Government of Western Australia
School Curriculum and Standards Authority

CHEMISTRY

GENERAL COURSE

Year 11 syllabus

IMPORTANT INFORMATION

This syllabus is effective from 1 January 2017.

Users of this syllabus are responsible for checking its currency.

Syllabuses are formally reviewed by the School Curriculum and Standards Authority on a cyclical basis, typically every five years.

Content

Rationale

Chemistry is the study of materials and substances and the transformations they undergo through interactions and the transfer of energy. Chemists can use an understanding of chemical structures and processes to adapt, control and manipulate systems to meet particular economic, environmental and social needs. This includes addressing the global challenges of climate change and security of water, food and energy supplies, and designing processes to maximise the efficient use of Earth's finite resources. This Chemistry General course will develop students' understanding of the key chemical concepts and models of structure, bonding, and chemical change, including the role of chemical, electrical and thermal energy. Students learn how models of structure and bonding enable chemists to predict properties and reactions and to adapt these for particular purposes.

Students explore key concepts and models through active inquiry into phenomena, and through contexts that exemplify the role of chemistry and chemists in society. Students design and conduct qualitative and quantitative investigations, both individually and collaboratively. They investigate questions and hypotheses, manipulate variables, analyse data, evaluate claims, solve problems and develop and communicate evidence-based arguments and models. Thinking in chemistry involves using differing scales, including macro, micro and nano-scales; using specialised representations, such as chemical symbols and equations; and being creative, as when designing new materials or models of chemical systems. The study of chemistry provides a foundation for undertaking investigations in a wide range of scientific fields, and often provides the unifying link across interdisciplinary studies.

Some of the major challenges and opportunities facing Australia and the Asia-Pacific region at the beginning of the twenty-first century are inextricably associated with chemistry. Issues of sustainability on local, national and global levels are, and will continue to be, tackled by the application of chemical knowledge, using a range of technologies. These include issues, such as the supply of clean drinking water, efficient production and use of energy, management of mineral resources, increasing acidification of the oceans, and climate change.

Studying the Chemistry General course will provide students with a suite of skills and understandings that are valuable to a wide range of further study pathways and careers. An understanding of chemistry is relevant to a range of careers, including those in forensic science, environmental science, engineering, medicine, pharmacy and sports science. Additionally, chemistry knowledge is valuable in occupations that rely on an understanding of materials and their interactions, such as art, winemaking, agriculture and food technology. Some students will use this course as a foundation to pursue further studies in chemistry, and all students will become more informed citizens, able to use chemical knowledge to inform evidence-based decision making, and engage critically with contemporary scientific issues.

Aims

The Chemistry General course aims to develop students':

- interest in, and appreciation of, chemistry and its usefulness in helping to explain phenomena and solve problems encountered in their ever-changing world
- understanding of the theories and models used to describe, explain and make predictions about chemical systems, structures and properties
- understanding of the factors that affect chemical systems, and how chemical systems can be controlled to produce desired products
- appreciation of chemistry as an experimental science that has developed through independent and collaborative research, and that has significant impacts on society and implications for decision making
- expertise in conducting a range of scientific investigations, including the collection and analysis of qualitative and quantitative data and the interpretation of evidence
- ability to critically evaluate and debate scientific arguments and claims in order to solve problems and generate informed, responsible and ethical conclusions
- ability to communicate chemical understanding and findings to a range of audiences, including through the use of appropriate representations, language and nomenclature.

Organisation

This course is organised into a Year 11 syllabus and a Year 12 syllabus. The cognitive complexity of the syllabus content increases from Year 11 to Year 12.

Structure of the syllabus

The Year 11 syllabus is divided into two units, each of one semester duration, which are typically delivered as a pair. The notional time for each unit is 55 class contact hours.

Unit 1

In this unit, students build on informal understandings of chemistry that they have already acquired through using different materials, tools and products in their lives, and through everyday chemical reactions, such as cooking, decomposition and rusting.

Students develop their understandings through scientific inquiry. They plan and conduct investigations to collect first-hand data safely and methodically. They investigate factors that affect solubility and change of state as well as gathering data to investigate factors that affect the rates of chemical reactions.

