VCE Chemistry

Examples of problem-based learning approaches in VCE Chemistry

A problem-based learning environment is conducive to linking scientific concepts to examining science-based issues in society. Scenarios can be developed from actual research studies reported in scientific journals, local scenarios or issues, an imaginary scenario, an interesting chemical phenomenon or a fact-based or fictional case study, as in the following example.

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| **Step 1**: Define the question/scenario/problem carefully: what are you trying to find out? | | |
| **Case study: The non-sparkling diamond**  **Problem brief:** An insurance company has received a claim for $15,000 to replace a 2-carat diamond ring that a female passenger in a car claimed had been internally shattered when the car was involved in a collision with another car. The passenger claims that the diamond no longer shines as brilliantly as it did before the accident and wants to purchase a replacement diamond. In her claim, the passenger states that she has had a quote for $25,000 as a replacement ring and can sell her ‘shattered’ ring for $10,000. The passenger’s jeweller has submitted photographs that show the diamond has an ‘inclusion’.  The insurance company has approached your chemistry class to investigate whether it is possible that a diamond can be shattered in a car accident, and to recommend whether the claim is legitimate and should be paid out.  **Student task**: Draw on chemistry concepts related to covalent bonding to develop a model or simulation that demonstrates to a non-chemistry expert what would be required for a diamond to ‘internally shatter’, and to prepare a report that includes a recommendation about the legitimacy of the insurance claim. | | |
| **Step 2**: Refine the question/ explore possible options/ determine what other information is required (class brainstorming) | **Step 3**: Plan the actual investigation/narrow your choices (class consensus) | **Step 4**: Test ideas, obtain further information, build and evaluate models (group and/or individual) |
| **Step 5**: Write a report and present a model that draws upon relevant discussions/research/experiments, including specific scientific terminology, in response to the brief. | | |
| Note: problem-based scenarios do not necessarily have a single solution | | |

A problem-based learning approach can also be used to develop specific science skills. The skills should link to relevant chemistry content. The following example focuses on the skill of hypothesis formulation.

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| **Step 1**: Define the question/scenario/problem carefully: what are you trying to find out? | | |
| **Question**: What factors affect crystallisation?  **Task**: This research question requires refining with a narrower focus to develop a testable hypothesis. | | |
| **Step 2**: Refine the question/explore possible options (class brainstorming)  **Possible responses:**  Crystals generally grow by the ordered deposition of solute particles onto the surface of a pre-existing crystal. Background research may be undertaken to explore possible factors that affect crystallisation before a hypothesis can be formulated. General issues for consideration include:  a. Solvent   * polarity of the solvent.   b. Solute and solution   * composition of solute (for example, simple ionic solid; ‘double’ salt, molecular solid – polar or non-polar) * solubility of solute in solvent * degree of saturation of solution (for example, saturated versus supersaturated).   c. Nucleation   * number of nucleation sites * type of nucleation site (for example, small seed crystal suspended into the solvent; seed crystals on base of container; scratched glass surface of container).   d. Physical conditions over the time allowed for crystal growth   * initial temperature of solvent * rate of cooling of solution * intensity of light * total volume and surface area of solvent * degree of stillness (for example, whether vibrations, draughts or other disturbances occur) * humidity of the surrounding air (in the case of water as the solvent).   e. Total time available for crystal growth   * number of days. | **Step 3**: Plan the actual investigation/ narrow your choices (class consensus)  **Possible responses:**  Need to identify dependent and independent variables and control other variables.  Independent variable (being selected) relates to a selected factor relating to the set-up for the crystallisation process to occur and could be:   * number of nucleation sites * temperature * light intensity * size of nucleation site * type of nucleation site * saturation level of solvent * nature of solvent.   Dependent variable (being measured) relates to ‘nature of the crystal’ that is formed and could be:   * size of crystal * crystal shape – degree of symmetry.   Control of variables is dependent on selected independent and dependent variables. | **Step 4**: Test ideas and obtain further information (group and/or individual)  **Possible responses:**   * Hypothesis example: ‘If, in nature, rocks that have cooled quickly only contain small mineral crystals, then the slower the rate of cooling of a solution, the larger the crystal that is produced.’ * Not all hypotheses are testable and not all variables can be controlled for some experiments. * For this problem, students generate possible hypotheses; provide feedback on each other’s hypotheses; modify own hypotheses. |
| **Step 5**: Write a conclusion that draws upon discussions/research/experiments, including discussion of scientific terms, control of variables and evaluation of experimental methodology. | | |
| Note: This class problem-based learning approach can be used to generate different questions for students to investigate, particularly for experimental investigations. | | |