VCE Chemistry

Examples of scientific methodologies applicable in VCE Chemistry

Examples of teaching and learning activities that utilise different scientific methodologies have been provided in the table below, with further examples being identified for each unit and area of study in the [Teaching and learning activities](https://www.vcaa.vic.edu.au/curriculum/vce/vce-study-designs/chemistry/Pages/Teaching-and-Learning.aspx).

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| **Methodology** | **Definition** | **Types of questions or investigations** | **Investigation examples** |
| Case study | A report of a specific chemistry invention, model, issue, or solution to a problem, at a particular place and point in time.  Case studies may discuss the analyses of specific topics from multi-aspect perspectives.  Relevant case studies for VCE Chemistry may be developed from media articles, research summaries and historical reports of the chemistry endeavours of individuals. | * What happened when…? * How can the problem of… be solved? * How does…solve the problem of…? * How did…? * How did…change previous understanding of …? * What lessons can be learned from…? * What is the evidence for…? * Evaluation of a strategy to… * Report and recommendations related to… | Select an endangered element and develop an argument that the element should be prioritised by society in taking action for conservation.  Discuss the social and scientific issues involved in the utilisation of seaweed (macroalgae) as a biofuel.  Discuss the role of creative thinking in chemistry in reviewing August Kekulé’s work in suggesting a structure for benzene.  Review the timeline from the discovery of penicillin in 1928 to its commercial production to treat bacterial infections in 1944.  Study the case of ozone depletion by CFCs and consider how green chemistry principles can be applied to develop safer alternatives that reduce harmful environmental effects. |
| Classification and identification | **Classification**: the arrangement of phenomena (objects or events) into manageable sets.  **Identification**: a process of recognition of phenomena as belonging to particular sets or possibly being part of a new or unique set; these inquiries involve the identification of features, tests or procedures that discriminate between objects or processes. | * Use criteria to classify… * Distinguish between… * Compare… * Show how…and…are different. | Identify samples of unknown ionic salts.  Access the structures of a range of medicinal compounds and identify functional groups, including isomers and chiral centres which are attributed to their bioactivity.  Illustrate the concept of activation energy using energy profile diagrams for catalysed and uncatalysed endothermic and exothermic reactions.  Prepare a summary sheet or flow chart outlining the rules for naming organic compounds. |
| Controlled experiment | Involves the identification of variables, commonly an experimental investigation of the relationship between an independent variable and a dependent variable, controlling all other variables. | * What effect does…have on…? * How does…affect…? * Is there a relationship between…and…? * Does…affect…? * Is…related to…? * Is…dependent on…? | Investigate how temperature affects the rate of crystal growth.  Investigate how the solubility of ionic compounds varies with temperature.  Conduct an experiment to determine the effect of pH on enzyme activity.  Determine the ideal temperature conditions to demonstrate that Vitamin C can be used as a catalyst to speed up the decomposition of hydrogen peroxide.  Compare the rate of reaction between [zinc granules and sulfuric acid](https://edu.rsc.org/experiments/catalysis-of-the-reaction-between-zinc-and-sulfuric-acid/1713.article), with and without copper as a catalyst, by measuring the rate of production of hydrogen gas bubbles.  Investigate the effect of varying concentrations of trypsin on the time taken to digest the gelatine coating on old-fashioned photographic film. |
| Fieldwork | Qualitative and/or quantitative investigations conducted outside the laboratory.  Includes site visitations, experiential learning opportunities (for example, visiting scientific laboratories to assist in data generation), and surveys. | * How does…change over time? * Visit…to see how chemistry is applied in the community. * What…? * Do…? * Are…? * Conduct a survey to… * Access instrumentation data related to… | Visit a community facility that is involved in metal recycling and discuss how any linear economy processes can be improved to move towards a circular economy.  Collect natural materials from the environment and test hypotheses by using chromatography to separate pigments and measuring their Rf values.  Visit an olive leaf distillery or oil refinery and summarise processes using images and brief descriptions.  Organise a site tour to a polymer manufacturing or recycling plant and summarise processes and safety precautions.  Visit a scientific laboratory or a university to observe how different analytical instrumentation techniques are applied to determine the identity of unknown substances in a sample. |
| Literature review | Research to access and collate secondary data and/or find out information about chemistry concepts. Students should record all data sources and references in their logbooks. Literature reviews generally relate to current issues, exploring applications of chemistry concepts, finding out new information, and extending understanding of chemistry ideas. | * What is…? * Research the concept...… * Research the discovery of… * How does…work? * Explain the chemistry involved in a contemporary issue… * Explain how… | Research a selected isotope and write a media article or produce an infographic on the usefulness of the isotope.  Compare the global warming potentials for greenhouse gases CO2, CH4 and H2O and explain why the differences occur.  Develop a presentation about the production, chemical structure and use of a selected natural product or synthetic medicine.  Discuss the action of penicillin as a competitive enzyme inhibitor. |
| Modelling | Construction of physical or conceptual models (students are not expected to construct mathematical models for VCE Chemistry, although they may examine data generated from others’ mathematical models; for example, projections as to the lifespan of critical elements in the periodic table).  Models improve the understanding of how things work, enable predictions about chemical phenomena to be made, and allow visualisation of phenomena that are too large, too small, too dangerous, or otherwise impractical to investigate in a laboratory or in the field. | * Construct a model to show… * Model a chemical structure… * Use an analogy to explain… * Use…to show… * Develop a spreadsheet to model… | Create ball-and-stick models of simple polyatomic molecules of different shapes.  Produce an animation or physical model to illustrate why ice is less dense than liquid water.  Use a spreadsheet to determine whether there is a relationship between the structures of different triglycerides and their melting points.  Create a model of the concept that chemical reactions involve the breaking and making of bonds.  Develop an analogy to illustrate collision theory.  Create an animation or other visual representation to illustrate how an HPLC column works at the particle level. |
| Product, process or system development | Design of an artefact, process or system to meet a human need; may involve technological applications in addition to scientific knowledge to answer questions or solve problems. | * Design, construct, test and evaluate… * Design a process to… * Is there a better way to…? * Create and test… * Change an aspect of a design for a purpose… | Formulate a biodegradable ink.  Make a lava lamp to illustrate the concepts of polarity and density.  Make sherbet by scaling quantities.  Construct a spectrometer and use it to observe the light from different sources around the home.  Design and construct a torsion viscometer to compare the viscosities of different fuels or hydrocarbons.  Design, construct and test a small-scale biogas generator.  Design, construct, test, and modify a polarimeter to study chirality in glucose molecules. |
| Simulation | Use of programs that show change over short or long periods of time, enable experiments that cannot be practically or safely undertaken in a school laboratory to be completed, and/or enable data entry by students to make predictions or to establish trends and patterns. | * What would be the effect on…if I…? * What is the relationship between …and….? * How can…be calculated? * How does … work? * What happens if…is changed in a system? * How can…be modelled? | Investigate trends in the periodic table.  Compare the movement of more and fewer polar molecules in a thin layer chromatography simulation.  Use a spreadsheet to manipulate data to illustrate the constancy of Kc at constant temperature.  Use a [simulation of a proton exchange membrane (PEM) fuel cell](https://sepuplhs.org/high/hydrogen/fuelcell_sim5.html) to investigate the design and system development of novel electrolysers for the hydrogen economy. |