Unit 2

In this unit, students investigate how chemistry plays an important part in their daily lives. Students appreciate the role of chemistry in contributing to a sustainable future by investigating recycling and disposal of community chemical wastes. They investigate ways that chemists assist in protecting the natural environment, such as conservation and management of our resources. They recognise and acknowledge that the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences.

Students understand and apply chemical language by interpreting symbols and formulae of some common elements and compounds.

In the laboratory, students investigate chemical changes involved in processes, such as food preservation and acid rain. They perform experiments to investigate reactions with acids and bases and use chemical aids, such as pH colour charts. They plan and conduct investigations to collect first-hand data safely and methodically.

Each unit includes:

- a unit description – a short description of the focus of the unit
- suggested contexts – a context in which the unit content could be taught
- unit content – the content to be taught and learned.

Organisation of content

Science strand descriptions

The Science curriculum has three interrelated strands: Science Inquiry Skills, Science as a Human Endeavour, and Science Understanding. These strands are used to organise the Science learning area from P - 12. In the senior secondary science courses, the three strands build on students' learning in the Year 7–10 Science curriculum.

In the practice of science, the three strands are closely integrated: the work of scientists reflects the nature and development of science, is built around scientific inquiry, and seeks to respond to and influence society. Students' experiences of school science should mirror this multifaceted view of science. To achieve this, the three strands of the science curriculum should be taught in an integrated way. The content descriptions for Science Inquiry Skills, Science as a Human Endeavour, and Science Understanding have been written so that this integration is possible in each unit.

Science Inquiry Skills

Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. This strand is concerned with evaluating claims, investigating ideas, solving problems, reasoning, drawing valid conclusions, and developing evidence-based arguments.

Science investigations are activities in which ideas, predictions or hypotheses are tested, and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities, including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. The investigation design will depend on the context and subject of the investigation.

Science as a Human Endeavour

Science concepts, models and theories are reviewed as their predictions and explanations are continually re-assessed through new evidence, often through the application of new technologies. This review process involves a diverse range of scientists working within an increasingly global community of practice.

The application of science may provide great benefits to individuals, the community and the environment, but may also pose risks and have unintended consequences. As an ever-evolving body of knowledge, science frequently informs public debate, but is not always able to provide definitive answers.

Science Understanding

Science understanding is evident when a person selects and integrates appropriate science concepts, models and theories to explain and predict phenomena, and applies those concepts, models and theories to new situations.

The Science Understanding content in each unit develops students' understanding of the key concepts, models and theories that underpin the subject, and of the strengths and limitations of different models and theories for explaining and predicting complex phenomena.

Safety

Science learning experiences may involve the use of potentially hazardous substances and/or hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students and that school practices meet the requirements of the *Work Health and Safety Act 2011*, in addition to relevant state or territory health and safety guidelines.

Animal ethics

Through a consideration of research ethics as part of Science Inquiry Skills, students will examine their own ethical position, draw on ethical perspectives when designing investigation methods, and ensure that any activities that impact on living organisms comply with the *Australian code of practice for the care and use of animals for scientific purposes 8th edition2013* (www.nhmrc.gov.au/guidelines/publications/ea28).

Any teaching activities that involve the care and use of, or interaction with, animals must comply with the *Australian code of practice for the care and use of animals for scientific purposes 8th edition 2013*, in addition to relevant state or territory guidelines.

Information regarding the care and use of animals in Western Australian schools and agricultural colleges can be viewed at www.det.wa.edu.au/curriculumsupport/animalethics/detcms/portal/.

Mathematical skills expected of students studying the Chemistry General course

The Chemistry General course requires students to use the mathematical skills they have developed through the Year 7–10 Mathematics curriculum, in addition to the numeracy skills they have developed through the Science Inquiry Skills strand of the Science curriculum.

Within the Science Inquiry Skills strand, students are required to gather, represent and analyse numerical data to identify the evidence that forms the basis of their scientific arguments, claims or conclusions. In gathering and recording numerical data, students are required to make measurements with an appropriate degree of accuracy and to represent measurements using appropriate units.

Students may need to be taught when it is appropriate to join points on a graph and when it is appropriate to use a line of best fit. They may also need to be taught how to construct a straight line that will serve as the line of best fit for a set of data presented graphically.

