Units 1 and 2 assessment task example: chemistry in real-life contexts

**Information for teachers**: One of the assessment task types for Units 1 and 2 is a ‘report of an application of chemistry to a real-life context’. This task can be used to support student agency through individual selection of topics of interest. A set of generic questions and a common rubric can be used to ensure that the task meets the VCE assessment principle of ‘equity’.

When designing tasks where students may undertake different investigations, teachers should ensure that tasks are of comparable scope and demand.

***Sample assessment task 1*** relates to Unit 1 Outcome 3. If used for this outcome, students are required to refer to sustainability principles, which should be included in outlining the task to students and in an assessment rubric.

***Sample assessment task 2*** also relates to Unit 1 Outcome 3 but could be used as a case study by teachers for Unit 1 Area of Study 2 in looking at organic molecules.

**Discussing real-life chemistry contexts**

# Students may be introduced to how chemistry contributes to people’s everyday lives through a variety of media products, guest speakers, videos and other information including articles sourced by students related to their own interests. Real-life contexts involving chemical concepts may be explored in all units of the *VCE Chemistry Study Design* by considering the chemicals and processes involved in producing food, clothing and medicines, and in providing transport options, technology applications, and a reliable energy supply. Chemical companies often include an explanation of the chemistry behind the development of new materials and processes. Research reports written in student-friendly language, such as those available at *Science Daily* or *The Conversation* enable provide rich sources of stimulus material that can be used to explore chemical knowledge and different methodologies for solving problems and answering questions of interest.

# Teachers should select and discuss articles relevant to the area of study to support the development of students’ science literacy as well as their scientific literacy skills.

Examples of relevant materials across Units 1 and 2 include:

* The chemistry of ochres (Unit 1 Area of Study 1):
* Hunting for ochre: <https://www.youtube.com/watch?v=HYvqknUT8IY>

# Yalmarralpana Ochre Pit <https://www.youtube.com/watch?v=Mgj4FMkH-xw>

* Microplastics (Unit 1 Area of Study 2):
* Microplastics in groundwater: <https://www.sciencedirect.com/science/article/abs/pii/S0048969722009433>
* Microplastics in the ocean: <https://www.sciencedaily.com/releases/2021/10/211027122120.htm>
* Acid rain (Unit 2 Area of Study 1):
* What is acid rain? <https://www.nationalgeographic.com/environment/article/acid-rain>
* Enhanced greenhouse effect (Unit 2 Area of Study 2):
* The greenhouse effect: <https://www.bgs.ac.uk/discovering-geology/climate-change/how-does-the-greenhouse-effect-work/>

Case studies are also useful in considering real-life chemistry contexts, for example, the Sudbury case study at <https://theconversation.com/what-mining-oil-and-gas-industries-can-learn-from-sudbury-the-city-that-went-from-major-polluter-to-thriving-environment-165595> is relevant to Unit 1 Area of Study 2 in terms of acid rain effects and how one city took action to ‘clean up’ its environment.

Teachers should discuss applications in terms of the relevant chemistry. In some cases, the chemistry is not published for copyright reasons, for example, the development of CSIRO’s topcoat reactivation technology <https://csiropedia.csiro.au/paintbond-a-spray-on-topcoat-for-aircraft/>. Discussions of the applications of chemical concepts in real-life contexts models for students what will be expected in the assessment task. **Such discussions should precede the assessment task that requires students to produce** a ‘report of an application of chemistry to a real-life context’.

**Scope of the sample assessment tasks**

Students should be given clear instructions prior to undertaking an assessment task. If an assessment rubric is used, such as the one included at the end of this document, it should be provided to students before the assessment task.

***Sample assessment task 1***

Students were presented with a media article and then given three lessons to research and prepare for a 7-minute oral presentation related to an application of chemistry in a real-life context. The task was based on a literature review where students were required to access at least two further sources of information to supplement the provided media article. Students were required to record all notes in their logbooks.

Students recorded their presentations at home and uploaded to the school’s electronic management system. The teacher assessed the presentations using a rubric. Students were required to view two other students’ presentations using a feedback form constructed by the teacher about the clarity and effectiveness the presentations; this feedback was then provided to students to reflect on their own presentations.

***Sample assessment task 2***

Students were given two weeks to research and prepare a report related to a question of interest, as described in the study design on pages 26 and 27 of the study design. Students could select their own area for investigation but were required to submit an outline of their proposed investigation to be approved by their teacher. Proposals had to include information relating to:

* timelines for the investigation (including what would be completed outside class time)
* dated entries in the logbook of primary and/or secondary data and other information accessed

The assessment task involved students preparing a report of their selected application that was no longer than two A4 sheets of paper, suitable for publication on the school website.

