Chapter overviews

These overviews show how the material in New Directions fits in with the relevant Achievement Standards and Unit Standards.

Symbols and abbreviations used

Objectives
At the beginning of each chapter overview, we have listed the objectives from Science in the New Zealand Curriculum which apply to that chapter. Then we have listed the Achievement or Unit Standards which are covered in total, or in part, by that chapter. On the right are the units that apply to those particular Standards.

We assume the majority of students will be doing the NCEA Achievement Standards for Science Level 1, so objectives for those relevant standards are written in normal (Roman) type, while additional objectives required for other Achievement or Unit Standards are written in *italics*.

Theory exercises
1.1 Matter matters (etc) refer to the theory exercises in *New Directions in Science Workbook*.

Practicals
Practicals labelled Inv 1.1 (etc) are included in *New Directions in Science Workbook*.
Practicals labelled P20 (etc) are included at the front of the student text for *New Directions in Science*. The aim for the practical is also included to guide you in your planning.

Revision
These activities are found in the Revision folder of the student CD that accompanies *New Directions in Science Workbook*. Intended for use at home, most activities take only a minute or two to complete and provide instant feedback for students.

Quizzes
The Quizzes provided for teachers parallel the Revision activities and are intended for classroom use. Each short quiz is followed by its answers. They allow teachers and students to monitor progress throughout the year.

Additional resources
Certain other texts are also listed. The criteria applied was, there must be sufficient material on these pages to make it worth fetching a box of these books from several rooms away for this lesson, even if your students have copies of *New Directions*.

Codes: FFSR = *Fifth Form Science Resources* from Pearson NZ
NHMW = *The Material World* from New House
NHLW = *The Living World* from New House
NHPEB = *Planet Earth and Beyond* from New House
PF = *Pathfinders Science Year 11* from New House

Fifth Form Science Resources

Teachers familiar with *Fifth Form Science Resources* will recognise a few cartoons and the occasional question reused from this earlier text. However, less than 10% of the material from *FFSR* reappears in *New Directions in Science*, which means it is practical to use the two books alongside each other: one as an issued text, and the other as a class set for occasional use.

FFSR was written long before NCEA though, and it lacks some of the material required for Science Level 1. Classes still using FFSR as an issued text should use the following units from *New Directions in Science*:

- Science 1.3: 6E, 7C, 7K
- Science 1.4: 1A and/or 1D, 1E, 2B
- Science 1.5: 14A, 15A-D, 16C, 16D
- Science 1.6: 8A, 8B, 9D, 12F
- Science 1.7: 13A-D, 13F, 13H, 13I, 13J

Curriculum and assessment summary

Chapter	Science Curriculum Achievement Objectives	Science Achievement Standards		Other Achievement Standards	Unit Standards	More Unit Standards
1	MW 5.1b	AS Science 1.4	AS Science 1.1 AS Science 1.2		US Chemistry 6329 (Atoms and groups)	US Chemistry 6324 (Ions in solution)
2	MW 6.1, MW 6.2, MW 6.3, ST 6.3			AS Chemistry 1.4	US Chemistry 8936 (Acids and bases)	US Chemistry 6325 (Rates)
3	MW 6.1, MW 6.2, MW 6.3, MW 6.4, ST 6.3				US Chemistry 8935 (Metals) US Chemistry 6331 (Chemical processes) US Chemistry 6323 (Industrial methods)	
4	MW 6.1, MW 6.4, ST 6.3	--		AS Chemistry 1.7	US Chemistry 8937 (Fuels)	
5	LW 6.1, LW 6.4, ST 6.2, ST 6.3	AS Science 1.3		AS Biology 1.8	US Biology 6298 (Humans and micro-organisms)	
6	LW 6.1, LW 6.4, ST 6.2					US Biology 6304 (Defences against disease)
7	LW 6.2/3 a and b LW 6.4, ST 6.2, ST 6.3			As Biology 1.3	US Biology 8923 (Transfer of genetic information)	US Biology 8924 (DNA)
8	PW 6.1	AS Science 1.6		AS Physics 1.4	US Physics 6366 (Linear motion)	US Physics 6375 (Graphical analysis)
9	PW 6.1, ST 6.2				US Physics 6367 (Forces)	US Physics 6369 (Formula and graphical methods)
10	PW 5.2, PW 6.2				US Physics 6368 (Energy transformations)	
11	PW 6.1, PW 6.2, PW 6.3, PW 6.4, ST 6.3				US Physics 8767 (Heat and temperature)	
12	PW 6.3				US Physics 6370 (Electricity)	
13	PE 5.3, PE 6.3, ST 6.2	AS Science 1.7			US Physics 6377 (Astronomy)	
14	PE 6.1/2 a, PE 6.4	AS Science 1.5			US Earth Science 6357 (Rocks and minerals)	US Earth Science 6356 (Geological resource)
15	PE 6.1/2 b				US Earth Science 6358 (Major rock types)	
16	PE 6. 1/2 b, ST 6.2, ST 6.3				US Earth Science 6359 (Geological time)	
17	ST 6.1	AS Science 1.1				

Scientific skills and attitudes are developed mainly through practical work, which is an integral part of this course: chapter 17 considers the key aspects of a scientific experiment in detail. In addition, students are given the opportunity to practice designing experiments in units 4G, 6E, 9A, 11D and 12E, while research and reporting skills are the focus of unit 14F.

Chapter 1 Atoms, elements and compounds

MW 5.1 (b): distinguish between elements, compounds and mixtures, using simple chemical and physical properties, and describe a simple model of the atom.

Note: students will be starting to develop ideas about chemical bonding at level 6.

AS Science 1.4	Describe chemical principles Atomic structure: numbers of protons, neutrons and electrons in an atom or monatomic ion, electron arrangements, linking charge on ion to group in the periodic table, naming or writing formulae of ionic compounds.	1A-1I
US Chemistry 6329	Relate similarities and differences within the periodic table to atomic structure. Describe the structure of atoms, relate the chemical properties of elements to their electron arrangement, and derive the formulae of ionic compounds.	1E-1H
US Chemistry 6324	Identify simple chemical species in solution Demonstrate knowledge of precipitation reactions, and carry out a procedure to identify cations and anions present in solutions.	1H, 1I, (and 2H) (A more extensive procedure for identification of ions will be required.)

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
1A Properties and uses This material should be revision for all but the weakest students.	• List the key properties of common substances, distinguishing between physical and chemical properties. • Relate the properties of common substances to their uses.		P1 Exploring properties To explore the properties of metals and non-metals.	1A 1 Properties of substances	1A Properties of gold.	
1B Elements, compounds and mixtures Although not specifically mentioned in any Standard, these fundamental ideas are worth revising.	• *Define the terms element, compound and mixture in terms of the particles they contain.* • *Determine whether a substance is an element, compound or mixture based on experimental evidence.*	**1.1** Matter matters	Inv 1.1 A simple chemical reaction P2 Modelling matter To make simple models of different types of substances. P3 Iron and sulfur To show the difference between elements and compounds.	1B 1 Atoms, elements & compounds 1B 2 Properties & particles	1B Particles revision	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
1C Separation techniques This unit will be of most use to those classes who will go on to investigate some aspect of industrial chemistry, and those least able students who need to revise basic laboratory skills.	• *Recall common separation techniques used in the laboratory or industry*		P4 Salt-making To make a chemical salt.			NHMW: p 13 White sugar from brown (practical)
1D Metals and non-metals This unit could be taught here, or used at the beginning of the Metals section. Students doing AS Chemistry 1.7 need to know the properties of graphite and diamond.	• Recall the characteristic physical properties of metals. • *Distinguish between metals and non-metals, based on their physical properties*. • Relate the properties of metals or non-metals to their uses. • *Recall the properties of graphite.*		Inv 1.2 Properties of metals and non-metals Inv 1.3 Comparing conductivities P5 Metals and non-metals To classify materials as metals or non-metals from their properties.	1D 1 Characteristics of metals and non-metals 1D 2 Properties and uses quiz	1D 1 Metal-non-metal words 1D 2 Metals and their uses	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
1E The stuff of elements—atoms Changes in AS Science 1.4 were made too late for this material to be broken into two units. We suggest one lesson be spent on the practical, and a second calculating the numbers of protons, neutrons and electrons in given particles.	• Recall the structure of atoms in terms of a central nucleus containing protons and neutrons and surrounded by electrons. • Recall that almost all the mass of an atom is concentrated in the nucleus, and that the rest of the atom is almost empty space. • Use a particle's atomic number, mass number and charge to predict its numbers of protons, neutrons and electrons. • Write the electron structure for atoms or ions of the first 20 elements. • Use the electron structure of an atom to predict the charge on the ion it will form (if any).	**1.2** Atom words **1.3** Mainly minerals **1.4** Atoms and ions	Inv 1.5 The structure of atoms P6 Building atoms To build models of atoms and ions.	1E 1 Atoms and ions 1E 2 Atoms key facts 1E 3 Inside an atom 1E 4 Atomic particles 1 1E 5 Atomic Particles 2 1E 6 Atomic particles 3 1E 7 Atoms and elements flipcards	1E 1 Atomic structure key facts 1E 2 Inside an atom 1E 3 Atomic particles 1 1E 4 Atomic particles 2	
1F The periodic table of elements This unit briefly covers the properties of the common elements as well as the relationship between an element's place on the periodic table and its atomic structure.	• Relate the charge of selected monatomic ions to the position of their elements on the periodic table. • *Predict the electron arrangement of an atom from its position on the periodic table.*	**1.5** It's elementary!	Inv 1.4 Recognising elements P7 Identifying elements To match samples of elements with their descriptions. P8 The periodic table To become familiar with the structure of the periodic table.	1F 1 Common elements 1F 2 The periodic table 1F 3 Outer-shell electrons and ions	1F 1 Elements and the periodic table 1F 2 Electron arrangements and ions	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
1G Reading formulae The distinction between ionic and covalent is extension work, as is the material on 'common' (in certain circles!) names. Ideas of bonding are listed in the curriculum document.	• *Describe bonding in ionic and covalent compounds.* • Name ions and ionic compounds from their formulae. • Count the number of atoms in a given chemical formula. • *Name, or write the formula for, simple covalent compounds, given their formula or name.*			1G 1 Naming ions 1 1G 2 Naming ions 2 1G 3 Matching chemical formulae 1 1G 4 Matching chemical formulae 2 1G 5 Chemical formula 3 flipcards 1G 6 Chemical formulae 4 memory 1G 7 Common names 1	1G 1 Naming ions 1G 2 Naming ionic compounds 1 1G 3 Naming ionic compounds 2 1G 4 Matching formulae for common substances	NHMW: p 21 Mastery checkpoint (extension for the most able students)
1H Writing formulae When students work out for themselves how to combine ions into formulae (as opposed to being shown by a classmate or teacher) they seem to learn more quickly. Lots of practice over several weeks will be needed to consolidate their knowledge.	• Correctly write symbols for common elements. • Correctly write formulae for ionic compounds, given a table of ions.	**1.6** Parlez vous chemistry?		1H 1 Which formula is correct? 1H2 Naming ions 2 memory 1H 3 Writing formulae	1H 1 Writing ionic formulae 1 1H 2 Writing ionic formulae 2	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
1I Ions in action This unit is intended to provide opportunities for formula writing during practical work. The more able students will enjoy becoming chemical detectives, while weaker students predict the formation of precipitates. See also 2H. This unit also covers the theory for US 6324, but a more extensive identification key is required for this standard.	• *Recognise a precipitate as a solid formed when two solutions mix.* • *Write ionic equations for precipitation reactions.* • *Carry out a procedure to identify ions in solution.* • *Predict the formation of precipitates from solubility data.*					

