VCE Physics

Examples of scientific methodologies applicable in VCE Physics

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**](https://www.vcaa.vic.edu.au/curriculum/vce/vce-study-designs/Physics/Pages/Teaching-and-Learning.aspx) activities.

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| Methodology | Definition | Types of questions or investigations | Investigation examples |
| Case study | A report of a specific physics invention, model, thought experiment, problem or issue at a particular place and point in time.  Case studies generally relate to past events or specific physics concepts, inventions, discoveries or conceptual examples. Relevant case studies for VCE Physics may be developed from media articles, research summaries and historical reports of the physics endeavours of individuals. | * What happened when…? * How did…? * How did…change previous understanding of …? * What lessons can be learned from…? * What is the evidence for…? | Read Henri Becquerel’s diary entries related to his experiments on radioactivity and justify that his discovery of radioactivity was a result of a systematic approach to experimentation rather than a chance event.  Investigate whether warm water freezes faster than cool water by considering the ‘Mpemba effect’.  Present the case study of Mr Peters and the use of radioisotopes in brain scans to introduce radioisotopes.  Access reports of nuclear accidents to identify causes and subsequent actions.  Discuss examples of brownouts and power failures caused by an increase in the use of household electrical devices during extreme weather events.  Analyse the ‘monkey and the hunter’ problem.  Discuss why Michael Faraday’s 1821 invention of the ‘homopolar motor’ was described by some people as the world’s simplest motor.  Analyse case studies related to possible health effects on humans living near power lines.  Discuss how the Michelson-Morley experiment with light disproved the previously held luminiferous aether theory.  Discuss how the discovery of the muon by Carl Anderson and Seth Neddermeyer in 1936 challenged previously understood ideas about particles. |
| 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. | Use practical examples to illustrate the difference between transverse and longitudinal waves.  Use criteria to classify different types of rainbows.  Compare artificial and natural satellite motion.  Distinguish between α, β-, β+ and γ radiation based on their properties  Discuss the nature and difference between scalar and vector quantities.  Compare emission and absorption spectra for selected elements. |
| 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, or sometimes more open-ended in looking at factors that affect a selected variable being investigated. | * What effect does…have on…? * How does…affect…? * Can…? * Is there a relationship between…and…? * Does…affect…? * Is…related to…? * Is…dependent on…? * Which…? * What…? | Investigate the relationship between refractive index and temperature for water and other liquids.  Measure the angles of each of the seven colours of a rainbow produced by a water hose to determine and compare their refractive indices.  Investigate the effect of temperature on the percentage rebound height of a squash ball.  Investigate how the drop time of a parachute is affected by different variables.  Investigate whether the light output of an LED is dependent on temperature.  Use a datalogger to investigate the nature of the friction force between two surfaces.  Investigate how the diameter of an electromagnetic coil affects the strength of the magnetic field and/or the electric current. |
| Fieldwork | Qualitative and/or quantitative investigations conducted outside the laboratory.  Includes site visitations (for example, radiology departments of hospitals, the Australian Synchrotron), experiential learning opportunities (for example, Luna Park, playgrounds), astronomical observations, and surveys. | * How does…change over time? * Visit…to see how physics is applied in the community. * What…? * Do…? * Are…? * Conduct a survey to… * Make and record observations in the environment about… | Investigate the factors that determine the speed of a water wave.  Take photographs that illustrate light phenomena or capture a rapidly occurring physical phenomenon related to motion.  Visit the radiology department of a local hospital and summarise the types of diagnostic and treatment options offered.  Use dataloggers and/or digital video cameras to investigate the displacement, velocity and acceleration of students as they perform long jumps and high jumps.  Determine reaction force through an investigation of the centripetal acceleration of a passenger in a Luna Park ride.  Conduct a survey to determine whether people are in favour of Australia developing nuclear power as an energy source.  Use a spectrometer to observe light from the stars. |
| Literature review | Research to access and collate secondary data and/or find out information about physics concepts. Students should record all data sources and references in their logbooks. Literature reviews generally relate to current issues, exploring physical phenomena as applications of physics concepts, finding out new information or how something works, and extending understanding of physics ideas. | * How does…work? * What is…? * Research the phenomenon… * Research the invention… * Evaluate proposals regarding… * What is…? * Compare different proposals… * Explain the physics involved in a contemporary issue… * Explain how… | Explore the phenomenon of a double reflection seen in a glass window.  Investigate and produce a short report related to the effects of exposure to ‘blue light’ emitted by electronics and energy-efficient light bulbs.  Research how holograms work.  Investigate the role of impulse and momentum in automotive safety.  Research and explain how a Geiger counter operates.  Explain how radioactive decay is used to make reliable predictions in the radiometric dating of materials.  Explain how a radiation-based smoke detector works.  Research how the apex vent in parachutes was invented.  Investigate the role of impulse and momentum in automotive safety.  Investigate and evaluate energy transmission proposals.  Report on an innovation that uses the photoelectric effect.  Explain how satellites provide experimental evidence that supports the phenomenon of time dilation. |
| Modelling | Construction of physical, mathematical or conceptual models.  Models improve the understanding of how things work, enable predictions about physical 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 phenomenon or physical structure… * Use an analogy to explain… * Use…to show… * Develop a spreadsheet to model… | Construct a conductivity star made of four different metals to demonstrate the different thermal conductivities of the metals.  Develop a model to investigate whether putting a coat on a snowman makes it melt faster.  Compare and evaluate analogies used to explain current and potential difference.  Make a model of a fuse.  Develop a spreadsheet that models the motion of a skydiver approaching terminal velocity.  Investigate the speed required for a marble to ‘loop the loop’, using flexible tubing or a slot-car set.  Access data related to the orbits of artificial satellites from the internet and use the data to determine the mass of Earth.  Use mathematical modelling to examine the way in which the correction factor g = 1/(1 – v2​/c2​)½ changes with speed. |
| 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… | Develop a fluid lens system with adjustable focus.  Design and produce a device based on a a simple circuit to detect light levels that will open a chicken coop in the morning and close it at night.  Change the length of the flash in a flashing LED.  Design and construct a ‘gravity car’.  Design, construct and test a fluid-based lens system with adjustable focus and suggest possible applications of your system.  Design and construct a device based on a compass needle that can be used to measure Earth’s magnetic field.  Build and test a simple electric motor.  Construct a spectrometer. |
| 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? | Explore black body radiation.  Simulate how unstable (radioactive) elements change into more stable nuclei.  Explore the properties of different types of radiation.  Investigate alpha and beta decay.  Investigate nuclear fission and fusion.  Model the operation of a DC circuit; explore the effects of changing circuit configuration.  Investigate projectile motion in terms of the range, maximum height and time of flight for a range of angles and initial speed.  Investigate collisions between objects.  Investigate the relationship between orbital radius and mass for orbiting objects.  Explore the nature of space and time in special relativity. |