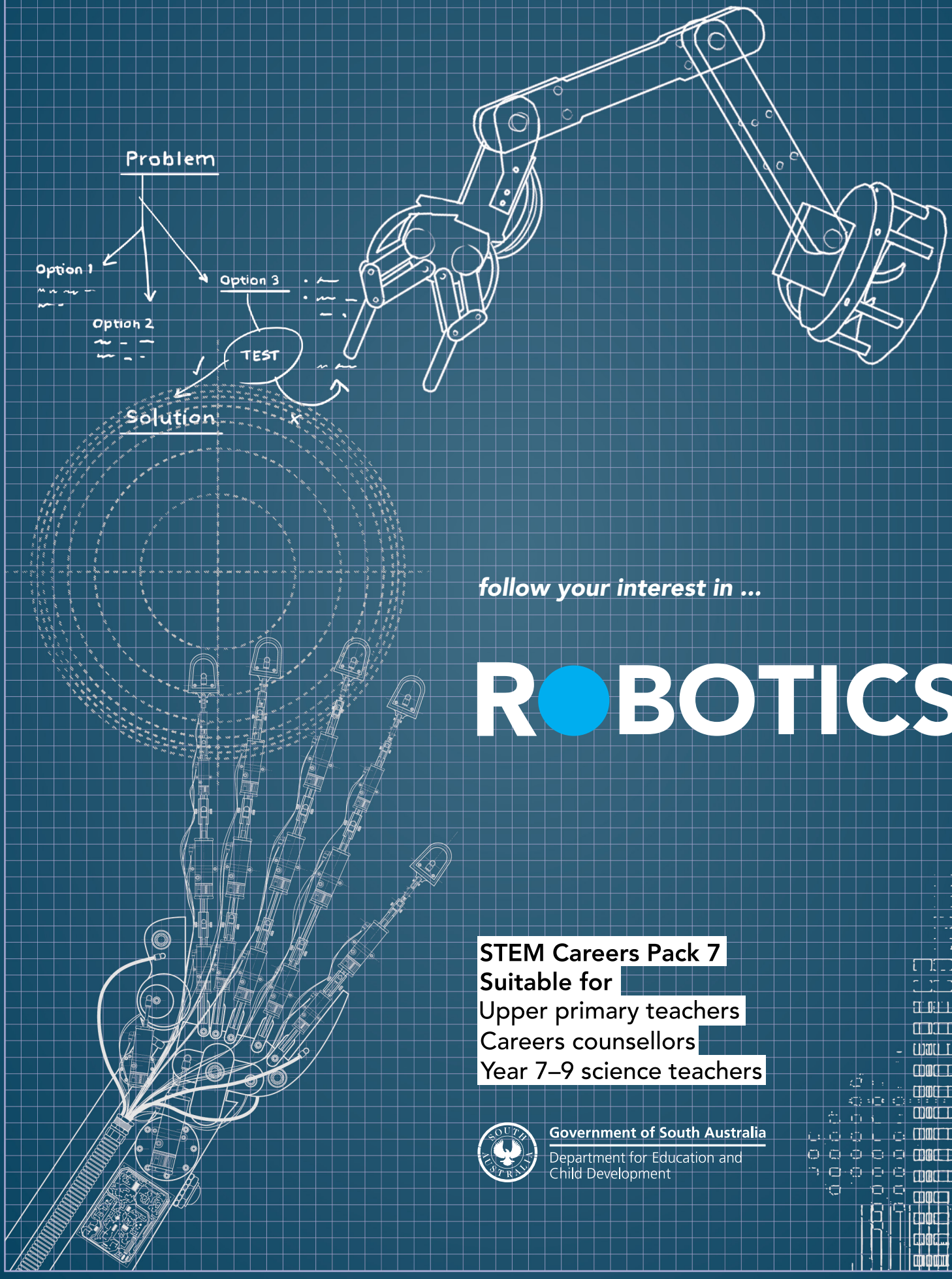
Ri Aus STEM careers



follow your interest in ...

ROBOTICS

STEM Careers Pack 7
Suitable for
Upper primary teachers
Careers counsellors
Year 7–9 science teachers

Government of South Australia
Department for Education and Child Development

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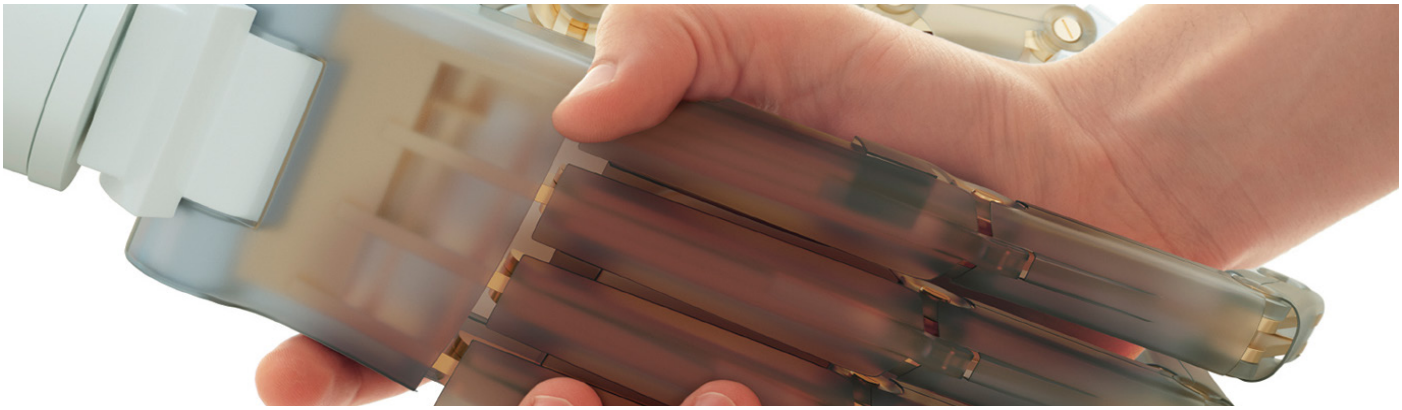
How to Use this Pack:

- Designed to be used as a whole, or select individual tasks.
- In conjunction with units of work on Science Understanding and Science Inquiry Skills.

Introduction



Follow your interests in…
Each STEM Career Pack provides teachers with a sequential set of tasks and information, including interviews, to take into the classroom. The Packs are aimed at: helping students to understand the nature of scientific knowledge, how science influences society and how society influences science (ie Australian Curriculum: Science, Science as a Human Endeavour); and making students aware of the wide variety of exciting STEM careers they could aspire to.

STEM Career Packs 5–8 focus on four interest areas: 3D printing, Art Conservation, Robotics and Forensics. It is anticipated that students who don't typically 'like' 'science' but are interested in 3D printers, art restoration, robots or CSI television shows, will come to see how their interests relate to the science they study at school and STEM career possibilities.

Bringing STEM careers to life:
There is a current shortage of people, particularly women studying and working in STEM (also generally referred to in these Packs as 'science'). There are many factors at play supported by a substantial body of research; two of these factors are addressed in these Packs. The first of these factors is that students find it difficult to identify themselves with scientists, technologists, engineers and mathematicians; they can't picture themselves working in a STEM career[1]. The second factor addressed here is that many students are simply unaware of the STEM careers available, what day to day work is entailed and what pathways lead into these careers[2].

Why is it important to address these factors in the middle years? Research has shown that experiences prior to 14 years of age are pivotal in developing students' interests in science, and influencing career choices[3].

> *'When asked about when they became interested in science, 48 per cent of the students traced the origin of their interest to junior secondary school; 12 per cent mentioned primary school…'*[1].

[1] Office of the Chief Scientist 2012, Health of Australian Science. Australian Government, Canberra.
[2] Panizzon, D & Westwell, M. 2009, Engaging students in STEM-related subjects. What does the research evidence say? Flinders Centre for Science Education in the 21st Century, Adelaide.
[3] Tytler, R, Osborne, J, Williams, G, Tytler, K, Cripps Clark, J, 2008, Opening up pathways: Engagement in STEM across the Primary–Secondary school transition. Australian Department of Education, Employment and Workplace elations, Australia.

