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Go to your **eBook** to access these **STEP UP chapters** as well as:

- Activity Book worksheets
- Answers
- Teacher support notes

Key	
■ ■ ■	Science inquiry skills
■ ■ ■	Biological sciences
■ ■ ■	Chemical sciences
■ ■ ■	Physical sciences
■ ■ ■	Earth and space sciences

How to use this book • STUDENT BOOK

Pearson Science 2nd edition has been updated to fully address all strands of the new **Australian Curriculum: Science** which has been adopted throughout the nation. Since some states have tailored the Australian Curriculum slightly for their own particular students, the coverage of the new **Victorian Curriculum: Science** is also captured in this new edition. We address inclusion by clearly indicating the additional content which enables flexibility to determine the approach, as well as the added bonus of an option to engage with **extension** and **revision** opportunities.

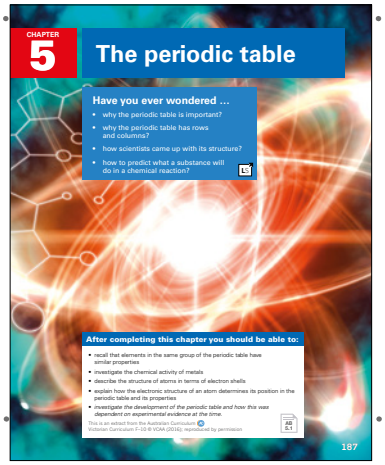
All aspects of the Student Books have been thoroughly reviewed by our **Literacy Consultant Dr Trish Weekes** and the result is **more accessible** content, **enhanced scaffolding** and **strengthened question and instructions sets**. The design is updated to improve the readability and navigation of the text.

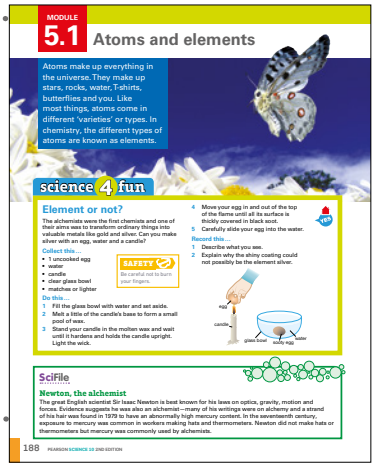
In this edition, we retain a flexible approach to teaching and learning. A careful mix of **inquiry**, **STEM** and a range of **practical investigations**, along with **fully updated** content reflect the dynamic and ever-changing nature of scientific knowledge and developments. Combined with the improved and enhanced sets of questions, this series provides a rich assortment of choice, supporting a **differentiated approach**.

An integrated and research-based approach to science education, which ensures every student has engaging, supportive and challenging opportunities.

Be set

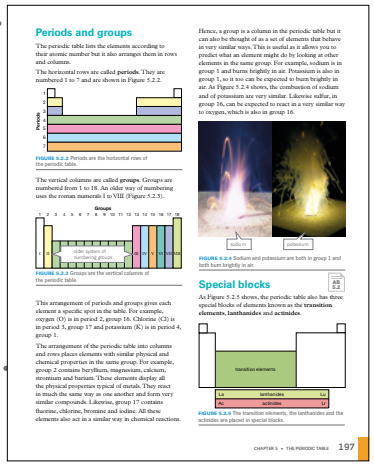
The **chapter opening page** sets a context for the chapter, engaging students through questions that get them thinking about the content and concepts to come. The chapter learning outcomes are provided in student friendly language and give transparency and direction for the chapter. Each chapter is divided into self-contained modules. The **module opening page** includes an introduction that places the material to come in a meaningful context.





