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Physics, Earth and Space Science NCEA NZC Level 1
Subject Learning Outcomes for Assessment of 1.2 and 1.4

Companion to the Physics, Earth and Space Science Learning Matrix

What are the Subject Learning Outcomes and how can I use them?

Subject Learning Outcomes identify the knowledge and skills that students need to be ready for assessment. Subject Learning Outcomes are informed by the Achievement Standards. They should be used in conjunction with the full suite of NCEA materials. For guidance on assessment criteria, please also refer to the Achievement Standards, Unpacking, and External Assessment Specifications or Conditions of Assessment as appropriate.

Subject Learning Outcomes do not replace any documents. This includes the External Assessment Specifications and Conditions of Assessment. All NCEA materials need to be used to fully understand the requirements of each Achievement Standard and to plan a robust teaching, learning, and assessment programme. Subject Learning Outcomes should not be used to make assessor judgments. The Achievement Standard and the Assessment Schedule for Internal Assessment Activities are used to make such judgments.

Subject Learning Outcomes, alongside other key documents, make clear to teachers what to include in their teaching and learning programmes and what student capabilities to check for, in the lead up to assessment. Each Subject Learning Outcome does not need the same amount of teaching time.

All learning should connect with students' lives in Aotearoa New Zealand and the Pacific. Teachers or students usually select the contexts. As such, contexts are not always specified in the Subject Learning Outcomes. Examples may be provided to illustrate topics and contexts, but they are not prescriptive.

Students are entitled to teaching that supports them to achieve higher levels of achievement. Subject Learning Outcomes mainly align with outcomes for the Achieved level. However, outcomes for higher levels of achievement are also included.

The knowledge and skills in the Subject Learning Outcomes are the expected learning that underpins each Achievement Standard. Students will draw on this learning during assessment. It is important to note that assessment is a sampling process so not everything that is taught will be assessed.

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Achievement Standard 92045 (1.2)	**Demonstrate understanding of a physical phenomenon through investigation.**	**Credits: 5**
What is being assessed	**Specific Learning Outcome (Students are able to….)**	
Use analytical and critical thinking, and skills in problem-solving and communication.	• Understand the differences between physical quantities, physics relationships, physics concepts, and physical phenomena. • Correctly link physics concepts to physical phenomenon. • Determine relationships in a physical phenomenon. • Represent physics relationships mathematically with graphs and formulae. • Use graphs and formulae to calculate and predict with certainty other unknown physical quantities.	
Understand the process of investigation.	Investigations typically include: • Identify a physics phenomenon and relevant physics concept(s) that are suitable for investigation. • Identify the purpose and context for an investigation of a phenomenon. • Construct focusing questions when planning an investigation of a phenomenon. • Determine suitable variables to determine relationships related to the phenomenon. • Describe other variables that could affect the results and how these could be controlled. • Plan health and safety precautions for an investigation. • Carry out an investigation to collect and record evidence (must include numerical data and may include observations).	
Investigate more than one relationship.	Investigating relationships typically includes: • Carry out two fair test investigations using variables that will provide evidence as part of the investigation of a phenomenon, OR • As part of the investigation of a relationship, determine a suitable controlled variable and further investigate it to provide evidence of a second relationship related to the phenomenon, OR • As part of the investigation, determine a lower or upper limit to a relationship and investigate it further to provide evidence of a second relationship related to the phenomenon.	

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Collecting and processing evidence.	Collecting and processing typically includes: • Collect measurements (numerical data) and/or observations of the relevant physical quantities. • Keep a clear record of measurements and observations. • Process evidence to provide more meaningful information. Examples include find averages, draw a graph and add a line of best fit, find a gradient from a graph. • Present the processed evidence in appropriate table(s), graph(s), and/or calculation(s).
Show understanding of physics concepts and relationships using collected evidence.	Demonstrating understanding typically includes: • Present work in an appropriate format. • Describe physics relationships or trends in numerical data gathered as evidence by comparing physical quantities. • Analyse more than one relationship in the processed evidence. • Explain how relevant physics concepts and relationships relate to a phenomenon using processed evidence.

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Achievement Standard 92047 (1.4)	**Demonstrate understanding of a physical system using energy concepts.**	**Credits: 5**
What is being assessed	**Specific Learning Outcome (Students are able to….)**	

Energy concepts, language and representations.	• State the law of conservation of energy.
	• Identify forms of energy associated with matter; limited to kinetic, gravitational, elastic, thermal, and chemical energy.
	• Identify processes that transfer energy between physical objects (or systems) including those that involve doing work, heating, electricity, and waves (does not include wave properties or behaviour).
	• Visually represent the energy changes in a system that has undergone change by using energy bar charts. This requires students to be able to
	  ○ identify the system,
	  ○ identify the initial and final states of the system, and the associated energy forms,
	  ○ apply the law of conservation of energy to solve quantitative problems.
	• Calculate power ($P = \frac{\Delta E}{t}$) and discuss how different objects and processes transfer energy at different rates.
	• Explain that, in some processes, not all energy transfers are useful.
	Calculate efficiency using either of the formulae:
	$$Efficiency = \frac{useful\ energy\ output}{energy\ input} \times 100\%$$
	Or
	$$Efficiency = \frac{useful\ power\ output}{power\ input} \times 100\%$$	

Apply energy concepts in the context of mechanics.	• Apply the kinetic energy formula $E_k = \frac{1}{2}mv^2$ to a moving object. • Apply the gravitational energy formula $E_g = mgh$ to an object that has its height changed. • Apply the concept of work to determine energy transfer due to a force using $W = Fd$	

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Apply energy concepts in the context of electricity.	• Identify the energy forms and the energy transfer processes involved in a simple* electric circuit. • State the definition of the physical quantities of voltage and current and measure their values in a simple* circuit. • Apply the formula $P = VI$ to components in a simple* electric circuit. *A "simple" circuit has few components. It could be AC or DC (charge flow is not important here), series or parallel, but it facilitates students to be able to make measurements of V and I and eventually calculate P.
Apply energy concepts in the context of heating and cooling.	• Describe substances using the three states of matter (solid, liquid, gas), their associated phase and energy changes, and model these substances using a simple kinetic model of particles. • Define the terms temperature and thermal energy and explain how they differ. Investigate and analyse the energy required to: ○ raise the temperature of a substance: $Q = mc\Delta T$ ○ change the state of a substance: $Q = mL$ • Explain the mechanisms of heating and cooling: conduction, convection and radiation. Identify which of these mechanisms are occurring in simple situations. • Apply the concepts of conduction, convection, radiation and evaporation to explain and/or propose methods of managing temperature.