**Sample task 1: Five chemistry inventions**

***Preparing for the assessment task***

Students discussed examples of the application of chemistry in real-life contexts throughout Units 1 and 2 by examining media articles, watching YouTubes about innovations and scientists’ research, and visiting local facilities including a plastics recycling plant and a local laboratory involved in water analysis.

* the development of a superhydrophobic surface at <https://www.sciencedaily.com/releases/2022/08/220804130650.htm> links to the concept of polarity in Unit 1 Area of Study 1
* the article about the chemistry of cooking a BBQ at

<https://theconversation.com/what-makes-smoky-charred-barbecue-taste-so-good-the-chemistry-of-cooking-over-an-open-flame-184206> relates to organic chemistry in Unit 1 Area of Study 2.

***Scope of the assessment task***

Students were presented with the following media article:

<https://theconversation.com/five-chemistry-inventions-that-enabled-the-modern-world-42452> that outlines some of the chemical concepts underpinning:

* the invention of penicillin and the reliance on chemical extraction and purification techniques.
* the Haber-Bosch process as a way of combining atmospheric nitrogen with hydrogen to produce ammonia, which could then be used to make useful products for society including fertilisers.
* the production of polythene as an accidental discovery with leaked oxygen into a high-pressure reaction system.
* the discovery of the progesterone-like molecules in the Mexican yam as a cheaper alternative to the syntheses of hormones used in the manufacture of the contraceptive pill.
* the discovery of a molecule known as 5CB that enabled liquid crystal displays (used in flat-screen colour displays, mobile phones and computers) to operate at room temperatures.

Students were given three lessons to conduct further research and to investigate the chemical reactions and processes involved in one of the five provided inventions and discoveries, or to negotiate to research a different chemistry-based invention or discovery.

Students recorded research in their logbooks and used this to present a 7-minute multimodal presentation in response to the general question, ‘Explain how chemistry is applied in an everyday context.’ The presentation was recorded at home and then uploaded onto the school’s electronic management system.

The learning program also included students viewing two other students’ presentations and providing feedback. The teacher allocated peer reviews across the class so that each student’s presentation was viewed by two other students, and that students viewed presentations involving different topics from the one that they had undertaken themselves.

**Sample task 2: Traditional grass tree glue compared with modern epoxy glue**

A student had visited Kings Park in Western Australia and became curious about how glue could be produced from the local grass trees, after reading about the many uses of grass trees by the Nyoongar people from south-western Australia (see Figure 1).

Text

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***Figure 1*** The photo is from a display board in Kings Park Perth, outlining the components of a glue favoured by the Nyoongar people. (Photograph by author Pat O’Shea)

The student undertook a literature review and presented a plan for a practical investigation based on the question in Investigation topic 3 on page 28 of the study design: ‘How do Aboriginal and Torres Strait Islander peoples’ glue formulations parallel the use of modern epoxy resins, and how sustainable are the chemical processes in producing these materials?’ The topic was approved by the teacher.

The student’s plan included:

* making and testing the plant-based glue, compared with an epoxy-based glue
* researching the chemistry (chemical structures and reactions) involved in the plant-based glue and epoxy-based glues
* presenting a 2-page, A4 paper, report in response to the investigation question.

Investigation findings (extracts from the student’s logbook and 2-page presentation):

* The principle behind both types of adhesives is based on the use of a monomer in the liquid state that can be shaped to fit the intended use. Fibres are then added to the liquid to reinforce it, and a hardening agent is then added to bring about polymerisation of the monomer. Once polymerised, the glue is hard and strong.

* Information about grass trees

|  |  |
| --- | --- |
| Grass Tree  Grass Tree Stock Photo  Figure 2 Grass tree Stock photo ID:92459513 | Notes:   * The grass tree (Xanthorrhoea) is particularly important to Aboriginal people: * the flowering spike was used a spear shaft or soaked in water to give a sweet-tasting fermented drink * in the bush, the flowers can indicate directions, since flowers of the spike would face on the warmer, sunnier northern side * the resin was used as an adhesive for tool and spear making, and for patching leaky water containers, canoes and didgeridoos * *Xanthorrhoea* comes from the Greek *xanthos*, which means ‘to flow’ and refers to the resin that seeps from the stem of the grass tree * Grasstrees: * grow in all Australian states and territories, especially on the east and west coast * grow at the rate of 2½ cm per year * can live up to 600 years * hardy: thrive in nutrient-poor soils; frost tolerant; survive bush fire and drought * Video (11 minutes): collecting grass tree resin <https://www.youtube.com/watch?v=gIqilb6ikg0> |

* Making a glue from grass trees:

A picture containing ground, outdoor, rock, soil

Description automatically generatedBefore heating, the resin is thermoplastic. After heating, it is a thermoset, as the solvents are driven off and the charcoal and heat cause crosslinks between these molecules to form.