Chapter 2 Acids and bases

MW 6.1: investigate and understand how familiar chemical substances can be grouped into families which have characteristic chemical properties (... metal compounds such as oxides, hydroxides and carbonates, mon-metal oxides...)
MW 6.2: investigate and relate the physical and chemical properties of a family of substances to their use in the home and the community, eg carbonates, bases, acids...
MW 6.3: investigate and understand factors that affect chemical processes, eg factors affecting changing rates of reactions.
ST 6.3: investigate how knowledge of science and technology is used by society when making decisions about environmental issues.

AS Science 1.4	Describe chemical principles. Reactions of acids and bases:	
AS Chemistry 1.4	Describe properties and reactions of metals, acids and bases. Characteristic properties and reactions of acids and bases; factors affecting rates of reaction.	
AS Chemistry 1.7	Describe properties and reactions of carbon and its compounds preparation, properties and uses of carbon dioxide	2F Teachers will need to add a section on carbon monoxide too.
US Chemistry 8936	Investigate chemical characteristics of acids and bases, and write balanced chemical equations for the characteristic reactions of acids.	
US Chemistry 6325	Carry out an investigation into a factor that influences the rate of reaction and demonstrate knowledge of actors that influence rates of reaction. (Practical and theory.)	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
2A Acids and bases This unit summarises the properties of acids and bases first met in Year 10. Although balancing equations is introduced here, there is ample opportunity to practice writing balanced chemical equations throughout chapters 2 and 3.	• Recall the properties of acids and bases • Name the salt formed from a given acid. • Write balanced, formula equations given the word equation for a reaction. • Give examples of common acidic or basic substances in the home	**2.1** Equation practice **2.2** A balanced life	Inv 2.1 Neutralising an acid P12 Neutralisation reactions To use neutralisation reactions to make salts.	2A 1 Acid or base? 2A 2 Salts from acids 2A 3 Assembling balanced equations 1 2A 4 Assembling balanced equations 2	2A 1 Acids or bases 2A 2 Complete word equations 2 2A 3 Balanced equations 1	NHMW p 34-35: Chemical book-keeping—equations (Balancing equations in more detail with lots of exercises)

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
2B How acid is acid? Although students should have investigated acidic and basic substances, and indicators, in Year 10, they will need to be reminded of the indicator colours.	• Use litmus and universal indicator solution to determine the acid-base character of a substance. • Predict the effect on litmus or universal indicator of common laboratory or household substances. • Use the pH scale to indicate degree of acidity or basicity.		Inv 2.2 Testing pH P13 Making and testing indicators To make and use an acid-base indicator. P14 Measuring pH To use universal indicator solution to find the pH of different substances. P15 Soil pH To investigate soil pH.	2B 1 Acids and bases key facts 2B 2 Acid or base?	2B 1 Acids and bases key facts 2B 2 Acid or base?	
2C Carbonates The thermal decomposition of carbonates is not required for AS 1.4.	• Recognise carbonates and hydrogen carbonates (bicarbonates) from their names or chemical formulae. • Recall the behaviour of carbonates or hydrogen carbonates in acid and identify the gas produced in these reactions. • *Recall the behaviour of calcium carbonate or copper carbonate when heated strongly.* • Write word and balanced formula equations for the reactions of carbonates.		**Inv 2.3 Acid on a carbonate** P16 The action of heat on a carbonate To observe the action of heat on copper carbonate. P17 Decomposition of a marble chip To investigate the action of heat on calcium carbonate. P18 Acid on a carbonate To investigate the reaction between acid and a carbonate.	2C 1 Carbonates 2C 2 Acids and carbonates-word equations	2C 1 Carbonates 2C 2 Complete word equations – carbonates 2C 3 Balanced equations 2: carbonates	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
2D Particle size The material on reaction rates is covered in the context of acids and bases (for particle size and catalysts), and metals (for concentration and temperature).	• *Give everyday examples of the control of reaction rate.* • *Predict how particle size affects reaction rate.* • *Use collision theory to explain why particle size affects reaction rate.* • *Sketch a graph showing how the rate of a reaction changes during the reaction.* • *Discuss the dangers of dust explosions.*	**2.4** Experimental design: particle size **2.5** Where there's smoke...	P19 Particle size To investigate the way particle size affect the speed of a reaction. P20 Solid versus solution To investigate the effect solutions have on the rate of reaction. Inv 2.4 Particle size and reaction rate			FFSR p 6-9: Rates of reaction (for teachers who want their rates work separate from other topics)
2E Oxides	• Classify oxides as acidic, basic or amphoteric according to their pH or their behaviour in acids and bases. • Write word and formula equations for the reactions of metal oxides with acids, and non-metal oxides with alkalis. • *Define an alkali as a soluble base.* • Give an example of an amphoteric oxide. • Discuss the use of acids in rust removal.		P21 Oxides To prepare a metal and non-metal oxide and compare them. P22 Extraction of aluminium oxide from bauxite To demonstrate the amphoteric nature of aluminium oxide and hydroxide.		2E Oxide equations	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
2F Carbon dioxide Students doing AS Chemistry 1.7 need to know about CO_2 in detail, but all students need to know the limewater test and the preparation of CO_2	• Describe the laboratory preparation of carbon dioxide; draw a diagram to show how to collect the gas formed; and write a balanced formula equation for the reaction which occurs. • Describe the limewater test for carbon dioxide. • *Write two balanced equations for the reactions which occur during the limewater test for carbon dioxide.* • *List the physical and chemical properties of carbon dioxide.* • *Relate the properties of carbon dioxide to its uses.*	**2.7** Carbon dioxide	P23 Carbon dioxide To prepare and test carbon dioxide.	2F 1 Carbon dioxide and other oxides	2F Oxides and carbon dioxide key facts	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
2G Oxides of sulfur The conversion of SO_2 to SO_3 is the context for the introduction of catalysts. Catalysts are not included in the rates section of AS Chemistry 1.4, but are required for US 6325. The role of SO_2 in air pollution is a consequence of the combustion of carbon fuels: AS Chemistry 1.7 or US 8937. This unit is also relevant to students researching aspects of industrial chemistry.	• *Discuss oxides of sulfur in air pollution and in industry.* • *Describe a catalyst as a substance which changes the rate of a reaction without being used up by it.* • *Name the catalyst used to convert sulfur dioxide into sulfur trioxide.* • *Give examples of catalysts in use.*		P24 Decomposition of hydrogen peroxide To observe the catalytic decomposition of hydrogen peroxide. P25 Catalysts To demonstrate a catalysed reaction			FFSR p34-35: Superphosphate (Extension)
2H Hydroxides All students need to cover the reactions of hydroxides and acids, while more able students could also consider the use of hydroxides in removing metal ions from solution. (See also 1I)	• Write word and formula equations for the reactions of metal hydroxides with acids. • Discuss the chemistry of indigestion remedies. • *Write ionic equations for the precipitation reactions between hydroxide ions and metal ions.* • *Give examples of the use of sodium hydroxide and calcium hydroxide in industry.*	**2.6** Reaction time **2.8 Household cleaners**	P26 Hydroxides To investigate some metal hydroxides. P27 Clean water To demonstrate the role of hydrated lime in removing metal ions from solution. Inv 2.5 Making a salt	2H 1 Hydroxide key facts 2H 2 Complete word equations 1 2H 3 Completing mixed word equations 2 2H 4 Missing substance 2H 5 Balancing equations 1 2H 6 Balancing equations 2 2H 7 Acid-base flipcards	2H 1 Hydroxide facts 2H 2 Oxide and hydroxide equations 1 2H 3 Neutralisation equations	FFSR p 14-15: Hydroxides (reading with questions on uses of hydroxides – good relief lesson)

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
2I At the limeworks This unit ties together ideas about carbonates, oxides and hydroxides in the context of a limeworks. It also links to Chapter 14: Rocks and minerals.	• *Give the chemical formula and name for limestone, lime and hydrated lime or slaked lime.* • *Summarise the chemical changes that occur during the processing of limestone to form lime and hydrated lime.* • *Give some uses for limestone, lime and slaked lime.*	**2.9** bLIMEy!				