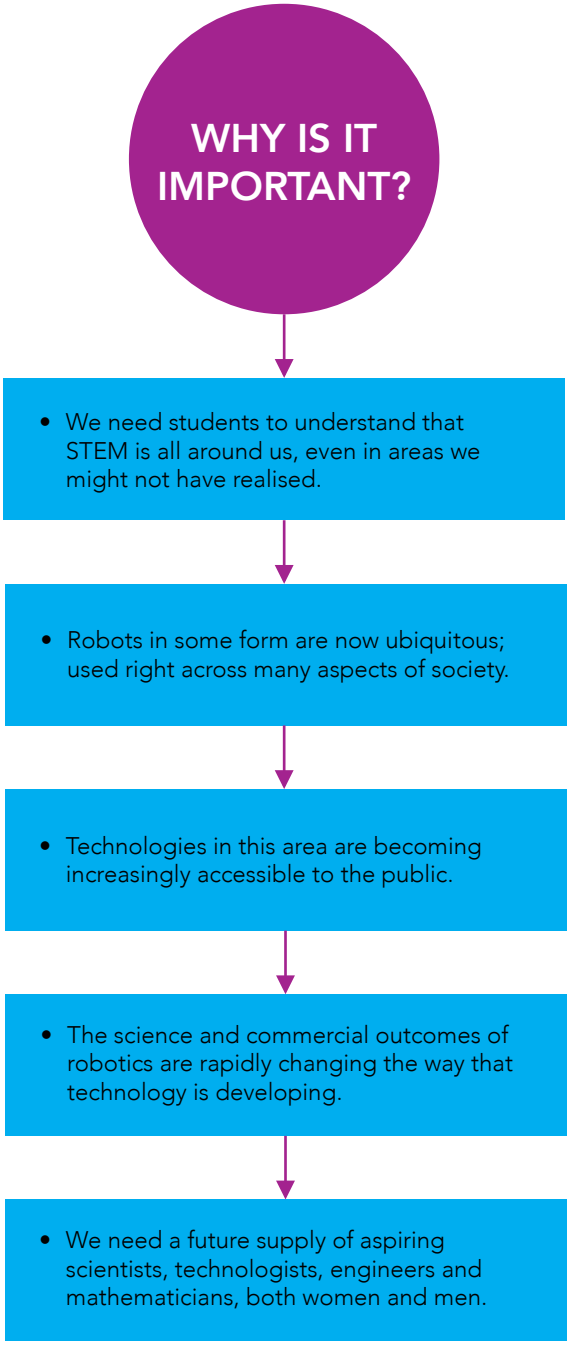
What do we want them to learn?

What is the intended learning?

Students will learn about the ways in which robots and robotics are transforming research, design and manufacturing. There are many outcomes of the technologies in this area that are already with us, including industrial automation on a mass scale. But some of the most exciting applications that have recently begun to emerge include machines that literally replace body parts, such as fully functional artificial limbs. Already there are few parts of our lives that don't involve robotics in some form; from car manufacturing to food processing; from desk-top work in the office to medical treatments for patients afflicted by disease or disability. The growing demand for and future potential of robots and robotics is truly enormous.

What do students bring?

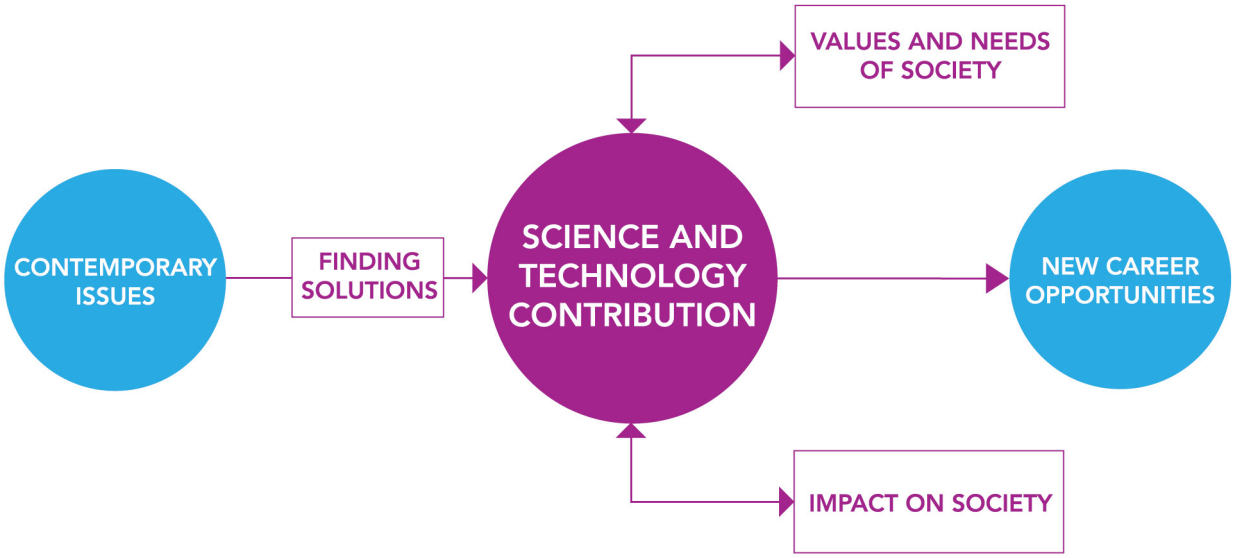
Students are unlikely to realise the broad extent to which robot technology affects their lives: from the fully automated vacuum cleaner that scurries around on the floor at home to a new limb with previously unimaginable fine motor skill capabilities for a soldier who lost his arm in a bomb blast. Potential applications that once seemed limited to science fiction novels are now potential realities. Students will undoubtedly have a wide range of thoughts on how robotics are and should be used and these ideas and perceptions will be enhanced through this guide.



Planning approach
Planning approach based on the SA Department for Education and Child Development's Learning Design: aligning what and how of teaching and learning in the Australian Curriculum. www.decd.sa.gov.au/teachingandlearning/pages/Leadersresource/44209/?reFlag=1

How will we know if they got it?

What could the intended learning look like at this level?



The Australian Curriculum: Science focus for this unit is **Science as a Human Endeavour**. Students will explore the ways that robots are used in different jobs and industries. They will learn about the potential and current applications of robotics, its limitations and relevant ethical concerns. As well as identifying and questioning their own beliefs and those of others, students will understand why such beliefs should be openly questioned and how they can do this in a constructive, respectful manner. Students will be able to demonstrate an increase in their knowledge of science careers as well as the role of science in society.

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Teachers use the intended learning, as indicated in the Quick Reference Table for this unit overleaf, in conjunction with the Achievement Standards in the Integration of the Tasks or the development of whole units of learning and assessment.

Students will demonstrate development towards the following Australian Curriculum skills and dispositions.

