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| Previous level’s achievement standard as a starting point of comparison Previous level’s achievement standard as a starting point of comparison **CURRICULUM AREA - SCIENCE** |
| **VCAA EXAMPLE – How effective is your ‘separating machine’?** **Context:**Students are provided with a mixture containing specific amounts of sand, salt, iron filings, polystyrene beads, water and oil. They work in pairs to design, test and evaluate a ‘separating machine’ prior to using it to separate the provided mixture. Stimulus questions may be used to prompt student inquiry: What are the strengths and limitations of different separating techniques? Do all mixture components dissolve in water? What are the physical properties of each component of the mixture? In what order should the components of the mixture be separated? The teaching and learning plan focuses primarily on the application of an understanding of the chemical principles associated with separation techniques and critical and creative thinking strategies to design and construct a functioning ‘separating machine’.**Content Descriptions:****Science Understanding*** Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations [(VCSSU090)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSSU090)
* Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques  [(VCSSU095)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSSU103)
* Water is an important resource that cycles through the environment  [(VCSSU101)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSSU104)

**Science Inquiry Skills*** Communicate ideas, findings and solutions to problems including identifying impacts and limitations of conclusions and using appropriate scientific language and representations [(VCSIS113)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSIS113)
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| **Science Level 6 Achievement Standard**  | **Example of Indicative Progress toward Level 8 Achievement Standard** | **Science Level 8 Achievement Standard** |
| By the end of Level 6:Students explain how scientific knowledge is used in decision making and develops from many people’s contributions. They discuss how scientific understandings, discoveries and inventions affect peoples’ lives. They compare the properties and behaviours of solids, liquids and gases. They compare observable changes to materials and classify these changes as reversible or irreversible. They explain everyday phenomena associated with the absorption, reflection and refraction of light. They compare different ways in which energy can be transformed from one form to another to generate electricity and evaluate their suitability for particular purposes. They construct electric circuits and distinguish between open and closed circuits. They explain how natural events cause rapid change to Earth’s surface and use models to describe the key features of our Solar System. They analyse how structural and behavioural adaptations of living things enhance their survival, and predict and describe the effect of environmental changes on individual living things. Students follow procedures to develop questions that they can investigate and design investigations into simple cause-and-effect relationships. When planning experimental methods, they identify and justify the variables they choose to change and measure in fair tests. They make predictions based on previous experiences or general rules. They identify and manage potential safety risks. They make and record accurate observations as tables, diagrams or descriptions. They organise data into tables and graphs to identify and analyse patterns and relationships. They compare patterns in data with their predictions when explaining their findings. They suggest where improvements to their experimental methods or research could improve the quality of their data. They refer to data when they report findings and use appropriate representations and simple reports to communicate their ideas, methods, findings and explanations. | In **Science**, indicative progression towards the Level 8 achievement standard may be when students:* identify familiar applications of separation techniques (for example, tea strainer, pool filters, gold panning, sewerage treatment, treatment of oil spills) but are not yet able to extend their understandings to unfamiliar applications (for example, safe disposal by dentists of mercury fillings using filtration and the use of chromatography in blood processing).
* identify and describe different types of separating techniques (for example, filtration, sieving, evaporation, crystallisation, decanting, chromatography, magnetic separation, precipitation, distillation and centrifuging), but are not yet able to sequence multiple separations within a mixture to obtain pure substances.
* identify that water can be extracted from mixtures by processes of evaporation followed by condensation to recover the water with close to 100% efficiency, but are not yet able to connect these processes to the water cycle.
* identify effective separation techniques to separate the components of a mixture, but are not yet able to identify the limitations of each technique.
* calculate the percentage recovery of each mixture component, but are not yet able to modify their experimental methods to achieve greater recovery.
* synthesise different elements of their investigation findings to draw conclusions, but are not yet able to identify gaps in their reasoning or missing elements in information.
* draw flowcharts to represent the sequencing of their separation procedures and include annotations that reflect investigation outcomes, but are not yet able to reconstruct the flowcharts to reflect the changes made in producing their final ‘separating machine’.
