ScienceWorld 3

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Teacher Edition

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The ScienceWorld 3 package

ScienceWorld 3 student book and CD

ScienceWorld 3 is designed to help teachers implement the Essential Learnings developed for the Queensland Curriculum and Reporting Framework (QCAR). *ScienceWorld 1* and *ScienceWorld 2* together provide adequate opportunities to develop all of the Essential Learnings students are required to achieve by the end of Year 9. *ScienceWorld 3* is designed to consolidate the Year 9 Essential Learnings and provide a foundation for the senior sciences. The Essential Learnings checklist on pages x–xi indicates how this is done.

The student CD contains:

- PDFs of each chapter in the textbook
- animations
- Crossword Wizard crosswords (one for each chapter).

Animations

- Drawing a line of best fit
- Sound waves
- How a microphone works
- Motion graphs
- Negative feedback
- Making sex cells
- DNA replication
- Recombining chromosomes
- Changing partners
- Chemical bonds
- How an electric cell works

ICT skillsheets

- Getting started with Microsoft Excel
- Getting started with dataloggers

ScienceWorld 3 Workbook

The workbook is designed to complement the text by developing students' literacy and *Ways of working* (Working scientifically) skills. It is designed to develop students' language and thinking skills so that they can:

- interact more effectively with the text
- speak and write in the various types of texts required in science
- apply higher-order thinking skills
- complement learning in other subject areas.

ScienceWorld 3 Teacher Edition and CD

The Teacher Edition of the textbook is in a larger format, reproducing the textbook pages with supporting teacher notes. The teacher CD contains:

- a course construction guide prepared as a template from which schools can develop their own work programs using the *ScienceWorld* series
- animations
- crosswords
- chapter tests (multiple choice, short answer, long answer and practical) with answers
- assessment tasks and marking rubrics matched to the Essential Learnings assessable elements and descriptors
- ICT skillsheets.

ScienceWorld website

The website (**www.scienceworld.net.au**) contains the course construction guide and links for the Webwatches in the text. These links are regularly updated.

Use the internet to research fuel cells and write a report which includes:

- types of fuel cells
- their advantages and disadvantages
- where they are used.

Go to www.scienceworld.net.au and follow the links to these useful websites:

Fuelling the 21st century

Fuel cell technology

How fuel cells work

Using the Teacher Edition

The Teacher Edition contains the student text as well as comprehensive and practical support for teachers in their day-to-day teaching. The following is a guide to the features of the Teacher Edition.

Planning page

At the beginning of each chapter is a flow chart to help plan the unit of work based on the chapter. It gives an overview of the chapter and shows where the Activities, Investigates, Experiments and Skillbuilders fit. It also indicates where the animations, crosswords, assessment tasks and chapter tests can be used.

Essential Learnings for Chapter 9

Essential Learnings	References: Student book (page number)	Workbook (page number)	Teacher Edition CD (Assessment task)
Knowledge and understanding *Life and living* The diversity of plants and animals can be explained using the theory of evolution through natural selection	pp. 213–224	Exercise 3 p. 70 Exercise 5 pp. 72–73	Assessment task 9 An endangered species
Science as a human endeavour Responsible, ethical and informed decisions about social priorities often require the application of scientific understanding		pp. 67–68 p. 76	Assessment task 9 An endangered species
Ways of working Draw conclusions that summarise and explain patterns, and that are consistent with the data and respond to the question	Investigate 17 pp. 214–215 Science in action p. 216		
Evaluate data, information and evidence to identify connections, construct arguments and link results to theory	pp. 218–224	Challenge Exercise p. 72	
Reflect on learning, apply new understandings and justify future applications	pp. 229–232	pp. 67–68 p. 76	

QSA Science Essential Learnings by the end of Year 9

Vocabulary
artificial selection
biotechnology
cloning
comparative anatomy
complementary base
embryos
environmental
evolutionary
genetically modified
Gondwana
haemoglobin
independent assortment
ligases
offspring
pesticides
populations
recombinant DNA
sickle cell anaemia
species
transgenic

Focus for learning
Discuss variations in organisms, the work of Charles Darwin and endangered species (page 206).

Equipment and chemicals (per group)
Activity page 208 — ruler or metre rule
Activity page 210 — playdough (2 different colours)
Investigate 17 pages 214–215 — three different colours of frog cards (20 red, 20 green and 20 yellow), a die
Investigate 18 page 228 — about 100 coloured paper clips (4 colours—red, green, yellow and blue), strip of cardboard 7 cm × 50 cm, scissors

Special preparations
Investigate 17 pages 214–215 — You will need A4 sheets of red, green and yellow card (about 120 gsm) which are available in newsagents. To prepare the frog cards, print the frog template from the teacher CD in the back of this book. Use these 24 frogs as your photocopy template, and copy enough frogs on red card for the whole class—these are the red frogs. Do the same for the green and yellow frogs.