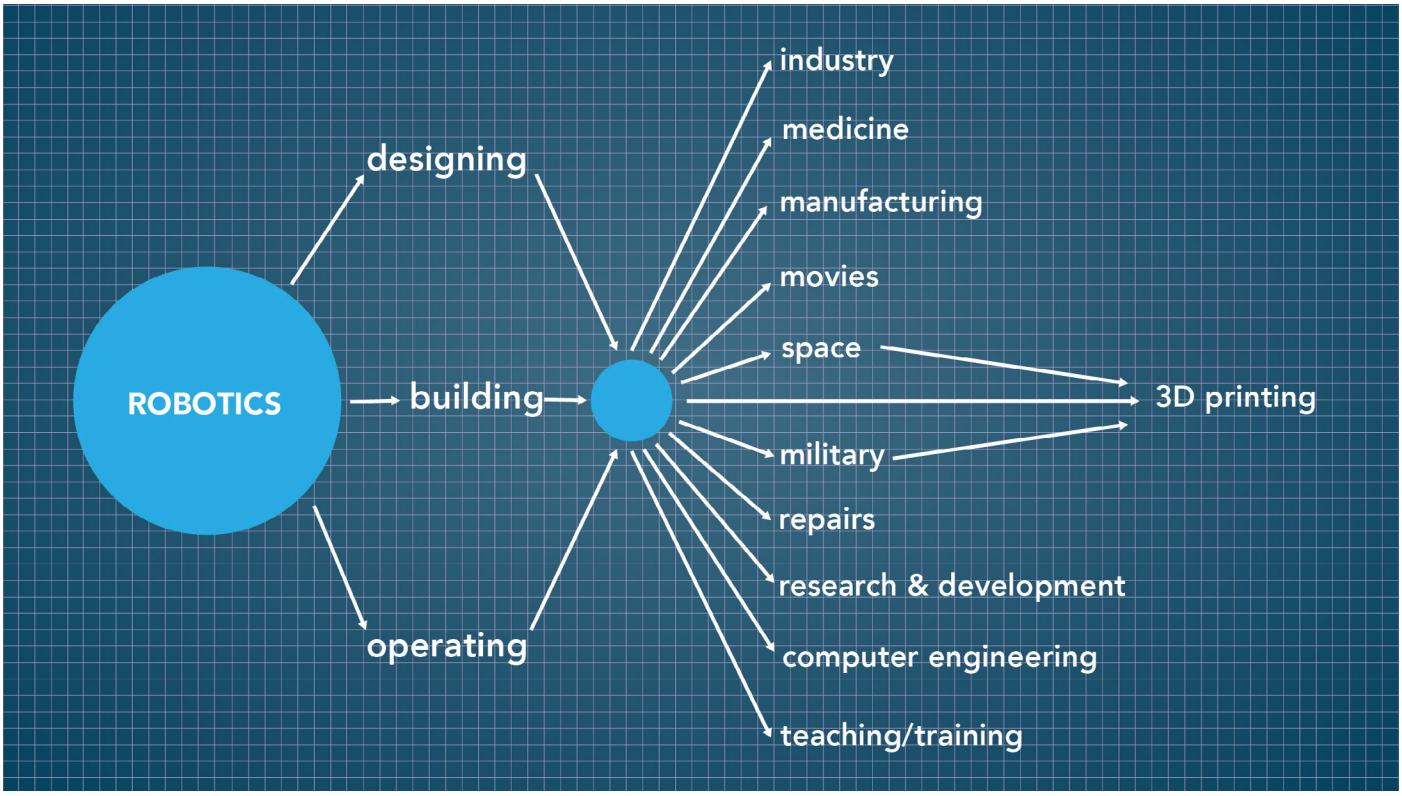
Quick reference table

Australian Curriculum: Science as a Human Endeavour

Australian Curriculum: Science as a Human Endeavour	Tasks				
Year 7	1	2	3	4	5
ACSHE120 - Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations.					
ACSHE121 - Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management.					
ACSHE224 - People use understanding and skills from across the disciplines of science in their occupations.					
Year 8					
ACSHE135 - Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations.					
ACSHE136 - Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management.					
ACSHE227 - People use understanding and skills from across the disciplines of science in their occupations.					
Year 9					
ACSHE158 - Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries.					
ACSHE160 - People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions.					
ACSHE161 - Advances in science and emerging sciences and technologies can significantly affect people's lives, including generating new career opportunities.					
ACSHE228 - The values and needs of contemporary society can influence the focus of scientific research.					
Year 10					
ACSHE192 - Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries.					
ACSHE194 - People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions.					
ACSHE195 - Advances in science and emerging sciences and technologies can significantly affect people's lives, including generating new career opportunities.					
ACSHE230 - The values and needs of contemporary society can influence the focus of scientific research.					
General Capabilities					
Personal and Social Capability: social awareness; and self-awareness					
Ethical Understanding: understanding ethical concepts and issues; reasoning in decision making and action; exploring values, rights and responsibilities.					
Critical and Creative Thinking: inquiring – identifying, exploring and clarifying information ideas; generating ideas, possibilities and actions; reflecting on thinking and processes; analysing, synthesising and evaluating reasoning and procedures.					
Literacy					

How will we know if they got it?

What evidence will enable us to assess the intended learning?



Science as a Human Endeavour

1. Students' knowledge and understanding of how robots are used in industry and the work they are capable of.
2. Students' understanding of the role of science, technology, engineering and maths (STEM) in robotics and of STEM careers that use these technologies.

Personal and Social Capability and Critical and Creative Thinking

3. Students' ability and disposition to reflect on their own and others' beliefs.
4. Students' ability to participate in a whole class discussion.

Ethical Understanding and Critical and Creative Thinking

5. Students' ability to identify current and future ethical issues relating to robotics and to articulate their position with reasons on these issues.
6. Students' ability to participate in reasoned discussion with peers (in pairs, small groups, or whole class) including the ability and disposition to draw on evidence and an underlying ethical principle when making informed decisions, as well as to evaluate their own and others' reasons.

What will we do to get there?

How will we engage, challenge and support their learning?

Tasks will draw on students' prior knowledge, relate learning to students' everyday lives and provide opportunities for students to direct their own learning. Throughout the unit, students will be expected to:

- reflect on their own ideas about robotics and how the ideas of others may differ from their own;
- understand how people use robotics to manufacture goods, in research and in medicine;
- engage in reflection and analysis during whole class discussions, group activities and peer assessment tasks; and
- understand the ethical considerations involved.

The three big ideas of the South Australia Teaching for Effective Learning framework (TfEL), were used in designing this unit:

Create safe conditions for rigorous learning
Focus – building a community of learners

Develop expert learners
Focus – expanding strategies for thinking, learning and working collaboratively

Personalise and connect learning
Focus – building on learners' understanding.

South Australian Teaching for Effective Learning Framework (SA TfEL)
www.decd.sa.gov.au/teachingandlearning/pages/Teaching/Teachlearnandassess/?reFlag=1

The terms 'understanding' and 'knowledge' are synonymous and thus used interchangeably throughout this unit.

Tasks

Pages

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Task 1: Definitions

Australian Curriculum Links			
Year 7 ACSHE 121	Year 8 ACSHE 136	Year 9 ACSHE 158 ACSHE 228	Year 10 ACSHE 192 ACSHE 230
Critical and Creative Thinking Literacy			

Part 1: What is a robot?

Drawing on their prior knowledge students are to look at the table below listing different everyday machines and decide whether or not they think it is a robot and record their reasons. Essentially, the reasons that students give for a machine being a robot form criteria for what a robot is. Once completed, collate the students' responses about why a machine is a robot and use these responses to write a definition of the word 'Robot'.

Object	Robot or not a robot?	Why or why isn't it a robot?
1. A car		
2. A manually operated kid's robotic arm		
3. A car factory production line machine (robotic arm)		
4. A computer		
5. NASA's Curiosity Mars rover		
6. A robotic vacuum cleaner		
7. An electronic garage door		
8. A toaster		
9. Automatic ball thrower		
10. Rube Goldberg machine (homemade mouse trap)		

Task 1: Definitions

Australian Curriculum Links			
Year 7 ACSHE 121	Year 8 ACSHE 136	Year 9 ACSHE 158 ACSHE 228	Year 10 ACSHE 192 ACSHE 230
Critical and Creative Thinking Literacy			

Part 2: What is the difference between a robot and a machine?

First, students are to read the following information. Second, ask the class whether or not their definition of a robot needs to be adjusted or whether it still stands as it is.

Next, students use an inclusive Venn diagram to tease out the features and actions of machines that are robots (inner smaller circle) and machines that are not robots (outer larger circle). Ask students for real life examples of each and include these in their diagram.

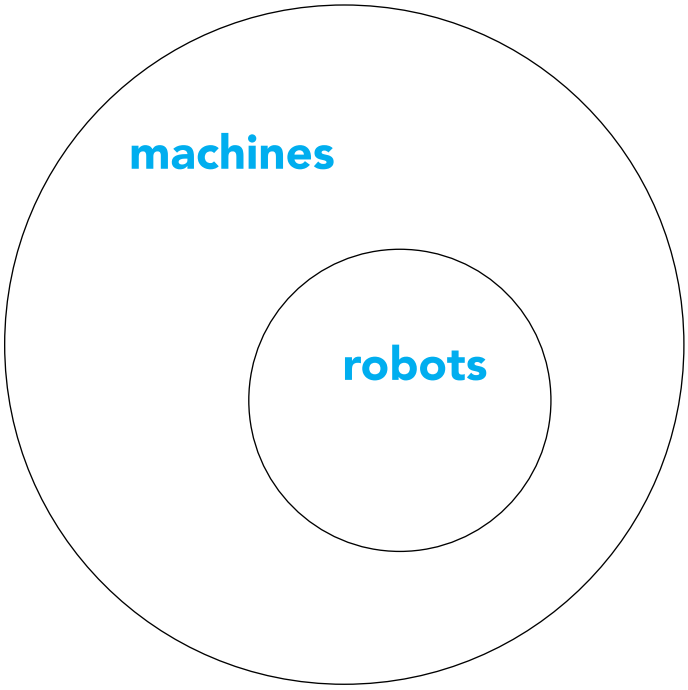
Activity: Student reading

Most people would think the term 'robot' means walking, talking machines that look like metal versions of us. However, any device capable of carrying out tasks with little or no help from people can be called a robot. Most robots used today work behind the scenes carrying out repetitive or complicated jobs that people don't want to do. Examples include the mechanical arms used for decades in the manufacturing industry to assemble, weld and paint cars and other products.

But some robots have found their way into the spotlight, playing pivotal roles to improve – and even saving – people's lives. In the aftermath of the 9/11 terror attacks in New York, in 2001, PackBot robots the size of shoeboxes, with tank-like wheels and crane arms, hunted through the rubble of the World Trade Center in search of victims – reaching places people couldn't. More recently, updated PackBots were the first to enter the Fukushima nuclear plant to help assess the damage after the 2011 earthquake and tsunami in Japan.

In medicine too, robots are also making a mark. Robotic assistance is gaining popularity among some surgeons in complex keyhole procedures. Only small cuts are needed for thin robotic arms and tiny tools to delve into the human body and reach diseased or damaged tissue. These automated devices can be manipulated to then move inside the body using actions that mirror a surgeon's precision movements outside the body.

There's no single accepted definition that separates 'robots' from 'machines'. It's widely accepted, however, that robots have the capability to react and respond to what happens around them. A machine, however, performs a pre-programmed role and behaviours and can't automatically respond to changes or cues in its environment.