It is assumed that students will be able to competently:

- perform calculations involving addition, subtraction, multiplication and division of quantities
- express fractions as percentages, and percentages as fractions
- calculate percentages
- recognise and use ratios
- convert between simple SI units, for example, milligrams to grams, grams to kilogram and millilitres to litres
- change the subject of a simple equation
- substitute physical quantities into an equation using consistent units
- comprehend and use the symbols/notations $<$, $>$, Δ, $\approx$
- translate information between graphical and numerical forms

- use appropriate forms, variables and scales for constructing graphs
- interpret frequency tables and diagrams, pie charts and histograms
- describe and compare data sets using mean
- interpret the shape of a linear graph.

Progression from the Year 7–10 curriculum

This syllabus continues to develop student understanding and skills from across the three strands of the Year 7–10 Science curriculum. In the Science Understanding strand, this syllabus draws on knowledge and understanding from across the four sub-strands of Biological, Physical, Chemical and Earth and Space Sciences.

In particular, this syllabus continues to develop the key concepts introduced in the Chemical Sciences sub-strand, that is, that the chemical and physical properties of substances are determined by their structure at an atomic scale; and that substances change and new substances are produced by the rearrangement of atoms through atomic interactions and energy transfer.

Representation of the general capabilities

The general capabilities encompass the knowledge, skills, behaviours and dispositions that will assist students to live and work successfully in the twenty-first century. Teachers may find opportunities to incorporate the capabilities into the teaching and learning program for the Chemistry General course. The general capabilities are not assessed unless they are identified within the specified unit content.

Literacy

Literacy is important in students' development of Science Inquiry Skills and their understanding of content presented through the Science Understanding and Science as a Human Endeavour strands. Students gather, interpret, synthesise and critically analyse information presented in a wide range of genres, modes and representations (including text, flow diagrams, symbols, graphs and tables). They evaluate information sources and compare and contrast ideas, information and opinions presented within and between texts. They communicate processes and ideas logically and fluently and structure evidence-based arguments, selecting genres and employing appropriate structures and features to communicate for specific purposes and audiences.

Numeracy

Numeracy is key to students' ability to apply a wide range of Science Inquiry Skills, including making and recording observations; ordering, representing and analysing data; and interpreting trends and relationships. They employ numeracy skills to interpret complex spatial and graphic representations, and to appreciate the ways in which chemical systems are structured, interact and change across spatial and temporal scales. They engage in analysis of data, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values.

Information and communication technology capability

Information and communication technology (ICT) capability is a key part of Science Inquiry Skills. Students use a range of strategies to locate, access and evaluate information from multiple digital sources; to collect, analyse and represent data; to model and interpret concepts and relationships; and to communicate and share science ideas, processes and information. Through exploration of Science as a Human Endeavour concepts, students assess the impact of ICT on the development of science and the application of science in society, particularly with regard to collating, storing, managing and analysing large data sets.

Critical and creative thinking

Critical and creative thinking is particularly important in the science inquiry process. Science inquiry requires the ability to construct, review and revise questions and hypotheses about increasingly complex and abstract scenarios and to design related investigation methods. Students interpret and evaluate data; interrogate, select and cross-reference evidence; and analyse processes, interpretations, conclusions and claims for validity and reliability, including reflecting on their own processes and conclusions. Science is a creative endeavour and students devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes as they develop Science Understanding and Science Inquiry Skills. They also appreciate the role of critical and creative individuals and the central importance of critique and review in the development and innovative application of science.

Personal and social capability

Personal and social capability is integral to a wide range of activities in the Chemistry General course, as students develop and practise skills of communication, teamwork, decision making, initiative-taking and self-discipline with increasing confidence and sophistication. In particular, students develop skills in both independent and collaborative investigation; they employ self-management skills to plan effectively, follow procedures efficiently and work safely; and they use collaboration skills to conduct investigations, share research and discuss ideas. In considering aspects of Science as a Human Endeavour, students also recognise the role of their own beliefs and attitudes in their response to science issues and applications, consider the perspectives of others, and gauge how science can affect people’s lives.

Ethical understanding

Ethical understanding is a vital part of science inquiry. Students evaluate the ethics of experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and they understand, critically analyse and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms. They use scientific information to evaluate the claims and actions of others and to inform ethical decisions about a range of social, environmental and personal issues and applications of science.

