Examples of scientific methodologies applicable in
VCE Environmental Science

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.

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| **Methodology** | **Definition** | **Types of questions or investigations** | **Investigation examples** |
| Case study | A report of a specific environmental problem or issue (for example, pollution, waste disposal, global warming, deforestation, food security) at a particular place and point in time that details the environmental concerns, impacts and evaluation of environmental management initiatives.  | * Evaluation of a strategy to…
* Report and recommendations related to…
* …. a case study
 | Integration of four organic farming practices for sustainable production of guava: a case studyUncool beans: the future of coffee under climate changeSowing the seeds: Peel Harvey’s Noongar community undertake seed collection and seed propagation to secure the future  |
| 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. | * Develop a key to…
* Adapt…to categorise…?
* Use classification keys to…
 | Develop a way of categorising pollution, other than as ‘air, water or soil’ pollutionDevise a new way of measuring human or industrial environmental impact other than through ‘carbon footprints’Use classification keys to identify macroinvertebrates in a riverSurvey your local neighbourhood for invasive/non-invasive plant species and compare with other students’ surveys |
| Controlled experiment | 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…?
* Can…?
 | To what extent do ‘green’ detergents block seed germination compared with conventional detergents?Can plants tolerate recycled ‘grey water’?How do different diets affect earthworm populations in compost bins and the quality of the soil they enrich?How does the concentration of nitrate in fertilisers affect seed germination?What is the minimum concentration of salt that will inhibit 50% of the growth of alfalfa seeds?How does the amount of dissolved oxygen change with temperature?Does the use of indoor plants change air quality?How does the colour of a water bottle affect the capacity of its contents to absorb heat? |
| Correlational study | An investigation to establish whether there is a relationship between two variables (note: students are not required to calculate correlation coefficients, but should recognise positive, negative and no correlation); the two variables are observed and measured, but neither is controlled or manipulated. | * Is there a relationship between…and…?
* Does…affect…?
* Is…related to…?
* Which…?
 | Which flower colours do butterflies or bees visit most often?Is there a relationship between the nitrogen content of soils and the growth of crops in different paddocks?Is vegetarianism associated with level of income?Are fishing yields related to lunar cycles?How is the presence of migratory birds in a wetland environment related to species diversity?Is there an association between indoor air quality and reported levels of work productivity? Is predator-proof fencing an effective way to conserve species? |
| Fieldwork  | Qualitative and/or quantitative investigations conducted outside the laboratory.  | * How does…change over time?
* What…?
* Do…?
* Are…?
 | How does a compost heap change over time?What nesting behaviours are observed in birds?Does biodiversity increase with distance away from a road?Are older people more resistant to environmental innovations than younger people? |

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| Literature review | Research to access and collate secondary data and/or find out information about environmental science concepts. Students should record all data sources and references in their logbooks. Literature reviews generally relate to past events or specific environmental science concepts or examples. | * What happened when…?
* How did…?
* How do…?
* What is…?
 | How have volcanic eruptions changed ecosystems?What is the difference between organic and bio-dynamic farming?How do nanoparticles affect ocean life?What is eutrophication?Is overfishing a problem in Australia?How have greenhouse gas concentrations changed over time?Research artificial processes for carbon sequestration |
| Modelling | Construction of physical or conceptual models (students are not expected to construct mathematical models for VCE Environmental Science, although they may examine data generated from others’ mathematical models, particularly related to climate science). Models improve the understanding of natural systems and how they react to changing conditions, such as exposure to hazardous substances and the effects of increased temperatures on environmental parameters. | * Construct a model to show…
* Model…
* Use an analogy to explain…
* Use…to show…
 | Construct a model of Earth’s layers, colour-coding and labelling main partsConstruct models to show how sea levels rise due to melting polar ice caps/glaciers and the thermal expansion of waterDesign and construct an experiment that models the natural and greenhouse effectsUse a balloon filled with air and a balloon filled with water, and apply a gas lighter flame close to each of the balloons in turn, to illustrate the heat capacity of water and the role of oceans in absorbing heat |
| 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…
 | Design, construct and test a mini ‘pot-in-a-pot refrigerator’ using the principle of evaporative cooling to achieve the best cooling effectDevise a sustainability scale for school useDesign, construct, evaluate and improve a system to filter waterCreate a recipe for, and test, an organic fertiliser made from food scraps Design a procedure to investigate the factors that affect the levels of carbon dioxide in a selected location |

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| Simulation | Use of programs that show change over short or long periods of time and/or enable data entry by students to make predictions or to establish trends and patterns (for example, change over short or long periods related to ecosystem relationships, greenhouse effect, links between transportation and global warming, Earth’s radiation ‘budget’, link between deforestation and soil erosion).  | * What would be the effect on…if I…?
* What is the relationship between …and….?
* How can…be calculated?
* What if…?
 | Use an online program to view ecological or environmental processes over time; for example, symbiosisHow can the population of fish in a lake be estimated using capture-mark-recapture? (generate data and use proportionality formula; for example, N = n1 x n2 / n3)Use an interactive applet to graph ice core data that shows Earth’s temperatures over 400,000 yearsApply a carbon footprint calculator to calculate footprints for different consumer profiles and scenarios |