Task 2:
Robots and humans

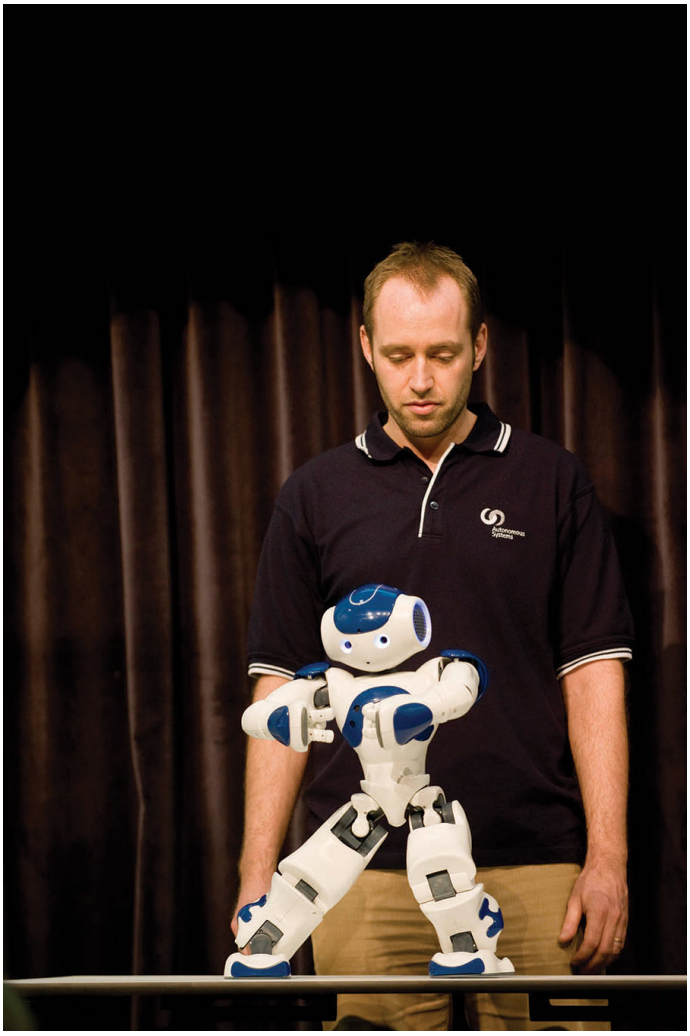
Australian Curriculum Links			
Year 7 ACSHE 120 ACSHE 121 ACSHE 224	Year 8 ACSHE 135 ACSHE 136 ACSHE 227	Year 9 ACSHE 158 ACSHE 161 ACSHE 228	Year 10 ACSHE 192 ACSHE 195 ACSHE 230
Personal and Social Capability Critical and Creative Thinking Literacy			

Part 1: Who uses robotics in their lives and in their jobs?

Part 1 here draws on the class definition of 'robot' developed in Task 1. As a class, make a list of all the different robots you have used or interacted with in the last 7 days. Which ones were for entertainment? Which performed domestic duties? (Students could even keep a diary for a set number of days and then share their experiences with the class.) Moving from a view of everyday robot use, take students to the extreme end of the spectrum and have them read the following career profiles of robotics engineers working at NASA.

- Julie Townsend – Rover Driver
  nasa.gov/audience/foreducators/robotics/careercorner/Julie_Townsend.html#.U4auw-JSSyYk

- Arin Morfopoulos - Robotics Engineer
  nasa.gov/audience/foreducators/robotics/careercorner/Arin_Morfopoulos.html#.U4av-JZSSyYk



Carol to label

Task 2:
Robots and humans

Australian Curriculum Links			
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Personal and Social Capability Critical and Creative Thinking Literacy			

Part 2: How are robots changing the way people live and work?

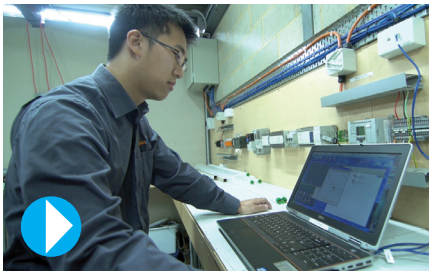
Students are to watch the interview clips of Zoz, Simon and Chris from Dematec and Robogals. Students are to take note of the science, technology, engineering and mathematics involved in the careers highlighted (which can be written into the diagram overleaf) and note any other points of interest. These notes can then be discussed as a class.

ZOZ, robotics

ZOZ, Follow your interests ...

CHRIS and SIMON, robotics

ROBOGALS, robotics



CHRIS and SIMON, problem solving

Task 2:
Robots and humans

Australian Curriculum Links			
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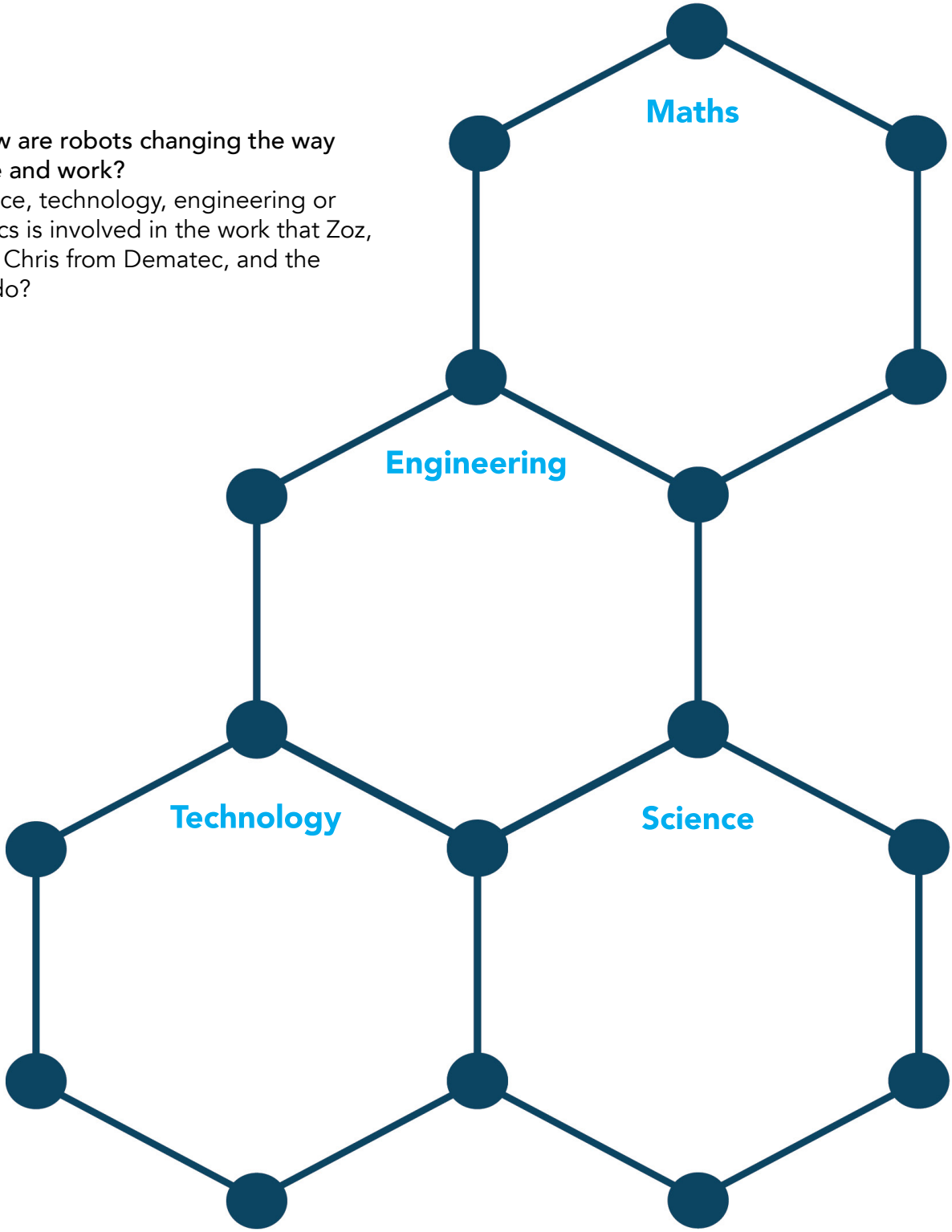
Personal and Social Capability Critical and Creative Thinking Literacy			

Part 2: How are robots changing the way people live and work?
What science, technology, engineering or mathematics is involved in the work that Zoz, Simon and Chris from Dematec, and the Robogals do?



Task 3:
Robots past and future

Australian Curriculum Links			
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Personal and Social Capability Critical and Creative Thinking Literacy			

Part 1: Have there always been robots?
Activity: Student reading
In this Task students read about the history of robots, research contemporary robots and then speculate as to the future of robots. It is the communication skills and uses of robots that students are concentrating on here. Both areas are of great interest and naturally raise ethical questions which are looked at in the following tasks.