Intercultural understanding

Intercultural understanding is fundamental to understanding aspects of Science as a Human Endeavour, as students appreciate the contributions of diverse cultures to developing science understanding and the challenges of working in culturally diverse collaborations.

They develop awareness that raising some debates within culturally diverse groups requires cultural sensitivity, and they demonstrate open-mindedness to the positions of others. Students also develop an understanding that cultural factors affect the ways in which science influences and is influenced by society.

Representation of the cross-curriculum priorities

The cross-curriculum priorities address contemporary issues which students face in a globalised world. Teachers may find opportunities to incorporate the priorities into the teaching and learning program for the Chemistry General course. The cross-curriculum priorities are not assessed unless they are identified within the specified unit content.

Aboriginal and Torres Strait Islander histories and cultures

Through an investigation of contexts that draw on Aboriginal and Torres Strait Islander histories and cultures students can appreciate the role of Aboriginal and Torres Strait Islander Peoples' knowledge in developing richer understandings of the chemical diversity in the Australian environment, for example, the chemical properties of plants used for bush medicines, or mineral ores used for decoration or artwork, and how items in the natural environment were used before modern materials became available.

Asia and Australia's engagement with Asia

Contexts that draw on Asian scientific research and development and collaborative endeavours in the Asia Pacific region provide an opportunity for students to investigate Asia and Australia's engagement with Asia. Students can examine the important role played by people of the Asia region in such areas as medicine, materials science, nanotechnology, energy security and food security. They can consider collaborative projects between Australian and Asian scientists and the contribution these make to scientific knowledge.

Sustainability

In the Chemistry General course, the Sustainability cross-curriculum priority provides authentic contexts for exploring, investigating and understanding the function and interactions of chemical systems. Chemistry explores a wide range of chemical systems that operate at different time and spatial scales. By investigating the relationships between chemical systems and system components, and how systems respond to change, students develop an appreciation for the ways in which interactions between matter and energy connect Earth's biosphere, geosphere, hydrosphere and atmosphere. Students appreciate that chemical science and its applications provide the basis for decision making in many areas of society and that these decisions can impact on the Earth system. They understand the importance of using science to predict possible effects of human and other activity, such as ocean acidification, mineral extraction or use of fossil fuels, and to develop management plans, alternative technologies or approaches, such as green chemistry, that minimise these effects and provide for a more sustainable future.

Unit 1

Unit description

In this unit, students build on informal understandings of chemistry that they have already acquired through using different materials, tools and products in their lives, and through everyday chemical reactions, such as cooking, decomposition and rusting.

Students develop their understandings through scientific inquiry. They plan and conduct investigations to collect first-hand data safely and methodically. They investigate factors that affect solubility and change of state as well as gathering data to investigate factors that affect the rates of chemical reactions.

Suggested contexts

Teachers may choose one or more of the following contexts for the teaching of concepts within Unit 1 (this list is not exhaustive):

- food chemistry
- consumer chemistry
- environmental chemistry
- green, recycling and waste management chemistry
- agricultural chemistry
- aquaculture
- sports chemistry.

Unit content

This unit includes the knowledge, understandings and skills described below.

Science Inquiry Skills

- construct questions for investigation; propose hypotheses; and predict possible outcomes
- plan investigations, including the procedure/s to be followed, the materials required, and the type and amount of data to be collected; assess risk and address ethical issues associated with these methods
- conduct investigations, appropriate to the chosen context/s, safely, competently and methodically for the collection of reliable data
- represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error and inconsistencies in data; and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate the conclusions by considering the quality of available evidence
- construct and use appropriate representations, to communicate conceptual understanding, solve problems and make predictions

- communicate scientific ideas and information for a specific purpose using appropriate language, nomenclature and formats, including scientific reports

