VCE Environmental Science: Sample teaching plan

Sample Course Outline – VCE Environmental Science Unit 4: How can climate change and the impacts of human energy use be managed?

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

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| **Week** | **Area of study** | **Key knowledge** | **Learning activities**  | **Science skills focus** | **Assessment tasks** |
| **1** | ***Area of study 1:******How can we respond to climate change?*** | **Major factors that affect Earth’s climate** (natural phenomena and anthropogenic factors affecting Earth’s energy balance; the interactions between solar energy, atmospheric gases and other matter; and carbon sequestration over short-term and long-term time periods) | * *Data analysis*: complete activities related to Earth’s energy balance and to climate science concepts from NASA’s ‘Earth Math’ website
* *Fieldwork and controlled experiments*: student designed investigations into: albedo effect; energy absorption, re-emission, radiation and dissipation in the greenhouse effect; carbon sequestration
* *Controlled experiment*: design and perform an investigation to determine whether land or water absorbs more heat
* *Product, process or system development*: work in groups to present a feasible method for natural or artificial carbon sequestration
* *Group activity*: use a PMI (plus, minus, interesting) tool to consider the impact of a selected permaculture project on the greenhouse effect
* *Debate***:** Christmas trees – natural or artificial?
 | * process quantitative data using appropriate mathematical relationships and units
* identify, research and construct aims and questions for investigation
* determine appropriate investigation methodology
* formulate hypotheses to focus investigations
* identify independent, dependent and controlled variables in controlled experiments
* discuss relevant environmental science information, ideas, concepts, theories and models and the connections between them
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| **2** |  |
| **3** | **Understanding climate change** (differences between natural and enhanced greenhouse effects; greenhouse gas concentrations over different time periods due to natural events, and human activities; greenhouse gas warming potential; methods used for measuring past and present changes in the atmosphere; use of data in modelling and assessing the rate and consequences of past and future climate change including confidence ratings based on Intergovernmental Panel on Climate Change (IPCC) guidelines)  | * *Modelling*: construct visual representations to illustrate the difference between the radiation associated with the natural and enhanced greenhouse effects
* *Controlled experiment*: investigate the warming potential of carbon dioxide or other greenhouse gases
* *Group activity*: Media analysis and the use of scientific data to justify the information – ‘Why cement emissions matter for climate change’
* *Case study*: divide class into seven groups to examine the seven global climate change case studies on the NASA website; each group completes a grid to identify impacts on each of Earth’s four spheres and presents to rest of the class
* *Data analysis*: review, graph and analyse past data and future climate projections from climate websites
* *Simulation*: investigate the greenhouse effect and global warming
* *Literature review*: use a PMI (plus, minus, interesting) to analyse methods used to collect past climate data
* *Correlational study*: use the internet to collate data to investigate possible correlations, for example, ‘Do mountains affect climate?’ or ‘Does distance from the equator impact on climate variation?’
* *Literature review*: research the effects of increased climate on pest species
* *Science communication:* Source cartoons relating to climate change uncertainty and summarise the arguments presented by climate change sceptics, classify arguments as ‘opinion’, ‘anecdote’ or ‘evidence’
 | * analyse and explain how models and theories are used to organise and understand observed phenomena and concepts related to environmental science, identifying limitations of selected models/theories
* process quantitative data using appropriate mathematical relationships and units
* process and analyse data to identify cause-and-effect relationships, correlations, and linear, non-linear or cyclical patterns
* evaluate data to determine the degree to which the evidence supports the aim of the investigation
* distinguish between opinion, anecdote and evidence (including weak and strong evidence), and scientific and non-scientific ideas
* identify and analyse experimental data qualitatively, handling, where appropriate, concepts of: accuracy, precision, repeatability, reproducibility and validity of measurements; errors; and degree of confidence and certainty in data, including confidence ratings of climate projections
* extrapolate and interpolate data points from graphs
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| **4** |  |
| **5** |  |
| **6** | **Managing climate change** (risks and opportunities associated with climate change for humans and ecological systems at a selected region or location; mitigation options for reducing net greenhouse emissions to slow climate change; adaptation options for building resilience to the effects of unavoidable climate change at a selected region or location; responsible decision-making) | * *Case study*: access and discuss local and/or global examples of how people are taking action to promote climate change resilience