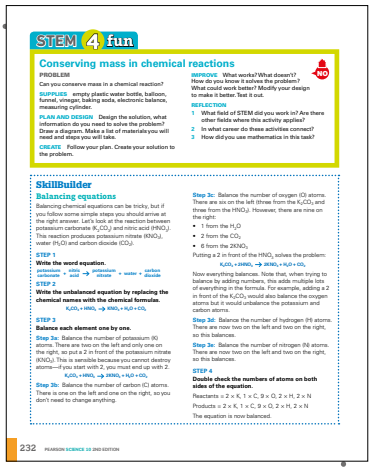
Be interested

Stunning and relevant **photos and illustrations** are purposefully selected to build understanding of the text. Students know when and how they should engage with artwork as each image is clearly referenced from within the text to develop understanding. Captions for every artwork, along with labels for more difficult images, build further meaning and understanding.



Be inventive

The **STEM4fun** activities are simple STEM-based applications. Students are given an open-ended problem and asked to create, design or improve something. These problems require students to draw on their acquired knowledge and skills, but are more about the process than the actual solution.


STEM 4 fun

Conserving mass in chemical reactions

PROBLEM

Can you conserve mass in a chemical reaction?

SUPPLIES empty plastic water bottle, balloon, funnel, vinegar, baking soda, electronic balance, measuring cylinder.

PLAN AND DESIGN Design the solution, what information do you need to solve the problem? Draw a diagram. Make a list of materials you will need and steps you will take.

CREATE Follow your plan. Create your solution to the problem.

IMPROVE What works? What doesn't? How do you know it solves the problem? What could work better? Modify your design to make it better. Test it out.

REFLECTION

1 What field of STEM did you work in? Are there other fields where this activity applies?
2 In what career do these activities connect?
3 How did you use mathematics in this task?

SkillBuilder

Balancing equations

Balancing chemical equations can be tricky, but if you follow some simple steps you should arrive at the right answer. Let's look at the reaction between potassium carbonate (K_2CO_3) and nitric acid (HNO_3). This reaction produces potassium nitrate (KNO_3), water (H_2O) and carbon dioxide (CO_2).

STEP 1
Write the word equation.
potassium carbonate + nitric acid → potassium nitrate + water + carbon dioxide

STEP 2
Write the unbalanced equation by replacing the chemical names with the chemical formulas.
$K_2CO_3 + HNO_3 \rightarrow KNO_3 + H_2O + CO_2$

STEP 3
Balance each element one by one.

Step 3a: Balance the number of potassium (K) atoms. There are two on the left and only one on the right, so put a 2 in front of the potassium nitrate (KNO_3). This is sensible because you cannot destroy atoms—if you start with 2, you must end up with 2.

$K_2CO_3 + HNO_3 \rightarrow 2KNO_3 + H_2O + CO_2$

Step 3b: Balance the number of carbon (C) atoms. There is one on the left and one on the right, so you don't need to change anything.

Step 3c: Balance the number of oxygen (O) atoms. There are six on the left (three from the K_2CO_3 and three from the HNO_3). However, there are nine on the right:
- 1 from the H_2O
- 2 from the CO_2
- 6 from the $2KNO_3$

Putting a 2 in front of the HNO_3 solves the problem:

$K_2CO_3 + 2HNO_3 \rightarrow 2KNO_3 + H_2O + CO_2$

Now everything balances. Note that, when trying to balance by adding numbers, this adds multiple lots of everything in the formula. For example, adding a 2 in front of the K_2CO_3 would also balance the oxygen atoms but it would unbalance the potassium and carbon atoms.

Step 3d: Balance the number of hydrogen (H) atoms. There are now two on the left and two on the right, so this balances.

Step 3e: Balance the number of nitrogen (N) atoms. There are now two on the left and two on the right, so this balances.

STEP 4
Double check the numbers of atoms on both sides of the equation.
Reactants = 2 × K, 1 × C, 9 × O, 2 × H, 2 × N
Products = 2 × K, 1 × C, 9 × O, 2 × H, 2 × N
The equation is now balanced.

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Be inquiring

Science4fun are inquiry based activities. They pre-empt the theory and get students to engage with the concepts through a simple activity that sets students up to 'discover' the science before they learn about it. Broadly speaking, they encourage students to think about what happens in the world and how science explains this.