Science as a Human Endeavour

- chemical analysis can be used to identify additives in foods. Artificial colours can be detected and identified by paper chromatography. Advances in technology have led to the use of instrumental methods, for example, gas chromatography and electrophoresis. These methods are very accurate, sensitive and rapid and are particularly useful when the amount of sample is very small
- being able to speed up or slow down chemical reactions is important in everyday life and in industry. Changes in temperature, concentration of solution, surface area of solids and the presence of catalysts all affect the rates of reactions. Fruit, for example, bananas, can have their rate of ripening increased through the use of ethene. Food preservation methods, for example, refrigeration, have been developed based on a knowledge of chemistry, physiology and microbiology and are used to slow down the rate of food spoilage
- water of suitable quality is essential for life. Drinking water should have sufficiently low levels of dissolved salts and microbes to meet the Australian drinking water guidelines and consumer and other regulatory requirements. These guidelines are constantly reviewed and evaluated on the basis of new information. The decision to amend the guidelines is arrived at by consensus

Science Understanding

The language of chemistry

- symbols and names of common elements and the names of compounds appropriate to the chosen context(s)

Atomic structure

- the structure of matter can be modelled in terms of particles called atoms composed of protons, neutrons and electrons
- the differences between atoms, molecules and ions

Properties of matter

- the differences between elements, compounds and mixtures
- examples of homogeneous and heterogeneous mixtures
- differences between physical and chemical properties
- the differences between physical and chemical changes
- evidence that a chemical change has occurred, for example:
  - colour change
  - gas evolved
  - temperature change
  - precipitation
  - light produced

- methods used to separate mixtures
  - decantation
  - filtration
  - crystallisation
  - evaporation
  - distillation
  - chromatography

States of matter

- properties of gases, liquids and solids in terms of the kinetic theory model
- phase changes

Solutions and solubility

- the different solute/solvent combinations that form different types of solutions, for example:
  - solid in liquid
  - gas in liquid
  - gas in gas
  - liquid in liquid
  - solid in solid
- the concept of solubility
  - unsaturated and saturated solutions
  - concentration scales, for example, grams per litre (g/L), parts per million (ppm) and volume per volume (v/v)
- simple calculations in context, such as solubility and concentration (g/L and mL/L)
- relationship between SI units and units in common usage
- factors that affect solubility
- analysis of food labelling to identify concentration scales used

Chemical reactions and reaction rates

- conservation of mass during a chemical reaction
- chemical reactions appropriate to the chosen context(s) can be represented using word equations
- qualitative description of reaction rates (time to complete) appropriate to the chosen context(s), for example, food spoilage, burning, respiration and cooking
- situations where the rates of chemical reactions are altered, for example, food preservation

Unit 2

Unit description

In this unit, students investigate how chemistry plays an important part in their daily lives. Students appreciate the role of chemistry in contributing to a sustainable future by investigating recycling and disposal of community chemical wastes. They investigate ways that chemists assist in protecting the natural environment, such as conservation and management of our resources. They recognise and acknowledge that the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences.

Students understand and apply chemical language by interpreting symbols and formulae of some common elements and compounds.

In the laboratory, students investigate chemical changes involved in processes, such as food preservation and acid rain. They perform experiments to investigate reactions with acids and bases and use chemical aids, such as pH colour charts.

Suggested contexts

Teachers may choose one or more of the following contexts for the teaching of concepts within Unit 2 (this list is not exhaustive):

- food chemistry
- consumer chemistry
- environmental chemistry
- green, recycling and waste management chemistry
- agricultural chemistry
- aquaculture
- sports chemistry.

Unit content

This unit builds on the content covered in Unit 1.

This unit includes the knowledge, understandings and skills described below.

Science Inquiry Skills

- construct questions for investigation; propose hypotheses; and predict possible outcomes
- plan investigations, including the procedure/s to be followed, the materials required, and the type and amount of data to be collected; assess risk and address ethical issues associated with these methods
- conduct investigations, appropriate to the chosen context/s, safely, competently and methodically for the collection of reliable data

- represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error and inconsistencies in data; and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate the conclusions by considering the quality of available evidence
- construct and use appropriate representations, to communicate conceptual understanding, solve problems and make predictions
- communicate scientific ideas and information for a specific purpose using appropriate language, nomenclature and formats, including scientific reports