* *Literature review*: research a ‘green’ building or house design; annotate the design to show how climate change has been taken into consideration
* *Media analysis*: source and evaluate articles relating to the media’s role (or a celebrity) in reporting options for managing climate change, for example, Morgan Freeman, Leonardo DiCaprio, David Attenborough; distinguish between scientific and non-scientific ideas
* *Graphic organiser*: present the economic, social and environmental impacts of climate change on a selected Australian town including mitigation/adaptation strategies required
* *Video*: watch a YouTube presentation from Harvard researchers ‘recycling a-climate warming gas could make greener farmed fish’ to discuss how methane can be used as a sustainable food for fish; discuss how this is a mitigation strategy that involves Earth’s four systems
 | * distinguish between opinion, anecdote and evidence (including weak and strong evidence), and scientific and non-scientific ideas
* discuss relevant environmental science information, ideas, concepts, theories and models and the connections between them
* critically evaluate and interpret a range of scientific and media texts (including journal articles, mass media communications and opinions in the public domain), processes, claims and conclusions related to environmental science by considering the quality of available evidence
* identify, describe and explain the limitations of conclusions, including identification of further evidence required
* discuss the implications of research findings and proposals
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| **7** |  |
| **8** | **Application of Earth systems thinking in the evaluation of a response to an environmental science scenario, case study, issue or challenge:** use the Summary from the ‘Climate change and little penguins’ report, March 2009 (Research Department, Phillip Island Nature Parks and Centre for Australian Weather and Climate Research, Bureau of Meteorology); construct a set of short answer questions related to each of the environmental issues; draw a table that students complete to show how the impacts of climate change relate to Earth’s four systems |
| **9** | ***Area of Study 3:******How is scientific inquiry used to investigate contemporary environmental challenges***? | **Investigation design** (investigation design based on scientific methodology and evidence; including the use of a logbook for primary data collection, the use of variables, data presentation and analysis, and relevant health, safety and ethical guidelines)  | * *Poster evaluation:* use completed student or online scientific research posters to discuss strengths/ weaknesses /opportunities /threats of provided examples; establish a set of criteria for effective science communication in posters
* *Formative assessment test:* hypothesis formulation and experimental design
* *Investigation design:* brainstorming in groups in relation to possible investigations related to climate change at a selected region or location
 | * identify independent, dependent and controlled variables in controlled experiments
* formulate hypotheses to focus investigations
* identify, research and construct aims and questions for investigation
* determine appropriate investigation methodology
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| **10** |  | **Scientific evidence** (nature of evidence; organising, analysing and evaluating data; logbook entries; assumptions and limitations of investigation methodology) | * *Reflection:* class discussion of the investigations undertaken in Unit 3 Area of Study 1 and Unit 4 Area of Study 1 and exploration of further investigations that could be undertaken
* *Student investigation confirmation:* negotiation, confirmation, safety and ethical considerations, and materials preparation
* *Students undertake investigation:* hypothesis and prediction made about investigation and outcomes; investigation may be undertaken in pairs, but write-up including discussion and conclusion must be individual;
* *Logbook entries:* Logbook authentication – regular sighting by teacher; sections of the poster or logbook assessed progressively
 | * predict possible outcomes of investigations
* design and conduct investigations
* systematically generate and record primary data
* work independently and collaboratively, adapting or extending processes as required and recording such modifications
* demonstrate safe laboratory practices
* apply relevant occupational health and safety guidelines
* demonstrate ethical conduct
 | Communication of the design, analysis and findings of a student-designed and student-conducted scientific investigation through a structured scientific poster and logbook entries: * students decide on an individual investigation topic and record topic ideas in their logbooks
* teacher collects logbooks and comments on appropriateness of topics /ideas/ methodology
* assessment: students assessed on development of hypothesis and method, taking into account teacher feedback
* students undertake investigation, with results and data evaluation recorded in logbooks
* assessment: logbooks and poster production
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| **11** |  |
| **12** |  | **Science communication** (conventions of science communication; conventions for scientific posters; key findings and implications) | * *Reporting/poster write-up phase:* logbook entries for planning and data analysis and evaluation are assessed progressively; the logbook entries contribute 75% to the student’s assessment
* *Scientific poster* (40 minutes):poster contributes 25% to the student’s assessment and is completed in class