Essential Learnings

The grid on the second page of each chapter links the Essential Learnings to pages in the textbook and the workbook, and also to the assessment tasks on the CD. It lists the *Knowledge and understanding* to be developed in the chapter and the key *Ways of working* used by students to develop and demonstrate this knowledge and understanding.

Vocabulary

The vocabulary list highlights key words that are used in the chapter, especially the words that students may have trouble spelling.

Focus for learning

The Getting Started at the beginning of each chapter provides a real-world learning focus designed to motivate students to engage with the topic. It also provides an opportunity for teachers to use a constructivist approach where you find out what students already know and then allow them to construct new understandings or consolidate their current understandings. The focus for learning statement on this page summarises the chapter's Getting Started.

Equipment and chemicals

This section is designed to help the laboratory technician prepare the equipment and chemicals needed (per group) for the whole chapter. Each Investigate and Experiment in the text has a materials list, but the teacher edition has a complete list for the whole chapter, including the Activities. Special preparations (eg frog cards) are given where needed.

Starting point

1 Ask students to skim through this chapter and jot down some *what* and *why* questions. Allow them to use the section headings to help generate their questions. At the completion of the chapter, they can see how many of these questions they can answer. They will probably be pleased to discover they know most of the answers.

2 Before students complete the Getting Started questions, they could perform some practical investigations of some properties of metals. At workstations around the classroom, have a selection of different metal strips or cubes, preferably of the same dimensions. In a chart, students could record observations about the metal's appearance, hardness, malleability, conductivity (remind students how to safely test this) and density (if using cubes). Ask students if they are investigating the physical or chemical properties of the metals.

3 Students could write their own set of questions about the information in the table on this page, and then give them to another student to answer. Some suggested questions are:

- Why are these elements metals?
- What makes each of the metals different?
- How is density measured?
- How do you think strength is measured?
- Oxygen, nitrogen and sulfur are non-metals. How are these elements different from the metals listed?

Starting point

These teacher notes, placed next to Getting Started, provide further help with planning the chapter and introducing the topic to students. They suggest ways of finding out what students know already, for example by using concept maps. They also include teacher demonstrations, brainstorming and discussion ideas, and suggestions for the use of multimedia.

Hints and tips

Throughout this Teacher Edition there are numerous hints and tips to make teaching more effective. Some of the suggestions can be applied generally; for example, the Inside/Outside Circles strategy, reflective questioning, and quick questions for revision.

Hints and tips

Divide the class into two equal groups, then have the students stand in two circles, one within the other. Students in the inner circle face outwards, directly facing another student in the outer circle. Give a one-minute time limit for each student to share something they have learned from this chapter, before one circle moves sideways to the next person, and the students share another fact. Five rotations are probably sufficient. This strategy is called 'Inside/Outside Circles', and it enables discussion between students while encouraging movement and interaction.

Learning experience

Make some paper reading glasses:

- Cut out a rectangular strip of paper, 15 × 5 cm.

- Punch into the paper a series of even pinholes for both eyes—three rows of five pinholes. (Use a piece of card as an underlay to the paper when punching the holes.) When the glasses are positioned over the face you can see through the holes with the left and right eye. Now hold a sheet of small print close to your eyes so that the image is blurry. Hold the reading glasses in front of your eyes and look at the printed sheet. The image should become sharp.
- The explanation for why this happens is the same as that for a pinhole camera.

Learning experiences

There are many suggestions on ways of extending the material in the text, as well as many extra activities. For example there are:

- teacher demonstrations
- teaching techniques such as summary cards, devising and playing games, and making models
- ideas to encourage higher-order thinking
- ideas for making the classroom more visually stimulating
- concept maps
- creative writing ideas
- excursions and suggestions for visiting speakers.

Activity notes and lab notes

These are detailed notes on the Activities, Investigates and Experiments. The notes are written by experienced teachers and laboratory technicians, and focus on issues of safety and classroom management. There are also suggestions to help get the most out of each activity or practical.