Science as a Human Endeavour

- human activity impacts on waterways. Chemical monitoring and management assists in providing safe water for human use and to protect the habitats of other organisms
- limestone has been widely used as a building material. The benefits of using limestone as a building material should be considered against the negative aspects of quarrying and the susceptibility of limestone to acid rain
- there are advantages and disadvantages associated with the use of hard water. For example, the calcium compounds present in hard water are good for the development and maintenance of bones and teeth and also help to reduce heart disease. However, hard water can increase economic costs due to the build-up of scale. The addition of commercial water softeners may reduce these economic costs
- eutrophication can be caused by agricultural run-off carrying fertilisers into waterways. The increased growth of aquatic plants, for example, algal blooms, causes a variety of problems, such as lack of oxygen needed for fish to survive and health problems for recreational users of the waterway. Knowledge of chemistry has been used to develop slow release fertilisers which have the potential to decrease the fertiliser concentration in agricultural run-off

Science Understanding

Analysis of aqueous solutions

- physical properties of water, for example, surface tension and adhesion, responsible for the formation of a meniscus
- indicators are used to identify different substances, for example, acids, bases and starch
- the pH scale can be used to identify neutral, basic and acidic solutions
- indicator colour is related to the pH of the solution
- physical and chemical analysis of solutions can be conducted, for example, pH, precipitation, conductivity, dissolved solids, turbidity and salinity
- solubility rules predict whether a precipitate will form when two dilute ionic solutions are mixed
- ion colour can be used to identify reactants and products in chemical processes
- observations and word equations for the following chemical reaction types:
  - acid-base
  - acid-carbonate

Aqueous solutions in action

- the cleaning action of soaps, detergents and shampoos
- the use of soap in hard and soft water
- biodegradability of soaps, detergents and shampoos
- the clean-up and remediation of oil spills
- eutrophication, for example, fertiliser use and sewage
- formation of limestone caves or scale

School-based assessment

The Western Australian Certificate of Education (WACE) Manual contains essential information on principles, policies and procedures for school-based assessment that needs to be read in conjunction with this syllabus.

Teachers design school-based assessment tasks to meet the needs of students. The table below provides details of the assessment types for the Chemistry General Year 11 syllabus and the weighting for each assessment type.

Assessment table – Year 11

Type of assessment	Weighting
Science inquiry Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. **Practical** Practical work can involve a range of activities, such as practical tests; modelling and simulations; qualitative and/or quantitative analysis of second-hand data; and brief summaries of practical activities. **Investigation** Investigations are more extensive activities, which can include experimental testing; chemical analyses; and comprehensive scientific reports. The assessed component of tasks of these types should be conducted in a supervised classroom setting.	50%
Extended response Tasks requiring an extended response may involve selecting and interpreting scientific and media texts and evaluating processes, claims and conclusions by considering the quality of available evidence; and using reasoning to construct scientific arguments. Assessment can take the form of answers to specific questions based on individual research and interpretation and evaluation of chemical information in scientific journals, media texts and/or advertising. Appropriate strategies should be used to authenticate student achievement on an out-of-class assessment task. For example, research completed out of class can be authenticated using an in-class assessment task under test conditions.	20%
Test Tests typically consist of multiple choice questions, and questions requiring short and extended answers. This assessment type is conducted in supervised classroom settings.	30%

Teachers are required to use the assessment table to develop an assessment outline for the pair of units (or for a single unit where only one is being studied).

The assessment outline must:

- include a set of assessment tasks
- include a general description of each task
- indicate the unit content to be assessed
- indicate a weighting for each task and each assessment type
- include the approximate timing of each task (for example, the week the task is conducted, or the issue and submission dates for an extended task).

In the assessment outline for the pair of units, each assessment type must be included at least twice. In the assessment outline where a single unit is being studied, each assessment type must be included at least once.

The set of assessment tasks must provide a representative sampling of the content for Unit 1 and Unit 2.

Assessment tasks not administered under test/controlled conditions require appropriate validation/authentication processes.

Grading

Schools report student achievement in terms of the following grades:

Grade	Interpretation
A	Excellent achievement
B	High achievement
C	Satisfactory achievement
D	Limited achievement
E	Very low achievement

The teacher prepares a ranked list and assigns the student a grade for the pair of units (or for a unit where only one unit is being studied). The grade is based on the student's overall performance as judged by reference to a set of pre-determined standards. These standards are defined by grade descriptions and annotated work samples. The grade descriptions for the Chemistry General Year 11 syllabus are provided in Appendix 1. They can also be accessed, together with annotated work samples, through the Guide to Grades link on the course page of the Authority website at www.scsa.wa.edu.au.

