VCE Chemistry: Sample teaching plan

Sample course outline – VCE Chemistry Unit 1: How can the diversity of materials be explained?

**Note:** This is a sample guide only and indicates one way to present the content from the *VCE Chemistry Study Design*. VCE units are designed based on a minimum of 50 hours of class time; this sample teaching plan is based on 3 hours per week over 19 weeks and includes activities covering the eight scientific methodologies. Teachers are advised to consider their own contexts in developing learning activities: Which local issues lend themselves to debate and investigation? Which experiments can students complete within the resource limitations of their learning environments? Which local fieldwork sites and chemistry-based facilities would support learning in the topic area? Which chemical industries would be appropriate for site visits?

| **Week** | **Area of study** | **Key knowledge** | **Learning activities**  | **Science skills focus** | **Assessment tasks** |
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| **1** | ***Area of Study 1:******How do the structures of materials explain their properties and reactions?*** | **Elements and the periodic table** (definitions; patterns and trends; critical elements) | * *Simulation*: Use simulations to investigate atomic structure
* *Classification and identification*: Conduct experiments to demonstrate periodic table trends
* *Case study*: Research an endangered element why a selected element is endangered and what can be done in the future to conserve the element
 | * systematically generate and record primary data, and collate secondary data, appropriate to the investigation, including use of databases and reputable online data sources
* organise and present data in useful and meaningful ways, including schematic diagrams, flow charts, tables and graphs
* use appropriate chemical terminology, representations and conventions
* distinguish between opinion, anecdote and evidence, and between scientific and non-scientific ideas
 | **Multimodal presentation** (10 minutes): Present a case for society to prioritise action for the conservation of a selected endangered element  |
| **2** | **Covalent substances** (Lewis structures; formulas; molecular shapes; VSEPR theory; bond strength; physical properties; diamond; graphite) | * *Modelling*: Create ball-and stick models of covalent compounds
* *Graphing*: Explain the boiling point trends of alkanes
* *Experiment*: Make bush soap from acacia leaves
* *Modelling*: Annotate a model of diamond
* *Experiment*: Use different ‘lead’ pencils to sketch an object; discuss how graphite properties can be explained by graphite’s layer lattice structure
 | * identify and analyse experimental data qualitatively, handling, where appropriate, concepts of: accuracy, precision, repeatability, reproducibility, resolution, and validity of measurements; and errors (random and systematic)
* analyse and explain how models and theories are used to organise and understand observed phenomena and concepts related to chemistry, identifying limitations of selected models/theories
* use appropriate chemical terminology, representations and conventions
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| **3** |  |
| **4** |  |
| **5** | **Reactions of metals** (properties; reactivity series; recycling) | * *Experiment:* Perform simple metal displacement reactions to create an activity series
* *Modelling*: Use plasticine and sand to model the properties of alloys
* *Fieldwork*: Visit a community facility involved in metal recycling; determine the extent to which processes align with circular economy thinking
 | * organise and present data in useful and meaningful ways
* analyse and explain how models and theories are used to organise and understand observed phenomena and concepts related to chemistry, identifying limitations of selected models/theories
* apply sustainability concepts (the transition from a linear towards a circular economy) to analyse and evaluate responses to chemistry-based issues and challenges
 | **Practical report** (30 minutes): Write a practical report of an investigation into the effects on the properties of metal pins of heat treatment (annealing, quenching and tempering) |
| **6** | **Reactions of ionic compounds** (properties; formulas; names; bonding; solubility tables) | * *Experiment*: Examine mineral crystals using a hand lens and a stereomicroscope
* *Modelling*: Model the structures and properties of different ionic compounds
* *Experiment:* Conduct qualitative tests to identify unknown ionic solids
* *Experiment:* Compare the electrical conductivity of covalent and ionic substances
* *Experiment*: Simulate crystal formation in rocks by making chocolate fudge under different temperature conditions
* *Experiment*: Participate in the RACI crystal growing competition
 | * record and summarise both qualitative and quantitative data, including use of a logbook as an authentication of generated or collated data
* apply relevant occupational health and safety guidelines while undertaking practical investigations
* organise and present data in useful and meaningful ways, including schematic diagrams, flow charts, tables
* analyse and explain how models and theories are used to organise and understand observed phenomena and concepts related to chemistry, identifying limitations of selected models/theories
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| **7** |  |
| **8** | **Separation and identification of the components of mixtures** (polarity; solubility; chromatography) | * *Product development*: Make a lava lamp and explain how the concepts of density and polarity are demonstrated
* *Experiment*: Investigate capillary action
* *Experiment*: Use chromatography to separate the pigments in different types of spinach; calculate Rf values
 | * organise and present data in useful and meaningful ways, including schematic diagrams, flow charts, tables, bar charts, line graphs
* repeat experiments to evaluate the precision of data
* evaluate investigation methods and suggest ways to improve precision, and to reduce the likelihood of errors
 | **Research report** (30 minutes class time – research undertaken outside class): Present a report on the role of emulsifiers in food or cosmetics |
| **9** | ***Area of Study 2:******How are materials quantified and classified?*** | **Quantifying atoms and compounds** (isotopes; RAM; mass spectrometry; Avogadro’s constant; molar mass; empirical and molecular formulae) | * *Calculations*: Complete worksheets to calculate relative atomic masses from abundances and relative isotopic masses; solve quantitative exercise involving the mole and Avogadro’s constant
* *Experiment*: Determine the empirical formula of CuO