MODULE 6.2 Energy in chemical reactions

One of the most important features of chemical reactions is that many can produce large amounts of energy. The energy from chemical reactions powers the modern world, with more than 80% of our energy needs coming from the burning of fossil fuels. You also use the energy from chemical reactions to light a birthday candle, cook food, start a car and to breathe. Even your smartphone is powered by the chemical reactions taking place in its battery.

science 4 fun

Acrobatic flame

Can a flame travel along a candle's furnes?

Collect this ...
- candle
- box of matches

SAFETY Be very careful when using matches and candles. Be careful to blow matches out and rinse with water to make sure they are out before disposing of them.

Do this ...
1 Light the candle and let it burn for a couple of minutes.
2 Strike another match and then blow out the candle.
3 Put the flame of the lit match into the furnes coming from the unlit candle.
4 The candle should reignite as if by magic. See how far you can get the flame to jump.

Record this ...
1 Describe what you saw.
2 Explain why you think this happened.

Chemical energy

All molecules store energy in the form of chemical potential energy. Chemical potential energy is the source of energy we get from fossil fuels, batteries and food.

The chemical energy is stored in the molecules. However, during a chemical reaction the atoms in the molecules are rearranged and so energy may be released. This is shown by the reaction between hydrogen and oxygen in Figure 6.2.1.

FIGURE 6.2.1 When two molecules of hydrogen (white) react with one molecule of oxygen (red), the atoms rearrange and release energy to form two water molecules.

CHAPTER 6 • CHEMICAL REACTIONS 237

Be inspired

Working with science career profiles cast a spotlight on the diversity of career opportunities available through science with a focus on future science directions, STEM and women in science. Profiles include questions that to relate to the topic.


SciFile

An eccentric scientist!

Figure 5.2.11 shows Mendeleev's extravagant hair and beard, which he only trimmed once a year. Mendeleev (and his mother) hitch-hiked over 6000km in 1848 to get to his first day of university in St Petersburg.

FIGURE 5.2.11 Dmitri Ivanovich Mendeleev constructed the first modern periodic table.

Working with Science

CHEMISTRY TECHNICIAN

Joshua Lodge knew that he wanted to study chemical engineering at university but wanted to gain some practical skills first. He enrolled in a Certificate IV in Laboratory Techniques and undertook an apprenticeship with Origin Energy while studying. After completing the Certificate IV, Joshua completed a Diploma of Chemistry and then enrolled in a Bachelor of Engineering (Chemical).

Joshua, who is shown in Figure 5.2.12, is still completing his degree while working as a process chemist at an Origin Energy power station. Process chemists are involved in synthesising and testing products and developing chemical processes that are safe, environmentally friendly and efficient.

Joshua won the Australian Apprentice (Trainee) of the Year Award in 2014 and was also a Vocational Education and Training (VET) pathway after high school was a great way for him to enter his chosen career and give him a solid foundation in hands-on skills. He gained invaluable industry skills during his apprenticeship and secured a full-time job through his work experience. He has had the opportunity to work on his own projects at the power station as well as gain experience at a variety of water treatment plants. Joshua's role as a process chemist involves water treatment work, such as treating sewage system effluent to make pure water.

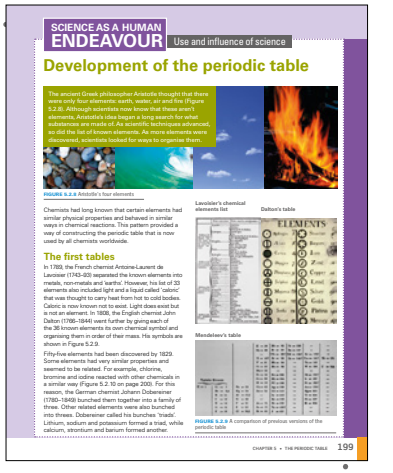
FIGURE 5.2.12 Joshua Lodge works as a process chemist at a large power station. He completed an apprenticeship and is now undertaking a Bachelor of Engineering (Chemical).