To be assigned a grade, a student must have had the opportunity to complete the education program, including the assessment program (unless the school accepts that there are exceptional and justifiable circumstances).

Refer to the WACE Manual for further information about the use of a ranked list in the process of assigning grades.

Appendix 1 – Grade descriptions Year 11

A	**Understanding and applying concepts** Applies models and principles to explain properties and behaviours of substances. Presents clear and logical arguments which are supported by evidence. Selects scientific information to support a point of view. Explains chemistry concepts using appropriate scientific language and representations. Correctly writes word equations for a variety of reaction types, e.g. acid reactions, precipitation reactions. Identifies different types of reactions and correctly predicts their products, e.g. acid reactions, precipitation reactions.
	Science Inquiry Skills Formulates a testable hypothesis that states the relationship between dependent and independent variables. Plans an investigation to collect appropriate data. Identifies controlled variables with specific detail. Organises data logically and presents it in a range of forms, including appropriate graphs and tables to reveal patterns and relationships. Processes experimental data to describe trends and explains these using relevant scientific concepts. Processes any numerical data using appropriate units. Uses evidence to make and justify conclusions that relate to the hypothesis. Recognises inconsistencies in data and suggests relevant and specific ways to improve an investigation. Communicates information and concepts logically, using correct scientific language, conventions and formats.

B	**Understanding and applying concepts** Describes and partially explains properties and behaviours of substances using models. Presents arguments or statements that are not well-supported by evidence. Selects some scientific information to support a point of view. Explains chemistry concepts using some scientific language and representations. Correctly writes word equations for some reaction types. Identifies different types of reactions and predicts their products with minor errors.
	Science Inquiry Skills Formulates a testable hypothesis that states the relationship between dependent and independent variables. Plans an investigation to collect appropriate data. Identifies some controlled variables without detail. Presents data in a range of forms, including appropriate graphs, tables and charts to reveal patterns and relationships. Describes trends and briefly explains these using relevant scientific concepts. Processes numerical data using appropriate units. Makes conclusions that relate to the hypothesis. Recognises inconsistencies in data and makes general suggestions to improve an investigation. Communicates information and concepts logically, generally using scientific language and formats. Makes some errors in the use of conventions.

C	**Understanding and applying concepts** Describes properties and behaviours of substances in a general way. Presents statements of ideas, with some development of an argument. Selects some scientific information to support a point of view but includes some irrelevant or incorrect information. Explains chemistry concepts, without detail, using representations and limited scientific language. Completes word equations with some errors. Identifies different types of reactions and predicts some products.
	Science Inquiry Skills With guidance, formulates a hypothesis, that includes dependent and independent variables, within a context. Plans an investigation to collect appropriate data. Inconsistently identifies some controlled variables. Presents data using tables and graphs to reveal patterns and trends. Describes trends in the data with limited processing of numerical data. Draws simple conclusions. Describes difficulties experienced in conducting the investigation and suggests general improvements. Communicates information and concepts, without detail, using some scientific language, conventions and formats.
D	**Understanding and applying concepts** Recognises the properties and behaviours of substances. Explanations are incomplete or contain errors. Presents statements of ideas, but with limited development of an argument. Selects inappropriate scientific information to support a point of view. Explains chemistry concepts using simple representations and everyday language. Responses are often incomplete. Chemical names are often incomplete or incorrect when writing word equations. Identifies some reaction types.
	Science Inquiry Skills With scaffolding, forms a simple hypothesis and predicts a general outcome for an investigation. Follows a provided experimental procedure to collect data. Confuses variables. Presents insufficient data that is disorganised. Identifies trends in the data incorrectly or overlooks trends. Offers simple conclusions that are not supported by the data or may not be related to the hypothesis. Describes difficulties experienced in conducting the investigation. Communicates information using everyday language with frequent errors. Responses are often incomplete.
E	Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.

Appendix 2 – Glossary

This glossary is provided to enable a common understanding of the key terms in this syllabus.