Chapter 3 Metals

MW 6.1: investigate and understand how familiar chemical substances can be grouped into families which have characteristic chemical properties (... metals...)
MW 6.2: investigate and relate the physical and chemical properties of a family of substances to their use in the home and the community, eg metals...
MW 6.3: investigate and understand factors that affect chemical processes, eg factors affecting changing rates of reactions.
MW 6.4: investigate and describe the applications and effects of chemical processes in everyday situations, eg corrosion...
ST 6.3: investigate how knowledge of science and technology is used by society when making decisions about environmental issues.

AS Science 1.4	Describe chemical principles Reactions of metals	3A-3C Teachers may like to begin a unit on metals with 1D
AS Science 1.1	Carry out a **practical** science investigation with direction (eg into a factor affecting reaction rate).	3C-3D
AS Science 1.2	**Research** with direction how science and technology are related (eg extraction or recycling of a metal).	3E
US Chemistry 8935	Investigate characteristic properties and reactions of metals. (Practical and theory)	3A-3C, 3E
US Chemistry 6331	Investigate a chemical process, and the effect of modifications to a chemical process. (Practical: eg corrosion, electroplating.	
US Chemistry 6323	Describe industrial methods of producing selected chemical substances, and describe the importance of selected chemical substances to society. (Range: two substances including at least one of - superphosphate, sodium hydroxide, urea, methanol, iron, aluminium.) (Research)	3E
US Chemistry 6325	Carry out an investigation into a factor that influences the rate of reaction and demonstrate knowledge of actors that influence rates of reaction. (Practical and theory.)	3C-3D

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
3A The activity series We begin investigations into the reactivity of metals with rusting, so that there is time to complete those experiments that take several days to react.	• Recognise that some metals are more reactive than others, and relate the reactivity of metals to their uses. • State that aluminium appears to be unreactive because it is protected by its oxide coat. • Discuss methods used to prevent iron from rusting.	**3.1** Properties and uses **3.2 Scrap metal** (**3.6** Rust prevention)	P28 Metals and oxygen To investigate the reaction of metals with oxygen. P29 The conditions needed for rusting To investigate the conditions necessary for rusting. P30 Stopping rusting To investigate the use of metals to stop iron from rusting. Inv 3.1 Investigating rust	3A 1 Recognising metals 3A 2 The reactivity of metals	3A 1 Reactions of metals 3A 2 Preventing rusting	FFSR p 18-19: Metals through the ages (relates properties to use and ease of extraction—with questions: good relief lesson). NHMW p 82-83 Chemistry on a grand scale (extension reading on corrosion prevention, with questions: relief lesson for more able classes).
3B Metals and water	• Write word and formula equations for the reactions between reactive metals and water. • Recognise the hazards of spraying water onto metal fires.	**3.3** Testing metals	P31 Metals and water To investigate the reaction of metals with water. Inv 3.2 Metals and water Inv 3.3 Sodium and water (teacher demo) Inv 3.4 Magnesium and steam		3B 1 Word equations	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
3C Metals and acid We assume students will have spent some time investigating the reaction between metals and acids in Year 10, so this unit uses these reactions to consider the affect of concentration on reaction rate.	• Write word and formula equations for the reactions of appropriate metals and acids. • Describe the test for hydrogen gas. • Use the reactivity series to predict the behaviour of metals in oxygen, water and acids. • Place metals in order of reactivity based on their relative reactivity with oxygen, water and acid. • *Describe the affect concentration has on rate of reaction.*	**3.5** Time for a quick one?	P32 Metals and acids To investigate the reaction of metals with acid. P33 Dilute versus concentrated To investigate how concentration affects the rate of a reaction. Inv 3.5 Metals and acid Inv 3.6 Concentration and reaction rate	3C 1 Metal key facts 3C 2 Completing word equations 1 3C 3 Completing word equations — acid reactions	3C 1 Reactions of metals 3C 2 Metal + acid word equations 3C 3 Metal + acid balanced equations 3C 4 More metal reactions	FFSR p 6-9: Rates of reaction (for teachers who want their rates work separate from other topics)
3D Rates of reaction This unit looks at the affect temperature has on reaction rate and also ties together the other ideas on reaction rate already discussed.	• *Discuss the affect of temperature on reaction rate.* • *Use collision theory to explain the affect of temperature on reaction rate.* • *Identify the factors affecting reaction rate in real-life situations.*	**3.4 The time pencil**	P34 Hot versus cold To investigate the effect of temperature on reaction rate. Inv 3.7 Temperature and reaction rate		3D Rates of reactions	PF p 68-71: Reaction rates (summarises *Rates* in one unit for students sitting US 6325)

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
3E Metals and metal ions This unit is not required for Science 1.4, but students doing Chemistry 1.4 need to relate the reactivity of metals to their extraction, and those doing US 8935 need to predict the results of displacement reactions.	• Relate the reactivity of a metal to its method of extraction. • Predict the behaviour of metals in solutions of metal ions when given an activity series.	**3.6** Rust prevention	P35 Metals and metal ions To investigate the reactivity of metals in solutions of various metal ions. P36 Copper from copper oxide To reduce copper oxide to copper metal.	3E 1 Chemistry revision flipcards 3E 3 Material world crossword		FFSR p 24-25: Extraction of metals (useful for Chemistry 1.4 or students doing research projects on iron or aluminium). NHMW also contains detailed notes on iron and aluminium suitable for project work. PF p 72-75: A chemical process (Hints for doing a chemical process research project, followed by details of aluminium extraction: ideal for students doing US 6323 or US 6331, or AS Science 1.2.)

Chapter 5 Humans and microbes

LW 6.1: investigate and describe examples of different types of helpful and harmful micro-organisms, eg bacteria, fungi, viruses and disease such as HIV/AIDS or leukemia, bacteria and fungi in biotechnology
LW 6.4: investigate a New Zealand example of how people apply biological principles to plant and animal management.
ST 6.2: describe how technology has contributed to, and at times helped to change, scientific ideas, eg ... electron microscope...
ST 6.3: investigate how knowledge of science and technology is used by society when making decisions about environmental issues eg... sewage treatment...

AS Biology 1.8	Describe biological ideas relating to how humans use and are affected by micro-organisms.	5A-5G
AS Science 1.3	Describe aspects of biological systems ... describe biological systems relating to micro-organisms...	5A-5G
US Biology 6298	Describe interactions between humans and micro-organisms ... carry out a practical investigation on how a selected variable affects the activity of a micro-organism; describe a human use of a micro-organism...	5A-5G

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
5A Understanding microbes	• Recognise that while some microbes cause disease, others are essential to human existance. • Define pathogens as disease-causing micro-organisms. • Discuss the role of micro-organisms in the nitrogen cycle. • Recall an experiment to grow microbes on an agar plate and answer questions about the method used, the importance of a control and the safety precautions taken.	**5.1** *Saturn Rings* science	P48 Growing microbes To grow microbes on an agar plate. Inv 5.1 Growing microbes	5A1 Growing microbes 5A 2 What microbes do 5A 3 The nitrogen cycle	5A 1 Microbes 5A 2 The nitrogen cycle	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
5B Understanding bacteria	• Draw and label a diagram of a generalised bacterial cell, briefly describing the function of each part. • Describe bacterial feeding by extra-cellular digestion, and reproduction by binary fission. • Explain the characteristic S-shaped curve for population growth of bacteria.		P50 Enzymes and starch To investigate how the enzymes in saliva affect starch.	5B 1 The structure of bacteria (drag and drop) 5B 2 The structure of bacteria (text) 5B 3 The structure of bacteria 5B 4 The structure of bacteria 5B 5 Bacteria	5B 1 Bacteria 1 5B 2 Bacteria 2	
5C Understanding fungi If you're not going to do unit 6B, then this is probably the best time to investigate antibiotics or antiseptics on an agar plate.	• Label a diagram showing the structure of a typical fungus and describe the function of each part. • Describe the feeding and reproduction of fungi and the conditions necessary for optimum growth. • Distinguish between saprophytic and parasitic fungi. • Account for the clear zone that appears on an agar plate around some fungal colonies. • Give examples of fungal diseases that affect plants, animals or humans.	**5.2** Unwanted mushrooms **5.3** Ah—Hokonui	P51 Fermentation To grow yeast cells. P54 Testing antiseptics To test the effectiveness of different antiseptic solutions. Inv 5.2 Fermentation trials	5C 1 The structure of fungi (drag and drop) 5C 2 The structure of fungi (text) 5C 3 Fungi 5C 4 Fungi facts	5C 1 Fungi 1 5C 2 Fungi 2	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
5D Mushroom farming Mushroom farming provides the context study the manipulation of environmental factors which affect the growth of microbes. Students doing US 6298 need to investigate these factors in detail. This unit also shows how biological principles are applied in a commercial setting	• Show how the growth of micro-organisms is encouraged or prevented by manipulating conditions such as temperature, humidity, nutrient availability or oxygen concentration. • *Discuss aspects of the life processes of bacteria and fungi with reference to mushroom farming or composting.* • Describe the role of microbes in the carbon cycle.	**5.3** Life processes	P52 Yoghurt To make some yoghurt.	5D 1 Carbon cycle	5D Carbon cycle	NHMW p 34-35: Micro chefs (A good summary of cheese-making with poster showing processes for many different cheeses. Contains a few questions, but will also require teacher input.)
5E Stopping microbes This unit shows how environmental factors are manipulated to prevent the growth of microbes. The use of antiseptics and antibiotics in killing microbes is discussed in 6B.	• Discuss methods of food preservation by the manipulation of factors that affect the life processes of microbes. • Explain the difference between pasteurised and UHT milk. • Show an understanding of the life processes of microbes by discussing the causes and prevention of food poisoning.	**5.4** Sausage sizzle **5.5** Milk treatment (**6.1** Friendly fungi **6.2** Disinfectant trials)	P53 Osmosis To investigate the effect of salt and sugar on potato cells. (Inv 6.1 Attacking bacteria)	5E 1 Stopping microbes 1 5E 2 Stopping microbes 2 5E 3 Stopping microbes 3 5E 4 Bacteria and fungi word search	5E Stopping microbes	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
5F Case study: Clean water This unit reinforces and extends work done in 5D and 5E. It should be included for students doing Biology 1.3 and US 6298, plus those more able students doing Science 1.3.	• Explain the difference between aerobic and anaerobic bacteria. • *Explain why a large flow of nutrients into a waterway leads to the death of aquatic animals and the production of unpleasant gases.*	**5.7 Yeast trials** **5.8** Quiet! Microbes at work				
5G Understanding viruses	• Draw and label a diagram showing the structure of a virus. • Describe the method of replication of viruses in living cells.	**5.9** Virally speaking **(6.3** Microbes crossword)		5G 1 Viruses 5C 2 Virus replication 5G 3 Microbes flipcards 5G 4 Type microbe key facts 1 5G 5 Type microbe key facts 2	5G 1 Virus 5G 2 Virus replication	