Review
1 A certificate, diploma or degree in laboratory techniques and chemistry can give you important practical skills for many different jobs. List five jobs that would use these skills.
2 What was the advantage for Joshua of doing an apprenticeship rather than going to university first?
3 What skills and knowledge do you think are important when working with chemicals?

CHAPTER 5 • THE PERIODIC TABLE 201

Be amazed

The **Science as a human endeavour** strand is addressed throughout the modules as well as in spreads. Many of the spreads have a special focus on Australian Scientists and highlight exciting developments, innovations and discoveries across all science fields. This feature also includes questions to help students build connections with the content they are learning and the relevance of these contributions.


SCIENCE AS A HUMAN ENDEAVOUR Use and influence of science

Development of the periodic table

The ancient Greek philosopher Aristotle thought that there were only four elements: earth, water, air and fire (Figure 5.2.2). Although scientists now know that these aren't elements, Aristotle's idea began a long search for what substances are made of. As scientific techniques advanced, so did the list of known elements. As more elements were discovered, scientists looked for ways to organise them.

FIGURE 5.2.2 Aristotle's four elements

Chemists had long known that certain elements had similar physical properties and behaved in similar ways in chemical reactions. This pattern provided a way of constructing the periodic table that is now used by all chemists worldwide.

The first tables

In 1789, the French chemist Antoine-Laurent de Lavoisier (1743–93) separated the known elements into metals, non-metals and 'earths'. However, his list of 33 elements also included light and a liquid called 'caloric' that was thought to carry heat from hot to cold bodies. Caloric is now known not to exist. Light does exist but is not an element. In 1808, the English chemist John Dalton (1766–1844) went further by giving each of the 36 known elements its own chemical symbol and organising them in order of their mass. His symbols are shown in Figure 5.2.3.

Fifty-five elements had been discovered by 1829. Some elements had very similar properties and seemed to be related. For example, chlorine, bromine and iodine reacted with other chemicals in a similar way (Figure 5.2.10 on page 200). For this reason, the German chemist Johann Dobereiner (1780–1849) bunched them together into a family of three. Other related elements were also bunched into threes. Dobereiner called his bunches 'triads'. Lithium, sodium and potassium formed a triad, while calcium, strontium and barium formed another.

Lavoisier's chemical elements list

Dalton's table

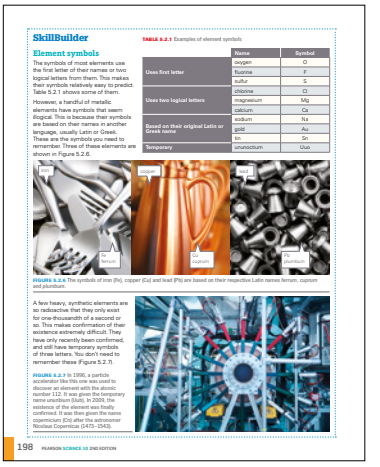
Mendeleev's table

FIGURE 5.2.3 A comparison of previous versions of the periodic table

CHAPTER 5 • THE PERIODIC TABLE 199

Be skilled

Skill builders outline a method or technique and are instructive and self-contained. They step students through the skill to support science application.


SkillBuilder

Element symbols

The symbols of most elements use the first letter of their names or two logical letters from them. This makes their symbols relatively easy to predict. Table 5.2.1 shows some of them.

However, a handful of metallic elements have symbols that seem illogical. This is because their symbols are based on their names in another language, usually Latin or Greek. These are the symbols you need to remember. Three of these elements are shown in Figure 5.2.6.

TABLE 5.2.1 Examples of element symbols

	Name	Symbol
Uses first letter	oxygen	O
	fluorine	F
	sulfur	S
Uses two logical letters	chlorine	Cl
	magnesium	Mg
	calcium	Ca
Based on their original Latin or Greek name	sodium	Na
	gold	Au
	tin	Sn
Temporary	ununobium	Uuo

FIGURE 5.2.6 The symbols of iron (Fe), copper (Cu) and lead (Pb) are based on their respective Latin names ferrum, cuprum and plumbum.