Robot (R)evolution
1495 – Italian genius Leonardo da Vinci sketches designs for a mechanical knight who could sit, stand, wave its arms and move its head and neck.
1899 – Serbian-American inventor Nikola Tesla demonstrates a remote-controlled vehicle: a boat that could be commanded to go, stop, turn left and right, turn its lights on and off, and even plunge underwater.
1921 – earliest mention of the word 'robot' – it's used in the play 'R.U.R.' by Czech writer Karel Capek: the play's title stands for 'Rosumovi Univerzální Roboti' (Rossum's Universal Robots) and is about humans who create robots that eventually kill their masters.
1941 – science fiction writer Isaac Asimov first uses the word 'robotics' to describe the technology of robots. The following year, he proposes the 'Three Laws of Robotics' to ensure robots never turn on their human makers.
1954 – Americans George Devol, an inventor, and Joe Engelberger (a physicist and engineer) create an industrial robot 'arm', which later led in 1961 to the first industrial robot, called 'Unimate'.
1973 – Ichiro Kato creates the WABOT-1, a full-scale human-like robot with the mental ability of an 18-month-old child.
1997 – Sojourner, the first robot to visit Mars, performs scientific experiments on the Red Planet while, back on Earth the inaugural RoboCup football tournament – for robots – kicks off in Nagoya, Japan.
1999 – US researchers build Nursebot, designed to remind the elderly and infirm about daily activities and guide them through their homes.
2000 – Japan-based car manufacturer and developer Honda unveils ASIMO, a humanoid robot with extraordinarily human-like movement capabilities, and uses it widely to popularise robotics.
2002 – the first robot to make it into ordinary people's homes is unveiled: a robotic vacuum called Roomba.
2006 – a 'robosurgeon' performs the world's first unassisted surgical operation, treating a patient suffering from an irregular heart rate.
2011 – the upper half of Robonaut 2 arrives at the International Space Station. R2 is intended to help astronauts with tasks on the station. Its legs arrived on a separate delivery in 2014!

Task 3:
Robots past and future

Australian Curriculum Links			
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Personal and Social Capability Critical and Creative Thinking Literacy			

Part 2: Research a robot

Now that students have an idea of robot history and how robots have been 'evolving', they are to take a look at some robots that are currently, or have recently been, in use. Ask students to choose one or more of the following machines and investigate its use and purpose. Then discuss as a class why it is considered a robot and what sort of intelligent work it performs and how.

Contemporary Robots:

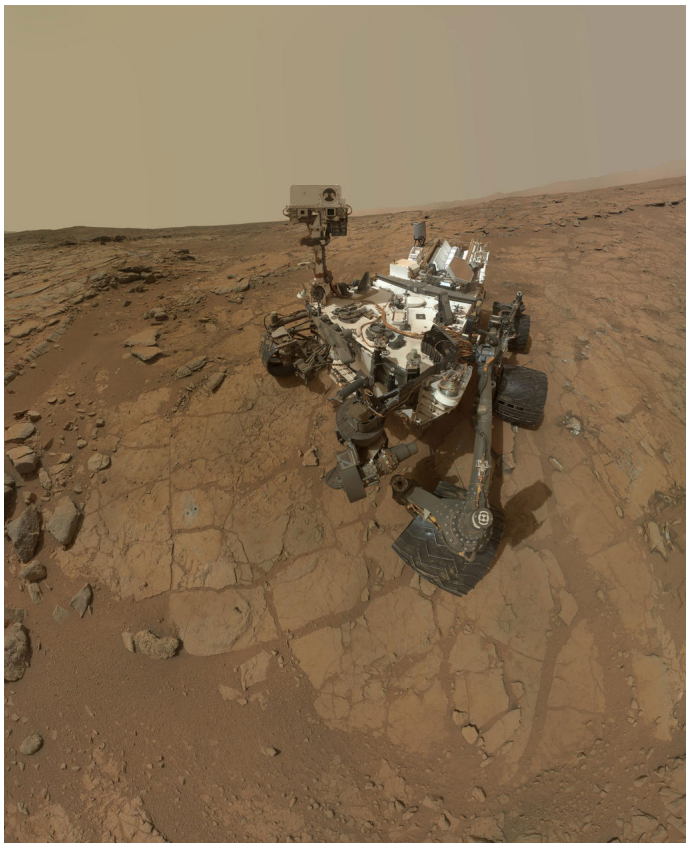
- Railway Collision Avoidance System, such as at the Docklands Light Railway, in London
- MYCIN, an artificial intelligence system used to identify the source of bacterial infections
- Urbie, NASA's urban robot
- Global Hawk, an unmanned surveillance
- Eurofighter Typhoon, an advanced combat fighter plane
- Deep Space I, the first in a series of remotely operated probes
- WASUBOT, a musician robot with a humanoid appearance
- Deep Blue, a chess-playing computer developed by IBM
- Care-O-bot, AIBO, E-Nose, Robokoneko, or any other 'intelligent' robot

Part 3: Robots of the future

First, students are to read the information below. Then, ask students to design their own robot of the future that interacts with other robots. They need to explain how their robot will communicate and how much of that communication humans will be aware of.

The idea of why and how robots will communicate should be discussed along with whether or not humans will be part of or even aware of this communication.

Next, ask students to consider the ultimate assistance a robot could give them. If they had a 'digital genie' of the future, a robot that could do anything they wished, what would they have it do and why? Students can share their ideas with the rest of the class.



Task 3:
Robots past and future

Australian Curriculum Links			
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Personal and Social Capability Critical and Creative Thinking Literacy			

Part 3: Robots of the future
Activity: Student reading, Future 'bots

Robots are likely to play an increasing role in everyday life. And they'll look more and more like humans and animals. For example, the rise of microdrones – remote-controlled aerial surveillance devices – has led to the development of a robotic hummingbird, dragonfly and most recently Robo-Bees that buzz around universities and company testing grounds. These remarkable mini-machines mimic nature's best-kept secrets by taking inspiration from some stunning insect capabilities. They can hover, fly and bump into objects without damaging themselves. Insect-inspired robots can remain stable in high winds and don't get tangled in wires or other drones for example. Researchers also hope to learn more about the collective hive behaviour of some insects through robotic insects.

Robotic insects are likely to soon be providing surveillance support to troops and monitoring traffic hotspots, providing early detection of problems and helping town planners improve roads. But these tiny automated creatures may also have a more biological function to play in the future. With bee numbers rapidly declining world-wide, due to a mite infection, there's enormous concern that crops will go unpollinated, which will add to the worldwide food shortage crisis already underway.

And so RoboBees could soon be drafted in to work alongside their natural counterparts to pollinate crops. Having a wingspan of just 3cm means the RoboBee is small enough to pollinate a flower. And with wings that move just like those of a natural insect – flapping 100 times a second – RoboBee is able to float in the air just like a regular bee, allowing it plenty of time to transfer pollen.

It's not only the hardware that's getting better. Robots being developed today aren't simply programmed to perform repetitive tasks, their software enables them to recognise and respond to information and objects in the real world and even learn from those experiences. This ability is allowing prototype robots to smell, taste, touch and interpret the world around them.

Task 4:
Robots and ethics

Australian Curriculum Links			
Year 7 ACSHE 120 ACSHE 121 ACSHE 224	Year 8 ACSHE 135 ACSHE 136 ACSHE 227	Year 9 ACSHE 158 ACSHE 160 ACSHE 161 ACSHE 228	Year 10 ACSHE 192 ACSHE 194 ACSHE 195 ACSHE 230
Personal and Social Capability Ethical Understanding Critical and Creative Thinking Literacy			

Part 1: What jobs are we happy for robots to do?
In this Task students are to consider one of the big ethical issues with robots: what jobs should we allow robots to perform? This is a question that scientists, psychologists, ethicists, industry and the rest of society are struggling with currently. It is an authentic and meaningful question for students to consider for themselves. Not only are people concerned that robots might take jobs away from humans and thus cause unemployment but people are unsure about how much a robot can and should interact with a human. Can robots care for a child? Not just physically but mentally and emotionally. Can we trust robots like we trust another human being? The answers to these questions are central to the future integration of robots into society.

Focus in on jobs for robots – First, stimulate students' thinking by talking them through the following resources (or other similar resources) and gathering their initial reactions.