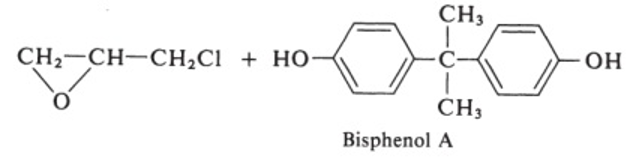
The three components of the glue:

* Charcoal
* Kangaroo dung
* Resin
* The following table shows comparisons between this ancient indigenous glue recipe and the modern epoxy resin composites.

|  |  |
| --- | --- |
| **Epoxy resin composite glue** | **Indigenous glue** |
| A piece of food on a plate  Description automatically generated with low confidence  Components:   * Epoxy resin monomer * Hardener * Fibre reinforcement | Components   * Tree resin monomers * Hardener (ash) * Fibre reinforcement (kangaroo dung) |

Figure 2 Comparison of the components of indigenous and epoxy resin composite glues (photographs by author, Pat O’Shea)

* Tree resins contain many organic compounds, for example, labdane, biformene, communic acid and communol (Reference <https://www.sciencedirect.com/topics/chemistry/plant-resin>).  The chemistry of tree resins is not yet fully understood.
* Epoxy resins contain some form of epoxyethane, commonly known as ethylene oxide. It has a characteristic triangular ring containing oxygen, which is highly reactive.
* One of the most common epoxy resins is bisphenol A (BPA), a copolymer of epoxyethane.



* The hardening agent adds crosslinks to the structure, making it thermosetting (see the cross-linked structure at <https://pslc.ws/macrog/epoxy.htm>).
* Note: Results of tests of strengths of the two glues were recorded in the student’s logbook.
* The student produced a report that was two A4 pages in length that included the points above.

**Assessment rubrics: a report of an application of chemical concepts to a real-life scenario**

Teachers may develop their own assessment marking schemes, rubrics or other tools to assess students’ report of the chemical concepts associated with a real-life scenario. The following is a sample rubric that can be used directly or adapted to suit the assessment task. Note that since the context of the assessment relates to Unit 2 Outcome 3, rubrics related to sustainability have been included.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Criterion** |  | **1 mark** | **2 marks** | **3 marks** |
| Background research | Logbook notes | Records research information in logbook | Records relevant research information in logbook | Annotates research information in terms of relevance to the investigation |
| Chemistry understanding | Chemical concepts | Describes the chemistry concepts involved in their investigation | Makes links between chemistry concepts involved in their investigation | Explains relationships between chemistry concepts involved in their investigation |
| Chemical structures | Names the chemical compounds involved in their investigation | Draws the chemical structures referred to in their investigation | Explains the nature of the bonding in the compounds involved in their investigation |
| Chemical processes | Identifies the chemical processes involved in their investigation | Discusses the chemical processes involved in their investigation | Analyses advantages and limitations of the chemical processes involved in their investigation |
| Application of sustainability principles | Green chemistry principles | Defines relevant green chemistry principles | Explains how green chemistry principles relate to the investigation | Discusses implications of green chemistry principles |
| Sustainable development goals | Identifies sustainable development goals relevant to the investigation | Describes how their investigation relates to sustainable development goals | Suggests long-term impacts of relevant findings from their investigation on sustainable development goals |
| Transition from a linear to a circular economy | Distinguishes between a linear economy and a circular economy | Indicates how aspects of their investigation relate to a linear or circular economy | Proposes ways to move from a linear to a circular economy in terms of aspects of their investigation |
| Importance of sustainability | States how sustainability principles relate to their investigation. | Explains why sustainability principles are important in their investigation | Discusses how sustainability is relevant to their investigation for future years |
| Communication |  | Communicates findings in language that is appropriate for the audience. | Sequences their communication logically. | Selects relevant data and information to support the communication |