 | By the end of Level 8:Students explain how evidence has led to an improved understanding of a scientific idea. They discuss how science knowledge can be applied to generate solutions to contemporary problems and explain how these solutions may impact on society. They investigate different forms of energy and explain how energy transfers and transformations cause change in simple systems. They use examples to illustrate how light forms images. They use a wave model to explain the properties of sound. They use the particle model to predict, compare and explain the physical and chemical properties and behaviours of substances. They describe and apply techniques to separate pure substances from mixtures. They provide evidence for observed chemical changes in terms of colour change, heat change, gas production and precipitate formation. They analyse the relationship between structure and function at cell, organ and body system levels. They identify and classify living things. They explain how living organisms can be classified into major taxonomic groups based on observable similarities and differences. They predict the effect of environmental changes on feeding relationships between organisms in a food web. They distinguish between different types of simple machines and predict, represent and analyse the effects of unbalanced forces, including Earth’s gravity, on motion. They compare processes of rock formation, including the time scales involved, and analyse how the sustainable use of resources depends on the way they are formed and cycle through Earth systems. They model how the relative positions of Earth, the Sun and the Moon affect phenomena on Earth.Students identify and construct questions and problems that they can investigate scientifically and make predictions based on scientific knowledge. They plan experiments, identifying variables to be changed, measured and controlled. They consider accuracy and ethics when planning investigations, including designing field or experimental methods. Students summarise data from different sources and construct representations of their data to reveal and analyse patterns and relationships, and use these when justifying their conclusions. They explain how modifications to methods could improve the quality of their data and apply their scientific knowledge and investigation findings to evaluate claims made by others. They use appropriate scientific language, representations and simple word equations to communicate science ideas, methods and findings. |

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| Previous level’s achievement standard as a starting point of comparison Previous level’s achievement standard as a starting point of comparison **CURRICULUM AREA – Science**  |
| **VCAA EXAMPLE – How do sensory cues affect reaction time?** **Context:**Students explore nervous system functioning by investigating which of visual, auditory or tactile cues are more important in affecting reaction time. They work in pairs and use a ‘catching a dropped ruler’ methodology to test the effect of visual cues, auditory cues and tactile cues on reaction times. Stimulus questions may be used to prompt student inquiry: Are results more accurate and reliable if a ‘trial’ is conducted first? How many experiment repetitions are sufficient to obtain reliable results? Do students have a ‘dominant’ hand? Do males have different reaction times compared with females? Do athletes have a faster reaction time than non-athletes? The teaching and learning plan links psychological and physics concepts and focuses primarily on the development of science inquiry skills in the context of data manipulation and quantitative science.**Content Descriptions:****Science Understanding*** Scientific understanding, including models and theories, are contestable and are refined over time trough as process of review by the scientific community [(VCSSU114)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSSU114)
* Multicellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment [(VCSSU117)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSSU117)
* An animal’s response to a stimulus is coordinated by its central nervous system (brain and spinal cord); neurons transmit electrical impulses and are connected by synapses [(VCSSU118)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSSU118)
* The explanation of the motion of objects involves the interaction of forces and the exchange of energy and can be described and predicted using the laws of physics [(VCSSU133)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSSU133)

**Science Inquiry Skills*** Formulate questions or hypotheses that can be investigated scientifically, including identification of independent, dependent and controlled variables [(VCSIS134)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSIS134)
* Independently plan, select and use appropriate investigation types, including fieldwork and laboratory experimentation, to collect reliable data, assess risk and address ethical issues associated with these investigation types  [(VCSIS135)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSIS135)
* Select and use appropriate equipment and technologies to systematically collect and record accurate and reliable data, and use repeat trials to improve accuracy, precision and reliability [(VCSIS136)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSIS136)
* Construct and use a range of representations, including graphs, keys, models and formulas, to record and summarise data from students’ own investigations and secondary sources, to represent qualitative and quantitative patterns or relationships, and distinguish between discrete and continuous data [(VCSIS137)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSIS137)
* Analyse patterns and trends in data, including describing relationships between variables, identifying inconsistencies in data and sources of uncertainty, and drawing conclusions that are consistent with evidence [(VCSIS138)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSIS138)
* Use knowledge of scientific concepts to evaluate investigation conclusions, including assessing the approaches used to solve problems, critically analysing the validity of information obtained from primary and secondary sources, suggesting possible alternative explanations and describing specific ways to improve the quality of data [(VCSIS139)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSIS139)
* Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations [(VCSIS140)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCSIS140)
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| **Science Level 8 Achievement Standard**  | **Example of Indicative Progress toward Level 10 Achievement Standard** | **Science Level 10 Achievement Standard** |