A few heavy, synthetic elements are so radioactive that they only exist for one-thousandth of a second or so. This makes confirmation of their existence extremely difficult. They have only recently been confirmed, and still have temporary symbols of three letters. You don't need to remember these (Figure 5.2.7).

FIGURE 5.2.7 In 1996, a particle accelerator like this one was used to discover an element with the atomic number 112. It was given the temporary name ununbium (Uub). In 2009, the existence of the element was finally confirmed. It was then given the name copernicium (Cn) after the astronomer Nicolaus Copernicus (1473–1543).

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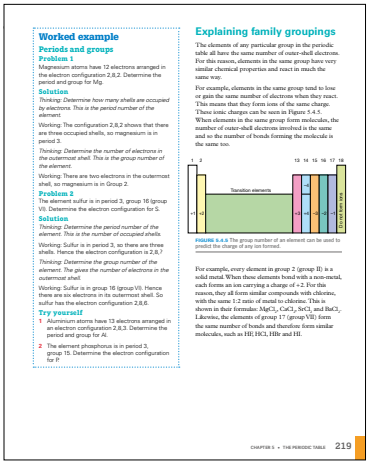
Be guided

Worked examples scaffold problems and techniques with a new thinking and working approach to guide students through solving problems and applying techniques to master and practice key skills.


Worked example

Periods and groups

Problem 1

Magnesium atoms have 12 electrons arranged in the electron configuration 2,8,2. Determine the period and group for Mg.

Solution

Thinking: Determine how many shells are occupied by electrons. This is the period number of the element.

Working: The configuration 2,8,2 shows that there are three occupied shells, so magnesium is in period 3.

Thinking: Determine the number of electrons in the outermost shell. This is the group number of the element.

Working: There are two electrons in the outermost shell, so magnesium is in Group 2.

Problem 2

The element sulfur is in period 3, group 16 (group VI). Determine the electron configuration for S.

Solution

Thinking: Determine the period number of the element. This is the number of occupied shells.

Working: Sulfur is in period 3, so there are three shells. Hence the electron configuration is 2,8,?

Thinking: Determine the group number of the element. The gives the number of electrons in the outermost shell.

Working: Sulfur is in group 16 (group VI). Hence there are six electrons in its outermost shell. So sulfur has the electron configuration 2,8,6.

Try yourself

1 Aluminium atoms have 13 electrons arranged in an electron configuration 2,8,3. Determine the period and group for Al.
2 The element phosphorus is in period 3, group 15. Determine the electron configuration for P.

Explaining family groupings

The elements of any particular group in the periodic table all have the same number of outer-shell electrons. For this reason, elements in the same group have very similar chemical properties and react in much the same way.

For example, elements in the same group tend to lose or gain the same number of electrons when they react. This means that they form ions of the same charge. These ionic charges can be seen in Figure 5.4.5. When elements in the same group form molecules, the number of outer-shell electrons involved is the same and so the number of bonds forming the molecule is the same too.

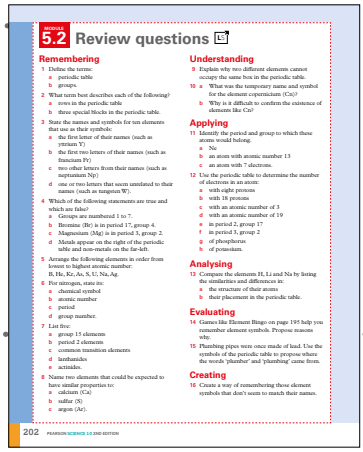
FIGURE 5.4.5 The group number of an element can be used to predict the charge of any ion formed.