Chapter 6 Defences against disease

LW 6.1: investigate and describe examples of different types of helpful and harmful micro-organisms, eg bacteria, fungi, viruses and disease such as HIV/AIDS or leukaemia, bacteria and fungi in biotechnology.
LW 6.4: investigate a New Zealand example of how people apply biological principles to plant and animal management.
ST 6.2: describe how technology has contributed to, and at times helped change, scientific ideas.

AS Biology 1.8	Describe biological ideas relating to how humans use and are affected by micro-organisms.	6D-E
AS Science 1.3	Describe aspects of biological systems ... describe biological systems relating to micro-organisms...	6D-E
US Biology 6298	Describe interactions between humans and micro-organisms ... carry out a practical investigation on how a selected variable affects the activity of a micro-organism; describe a human use of a micro-organism; and describe effects of a micro-organism on people.	6D-E
US Biology 6304	Describe natural and artificial human defence mechanisms against pathogenic diseases ... describe the body's defence systems; describe the development of immunity to disease; and investigate the use of medicines to treat pathogenic disease.	6A-E

The ideas in this chapter are also examined in AS Human Biology 1.4 (describe how humans respond to pathogens), but that standard requires considerably more detail than is included in this book.

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
6A Nature's battleground This material is only required for US 6304.	• *Describe the body's natural defences against pathogens.* • *Recognise the roles of the blood and lymph system in the body's defences.*					
6B The magic bullet All students need to know about disinfectants and antibiotics, including the agar plate testing of antibiotics or disinfectants.	• *Discuss the use of disinfectants, antiseptics, antibiotics and antiviral agents in fighting disease.*	**6.1** Friendly fungi **6.2** Disinfectant trials	P54 Testing antiseptics To test the effectiveness of different antiseptic solutions. Inv 6.1 Attacking bacteria			

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
6C Immunity This material is only required for US 6304.	• *Distinguish between different kinds of immunity: active and passive, natural and artificial.* • *Discuss immunisation as a method of disease prevention in New Zealand.* • *Describe the effect of HIV/AIDS on the immune system.*					
6D Case study: Meningococcal disease All four of the above assessment statements require students to know how microbes cause disease in humans.	• Investigate a pathogenic disease: identify the causal pathogen; state the disease symptoms; describe how medicines are used to treat the disease and/or its symptoms; and describe how the disease is spread.					
6E Microbiology in the 21st century This unit revises the ideas covered in chapter 5.	• Apply biological ideas about micro-organisms to contemporary applications.	**6.3** Microbes crossword				

Chapter 7 Genetics

LW 6.2/3 (a) describe cell division and explain how genetic information is passed from one generation to the next eg chromosomes and DNA, simple Mendelian genetics.
LW 6.2 (b) investigate examples of the contemporary applications of genetics eg animal and plant breeding
LW 6.4: investigate a New Zealand example of how people apply biological principles to plant and animal management
ST 6.2: describe how technology has contributed to, and at times helped change, scientific ideas.
ST 6.3: investigate how knowledge of science and technology is used by society when making decisions about environmental issues.

AS Science 1.3	Describe aspects of biological systems Chromosomes, genes, alleles and DNA, mitosis and meiosis; Punnett squares; contemporary applications.	7B-7K
AS Biology 1.3	Describe the transfer of genetic information The structure of DNA; cell division; solving genetic problems; applications of genetics.	7A-7K
US Biology 8923	Describe mechanisms for the transfer of genetic information. Describe cell division and determine simple monohybrid inheritance patterns.	7D-7E, 7G-7K
US Biology 8924	Describe the structure and replication of deoxyribonucleic acid (DNA).	7F

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
7A Reproduction While only those students doing Biology 1.3 are required to understand the importance of variation, it is helpful for all students to revise some of the ideas and language of reproduction covered in Year 9 or 10	• *Discuss the significance of variation within individuals on the survival of the species.*			7A 1 Reproduction revision	7A Reproduction revision	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
7B Continuous variation This unit revises ideas about variation within a species that should have been covered at level 4. This work leads on to the selective breeding unit which follows.	• Give examples of human characteristics that show continuous variation		P55 Continuous variation To measure continuous variation in height of your classmates. Inv 7.1 Continuous variation	7B 1 Reproduction and continuous variation	7B Genetics and variation	
7C Case study: Selective breeding in the dairy industry Students doing Science 1.3 or Biology 1.3 need to be able to discuss contemporary applications of genetics, such as selective breeding.	• Discuss the application of genetics through selective breeding in the dairy industry.	**7.1 Red Rascal** **17.5** Research: Plant or animal breeding				NHLW p 70-71: Genetics and the dairy industry (complements the material in *New Directions* and includes many questions.)

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
7D Mendel and his peas This unit is intended to provide able students with background information about Mendel. Less able students would probably be better off seeing one of the many good videos which summarise Mendel's experiments.	• Recognise that individuals carry two copies of genes for characteristics—one from each parent. • Define a dominant characteristic as one which is visible if a single copy of that gene is present, and a recessive characteristic as one which is only visible if the dominant gene is not present. • Appreciate the statistical nature of genetic predictions in that they forecast probabilities and not specific outcomes.		Inv 7.3 Human genetics			
7E Understanding Mendel This unit shows how the principles Mendel worked out are applied.	• Explain the process of inheritance and use correctly the terms gamete, zygote, chromosome, gene, allele, dominant, recessive, genotype and phenotype.	**7.3** The genetics code	P56 Inherited traits To investigate different traits in your classmates P57 Gene combinations To investigate how the genes for a particular characteristic combine in cross-breeding. Inv 7.2 The principles of genetics	7E 1 The language of genetics 7E 2 Mendel crossword	7E Mendel	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
7F The book of life The arrangement of base pairs and structure of DNA is not required for Science 1.3, but those students doing Biology 1.3 or US 8924 need to know the structure and replication of DNA in detail.	• Recognise the relationships between the cell nucleus, chromosomes, DNA, genes, alleles and bases. • *Describe the structure of DNA as a double helix, identify the position of the phosphate and sugar groups, and the arrangement of the base pairs.* • *Describe the stages in the replication of DNA and explain why it can be called semiconservative.* • *Show how the structure and replication of DNA allows genetic information to be passed from one generation to the next.* • *State what a karyotype is, and use a karyotype to determine the sex of an individual.*			7F 1 Chromosomes and DNA 7F 2 Inside genetics	7F Chromosomes	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
7G Cell division: mitosis Students doing Science 1.3 need only distinguish between mitosis and meiosis, while those doing Biology 1.3 or US 8923 need to know these processes in detail. Those doing either Achievement Standard need to answer questions on contemporary applications of genetics such as DNA profiling and cloning.	• State where mitosis occurs, its purpose, and that chromosome number is maintained. • *Complete a diagram showing the sequence of events occurring during mitosis.* • Recognise that all body cells contain the complete genetic code for that individual. • Discuss practical aspects of DNA profiling. • Use stimulus material to answer questions about cloning.			7G 1 Stages in mitosis 1 7G 2 Stages in mitosis 2		FFSR p 66-67: Plant tissue culturing (shows how plants are cloned: suitable relief lesson for middle to able classes.) FFSR 68-9: Uses of DNA profiling (will occupy most classes for half a period of relief work) FFSR p 75: Tech focus on DNA profiling: (how it's done – but no questions).