- Driverless cars could let you sleep
  https://www.youtube.com/watch?v=aBxfcmu-loUA

- Top 10 Humanoid Robots
  https://www.youtube.com/watch?v=OlM2v-luYk8A

- Meet 'Rex' The Military's Robotic Bomb-Sniffing Dog
  https://www.youtube.com/watch?v=KWDoS-dta904
  Note: robot soldiers are also addressed in STEM Careers Pack 2: Bringing Military Science to Life

- Asimov's Three Laws of Robotics:
  Before introducing the Three Laws to students, introduce them to who Isaac Asimov was and his work as a scientist and an author. You could even include the reading of segments from his science-fiction novels on robots or clips from the movies made from his books.
  http://en.wikipedia.org/wiki/Isaac_Asimov
  http://en.wikipedia.org/wiki/Three_Laws_of_Robotics

Note: Two relevant movies that students could watch in full or specific snippets of are: *Bicentennial Man* and *iRobot.*

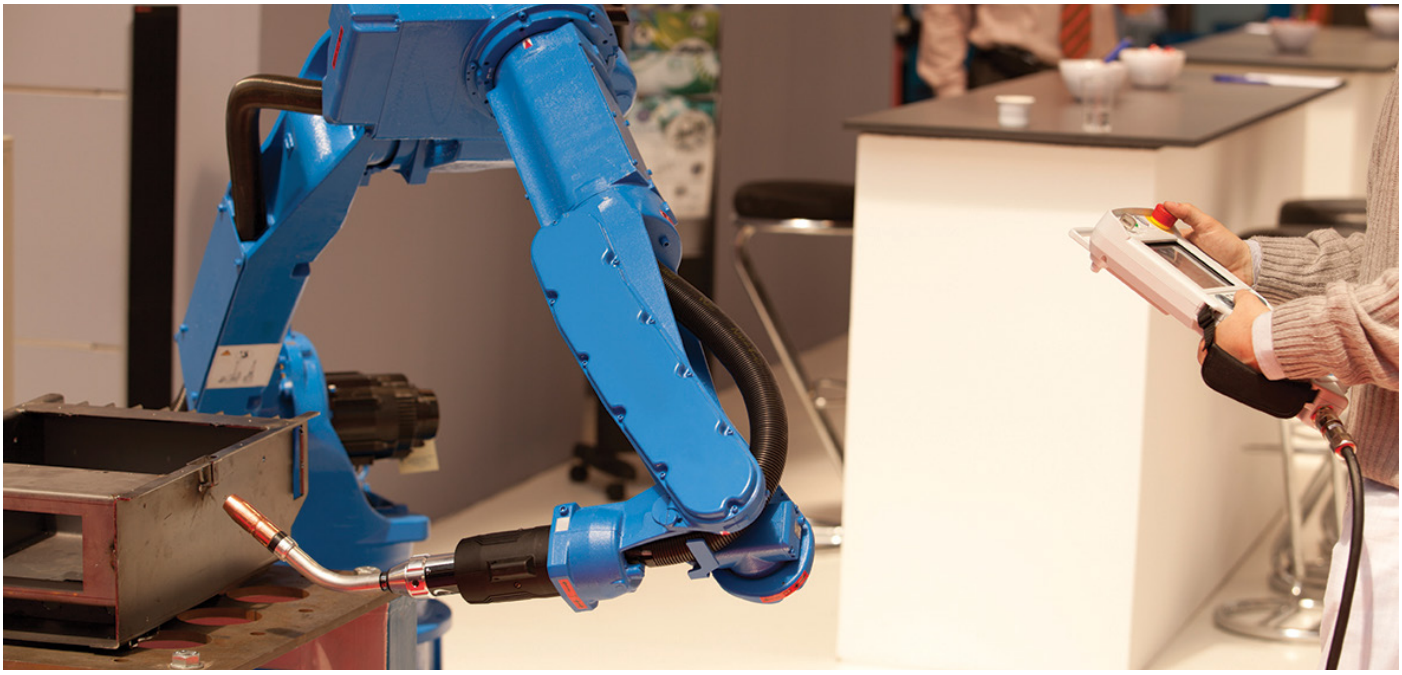
1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

- PUBLIC ATTITUDES TOWARDS ROBOTS
  (read the executive summary)
  http://ec.europa.eu/public_opinion/archives/ebs/ebs_382_en.pdf

  Before looking at the report findings ask students how they feel about robots.

Task 4:
Robots and ethics

Australian Curriculum Links			
Year 7 ACSHE 120 ACSHE 121 ACSHE 224	Year 8 ACSHE 135 ACSHE 136 ACSHE 227	Year 9 ACSHE 158 ACSHE 160 ACSHE 161 ACSHE 228	Year 10 ACSHE 192 ACSHE 194 ACSHE 195 ACSHE 230
Personal and Social Capability Ethical Understanding Critical and Creative Thinking Literacy			



Ask students, either individually at first or as a whole class to consider the jobs suggested in the table overleaf and decide whether a robot should do that job. Make sure students justify their choices. The reasons students give should be discussed as a class and on the basis of this discussion the class can then write a set of guidelines for the kinds of jobs they think robots should and should not do.

In order to answer these ethical questions students must of course apply (consciously or subconsciously) an ethical principle in order to work out which action should be taken and why.

As part of the whole class discussion what you want to be drawing out from students are the ethical concepts they are using (such as, fairness, rights and responsibilities) and the ethical principles they are basing their decision on, such as the weighing up of consequences and choosing the action that brings about the best (likely) consequences for those most in need.

What is important here is that students practice giving reasons and evaluating their own and others' reasons. This is an important disposition and set of skills to develop in students in relation to science and everyday life. Raising and addressing ethical questions in the classroom ought to be encouraged and is supported by the **Australian Curriculum** in the **Ethical Understanding General Capability.**

Task 4:
Robots and ethics

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Jobs for consideration	Is it okay for a robot to do this job? Yes/No?	Why or why not? (explain your reasons)
Diagnosing patients, like a GP, for health problems such as the flu or broken bones		
Diagnosing patients, like a medical specialist, for health problems like cancer or psychiatric disorders		
Driving a public bus in a city		
Writing novels about human relationships		
Soldiers fighting a war and killing the enemy		
Babysitting a 5-year-old for 2 hours		
Assisting behind a shop counter in a busy department store		
Defending people in court, as lawyers do		
Preparing the annual budget for a country by assessing where tax cuts should be made, as politicians do		
Being a crossing guard at a pedestrian crossing outside a primary school		
Hosting a reality TV show		
Cooking meals in a restaurant		
Teaching a class of 25 young students		
Taking professional photographs		

Task 4:
Robots and ethics

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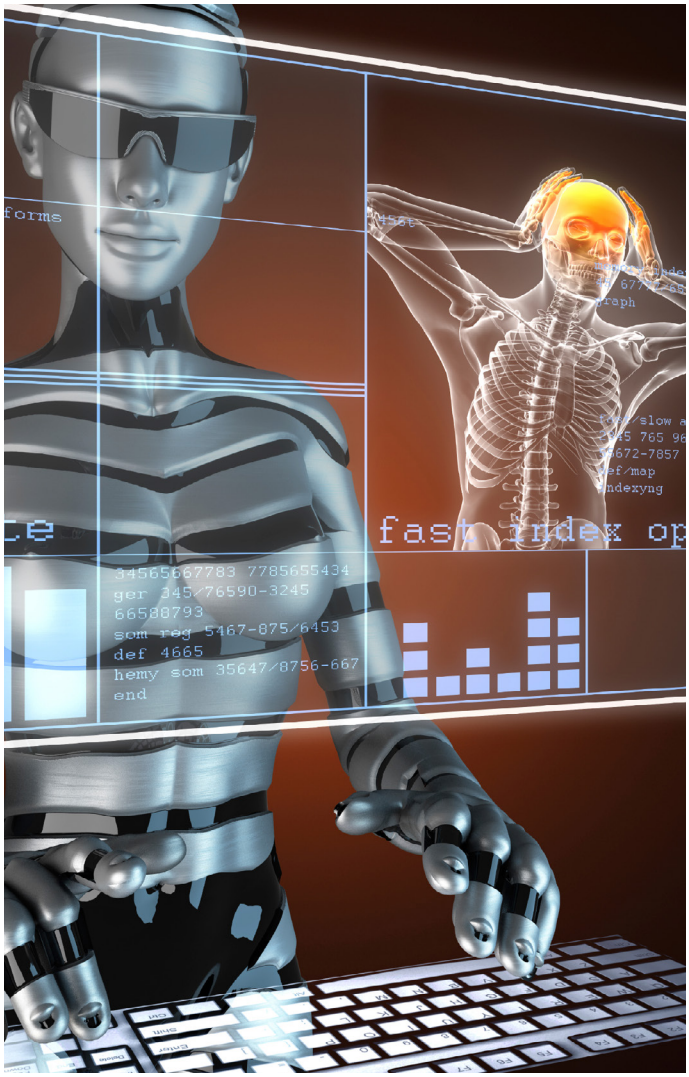
Suggestions for Assessing Task 4

Peer assessment of reasoning and discussion skills: as a class, prior to engaging in the task, develop a set of criteria for a reasoned whole class discussion. Students should be able to identify basic criteria for engaging in whole class discussion. Students could also use these criteria to assess their own reasoning and discussion skills and even identify a specific skill which they would like to focus on developing.

As for the reasoning elements, you could develop your own checklist using the criteria for Community of Inquiry discussions [footnote] or use the checklist on the RiAus website: http://riaus.org.au/wp-content/uploads/2013/05/SBTH_Reasoning_Skills_checklist.pdf. Ultimately you want students to be skilled at clearly articulating their position and reasons on an issue and be prepared to reassess this position and their reasons in the light of new evidence, circumstances or other relevant considerations.