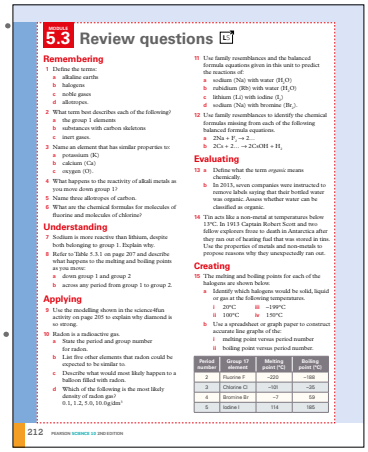
For example, every element in group 2 (group II) is a solid metal. When these elements bond with a non-metal, each forms an ion carrying a charge of +2. For this reason, they all form similar compounds with chlorine, with the same 1:2 ratio of metal to chlorine. This is shown in their formulas: $MgCl_2$, $CaCl_2$, $SrCl_2$ and $BaCl_2$. Likewise, the elements of group 17 (group VII) form the same number of bonds and therefore form similar molecules, such as HF, HCl, HBr and HI.

CHAPTER 5 • THE PERIODIC TABLE 219

Be confident

Each module concludes with a comprehensive **module review** set that checks for understanding of key concepts and ideas developed through a carefully prepared range of Blooms categorised questions. Students enjoy the benefit of checkpoint opportunities to engage with module review questions at key points throughout the module.

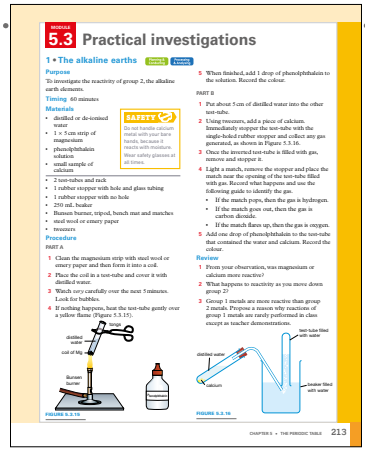


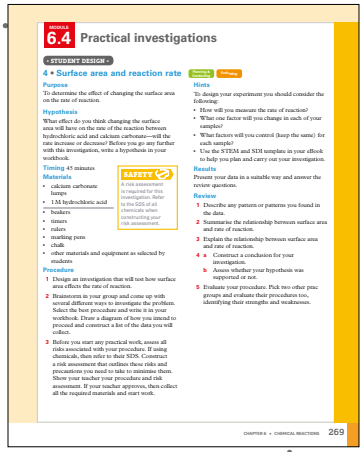


Be investigative

Practical investigations are placed at the end of each module. New student design investigations and STEM inquiry tasks provide students with opportunities to plan investigations, design and trial their plans to seek answers and solve problems. A timing suggestion assists with planning, whilst safety boxes highlight significant hazards. Full risk assessments, safety notes and technician's checklist and recipes provided via ProductLink and eBooks.

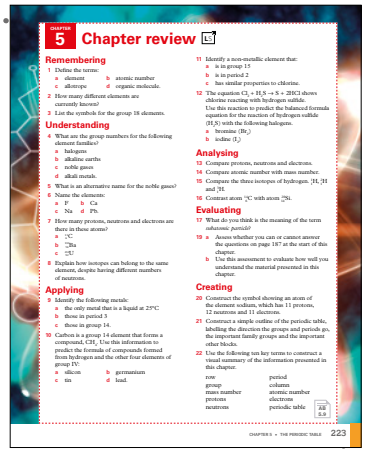
Practical investigation icons appear throughout the modules to indicate suggested times for practical work. An icon will also appear to indicate where a SPARKlab alternative is available.





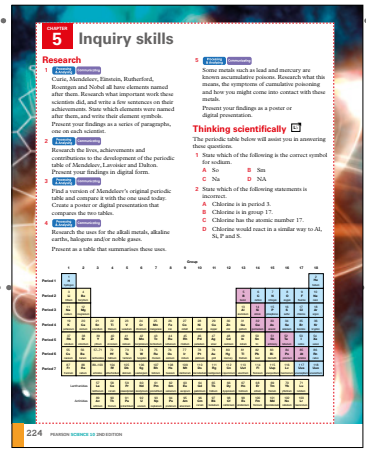
Be extended

Each chapter concludes with an improved and richer assortment of questions organised within the Blooms structure, that bring together the learning of concepts from across a chapter. Apply knowledge and skills to answer questions, engage in fresh new opportunities for **inquiry** and extend into **research** to take your learning to a new level with the enhanced **Chapter review**.