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
7H Cell division: meiosis Students doing Science 1.3 need only distinguish between mitosis and meiosis, while those doing Biology 1.3 or US 8923 need to know these processes in detail. The material on seedless mandarins and crossing over is extension work.	• State where meiosis occurs, its purpose, and that the daughter cells contain half the number of chromosomes of the parent cell. • *Complete a diagram showing the sequence of events during meiosis and identify differences in the process and outcome of meiosis and mitosis.* • Discuss the changes in chromosome number during the different stages of sexual reproduction. • *Recognise that meiosis can only occur if the parent cell has an even number of chromosomes, and thus that any organism with an odd number of chromosomes will be sterile.*	**7.2** Threads of life		7H 1 Mitosis and Meiosis 1 7H 2 Mitosis and meiosis 2 7H 3 Human Reproduction 7H 4 Reproduction reasons 7H 5 Genetics word search	7H Mitosis and meiosis key facts	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
7I Punnett squares and pedigrees This unit provides lots of practice in solving problems in genetics.	• Draw Punnett squares to show the expected phenotype and genotype ratios in offspring. • Draw or read a pedigree chart, recognising the family relationships shown. • Use pedigree charts to make deductions about the genotype or phenotype of specific individuals • Describe the role of the X and Y chromosomes in sex determination and illustrate by a simple cross that there should be a 50:50 sex ratio.	**7.4** Puppy dog's eyes	P58 Family trees To construct a personal family tree.	7I 1 Punnett practice 1: sex chromosomes 7I 2 Punnett practice 2: Flower colour 7I 3 Mya the blue eyed baby	7I Punnett squares and pedigrees 7I 2 Punnett square 1 7I 3 Punnett square 2	
7J DNA profiling: problems and possibilities Although this unit considers some of the social aspects of DNA profiling, it also provides students with more practice in drawing Punnett squares.	• Use stimulus material to discuss some of the social implications of gene testing.	**7.5** The case of the blind guide dog		7J 1 Punnett square 3: Huntington's disease 7J 2 Probability for genetics		

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
7K Recombinant DNA Both Science 1.3 and Biology 1.3 require students to answer questions on contemporary applications of genetics	• Use diagrams to show how a genetically modified organism could be created. • Discuss the risks and benefits of the use of GMOs.	**7.6** Cholera vaccine recalled		7K 1 Recombinant DNA facts 7K 2 Genetics keyfacts flash cards 7K 3 Genetics revision crossword 7K 4 Genetics revision flipcards 7K 5 Living World revision crossword	7K Recombinant DNA facts	NHLW p 28-29: Pest control and the Bt gene (a topical issue, but teachers will need to consider how to use this material.)

Chapter 8 Motion

PW 6.1 carry out practical investigations, with effective control of variables, into common physical phenomena, and relate their findings to scientific theories. By the end of year 11 students should have had learning experiences with.... motion.

AS Science 1.6	Describe aspects of physics ...distance, speed, constant acceleration, motion time graphs including gradients and simple areas..	8A-8F
AS Physics 1.4	Demonstrate understanding of mechanics in one dimension Addition and subtraction of vectors in one dimension; distance; speed (instantaneous, average and constant); displacement; velocity (average and constant), positive and negative acceleration (constant); motion/time graphs and the interpretation of their gradients and areas.	8A-8F
AS Science 1.1	Carry out a **practical** science investigation with direction (eg investigate the stopping distance of a marble with the height of launching on a ramp).	8A-8B
US Physics 6366	Knowledge of linear motion. Sketch graphs of constantly accelerated linear motion for a given situation; describe the motion of an object from a given sketch graph, and determine an unknown quantity for an object with constant linear acceleration.	8B-8F
US Physics 6375	Use graphical analysis to recognise a directly proportional physical relationship Graph data, identify the relationship in words, calculate the gradient, interpolate or extrapolate the value of an unknown.	8B-8F

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
8A The language of physics While we always hope that Y11 students have mastered the metric system and can read scales, many less able students will need this revision. The problem solving work in question 4 is intended to train students to think about the quantities involved before they have a method memorised.	• Express physical quantities in appropriate SI units. • Use prefixes for SI units correctly. • Select the appropriate formula from a list to solve problems. • Read scales on common laboratory apparatus.	**8.1** Measuring up **8.2** Units and formulas		8A 1 SI unit names flipcards 8A 2 SI unit symbols memory 8A 3 Which formula 1 8A 4 Which formula 2	8A 1 SI units 8A 2 SI prefixes 8A 3 Which formula?	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
8B Drawing and reading graphs One also hopes Y11 students can plot graphs without error, but again, most will benefit from this revision. The idea of sketch graphs will be new to many students. Note that graphing and the identification of dependent and independent variable are also important for Science 1.1.	• Plot a line graph for a given set of data, including a suitable line of best fit. • Interpolate or extrapolate to determine a value for a point not included in the data set. • Describe in words the relationship shown by the graph. • Draw or interpret sketched graphs showing relationships without numerical data. • Identify the dependent and independent variables in a given investigation.			8B 1 Graphs	8B Graphs	
8C Distance, speed and time Science 1.6 mentions speed and distance, while Physics 1.4 and US 6366 also include displacement and velocity. 'Sensible rounding' is expected for excellence.	• Recall the relationship between distance, speed and time and use the formula $V_{average} = \frac{d}{t}$ in calculations. • *Distinguish between distance and displacement, speed and velocity.* • Solve problems involving distance, speed and time in non-standard units. • Use sensible rounding in calculations.		P59 Distance, displacement, speed and velocity To measure the speed and velocity of motion.		8C Distance, speed, time calculations	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
8D Distance-time graphs	• Describe an object's motion from the shape of its distance-time graph. • Find the speed of an object from its gradient at a given point on a distance-time graph.		P60 Distance-time graphs To interpret different distance-time graphs. Inv 8.1 Graphing a journey	8D 1 In distance-time graphs... 8D 2 Interpreting distance time graphs		
8E Ticker-timers Ticker-timers aren't as impressive as data-loggers, but they are excellent for showing the relationships between distance, speed and acceleration. Remember too, that although they may be 'old hat' to teachers, they are new to most students.	• Use a ticker-timer to investigate the motion of an object. • Describe an object's motion from the tape made by a ticker-timer, or from a velocity-time graph. • Calculate the acceleration of an object by finding the gradient of a velocity-time graph at a given point. • Calculate the distance travelled by an object by calculating the area under a velocity-time graph.	**8.6** Going dotty **8.7** A walk to the Post Shop	P61 Ticker-timer To use a ticker-timer to study the motion of a toy car. Inv 8.2 Testing ticker-timer	8E 1 Ticker timers	8E Motion graphs 1 8E Motion graphs 2	
8F Acceleration, speed and time	• Use $a = \frac{\Delta v}{\Delta t}$ to solve problems. • Use a velocity-time graph to solve motion problems. • Distinguish between instantaneous speed and average speed.	**8.8** Burnt out satellite		8F 1 Acceleration 8F 2 Speed time graphs	8F Speed time graph	

Chapter 9 Forces

PW 6.1: carry out practical investigations, with effective control of variables, into common physical phenomena, and relate their findings to scientific theories, eg force and acceleration...
ST 6.2: describe how technology has contributed to, and at times helped change, scientific ideas.

AS Science 1.6	Describe aspects of physical systems ... mass, force (push, pull, friction, weight, reaction), acceleration, balanced forces	9A-9D
US Physics 6367	The results of forces acting on an object. Explain the results of forces acting on an object; explain the links between force and pressure; and determine an unknown quantity for a situation where forces are acting on an object.	9A-D
US Physics 6369	Apply formulae and graphical methods to find unknowns for a physical system.	9C

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
9A Forces Students will have had some experience with forces in Years 7-10, so this unit is intended to revise this earlier work.	• Identify the nature, relative size and direction of forces acting on objects. • List the affects on objects of an unbalanced force. • Explain the results of forces acting on an object.		P62 Measuring friction To compare the frictional forces of different surfaces.	9A 1 Forces 9A 2 Newton's Laws of Force and Motion	9A Forces	FFSR p 150: Tech. focus—Friction in sport. (for interest: no questions.)
9B Measuring forces: gravity It is worth reminding students of the distinction between mass and weight. More able classes will find the extension questions challenging.	• Understand that weight is the result of the force of gravity acting on an object. • Calculate the weight of an object in different gravitational fields.	**9.1** A stretchy problem **9.2** Archimedes' Principle	P63 Mass and weight To investigate the relationship between mass and weight in a school laboratory. P64 The acceleration due to gravity To investigate the motion of falling objects.	9B 1 Gravity	9B Mass and weight	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
9C Force, mass and acceleration Students doing Physics 1.4 or US 6367 need to cover pressure as well as mass and acceleration.	• Recall an experiment investigating the relationship between force, mass and acceleration. • Use the formula $F_{net} = ma$ to solve problems. • *Use the formula* $P = \frac{F}{A}$ *to solve problems.*	**9.3** Force, mass and acceleration	P65 Newton's law To investigate the relationship between force, mass and acceleration. **Inv 9.1 Force and acceleration**	9C 1 Force, mass and acceleration	9C Force, mass and acceleration calculations	
9D Balanced and unbalanced forces This unit reinforces ideas introduced in 9A and considers the idea of force as a vector quantity with both size and direction.	• Add vectors to determine the net force on an object.		P66 Balanced and unbalanced forces To investigate the action of forces on a trolley.	9D 1 Balanced and unbalanced forces	9D Balanced and unbalanced forces	

Chapter 10 Energy

PW 5.2 Describe various ways in which energy can be transformed and transferred in our everyday world, eg rockets, electric blankets, hair driers.
PW 6.2 Demonstrate an understanding of the applications of energy and its transfer and transformation, eg heat transfer, kinetic and potential energy.