Algebraic representation	A set of symbols linked by mathematical operations; the set of symbols summarise relationships between variables.
Anomalous data	Data that does not fit a pattern; outlier.
Data	The plural of datum; the measurement of an attribute, for example, the volume of gas or the type of rubber. This does not necessarily mean a single measurement: it may be the result of averaging several repeated measurements. Data may be quantitative or qualitative and be from primary or secondary sources.
Evidence	In science, evidence is data that is considered reliable and valid and which can be used to support a particular idea, conclusion or decision. Evidence gives weight or value to data by considering its credibility, acceptance, bias, status, appropriateness and reasonableness.
Genre	The categories into which texts are grouped; genre distinguishes texts on the basis of their subject matter, form and structure (for example, scientific reports, field guides, explanations, procedures, biographies, media articles, persuasive texts, narratives).
Green chemistry	Chemistry that aims to design products and processes that minimise the use and generation of hazardous substances and wastes. Principles of green chemistry include prevention of waste; atom economy; design of less toxic chemicals and synthesis methods; use of safer solvents and auxiliaries; design for energy efficiency; use of renewable feedstocks; reduction of unnecessary derivatives; use of catalytic reagents rather than stoichiometric reagents; design for degradation; design of in-process analysis for pollution prevention; and safer chemistry for accident prevention.
Hypothesis	A scientific statement based on the available information that can be tested by experimentation. When appropriate, the statement expresses an expected relationship between the independent and dependent variables for observed phenomena.
Investigation	A scientific process of answering a question, exploring an idea or solving a problem that requires activities, such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities. Investigations can include observation, research, field work, laboratory experimentation and manipulation of simulations.
Law	A statement describing invariable relationships between phenomena in specified conditions, frequently expressed mathematically.
Measurement error	The difference between the measurement result and a currently accepted or standard value of a quantity.
Media texts	Spoken, print, graphic or electronic communications with a public audience. Media texts can be found in newspapers, magazines and on television, film, radio, computer software and the internet.
Mode	The various processes of communication – listening, speaking, reading/viewing and writing/creating.

Model	A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.
Primary data	Data collected directly by a person or group.
Primary source	Report of data created by the person or persons directly involved in observations of one or more events, experiments, investigations or projects.
Random error	Uncontrollable effects of the measurement equipment, procedure and environment on a measurement result; the magnitude of random error for a measurement result can be estimated by finding the spread of values around the average of independent, repeated measurements of the quantity.
Reliable data	Data that has been judged to have a high level of reliability; reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute, achieving similar results for the same population.
Reliability	The degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute, achieving similar results for the same population.
Representation	A verbal, visual, physical or mathematical demonstration of understanding of a science concept or concepts. A concept can be represented in a range of ways and using multiple modes.
Research	To locate, gather, record, attribute and analyse information in order to develop understanding.
Research ethics	Norms of conduct that determine ethical research behavior; research ethics are governed by principles such as honesty, objectivity, integrity, openness and respect for intellectual property and include consideration of animal ethics.
Risk assessment	Evaluations performed to identify, assess and control hazards in a systematic way that is consistent, relevant and applicable to all school activities. Requirements for risk assessments related to particular activities will be determined by jurisdictions, schools or teachers as appropriate.
Secondary data	Data collected by a person or group other than the person or group using the data.
Secondary source	Information that has been compiled from records of primary sources by a person or persons not directly involved in the primary event.
Significant figures	The use of place value to represent a measurement result accurately and precisely.
Simulation	A representation of a process, event or system which imitates a real or idealised situation.
System	A group of interacting objects, materials or processes that form an integrated whole. Systems can be open or closed.
Systematic error	The contribution to the uncertainty in a measurement result that is identifiable and quantifiable, for example, imperfect calibration of measurement instruments.
Theory	A set of concepts, claims and/or laws that can be used to explain and predict a wide range of related observed or observable phenomena. Theories are typically founded on clearly identified assumptions, are testable, produce reproducible results and have explanatory power.

Uncertainty	Range of values for a measurement result, taking account of the likely values that could be attributed to the measurement result given the measurement equipment, procedure and environment.
Validity	The extent to which tests measure what was intended; the extent to which data, inferences and actions produced from tests and other processes are accurate.