 | * demonstrate ethical conduct when reporting investigations
* use clear, coherent and concise expression
* acknowledge sources of information and assistance, and use standard scientific referencing conventions
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| **13** | ***Area of Study 2:*** ***What might be a more sustainable mix of energy sources?*** | **Comparison of different energy sources** (non-renewable energy sources, renewable energy sources, consequences of fossil fuel combustion for the carbon cycle; the concept of peak oil; energy efficiency calculations; implications of the first and second laws of thermodynamics; sustainability principles and impacts on the environment, society and the economy of use of energy resources) | * *Simulation game:* play the ‘renew a bead game’ to explore timescales associated with the use of renewable and non-renewable energy resources
* *Classification and identification:* work in groups to develop criteria for the classification of an energy system as being sustainable
* *Literature review:* read the articles ‘Nuclear power: a real option’ and ‘Nuclear power stations are not appropriate for Australia – and probably never will be’ as a basis for a class debate about the use of nuclear energy in Australia
* *Fieldwork:* design and undertake a microclimate investigation to identify areas in the school grounds that could be suitable sites for solar panels or wind turbines; compare predictions with outcomes using data to justify conclusions
* *Comparison:* construct a PMI (plus, minus, interesting) graphic organiser to compare energy types including relative contributions to the enhanced greenhouse effect
* *Infographic:* produce an infographic on a selected non-renewable and/or renewable energy resource demonstrating formation, extraction, use and impacts
* *Data analysis:* compare energy sources in Australia with those of other countries using data from the World Bank website
 | * discuss relevant environmental science information, ideas, concepts, theories and models and the connections between them
* formulate hypotheses to focus investigations
* predict possible outcomes of investigations
* evaluate data to determine the degree to which the evidence supports or refutes the initial prediction
* identify, describe and explain the limitations of conclusions, including identification of further evidence required
* use appropriate environmental science terminology, representations and conventions, including standard abbreviations, graphing conventions and units of measurement
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| **14** |  |
| **15** |  |
| **16** | **Managing the impacts of human energy use** (options for rehabilitating extraction sites; managing current and projected base and peak load energy needs; options for building a sustainable energy future based on historical and current scientific data; factors affecting responsible decision-making around building a sustainable energy future) | * *Fieldwork*: undertake an energy audit of your school’ propose ways to improve energy efficiency and reduce energy use
* *Literature review*: research the application of sustainability principles at a selected mining site
* *Case study*: read information on the Adani Coal Mine website and discuss to what extent the project meets sustainability principles; access ‘for’ and ‘against’ articles related to the project and categorise quotes as being scientific’ or ‘non-scientific’
* *Simulation*: use the interactive ‘design our climate’ tool to investigate how different energy choices can reduce greenhouse gas emissions
* *Innovation*: create a SWOT (strengths/ weaknesses /opportunities /threats) chart to consider an increased shift towards using renewable energy resources in relation to current technological developments
* *Investigation*: make a pot-in-a-pot (Zeer) refrigerator
* *Infographic*: create an infographic on recovery/ cogeneration and emissions control of energy sources
* *Product, process or system development*: research an innovation in energy technologies and produce a short item suitable for publication in a school communication, including reference to the effects on Earth’s four systems
 | * analyse and evaluate environmental science scenarios, case studies, issues and challenges using the sustainability principles of conservation of biodiversity and ecological integrity, efficiency of resource use, intergenerational equity, intragenerational equity, precautionary principle, and user pays principle
* distinguish between opinion, anecdote and evidence (including weak and strong evidence), and scientific and non-scientific ideas
* apply Earth systems thinking to analyse and evaluate responses to environmental science scenarios, case studies, issues and challenges in terms of supporting and sustaining ecological integrity
* identify and explain when judgments or decisions associated with issues related to environmental science may be based on sociocultural, economic, political, legal and/or ethical factors and not solely on scientific evidence
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| **17** | **Designed or practical response to a real or theoretical environmental issue or challenge**: students use the results from their pot-in-a-pot (or Zeer) refrigerator to design and test an improved design; justification of the reasons for suggested modifications are recorded and assessed in logbooks; data generation from testing of device is recorded in logbooks; data analysis and conclusions assessed in class |
| **18** | **Unit revision** |
| **19** |