role play (about stem cells)  
20–40min, pairs/small groups

Optional task: Role play about stem cells. Catering for the kinaesthetic learners, ask students to create a short role play about the types of stem cells.

Activity 3.4 Reprogramming cells – iPS and SCNT videos  
10–30min, individual

Introduce the concept of iPS and SCNT (cloning) as a way of obtaining stem cells. Watch the videos and discuss as a group, and/or ask students to write a brief summary of what they have learned. Use a Venn diagram to investigate the differences and similarities of the different stem cell types.

## 3. Consolidating understanding about stem cells

Activity 4.2 Use of stem cells – media review.  
20–30min research + 15–30 min presentation, individual/pairs

Distribute different articles about the research in the field of stem cells. Ask some students to research bone marrow and cord blood usage (as these techniques have been in use for many years now). Ask students to provide a summary of their findings to the class.

Activity 5.1 Opinion poll  
15–20min, group

Use some of the opinion poll slides to get students thinking about how they personally feel about stem cells and their (potential) use in society. Run a class poll to see how their views compare.

Activity 6.5 It's personal  
30–90min, individual/pairs /groups

Use one of the chapter 6 activities to finish the teaching sequence. Use the 'It's personal' activities to get students reflecting on what they have learned.

## Suggested teaching plan – Scenario 2: Year 11 biology

*'I am exploring cells with year 11 students in biology. We are looking at plant and animal cells. I would like to link key concepts and promote more depth to student understanding about cells and tissues in different organisms.'*

Suggestion: Incorporate the following activities into the regular teaching unit. The context for each activity is provided.

Activity 1.1 Picture stimulation  
10–15 min, individual

Activity 1.3 What are stem cells?  
10–15min, individual

**Stem cells give rise to many different cell types.** Students are taught about cells in terms of the different cell types, such as an intestinal lining cell, a sperm cell, a blood cell, a stomata cell. How do these cells arise though? Ask students to consider the unlabelled diagram and think about how versatile stem cells are. Follow the exercise up with 'activity 1.3 What are stem cells?'. Alternatively, provide the labelled stem cell diagram with activity 1.3.

Activity 2.2.1 Mind map about stem cells (summary)  
10–15min, individual

**There are different types of stem cells.** Students can research these different stem cell types and summarise their learning on the mind map (activity 2.2.1).

Activity 2.2.2 Stem cell picture sorting  
15–30min, individual/pairs

**Scientists use microscopy to study cells.** Use the picture sorting exercise and accompanying diagram 2.2.2 'What am I looking at' to demonstrate the variety of images that can be obtained using a microscope. Link this exercise to proteins – i.e. how different proteins are made from different genes, different cells produce different proteins (different gene expression).

Activity 2.4 Potent lingo  
10–15min, individual/pairs

**Scientists use words to describe things.** Many scientific words have Latin or Greek origins. Learning about biology can sometimes be overwhelming because there are so many new words. This activity helps students realise that some difficult scientific words contain smaller, descriptive words.

Activity 2.5 What's so special about stem cells  
15–30min, individual

Activity 3.3 Reprogramming cells – plants do it naturally  
10–15min, individual

**Plant and animal cells have similarities and differences.** Students understand the basic differences between plant and animal cells, such as plants have chloroplasts and animal cells have lysosomes etc. The cells themselves develop into specialised cell types and different tissue types. These two activities can be used together to highlight the origins of the many different cell and tissue types that make up animals and plants. The concepts of differentiation and transdifferentiation (cell reprogramming) are covered in these activities.

Activity 3.4 Reprogramming cells – iPS and SCNT videos  
10–30min, individual

**Scientists can reprogram specialised cells.** Use activity 3.4 to highlight not only the current research being done into cell reprogramming, but also highlight the amazing work being done here and overseas in the field of stem cell research.

Activity 3.5 How are stem cells specialised into different cell types?  
20–40min, individual

**How are cells specialised?** This activity outlines how cells become specialised, particularly in the human body. Some cells and tissues cannot be replaced, whereas some cells are continually being made via mitosis. Link this topic to the idea of mitosis and highlight that many cells require stem cells to make more cells of a particular type.