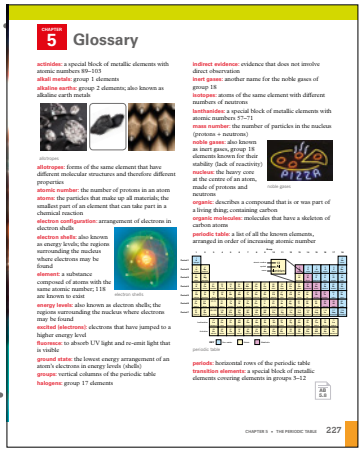
Be a thinker

Following the chapter review are **thinking questions** relevant to the chapter. These test students' science and interpretive skills.



Be supported

Every chapter concludes with an illustrated **glossary** that is an easy reference for additional support in comprehension of key terms. All key terms are bolded throughout the chapter.


CHAPTER 5 Glossary

actinides: a special block of metallic elements with atomic numbers 89–103
alkali metals: group 1 elements
alkaline earths: group 2 elements; also known as alkaline earth metals

allotropes: forms of the same element that have different molecular structures and therefore different properties
atomic number: the number of protons in an atom
atoms: the particles that make up all materials; the smallest part of an element that can take part in a chemical reaction
electron configuration: arrangement of electrons in electron shells
electron shells: also known as energy levels; the regions surrounding the nucleus where electrons may be found
element: a substance composed of atoms with the same atomic number; 118 are known to exist
energy levels: also known as electron shells; the regions surrounding the nucleus where electrons may be found
excited (electrons): electrons that have jumped to a higher energy level
fluorescent: to absorb UV light and re-emit light that is visible
ground state: the lowest energy arrangement of an atom's electrons in energy levels (shells)
groups: vertical columns of the periodic table
halogens: group 17 elements

indirect evidence: evidence that does not involve direct observation
inert gases: another name for the noble gases of group 18
isotopes: atoms of the same element with different numbers of neutrons
lanthanides: a special block of metallic elements with atomic numbers 57–71
mass number: the number of particles in the nucleus (protons + neutrons)
noble gases: also known as inert gases, group 18 elements known for their stability (lack of reactivity)
nucleus: the heavy core at the centre of an atom, made of protons and neutrons
organic: describes a compound that is or was part of a living thing; containing carbon
organic molecules: molecules that have a skeleton of carbon atoms
periodic table: a list of all the known elements, arranged in order of increasing atomic number

periods: horizontal rows of the periodic table
transition elements: a special block of metallic elements covering elements in groups 3–12

CHAPTER 5 • THE PERIODIC TABLE 227

Be reinforced

The **Activity Book** provides a set of worksheets for every student book chapter, giving lots of opportunities for practice, application and extension. Reference **Activity Book icons** indicate when the best time is to engage with a particular worksheet.

AB 4.2

Be progressed

Lightbook Starter contains **complementary sets of questions** for the module and chapter review sets from within the **student book**. This serves as alternate or additional assessment opportunities for students who enjoy the benefit of **instant feedback**, **hints** and **auto-correction** when engaging with this cutting-edge digital **formative** and **summative assessment** platform. Questions are all **tracked** against curriculum learning outcomes, making **progress** monitoring simple. A handy icon indicates the best time to engage with Lightbook Starter.

Be prepared

Focussed on supporting the greater **diversity of learners and pathways**, a 'step-up' program has been developed to launch students into senior sciences, in addition to the 'core' science program. A series of **step up chapters**, written by experienced senior science teachers, have been developed with the view to providing all students with best chance of success.

The **Year 9 Student Book** features a step up chapter on **Psychology**. The **Year 10 Student Book** includes step up chapters for **Biology**, **Chemistry** and **Physics**. These chapters are referenced from the print text and are provided in full via the **eBook**. The eBook also contains **worksheets** specific to supporting the application and development of skills and knowledge from within the text.