* *Modelling*: Visualise the mole through calculations (depth of a ‘blanket’ of a mole of marshmallows over Australia; height of a ‘tower’ made from a mole of dollar coins or sheets of A4 paper; length of time to count a mole of marbles if one was counted every second every day until finished)
* *Display*: Create a classroom exhibition of one mole of different substances
 | * process quantitative data using appropriate mathematical relationships and units, including calculations of ratios, percentages, percentage change and mean
* evaluate data to determine the degree to which the evidence supports the aim of the investigation
* use appropriate numbers of significant figures in calculations
* use appropriate chemical terminology, representations and conventions, including standard abbreviations, graphing conventions, algebraic equations, units of measurement and significant figures
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| **10** |  |
| **11** | **Test** (30 minutes): Mole quantities |
| **12** | **Families of organic compounds** (families; formulas; uses; representations; IUPAC nomenclature; plant-based biomass; everyday products) | * *Modelling*: Use toothpicks and plasticine to construct and name a range of organic compounds, including isomers
* *Research*: Production of solvents, pharmaceuticals, adhesives, dyes and paints from fossil fuels, including environmental and health impacts
* *Case study*: Production of plant-based biofuels as an alternative to fossil fuels
* *Fieldwork*: Visit an oil distillery
 | * organise and present data in useful and meaningful ways, including schematic diagrams, flow charts, tables, bar charts, line graphs
* demonstrate ethical conduct when undertaking and reporting investigations
* critically evaluate and interpret a range of scientific and media texts, processes, claims and conclusions related to chemistry by considering the quality of available evidence
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| **13** | **Graphic organiser** (30 minutes): Produce an infographic or flow chart of a process involving the production of a useful organic compound for society |
| **14** | **Polymers and society** (addition and condensation reactions; natural and manufactured polymers; linear polymers; categorisation; recycling; innovations) | * *Experiment*: Make edible, biodegradable food-safe calcium alginate beads and investigate how the concentration of acidic beverage juices used impacts the stability and durability of the water capsules formed
* *Modelling:* Make an ethene molecule and model polymerisation by ‘reacting’ your molecule with other students’ molecules
* *Experiment*: make a polymer glue from milk
* *Case study*: Present an example of how the re-purposing of a non-biodegradable plastic contributes to a more sustainable future
* *Experiment*: Make absorbable medical sutures from renewable feedstocks and compare properties with those of commercially available absorbable and non-absorbable sutures
* *Research*: Present an example of an innovation in polymer production
 | * use appropriate chemical terminology, representations and conventions
* use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with evidence and relevant to the question under investigation
* apply sustainability concepts (green chemistry principles, development goals and the transition from a linear towards a circular economy) to analyse and evaluate responses to chemistry-based scenarios, case studies, issues and challenges
* identify and explain when judgements or decisions associated with chemistry-related issues may be based on sociocultural, economic, political, legal and/or ethical factors and not solely on scientific evidence
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| **15** | **Report** (30 minutes): report of an application of chemical concepts to a real-world context |
| **16** | ***Area of Study 3:*** ***How can chemical principles be applied to create a more sustainable future?*** | **Scientific evidence** (primary and secondary data; nature and quality of evidence; data management; logbook use)**Sustainability** (concepts and principles; research question relevance) | * Provide students with a list of possible investigation topics from pages 27–29 of the study design
* Confirm student investigation questions and organise research teams for each question
* Construct a rubric using the key knowledge points on pages 29 and 30 of the study design; issue to students at the start of the task, for equitable assessment of multiple topics in the class
* Revise sustainability concepts: green chemistry principles; UN Sustainable Development Goals; transition from a linear to a circular economy
* Flipped classroom: Students research information related to their investigation question
* Use Socratic seminar strategy for clarifying concepts within each research team (refer to the Unit 1 Area of Study 3 Detailed example in the online VCAA Teaching and learning activities); students develop their presentation
* Student presentation to the class or a nominated audience – assess presentation using a rubric
* Students write a personal reflection in response to two questions: What did I learn? How does my research inform a sustainable future?
 | * identify, research and construct aims and questions for investigation
* work independently and collaboratively as appropriate and within identified research constraints, adapting or extending processes as required and recording such modifications in a logbook
* record and summarise both qualitative and quantitative data
* organise and present data in useful and meaningful ways
* apply sustainability concepts to analyse and evaluate chemistry-based scenarios, case studies, issues and challenges
* identify and explain when judgements or decisions associated with chemistry-related issues may be based on sociocultural, economic, political, legal and/or ethical factors and not solely on scientific evidence
* use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with evidence and relevant to the question under investigation
* use clear, coherent and concise expression to communicate to specific audiences and for specific purposes in appropriate scientific genres
 | * **Group presentation related to the sustainable production or use of a selected material** (10 minutes) – rubric marking of the presentation
* **Individual student reflection** (15 minutes): key learnings; explanation of sustainability concepts relevant to investigation question; discussion of the significance of investigation findings for society
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| **17** | **Scientific communication** (concepts; effective science communication; use of data representations; influence of sociocultural factors; referencing) |
| **18** | **Unit revision** |
| **19** |