AS Science 1.6	Describe aspects of physical systems Heat, kinetic, gravitational potential, elastic potential, chemical potential, sound, and solar energies, conservation of energy, transfer of energy, power, work.	10A-10E
US Physics 6368	Knowledge of energy transformations Explain a given situation in terms of the energy transformations present; explain a given situation in terms of force, power and work; and determine an unknown quantity for a situation involving an energy transformation.	10A-10E

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
10A Energy—what is it? This unit revises ideas on energy covered in Years 9 and 10.	• Explain energy transformations in everyday situations. • Recall and apply the law of conservation of energy.	**10.1** Energy	P67 An energy transfer system To investigate the energy changes in a simple system. P68 Energy changers To identify energy transformations. Inv 10.1 Energy transformations	10A 1 Energy examples 10A 2 Energy changes	10A 1 Types of energy 10A 2 Energy transformations	PF p 28-31: Energy and change (Looks at each kind of energy in more detail: good for students needing more revision.)
10B Kinetic energy: energy in motion	• Recall the relationships between kinetic energy and velocity, and kinetic energy and mass. • Apply an understanding of kinetic energy to everyday situations. • Use $E_k = \frac{1}{2}mv^2$ to solve problems.	**10.2** Crash!	P69 Investigating kinetic energy To investigate the relationship between kinetic energy, speed and mass. P70 Measuring kinetic energy To find the kinetic energy of a toy car.			FFSR p 146-147: Car safety (Extension material for able students mentioning impulse and momentum as well as energy issues. With questions.)

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
10C Potential energy: stored energy	• Identify types of energy stored in everyday situations. • Use $E_p = m.g.h$ to solve problems.		P71 Measuring potential energy. To measure the potential energy of an object.		10C Kinetic and potential energy calculations	
10D Work Although machines are not mentioned in the Standards, they may appear in exam questions considering applications of force and energy.	• Define work in terms of force and distance. • Recognise that energy is transferred when work is done. • Solve problems using W = F.d • Explain a given situation in terms of work, energy, force and distance.	**10.3** The work-out	P72 Work To find out how much work is done when lifting a book. Inv 10.2 Work and energy		10 D Work calculations	
10E Power Ideas about energy efficiency are implied for excellence in Science 1.6 or Physics 1.4.	• Define power in terms of work done or energy transferred and time. • Solve problems using $P = \frac{W}{t}$. • Apply ideas of power or efficiency to everyday situations.	**10.4** Down the pole	P73 Personal power To find out how powerful you are. Inv 10.3 Personal power	10E Energy flipcards	10 E Power calculations	

Chapter 11 Heat

PW 6.1 Carry out practical investigations, with effective control of variables, into common physical phenomena, and relate their findings to scientific theories, eg... insulation, heat capacity of different materials.
PW 6.2 Demonstrate an understanding of the applications of energy and its transfer and transformation, eg heat transfer.
PW 6.3 Investigate and establish patterns in physical phenomena and make useful predictions, eg ... heat retention of various materials, heat and temperature change, food requirements and body shape of animals.
PW 6.4 Investigate and report on how physical principles are used in some common household appliances, eg... refrigerator...
ST 6.3: Investigate how knowledge of science and technology is used by society when making decisions about environmental issues.

AS Science 1.6	Describe aspects of physics heat transfer via conduction, convection, radiation	11A-11E
US Physics 8767	Demonstrate knowledge of heat and temperature. Describe mechanisms of heat transfer and the factors which affect it; describe the relationship between heat capacity and temperature change; and describe applications involving heat transfer.	11A-11E

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
11A Heat and temperature The distinction between heat and temperature is not mentioned for Science 1.6, but is probably worth making in any case.	• *Distinguish between heat and temperature.* • Describe particle movement when objects are heated or cooled.	**11.1** Heat wave	P74 Heat and temperature To illustrate the difference between heat and temperature. **Inv 11.1 Heating and cooling**	11A 1 Heat and particles	11A Particles and heat	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
11B Conduction	• Describe the transfer of heat through conduction in terms of particle movement. • Identify substances which are good, or poor, conductors of heat. • Apply knowledge of the conduction of heat to situations in everyday life.		P75 Thermal conductivities To illustrate how rods of different materials have different thermal conductivities. P76 A miner's safety lamp To demonstrate the effectiveness of metals as conductors of heat. Inv 11.3 Conduction	11B 1 Conduction	11B Conduction	
11C Convection Note that land and sea breezes are covered in 11E.	• Describe the transfer of heat through convection in terms of particle movement. • Draw diagrams to show convection currents in different situations. • Apply knowledge of convection to situations in everyday life.	**11.2** Up, up and away!	P77 Hot and cold To investigate the behaviour of hot and cold water. P78 Convection currents To illustrate convection currents in water. Inv 11.2 Convection	11C 1 Convection		
11D Thermal radiation	• Describe heat transfer by radiation. • Describe experiments investigating the rate of heat transfer by radiation for different surfaces. • Apply knowledge of heat transfer by radiation to situations in everyday life.	**11.3** The heat is on	P79 Radiation To investigate the radiation of heat from different coloured surfaces. P80 Absorbing surfaces To illustrate how different surfaces absorb radiant heat at different rates. Inv 11.4 Experimental design: radiation	11D 1 Radiation 11D 2 Heat transfer 1 11D 3 Heat transfer 2 11D 4 Vacuum flask	11D 1 Heat transfer 1 11D 2 Heat transfer 2	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
11E Specific heat and breezes Although heat capacity is not mentioned for Science 1.6, students need to understand the causes of land and sea breezes. Latent heat is not mentioned in either assessment statement, but since the content is covered in MW 5.1, students could be expected to include ideas of phase changes in their discussion of applications of heat transfer.	• Draw and label diagrams to explain the formation of land and sea breezes. • *Describe the relationship between the heat capacity of a substance and its temperature change.* • Discuss applications of heat transfer in everyday life in terms of the materials involved and factors affecting the rate of heat transfer.	**11.5** Car cooling system	P81 Specific heat To investigate the difference in heat capacity between sand (land) and water (sea). P82 Melting and freezing To investigate the cooling curve for paradichloro benzene. P83 Cooling and evaporation To illustrate the cooling effect of evaporation.	11E 1 Sea breezes		
11F Keeping warm This unit provides further opportunity to revise ideas of heat transfer in everyday life.	• Apply knowledge of methods of heat transfer to everyday situations.	**11.4 A beautiful bath** **17.1** Insulation trial		11 F 1 Heat transfer crossword	11F Keeping warm	FFSR p 151, 155-6: Tech focus—Staying Warm and questions: Hot boxes and Flax cloaks and wharepuni (enough work here for a relief lesson for more able students).

Chapter 12 Electricity

PW 6.3: investigate and establish patterns in physical phenomena and make useful predictions, eg voltage and current...
By the end of Year 11 students should have had learning experiences with ... simple electrical circuits. They should be starting to use the language of physicists, including the terms... power, voltage, current and resistance.

AS Science 1.6	Describe aspects of physical systems Voltage, current, resistance, power in DC circuits, circuit diagrams. Voltage and current behaviour in series and simple parallel circuits. Circuit diagrams will involve the use of wires, voltmeters, ammeters, switches, diodes, cells and batteries, lamps, and resistors.	12B-12H
US Physics 6370	Describe and construct simple electrical systems. Describe a simple electrical system; draw a circuit diagram for a simple electrical system; and construct a simple electrical circuit from a circuit diagram.	12A-12H

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
12A Shower power US 6370 requires an understanding of conductors and insulators. Science 1.6 does not, but it is useful to relate ideas about static electricity covered in earlier years to work done on atomic structure this year.	• *Describe the behaviour of electricity in conductors and insulators in terms of the movement of charged particles.*		P84 Charge transfer To investigate the transfer of charged particles	12A 1 Electricity facts 12A 2 Introduction to electricity	12A Electricity facts	
12B Electricity in the home This unit introduces the quantities of current, power and voltage met in everyday life, and looks at how electricity is paid for in New Zealand	• Define the terms current, voltage and power. • Use the formula $P = VI$ to solve problems. • Use the formula $P = \frac{E}{t}$ to solve problems.	**12.1** Electricity in the home		12B 1 Using electricity	12B 1 Electricity language 12B 2 Electrical calculations	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
12C Electrician's shorthand	• Draw circuit diagrams for simple electrical circuits using approved symbols and format. • *Construct a simple electrical circuit from a circuit diagram.* • State the function of components in a circuit. • Identify components wired in series and parallel and describe the characteristics of series and parallel circuits.	**12.2** All wired up	P85 Series and parallel circuits To investigate the effect of adding components in series or parallel. Inv 12.1 Switching on to circuits	12C 1 Electrical symbols 12C 2 Electricity components 12C 3 Functions of components in a circuit 12C 4 Remembering circuit symbols	12C 1 Circuit components 1 12C 2 Circuit components 2 12C 3 Drawing circuits	
12D Measuring electricity	• Correctly use an ammeter or voltmeter in an electrical circuit to measure current or voltage. • Describe the relationship between current measurements at various points of a series or parallel circuit. • Describe the relationship between voltage measurements at various points of a series or parallel circuit.	**12.3** Voltage and current in series and parallel circuits	P86 Voltage in circuits To investigate voltage in series and parallel circuits. P87 Current in circuits To investigate current in series and parallel circuits Inv 12.2 Current in series and parallel circuits Inv 12.3 Voltage in series and parallel circuits	12D 1 Circuits and meters 1 12D 2 Circuits and meters 2 12D 3 Predicting voltage and current	12D 1 Circuits facts 12D 2 Predicting current and voltage	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
12E Producing electricity: cells and batteries This unit provides more able students with an understanding of how energy is transferred in an electrical circuit.	• Predict the affect of connecting cells in series or parallel.		P88 Cells in series To investigate the voltage of cells in series. P89 Cells in parallel To investigate the voltage of cells in parallel.			
12F Diodes and direct current Diodes are one of the components listed for Science 1.6, and an understanding of diodes is not possible without knowledge of conventional current.	• Show the direction of flow of conventional current in a circuit. • Predict the affect of diodes in a circuit.	**12.4** Diodes	P90 Diodes To investigate the function of a diode. Inv 12.4 Diodes			
12G Resistance	• Predict the affect on resistance of changes in length, thickness or temperature of a wire. • Apply an understanding of resistance to everyday situations.	**12.5** Through thick and thin	P91 The factors that affect resistance To investigate the effect of length and thickness of wire on resistance.	12G 1 Resistance 12G 2 Resistance 2	12G Resistance	FFSR p 118-9: Resistance (Considers the uses of resistors, including light bulbs, fuses and variable resistors--with question: good relief lesson.)
12H Ohm's law	• Recall an experiment which investigates the relationship between voltage, current and resistance. • Appreciate the relationship between current and resistance in a circuit. • Use the formula V = IR to solve problems.	**12.6** A problem of resistance **12.7** Electrical calculations	P92 Investigating Ohm's law To investigate the relationship between voltage and current at constant resistance. Inv 12.5 Ohm's law	12H 1 Electricity flipcards 12H 2 Physical World Revision crossword	12H Electricity calculations	FFSR p 148-149: Physics at home (Looks at how various appliances work: revision across all physics topics, suitable examination revision for able students—with questions.)