Lab notes

- The use of ammonium nitrate is now banned in schools in Australia. Ammonium sulfate can be used as a replacement.
- Check that the terminals and clips are clean to ensure a good electrical connection.
- Use a bench mat under the dish in case of spillage.
- This works well as a demonstration using an overhead projector in a darkened room.
- If you are experiencing difficulty with obtaining copper mesh, copper strips with nail-punched holes in it can be used.
- The dark blue colour is due to the formation of a tetraammine copper complex: $Cu(NH_3)_4^{2+}(aq)$

Homework

These contain suggestions on what material in the text could be used for homework, as well as extra activities.

Homework

An interesting task is to make a flip book showing how two atoms bond together. Students could choose to show ionic or covalent bonding. Medium-sized blocks of Post-it notes work well for this activity. A minimum of five diagrams needs to be drawn—the more diagrams drawn, the more effective the flip book will be. Those experiencing difficulties could view the Working with technology animation on the CD.

Animation and assessment task reminders

Where appropriate, there are reminders about using the animations on the student and teacher CDs, as well as suggestions on when the assessment tasks for each chapter could be given to students.

Issues

In many chapters there are suggested issues for investigation, discussion, debate or action. These issues are an excellent opportunity for students to demonstrate knowledge and achievement of *Science as a human endeavour*: Responsible and informed decisions about real-world issues are influenced by the application of scientific knowledge.

Issues

- Should *all* cars driven on Australian roads have airbags? Investigate the issues surrounding this question.
- An issues map can help students to identify the different dimensions of, or perspectives on, a particular event or issue. It is often helpful to phrase the issue as a question so it can be explored differently, depending on the diverse viewpoints held by students. Students then brainstorm the issue using the map. The responses can be categorised as positive or negative. An example map template for the issue of airbags is shown.

Research

These contain suggestions for research questions and how students could report their findings, eg posters, audio files for MP3 or MP4 players.

Research

Ask students to prepare a presentation on electrolysis and the beauty industry, or electroplating and the car industry. Have students find out as much as they can about one of the industries and present their findings in a simple way that a Year 8 student would understand. The project should be directly related to this chapter. A variety of presentation formats can be used: multimedia presentation, video, audio file for MP3 or MP4 players, a role play of a mock interview, or a song.

Solutions

Answers are provided for Check!, Challenge, Main ideas and Review, and these are placed as near as possible to each question.

Essential Learnings checklist

Ways of working Students are able to:	***ScienceWorld 3 chapters***
Identify problems and issues, formulate scientific questions and design investigations	10
Plan investigations guided by scientific concepts and design and carry out fair tests	1, 2, 3, 5, 7, 12
Research and analyse data, information and evidence	2, 3, 5, 7, 8, 11
Evaluate data, information and evidence to identify connections, construct arguments and link results to theory	3, 4, 5, 9
Select and use scientific equipment and technologies to enhance the reliability and accuracy of data collected in investigations	2, 3, 5, 11, 12
Conduct and apply safety audits and identify and manage risks	10
Draw conclusions that summarise and explain patterns, and that are consistent with the data and respond to the question	1, 4, 6, 7, 9, 11, 12
Communicate scientific ideas, explanations, conclusions, decisions and data, using scientific argument and terminology, in appropriate formats	1, 2, 3, 4, 6, 7, 8, 12, 13
Reflect on different perspectives and evaluate the influence of people's values and culture on the applications of science	1, 2, 6
Reflect on learning, apply new understandings and justify future applications	8, 9, 13
Knowledge and understanding ***Science as a human endeavour*** **Responsible and informed decisions about real-world issues are influenced by the application of scientific knowledge.**	
Immediate and long-term consequences of human activity can be predicted by considering past and present events	6
Responsible, ethical and informed decisions about social priorities often require the application of scientific understanding	6, 8, 9
People from different cultures contribute to and shape the development of science	4, 11, 13
Earth and beyond **Events on earth and in space are explained using scientific theories and ideas, including the geological and environmental history of the earth and the universe.**	
Scientific ideas and theories offer explanations about the earth that extend to the origins of the universe	
Global patterns of change on earth and in its atmosphere can be predicted and modelled	
Geological evidence can be interpreted to provide information about past and present events	