All Year 10 Student book chapters include a new series of **Exam-style questions** to provide students practice and exposure in preparation for examinations.

Student pathways

Pearson Science SB10 is designed to cater for a range of student abilities and prepare students for future pathways they may plan to pursue.

Pearson Science SB10		Focus of chapter	Pathway	
Chapter 1	Science investigation skills	Curriculum science skills: a reference tool for use all year		Year 10 and all senior sciences
Chapter 2	DNA and genetics	Curriculum strands and elaborations		Biology
Chapter 3	Geological time			Biology
Chapter 4	Natural selection and evolution			Biology
Chapter 5	The periodic table			Chemistry
Chapter 6	Chemical reactions			Chemistry
Chapter 7	Global systems			Earth sciences
Chapter 8	The universe			Earth sciences
Chapter 9	Motion and energy			Physics
Chapter 10	Forensic science			Biology
Chapter 11	Biology	Extension		Biology
Chapter 12	Chemistry			Chemistry
Chapter 13	Physics			Physics

SERIES COMPONENTS

Pearson Science 2nd edition Teacher Companion

The Teacher Companion makes lesson preparation easy by combining full-colour student book pages with teaching strategies, ideas for class activities and fully worked solutions. All of the Activity Book pages are also included and are complete with model answers.

Be prepared

The **Chapter preview** provides an overview for planning purposes, including things to be aware of and organise ahead of commencing. The **pre-prep** also has an indicator of the time allocation to complete the chapter.

Be an expert

A further improved Teacher Companion places the support of **experts** alongside every Pearson Science 2e teachers, featuring wrap-around teaching and learning strategies and support from:

- **Literacy Consultant: Dr Trish Weekes**
- **Differentiation Consultant: Anna Bennett**
- **School laboratory technicians: Penny Lee and Donna Chapman**

Be confident

All practical activities have been trialled, reviewed, amended and replaced as necessary to ensure teachers and students can undertake practical activities that are tested, work and will yield effective results. Suggested replacement materials and equipment provided to make science more accessible.

Full risk assessments, safety notes and technician's checklist and recipes provided. Pracs and risk assessments have been updated to reflect new regulations around safety and materials in school science classrooms.

Be informed

Full **answers** including suggested findings and possible answers to practical activities, fully worked solutions and support for open-ended research, inquiry and STEM activities.

Pearson Science Lightbook Starter

Lightbook Starter offers a **digital formative and summative assessment tool** with **hints**, **instant feedback** and **auto-correction** of responses. Students and teachers also enjoy the visibility of learning through a **progress tracker** which shows student achievement against curriculum learning outcomes. Lightbook Starter provides questions with the most sophisticated auto-correction of answers.

Be ready

Commence each chapter with questions to establish a baseline for each student around prior knowledge. The **'before you begin'** section includes useful preparatory material with **interactive** resources to **activate prior knowledge** and **reteach key concepts**.

Be in control

Lightbook starter is written to enable teachers and students to use this digital assessment tool as an **alternative** (or additional practice) **to student book questions**. The Lightbook Starter structure mirrors the student book question set, thereby providing a complimentary alternative to the student book questions. This supports a fully integrated approach to digital assessment and feedback.

Be assisted

Module review questions (with **hints** and **solutions**), help students **check for understanding** of learning, revise and provide useful **formative assessment** to help teachers identify areas of weakness, great for lesson planning. These serve as a touchpoint throughout the chapter and students benefit from auto-corrected responses which provide **instant feedback** and support.

Be assessed

The **Chapter Review** in the student book has a complimentary **assessment** set in Lightbook Starter. Use this as an alternative to a class test at the end of a topic.

Be reflective

An integrated **reflection** set supports students in considering their progress and future areas for focus.

Be tracked

Enjoy seeing progress through the learning outcomes updated instantly in the **progress tracker**.

LightbookStarter LS

Pearson Science eBook

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