Chapter 13 Astronomy

PE 5.3 (a): use simple technological devices, such as telescopes and simple star maps, to observe and describe changing patterns in our night sky, eg position of the Moon, orientation of the Southern Cross.
PE 6.3: use information from a range of sources, including their own observations, to explain spatial relationships of objects in the night sky and the challenge such spatial relationships present to space exploration, eg distance between and changing positions of objects; theories about the origins of the Universe.
ST 6.2: describe how technology has contributed to, and at times helped change, scientific ideas.

AS Science 1.7	Describe aspects of astronomy Spatial relationships within the solar system; space exploration of the solar system	13A-13J
US Physics 6377	Observe and explain the movement of objects in the solar system. Carry out observations to collect data on a solar system object; predict the position of an solar system object over time; and explain the movement of a solar system object as observed from the earth.	13A, 13D, 13G, 13H

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
13A Our solar system Much of this unit should be revision. Weaker students will need reminding about the motions that cause a day and a year, while more able students will be challenged by the difference between solar and sidereal days, and by the relationship between distance from the Sun and a planet's speed.	• Explain the relationship between the Sun, planets and moons. • Describe the movement of a planet that makes its day and its year. • Explain the difference between a solar day and a sidereal day. • Appreciate the relative sizes of objects in our solar system. • State the relationship between a planet's distance from the Sun and its orbital speed.		P93 Planets and moons To demonstrate the different motions of planets and moons. Inv 13.1 Moon-watching	13A 1 Remembering our solar system 13A 2 Planet facts 13A 3 Planets memory	13A 1 Our solar system 13A 2 Astronomy words	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
13B Sun and Earth Although this unit revises content taught in earlier years, most students will benefit from this revision, and even the most able students will be surprised by some of the differences between 'clock' time and 'sundial' time.	• Recall the apparent movement of the Sun each day and relate it to the Earth's movement. • Discuss differences between 'clock' time and time shown on a correctly-set-up sundial. • Explain how longitude can be determined using a clock set to Greenwich Mean Time.	**13.1** Circles in the sky	P94 An equatorial sundial To make and use an equatorial sundial.	13B 1 Time		
13C Seasons	• Account for seasons on Earth by describing the Earth's tilt on its axis and the altitude of the Sun. • Recall patterns in the time and location of sunrise, sunset and the altitude of the sun at noon, for different locations on Earth at different times of the year.	**13.2** Seasons	P95 Investigating seasons To investigate the effect of angles on light intensity. Inv 13.2 Seasons Inv 13.3 Tracking the Sun	13C 1 Astronomy words crossword 13C 2 New Zealand's Sun	13C 1 Time and seasons	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
13D Moon and Earth	• Use a diagram to explain the appearance of the Moon, as seen from Earth, at different positions in its orbit. • Sketch the appearance of the Moon from Earth for a given position in its orbit. • Draw a diagram to explain what happens during a lunar eclipse. • Sketch a series of diagrams to show what is seen during a lunar eclipse.	**13.3** A lunar eclipse **13.4** Earth and Moon	P96 Sun, Moon and Earth To investigate the visible effects of the motion of the Moon around the Earth.	13D 1 Phases of the Moon	13D Phases of the Moon	
13E Tides Tides are a consequence of the motion of the Moon around the Earth, while Spring and Neap tides depend on the arrangement of the Sun, Moon and Earth in space. Thus, even though they are not specifically mentioned in AS Science 1.7, one cannot guarantee that they will not appear in the exam.	• Recall the number of high and low tides each day and the time interval between successive high tides. • Draw a diagram to show the formation of tides. • Draw diagrams to account for the formation of Spring and Neap tides. • Apply an understanding of tides to everyday situations.				13E Seasons, Moon and tides	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
13F Our Sun This unit is mostly concerned with solar eclipses, while the practical looks at spectra.	• Draw a diagram to show what happens during a solar eclipse. • Explain the differences in cause and effect of total, partial and annular eclipses. • *Answer simple questions about the composition and structural features of the Sun.* • Appreciate that spectra from the Sun or stars can provide information about the elements they contain.		P97 Flame tests To identify elements from their coloured flames. Inv 13.4 Solar eclipses	13F 1 Understanding eclipses 13F 2 Eclipse choices 13F 3 Explanations: Sun, Moon and Earth 13F 4 A closer look at our Sun 13F 5 Our Sun	13F 1 A solar eclipse 13F 2 Sun facts	
13G The night sky	• Identify key features of the celestial sphere. • Explain the retrograde motion of certain planets. • Account for differences in the appearance of various stars or constellations at different times of the night or year, and for different locations on Earth.	**13.5 Observing the planets** **13.6** Elliptical orbits	P98 Investigating retrograde motion To construct a diagram showing retrograde motion. Inv 13.5 Investigating retrograde motion	13G 1 Understanding planetary motion	13G 1 The night sky 13G 2 Retrograde motion	FFSR p 82-3: Naked-eye phenomena (More in-depth look at the celestial sphere, the ecloptic and related issues—with questions.

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
13H Practical astronomy Computer simulations make it possible to make observations of the night sky during class time regardless of the weather. Star charts generated for a particular location, direction, date and time make it easy for beginners to locate planets or specific constellations at home later.	• Apply an understanding of the apparent movement of celestial objects throughout the night or year to make predict their positions at a given time. • Use Crux (the Southern Cross) to find the position of the South Celestial Pole. • Discuss the use of astronomical instruments like binoculars or telescopes in observational astronomy. • Explain why astronomers often attach small motors to their telescopes, and why telescopes are often located on mountains.	**13.7** Telescopes	P99 The night sky To use a computer simulation to investigate the apparent movement of objects in the night sky.	13H 1 Explanations: telescopes	13H Telescopes	FFSR p 108: Tech focus—Telescopes (how telescopes work: no questions.)
13I Artificial satellites	• Describe the motion of circumpolar and geostationary satellites. • Explain why artificial satellites are sometime visible from Earth and account for the times when they are not visible. • Discuss practical applications of artificial satellites.	**13.8** Satellites		13 I 1 Artificial Satellites 13I 2 Satellite true-false 13I 3 Astronomy word search		

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
13J Exploring the solar system As well as the material covered here, it is probably a good idea to show one or two of the many videos about the planets.	• Discuss challenges in human exploration of the solar system.	**13.9** Destination Gamma Crux **13.10** Exploring the solar system	Inv 13.7 The Cassini-Huygens mission to Saturn **Inv 13.8 The Phoenix mission**	13J 1 Energy and space probes 13J 2 Exploring space 13J 3 Astronomy revision 13J 4 Astronomy flipcards		FFSR p 104-5: Space exploration (includes spectral analysis, space telescopes and the Voyager missions. With questions.
13K Beyond the solar system Astronomy beyond the solar system is not required for AS Science 1.7, but are included in the curriculum document.	• *Describe how interstellar and intergalactic distances are determined using parallax, Cepheid variables and redshift.* • *Sketch a diagram of our galaxy and show the location of our solar system.* • *Describe the theory of the Big Bang and give evidence to support this theory.*		P100 The big bang To demonstrate the expanding universe.			

Chapter 14 Rocks and minerals

PE 6.1/2 a: investigate and classify some common minerals and rocks according to their easily observed properties and relate to their common use, eg calcite, feldspar, quartz, sulfur, magnetite, gemstones, building materials, road aggregates, use in industry.
PE 6.4: report on an important natural resource in New Zealand, including its method of formation, location, and extraction, as appropriate, and any issues associated with its use, eg water, limestone, coal, natural gas.
Investigative skills and attitudes levels 5 and 6:

- locate information through catalogues, indexes and computers
- use information-processing techniques to process information related to the purpose
- present well reasoned, complete reports supported by relevant data in ways and forms appropriate to nominated audiences.