Knowledge and understanding	***ScienceWorld 3 chapters***
Energy and change **Forces and energy are identified and analysed to help understand and develop technologies, and to make predictions about events in the world.**	
An unbalanced force acting on a body results in a change in motion	5, 13
Objects remain stationary or in constant motion under the influence of balanced forces	5, 13
Energy can be transferred from one medium to another	
Transfer of energy can vary according to the medium in which it travels	3
Energy is conserved when it is transferred or transformed	4, 6, 12
Life and living **Organisms interact with their environment in order to survive and reproduce.**	
The diversity of plants and animals can be explained using the theory of evolution through natural selection	9
In ecosystems, organisms interact with each other and their surroundings	
Complex organisms depend on interacting body systems to meet their needs internally and with respect to their environment	7
All the information required for life is a result of genetic information being passed from parent to offspring	8
Changes in ecosystems have causes and consequences that may be predicted	
Natural and processed materials **The properties of materials are determined by their structure and their interaction with other materials.**	
Changes in physical properties of substances can be explained using the particle model	
Matter can be classified according to its structure	10, 11
Chemical reactions can be described using word and balanced equations	10, 11, 12
Reaction rate is affected by various factors, including temperature, concentration and surface area	

Source: QSA *Science Essential Learnings by the end of Year 9*

There are many opportunities throughout *ScienceWorld* to develop Essential Learnings such as *Responsible, ethical and informed decisions about social priorities often require the application of scientific understanding.*

Before you start

At the start of any year it may be a good idea to introduce the lab technician and/or head of science. This helps to promote responsible and respectful learners as they see who they are accountable to. Students should know who the lab technician is, so that if extra experiment items are needed or equipment is malfunctioning at any time, students can ask the technician to get the item or come into the classroom if required.

Explain to the students any emergency procedures: where to locate necessary equipment and how to use fire extinguishers, fire blanket, eye bath, and so on. In case evacuation of the room is necessary, tell and/or show the class where to evacuate.

Remind students about the necessity of wearing a lab coat or apron. If the students have their own, insist they bring them for each practical lesson. Any student who does not bring a lab coat should be asked to sit out of the activity and complete a theory exercise instead. Students much prefer practical work to theory and hence quickly remember to bring their lab coats. If a student consistently does not bring a lab coat, make sure to follow it up.

When you revise the safety rules for a laboratory, turning it into a quiz is always fun. Not only is it vital for the students to remember each rule, but they should know *why* it is important, so incorporate this into the quiz.

Part of your student laboratory skills and practical assessment may include a section for correctly following safety rules. If a student does not have their lab coat buttoned up, hair tied back, safety glasses on and so on, deduct marks from their overall practical grade. You may like to explain to the class that an easy way to obtain extra marks for an activity is to follow the safety rules.

Transition science

ScienceWorld 3 is designed to help you make the transition from the junior school to the senior school. It will help you clarify the ideas you have about science subjects which you may study in Year 11. If you are not sure what senior biology, chemistry and physics are like, the chapters in this book will give you some idea. Work in small groups to discuss these questions.

1. To solve everyday problems you often need to **work scientifically**. What does this mean?
2. Which chapters in this book are mainly about working scientifically?
3. You use the skills of working scientifically in the four areas of science below. Check the contents list on the previous page. You will notice that the chapters are grouped. Browse through the Physics chapters to get an idea of what physics is like. Do the same for the Biology, Chemistry and Astronomy chapters.
4. Which of the four areas do you like best? Why?
5. Which of the four areas would you need to study environmental science? Explain.
6. Whether or not you do science next year, this book explores and encourages debate about the relationships between science, society and technology. It contains many ideas and issues that you will hear about in the news and discuss with others. For instance:
   - experiments using animals (pages 7–8)
   - use of nuclear power (Chapter 6)
   - lighting homes in remote villages around the world (page 151)
   - gene technology and cloning (Chapter 9).

   Do you think that science can solve all our problems? Explain.

Physics is the study of how objects, from the very tiny to the very big, behave.

Chemistry is the study of matter, of natural and processed materials. You study what substances are made of and how they react with each other.

Biology is the study of life and living things.

Astronomy is the scientific study of the universe and all it contains.

General hints and tips

Throughout the year, try to organise as many incursions, excursions and guest speakers relating to science as you can. If possible, have former students currently working in the science field come back and share their work or study experiences. Maybe there are parents at the school who are working scientifically (engineers, horticulturists, health workers, etc) who could be interviewed about their work and the science skills they use. If so, prepare a set of questions and give them a copy beforehand so they know what to expect.

Try to immerse the students in science; enthuse and enthral them as much as you can. Consider showing fun or topical science TV snippets such as *MythBusters*, *Sleek Geeks* or *Catalyst*. Source some fascinating DVDs showing science at work, but make sure you present short, interesting snippets. Encourage your class to seek opportunities to enter science competitions and get involved in community or industry science-related projects. The students are at an age where they will have to start making decisions about their future pathways and career aspirations. Australia has a shortage of scientists and medical science professionals, so promote science as much as possible.