Note: the terms 'morally' and 'ethically' are used interchangeably in this resource.



There are many resources to support teachers in this task, most notably, resources captured under 'Philosophy for Children' and 'Community of Inquiry'. Here are some resources that will be helpful: Institute for the Advancement of Philosophy for Children (IAPC)
www.montclair.edu/cehs/academics/centers-and-institutes/iapc/what-is/

- DeHaan, C., MacColl, S. & McCutcheon, L. (1995) Philosophy with Kids, Book 3, Hawthorn: ACER, pp. 13-17
- Cam, P. (1995) Thinking Together, Sydney: Hale & Iremonger, pp. 41-54
- White, T (1988) Right and wrong a brief guide to understanding ethics. New Jersey, Prentice Hall.
- Burgh, G., Field, T. & Freakley, M. (2006) Ethics and the Community of Inquiry: education for deliberative democracy. Australia: Thomson Social Science Press.

The Philosophy for Children movement uses Community of Inquiry as its primary methodology. In the pack 'You can be a scientist' the Community of Inquiry method was referred to in relation to whole class guided discussions. This same methodology should be used for whole class discussions of ethical questions.

Task 5:
Intelligence. Human and artificial.

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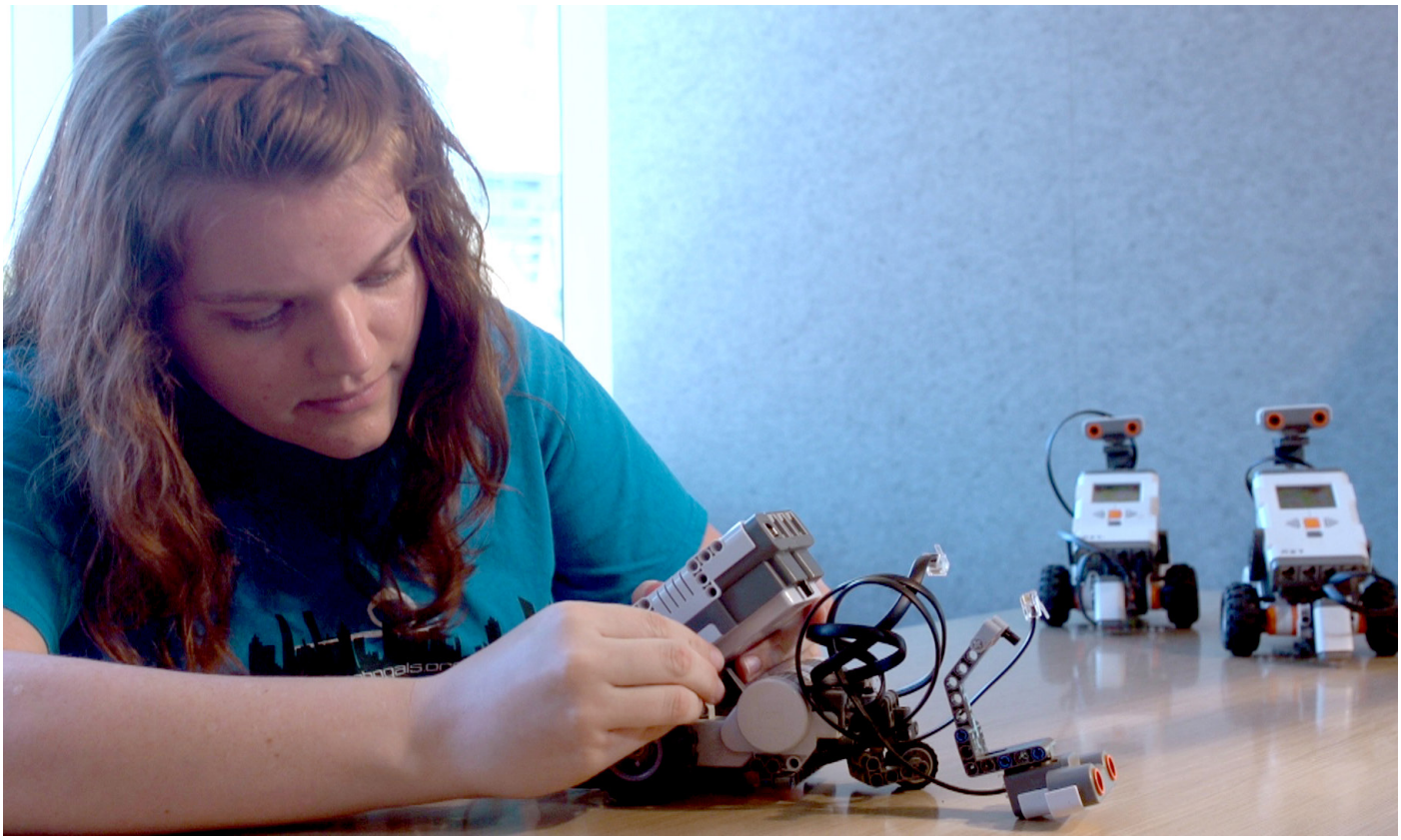
Part 1: Are robots as intelligent as humans?
By now the students will be thinking about whether robots are intelligent and comparing a robot's level of intelligence to that of humans. Start by having students, individually or as a class, work through the following table (page 22). If necessary, have students further research contemporary robots and robots of the future.



Task 5:
Intelligence. Human and artificial.

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Task	Who is intelligent enough?			
	Humans	A personal computer or smart device	Contemporary robots	Prediction: Future robots
Interpret data				
Learn				
Recognise faces				
Invent				
Make decisions				
Make ethical decisions				
Correct mistakes				
Hallucinate				
Speak 1,000 languages				
Laugh and joke				
Enjoy a compliment				
Be angry				
Fall in love				
Have a conversation				
Interview a job candidate				
Diagnose an illness				
Desire to understand				
Have a conscience				
Calculate π to 20 decimal places				
Design codes				
Decipher codes				

Task 5:
Intelligence. Human and artificial.

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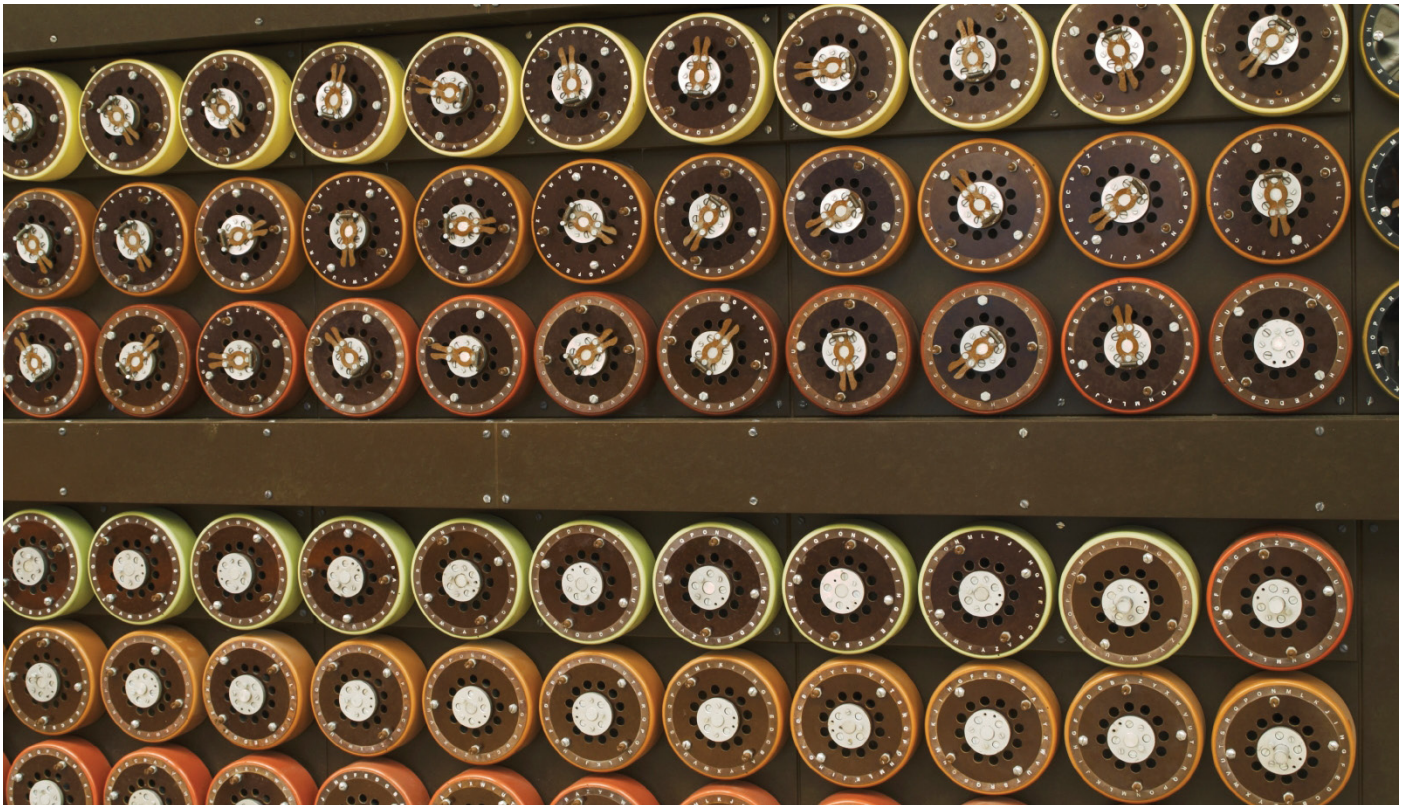

Part 2: The Turing Test

The 'Turing Test' was developed by twentieth century British mathematician Alan Turing, the 'father' of modern computer science and thus the foundation of robotics. The test is designed to establish whether or not a machine can think like a human so much so that it would be impossible to distinguish between a thinking human and a thinking machine. There have been many attempts at the test and debates about whether or not particular machines have passed.