| By the end of Level 8:Students explain how evidence has led to an improved understanding of a scientific idea. They discuss how science knowledge can be applied to generate solutions to contemporary problems and explain how these solutions may impact on society. They investigate different forms of energy and explain how energy transfers and transformations cause change in simple systems. They use examples to illustrate how light forms images. They use a wave model to explain the properties of sound. They use the particle model to predict, compare and explain the physical and chemical properties and behaviours of substances. They describe and apply techniques to separate pure substances from mixtures. They provide evidence for observed chemical changes in terms of colour change, heat change, gas production and precipitate formation. They analyse the relationship between structure and function at cell, organ and body system levels. They identify and classify living things. They explain how living organisms can be classified into major taxonomic groups based on observable similarities and differences. They predict the effect of environmental changes on feeding relationships between organisms in a food web. They distinguish between different types of simple machines and predict, represent and analyse the effects of unbalanced forces, including Earth’s gravity, on motion. They compare processes of rock formation, including the time scales involved, and analyse how the sustainable use of resources depends on the way they are formed and cycle through Earth systems. They model how the relative positions of Earth, the Sun and the Moon affect phenomena on Earth.Students identify and construct questions and problems that they can investigate scientifically and make predictions based on scientific knowledge. They plan experiments, identifying variables to be changed, measured and controlled. They consider accuracy and ethics when planning investigations, including designing field or experimental methods. Students summarise data from different sources and construct representations of their data to reveal and analyse patterns and relationships, and use these when justifying their conclusions. They explain how modifications to methods could improve the quality of their data and apply their scientific knowledge and investigation findings to evaluate claims made by others. They use appropriate scientific language, representations and simple word equations to communicate science ideas, methods and findings. | In **Science**, indicative progression towards the Level 10 achievement standard may be when students:* outline how scientific understanding has progressed from thinking that human mental processes were too fast to measure to empirical studies such as Donder’s work (1865) on the measurability of reaction time and contemporary studies (for example, visual choice reaction times), but not yet able to describe how progressive studies challenge and/or extend previous ideas and scientific investigation techniques.
* explain how messages are conveyed from receptor to effector in neural pathways related to reaction times, but are not yet able to account for touch and audio stimuli having faster reaction times, on average, than auditory stimuli.
* explain reaction time as a measure of how quickly an organism responds to a stimulus, but is not yet able to distinguish between voluntary and involuntary (reflex)responses or to account for the survival advantages for an organism of an involuntary reflex being faster than a voluntary reaction.
* provide qualitative explanations of the relationship between distance and speed and distinguish between distance and displacement, and speed and velocity, but are not yet able to apply provided physics formulas to evaluate and explain their predictions related to speed
* identify independent, dependent and controlled variables, but are not yet able to suggest further variables that may be manipulated to extend their investigation related to reaction times.
* collate class data related to reaction times and identify discrepant or conflicting results, but are not yet able to offer plausible reasons for differences in data or to suggest alternative explanations of differing results.
* represent investigation findings in graphical form, but may not yet be able to distinguish between the representations of continuous and discrete variables in a graph.
* use an appropriate ‘ruler drop’ technique in the measurement of reaction times, but are not yet able to suggest how digital technologies may be used to generate more accurate, precise or reliable data.
* use data from their own investigations to support their arguments, but are not yet able to incorporate class findings into their discussions and conclusions.
 | By the end of Level 10:Students analyse how models and theories have developed over time and discuss the factors that prompted their review. They predict how future applications of science and technology may affect people’s lives. They explain the concept of energy conservation and model energy transfer and transformation within systems. They analyse how biological systems function and respond to external changes with reference to the interdependencies between individual components, energy transfers and flows of matter. They evaluate the evidence for scientific theories that explain the origin of the Universe and the diversity of life on Earth. They explain the role of DNA and genes in cell division and genetic inheritance. They apply geological timescales to elaborate their explanations of both natural selection and evolution. They explain how similarities in the chemical behaviour of elements and their compounds and their atomic structures are represented in the way the periodic table has been constructed. They compare the properties of a range of elements representative of the major groups and periods in the periodic table. They use atomic symbols and balanced chemical equations to summarise chemical reactions, including neutralisation and combustion. They explain natural radioactivity in terms of atoms and energy change. They explain how different factors influence the rate of reactions. They explain global features and events in terms of geological processes and timescales, and describe and analyse interactions and cycles within and between Earth’s spheres. They give both qualitative and quantitative explanations of the relationships between distance, speed, acceleration, mass and force to predict and explain motion. They use the concepts of voltage and current to explain the operation of electric circuits and use a field model to explain interactions between magnets. Students develop questions and hypotheses that can be investigated using a range of inquiry skills. They independently design and improve appropriate methods of investigation including the control and accurate measurement of variables and systematic collection of data. They explain how they have considered reliability, precision, safety, fairness and ethics in their methods and identify where digital technologies can be used to enhance the quality of data. They analyse trends in data, explain relationships between variables and identify sources of uncertainty. When selecting evidence and developing and justifying conclusions, they account for inconsistencies in results and identify alternative explanations for findings. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and use appropriate scientific language, representations and balanced chemical equations when communicating their findings and ideas for specific purposes.  |