AS Science 1.5	Describe aspects of geology Types of rocks including the design and use of keys to classify rocks	14A-B
AS Science 1.2	**Research** with direction how science and technology are related (eg extraction of a mineral resource).	14E-F
US Earth Science 6357	Identify and investigate common minerals and rocks and their uses. Identify and classify common rocks and minerals; investigate the industrial use of a rock or mineral.	14A-E
US Earth Science 6356	Report on a geological resource in New Zealand Process and interpret information, and report on an important geological resource in New Zealand.	14E-F

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
14A Recognising rocks We begin geology with a look at the characteristics of different kinds of rocks.	• Use the physical characteristics of rocks to classify them as igneous, sedimentary or metamorphic. • Design or use keys to identify rocks based on their easily observable characteristics. • Describe a rock's texture, structure, particles and whether it fractures or cleaves.	**14.1 Name that rock!**	P101 Classifying rocks To classify rocks as igneous, sedimentary or metamorphic according to their physical characteristics. P102 Identifying rocks To identify rocks according to a supplied key. Inv 14.1 Rock identification	14A 1 Identifying rocks 1 14A 2 Identifying rocks 2 14A 3 Describing rocks 14A 4 Classifying rocks by type	14A 1 Rock identification 14A 2 Rock classification	
14B Building stones Through their use as building stones we consider the characteristics of commonly-used rocks.	• Link the properties of common rocks to their uses.		P103 Tough rocks To find out which rocks are the most resistant to physical weathering.			
14C Identifying minerals 1 Although this material is not required for AS Science 1.5, an understanding of minerals is necessary to understand the properties of different types of rocks.	• *Define a mineral as a naturally-occurring inorganic solid with a definite chemical composition.* • *Describe the lustre and habit of mineral samples and identify minerals with a single cleavage plane.*		P104 Investigating minerals To explore some of the characteristic properties of different minerals			

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
14D Identifying minerals 2 This unit gives further practice in using keys and in sorting substances according to their different properties.	• *Determine the hardness and streak of mineral samples.* • *Use a key to identify minerals from their properties.*					
14E Processed rock: minerals in New Zealand AS Science 1.5 no longer requires students to recall the properties and use of minerals, but this unit is relevant for those who may choose to do a research project on a mineral.	• *Relate the properties of common minerals in New Zealand to their uses.*					FFSR p 100-101: NZ mineral resources (an overview of what and where, useful for students doing research projects).
14F Extraction of a mineral resource This unit details the extraction of gold and gives guidelines for other research projects.	• *Write a report on an important geological resource in New Zealand, identifying the geological origin, location, extraction and processing of the resource, and outlining two issues relating to its extraction such as sustainability, resource size, and environmental or cultural impact.*	**17.3 Communication: science in the home** **17.4 Communication: it's *scientifically* better!**				FFSR 102-103: Water—a life-giving resource (possible relief lesson or resource material for a pamphlet). NHPEB p 46-53 (in depth study of gold mining) PF p 104-107: Mineral extraction (Provides a framework for a research project suitable for AS Science 1.2 or US 6356 and followed by details about the extraction of salt at Grassmere: possible relief lesson or pamphlet topic.)

Chapter 15 The rock cycle

PE 6.1/2 b: investigate how the three major types of rocks are formed (igneous, metamorphic, and sedimentary)...

AS Science 1.5	Describe aspects of geology Formation of rocks; links between geological events and the environment in which rocks are formed.	15A-D
US 6358	Investigate the origin of major rock types. Describe the formation of examples of plutonic and volcanic igneous rocks, clastic and non-clastic sedimentary rocks, metamorphic rocks, and explain the rock cycle.	15A-D

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
15A Igneous rocks Differences between igneous rocks are investigated: volcanic/plutonic and high/low silica. We also look at igneous landforms.	• Account for the differences in crystal size between volcanic and plutonic rocks by describing how they were formed. • Give examples of volcanic and plutonic rocks.	**15.2** Mountains of lava	P105 Model volcanic rocks To make a model of some volcanic rocks using molten sugar. P106 Crystal size To investigate the conditions required for the growth of large and small crystals. Inv 15.1 Why does pumice float? Inv 15.1 Crystal size	15A 1 Igneous rocks 1 15A 2 Igneous rock facts 2 15A 3 Igneous rocks (table) 3	15A 1 Remembering igneous rocks 15A 2 Igneous facts	
15B Sediment to stone Both P107 and P108 are highly recommended for this unit.	• Classify sedimentary rocks as clastic or non-clastic. • Describe the formation of specific clastic and non-clastic rocks. • Describe one method of forming fossils.	**15.1** Classifications **15.3** Clear as mud	P107 Modelling a sedimentary rock To make a model of a sedimentary rock using sand. P108 A deposition column To demonstrate sorting of sediments. Inv 15.3 A closer look at rocks	15B 1 Making sedimentary rocks 15B 2 Sedimentary rock words 1 15B 3 Sedimentary rock words 2 15B 4 Clastic sedimentary rocks	15B 1 Sedimentary rock facts 15B 2 Sedimentary environments	

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
15C Metamorphic rocks This unit revises aspects of plate tectonics and the structure of the Earth as well as considering different kinds of metamorphic rocks.	• Describe the different types of metamorphism • Describe the sequence of events in the formation of specific metamorphic rocks. • Label a diagram of a subduction zone	**15.4** Geospeak		15C 1 Subduction zone (drag and drop) 15C 2 Plate tectonics revision 15C 3 Metamorphic and plate tectonic facts	15C Metamorphic rock facts	
15D The rock cycle Teachers may prefer to begin this chapter with the rock cycle, then look at each section of the cycle in more detail through 15A-C.	• Complete a diagram showing the processes occurring in the rock cycle. • Recognise that uplift and erosion must occur before rocks formed within the Earth's crust appear on the Earth's surface. • Identify the environment in which specific rocks are formed.	**15.5** Fossil Hunter **15.6 The rock cycle**		15D 1 Rocks word search 15D 2 Processes in the rock cycle 15D 2 Remembering rocks 15D 4 Rock story 1 15D 5 Rock story 2 15D 6 Rock story 3 15D 7 Rock cycle crossword 15D 8 Rock cycle diagram	15D 1 Remembering rocks 15D 2 Rock story 1 15D 3 Rock story 2	

Chapter 16 Geological time

PE 6.1/2 b: ...describe how rock sequences provide evidence for past events through geological time.
ST 6.2: describe how technology has contributed to, and at times helped change, scientific ideas.
ST 6.3: investigate how knowledge of science and technology is used by society when making decisions about environmental issues.

AS Science 1.5	Describe aspects of geology Relative age relationships of rocks in simple stratigraphic columns.	16A-D
US Earth Science 6359	Demonstrate knowledge of the measurement of geological time. Establish the sequence of geological events; use radiometric data to establish the absolute age of a rock layer, and recall the geological time scale.	16A-D

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
16A Dating rocks Only students doing US 6359 are expected to remember the geological time scale, but all students will enjoy working out how old the rocks in various parts of New Zealand are believe to be.	• Apply the principle of superposition to estimate relative ages of particular strata • *Recall the geological time scale.* • *Use radiometric data to establish the absolute age of a rock layer.*	**16.1** Formation of New Zealand	P109 Half-life To investigate radioactive half-life.			
16B Time capsules Students need lots of practice in interpreting diagrams or photographs. Units 16B, 16C and 16D are designed to develop the skills they need.	• Discuss the evidence provided by particle size, roundness of grain and sorting in deducing the geological history of a rock. • Describe the information fossils provide about the environment which existed when the rock was formed.	**16.2** Past environments	.	16B Matching rocks to environments	16B Past environments	NHPEB p 8: Steam table (practical) FFSR p 98-99: A window on the past (more detail than in *New Directions*: suitable for more able classes as a relief lesson).

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
16C Putting the pictures together This Cliff Story is more complex than those we would expect students to interpret, but it shows the strategies involved.	• Establish the sequence of geological events using the principles of original horizontality, superposition, *lateral continuity* and cross-cutting relationships, *unconformities*, inclusions and fossil correlation.	**16.3** Time detectives		16C 1 Rock sequences 1 16C 2 Rock sequences 2 16C 3 Rock sequences 3 16C 4 Rock sequences 4 16C 5 Rock sequences 5	16C Rock sequence	
16D Case study: Cape Kidnappers This unit gives further practice in interpreting stratigraphic columns and shows how knowledge of geology is important in everyday life.		**16.4** Cliff stories		16D 1 Geological time - key facts 16D 2 Cliff story 1 16D 3 Cliff story 2 16D 4 Cliff story 3 16D 5 Cliff story 4 16D 6 Geology revision crossword 16D 7 Geology flipcards	16D 1 Geological time key facts 16D 2 Geological history of a cutting	FFSR p 106-107: Taupo—a detective story (shows how evidence is collected and interpreted—includes questions: for interest or relief).

Chapter 17 Scientific investigations

Nature of science and its relationship to technology 6.1: understand the characteristics of a scientific experiment.
Investigative skills and attitudes levels 5 and 6:

- design 'fair tests', simple experiments, trials, and surveys, with clear specification and control of likely variables
- select and use measuring instruments to make qualitative and quantitative observations and standard measurements with appropriate precision
- systematically record observations and measurements
- identify trends, relationships and patterns, in recorded data by analysing data using statistical and graphing procedures as appropriate
- set their findings or possible solutions against established scientific theory to draw and justify conclusions
- present well reasoned, complete reports supported by relevant data in ways and forms, appropriate to nominated audiences

AS Science 1.1	Carry out a **practical** science investigation with direction.	17A-17B

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
17A Scientific experiments This unit summarises ideas about fair tests from years 9 and 10.	For a given experiment: • write a clear aim or hypothesis • identify the variables that need to be controlled, and suggest suitable methods to control them • write a clear method • write a sensible conclusion • appreciate the need to repeat the experiment to obtain reliable results.	**17.1** Insulation trial **17.2** Light on				

Unit (from text book)	Student learning objectives	Theory exercises (Workbook)	Practicals from and text book	Computer revision tasks	Quizzes	Additional resources
17B Excellent investigations This unit teaches the skills needed to gain merit or excellence in AS Science 1.1.	For a given experiment: • identify the dependent and independent variables • present the results in a suitable table, using appropriate units for all measurements • plot a suitable graph of the results • identify sources of experimental error and suggest ways to minimise them • discuss the scientific principle demonstrated by the experiment.					