Activity 3.1 Forming an embryo  
15–20min, individual

**Sperm cells, egg cells and an embryo.** This activity outlines how an embryo is made. It can be incorporated into a unit on cells or reproduction.

## Suggested teaching plan – Scenario 3: Year 12 biology

Suggestion: Incorporate the following activities into the regular teaching unit. The context for each activity is provided.

Activity 3.5 How are stem cells specialised into different cell types?  
20–40min, individual

*'I am looking for an activity to help consolidate the concepts of gene expression and signal transduction.'*

Activity 4.1.2 What are stem cells being used for?  
10–20min, individual

*'I am looking of an example of HLA matching and/or tissue transplants.'*

Activity 4.2 Use of stem cells – media review.  
20–30min research + 15–30 min presentation, individual/pairs

*'I want to link the teaching of disease to something tangible and interesting.'*

Activity 4.3 Stem cells assignment 1: 'Stem cells can help...'  
2–4 lessons, individual

*'I am looking for a research task where students can investigate a disease and the current treatment/s OR research being undertaken into future treatment/s.'*

Activity 4.3 Stem cells assignment 2: Stem cells treat mystery illness  
2–4 lessons, individual

*'I am after a research/summary task that links together the concepts of the nervous system, autoimmune disease and the body detecting/fighting pathogens.'*

Activity 5.1 Opinion poll  
15–20min, group

*'I want an activity that gets my students thinking about issues and implications relating to scientific and technological developments.'*

Activity 5.4 Headline splash  
15–50 min individual/pairs

Activity 6.2 It's topical – stem cell essay  
1–2 lessons, individual

*'I am after an assessment task for year 12 biology that investigates a current application of gene technology/biotechnology.'*

Activity 6.3 It's printable – writing media articles  
15–50 min individual/pairs

Activity 6.5 It's presentable – oral presentation  
60–90min, individual/pairs

Activity 6.5 It's presentable – poster presentation  
60–90min, individual/pairs

Activity 6.5 It's presentable – webpage presentation  
30–90min, individual/pairs

Activity 6.5 It's presentable – video presentation  
60–90min, individual/pairs/groups



## Suggested teaching plan – Scenario 4: English (issues)

*'My students are going to be exploring stem cells for their issues essay. I need them to understand the basic concepts of stem cells, but I don't want to overload them with too much scientific information.'*

Activity 1.2 Stem cell word splash  
10–30 mins, individual or groups

Introduce the idea of stem cells and the issues/topics surrounding stem cell research and use by using this group/individual activity.

Activity 1.3 What are stem cells?  
10–15min, individual

Consolidate student understanding of the versatility and appeal of stem cells by using this activity.

Handout 2.1.4 Types of stem cells  
– jumbled task (complex)  
15–25min, individual/pairs

Use this stand alone activity (or use the research task option if time permits) to introduce students to the different kinds of stem cells and how they are derived, their uses, advantages and drawbacks.

Activity 3.4 Reprogramming cells  
– iPS and SCNT videos  
10–30min, individual

To further investigate how stem cells are obtained, use these activities to highlight the difference between the three pluripotent stem cell types.

Activity 3.2 IVF – how does it work?  
20–40min, individual/pairs

Activity 4.1.1 Timeline activity  
10–20min, individual

'Look at the progress of stem cell research.' To give students an appreciation of this, the time line activity would be useful.

Activity 5.1 Opinion poll  
15–20min, group

To investigate the issues surrounding stem cell research and use, use the polling activity to ascertain student feeling on the different issues. This task can also highlight any student misconceptions. (Activity 5.2 'facts and fiction' can also be useful.)

Activity 5.5 Medical tourism  
15–30 min, individual/pairs

Optional task: Medical tourism. This is an interesting side issue regarding stem cell use and the use of other therapies that could be another interesting topic for students to investigate.

Activity 6.1 It's stem cells  
– the issues  
10–50min,  
individual/pairs/ groups

These tasks can be used to discuss the issues, prepare students for the assessment task or can be used as the assessment task.

Activity 6.2 It's topical  
– stem cell essay  
1–2 lessons, individual