Ask students to research The Turing Test and recent attempts to pass it.

Suggested resources:

- Turing test http://en.wikipedia.org/wiki/Turing_test
- Turing Test - Daniel Dennett https://www.youtube.com/watch?v=e8vZy-8a9lSc
- Oppy, Graham and Dowe, David, "The Turing Test", The Stanford Encyclopedia of Philosophy (Spring 2011 Edition), Edward N. Zalta (ed.), URL = http://plato.stanford.edu/archives/spr2011/entries/turing-test/

Task 5:
Intelligence. Human and artificial.

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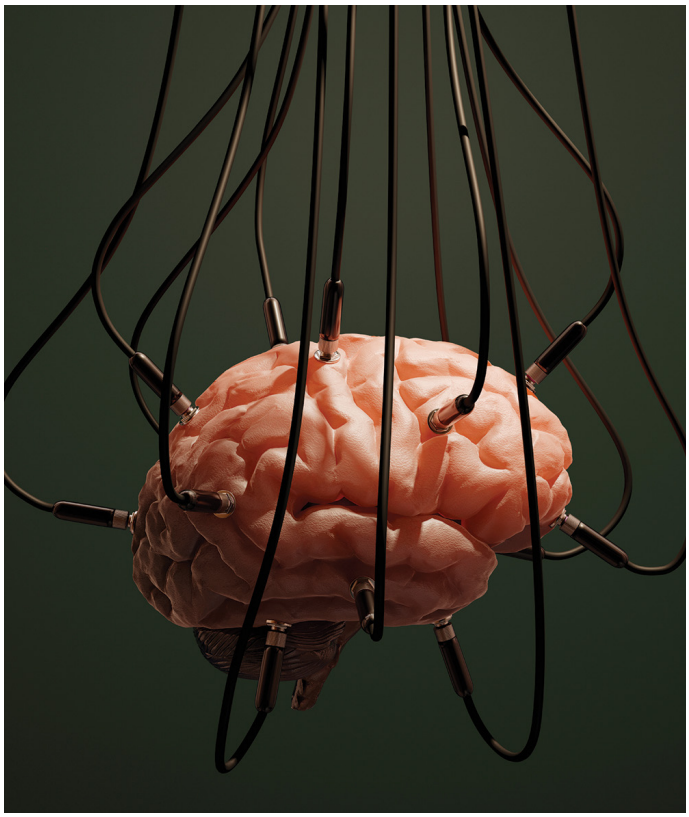
Part 3: Will we reach singularity?

One firm believer in the idea that robots will develop their own culture is famed technologist Ray Kurzweil, a visionary inventor and futurist who is now Google's director of engineering. Kurzweil popularised a concept called 'the singularity' – a hypothetical moment in the future after which machines will possess superhuman intelligence. If his predictions are correct, it means that the world as we know it now will soon become be a distant memory. Robots might not only shape the future, they could be the future. Popular movies dealing with singularity such as *Tron*, *The Matrix*, *Avatar*, *Bicentenary Man*, *iRobot*, and *Transcendence* can be used as stimulus and examples of what the world might look like and how we might interact if singularity ever takes place. Not everyone believes in singularity and in its own right the idea of singularity open up numerous philosophical questions some of which are dealt with in these movies.

In this Part ask students to contemplate the question and possibility of singularity. To stimulate students' thinking have them watch parts of some or all of the movies listed above. Search the web for relevant information and clips such as: Stuff From The Future - What is the Singularity? http://www.youtube.com/watch?v=DNyoUYw6Qvg. Engage students in a discussion of their questions about the science, the ethics, the possibilities of singularity and what the future of robots and intelligent machines might hold.

Suggestions for Assessing Part 3

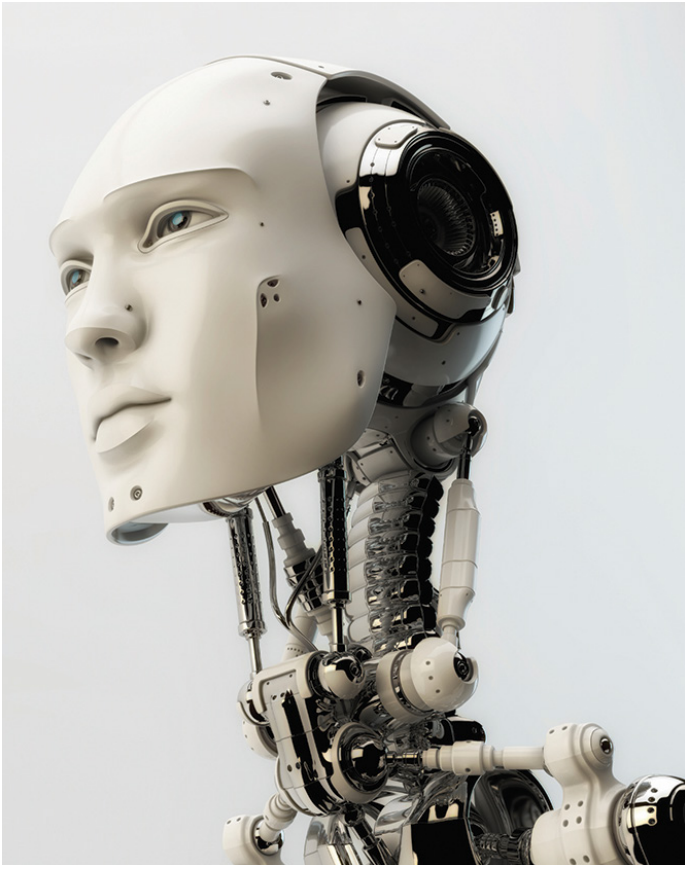
Here you could ask students to describe, in a written piece, what they see as the future of robots. Ask them to think about all they have learnt in this unit and predict the future of robots and how they feel about that future and why. What you expect to see is evidence of students' collating and synthesising all that they have learnt and considered thus far.



Task 6:
Personal reflection

To engage students in reflection of the tasks they have completed, use the following questions to stimulate discussion:

- What if anything about the future of robotics excites you? Would you like to work in robotics?
- Consider the way robots are used in different areas from engineering to medicine. Did you find that robots were used more or less than you originally thought?
- Would you now change the way you define a 'robot'? If so, in what way?
- Do you have any fears for the future because of what you now know about robotics?



Resources

Websites

Attack of the Robot Bees, RiAus
http://riaus.org.au/topic-tags/robots/

JPL Robotics
https://www-robotics.jpl.nasa.gov

NASA Robotics Career Corner
http://www.nasa.gov/audience/foreducators/robotics/careercorner/

Relevant articles/reports

Ask the experts: will robots take over the world? Science Alert
http://www.sciencealert.com.au/features/20130808-24670.html?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencealert-latestnews+%28ScienceAlert-Latest+Stories%29

Forget Robots. We'll Soon Be Fusing Technology With Living Matter, Wired, 27 May 2014
http://www.wired.com/2014/05/the-robots-of-the-future-are-already-here-the-cyborgs-are-coming-next/

Video

Inventor, entrepreneur and visionary Ray Kurzweil explains in abundant, grounded detail why, by the 2020s, we will have reverse-engineered the human brain and nanobots will be operating your consciousness.
http://www.ted.com/talks/ray_kurzweil_on_how_technology_will_transform_us

Inside Adam Savage's Cave: Awesome Robot Spider!
https://www.youtube.com/watch?v=-vVblGlIMgw

Future Humanoid Robots -From Fiction to Reality - 2014 Documentary
https://www.youtube.com/watch?v=13JGGbB2ctM

Audio

Robots and Bugs, Radio Adelaide
https://radio.adelaide.edu.au/science-riaus-robots-and-bugs/

RiAus STEM careers

STEM Careers Pack 7: Follow your interest in ... Robotics
is a publication of RiAus (Royal Institution of Australia) in partnership with DECD (Department for Education and Child Development). 2014.

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