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Physics, Earth and Space Science NCEA NZC Level 1
Subject Learning Outcomes for Assessment of 1.1 and 1.3

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 1.1 (92044): Demonstrate understanding of human-induced change within the Earth system (5 Credits)

What is being assessed	Subject Learning Outcomes
The Earth system	Students are able to: • describe the Earth as a system made up of the atmosphere, biosphere, geosphere, and hydrosphere, existing within space. This includes describing features of Earth's spheres and natural changes within the Earth system • describe how the Earth's spheres are interconnected by referring to the scientific models that illustrate matter cycling and energy flow through the Earth system, for example, the carbon cycle or soil erosion; warming of the atmosphere by the greenhouse effect • apply Earth and space science ideas alongside mātauranga Māori, Pacific and other relevant knowledge systems to develop a more comprehensive understanding of the Earth system.
The effect of human-induced change within the Earth system	Students are able to: • describe human activity that directly or indirectly causes change in the Earth system in more than one sphere • describe natural events and Earth processes that can be linked to the human-induced change being researched • describe human-induced change within the Earth system, for example, a change in any local or global aspect of the atmosphere, biosphere, geosphere, or hydrosphere; such as increasing carbon dioxide in the atmosphere, changing land use (urbanisation, deforestation) or agricultural riparian planting • describe positive and/or negative effects of human-induced change in the Earth system, for example increasing global temperatures, soil erosion or reduction of nitrates in waterways • explain the effects of human activities in one sphere and link these effects with subsequent implications in another sphere, for example, soil erosion and runoff leading to sedimentation and reduced biodiversity in waterways • show that we all have a role in tiakitanga, which highlights the importance of caring for all our whenua equally as ākonga exist within these Earth systems, interweaving the wellbeing of people with the wellbeing of the environment.

Use of science ideas to analyse implications of human-induced change within the Earth system	Students are able to:
	• use science ideas to describe how human activity can result in change to more than one sphere in the Earth system, for example how a change in one sphere of the Earth system may affect another sphere
	  ○ a science idea comes from the science body of knowledge. It is robust yet tentative and supported by verified evidence. Science ideas vary in complexity and can include theories, principles, or laws. Examples of appropriate science ideas that could be used to demonstrate effects of human-induced change include:
	  ▪ a description of a process within the earth system such as the greenhouse effect, weathering and erosion, or energy flow through ecosystems
	  ▪ reference to data collected and verified through the scientific method, such as water quality data, heavy metal composition of soil samples, or ecological surveys showing biodiversity reduction or recovery rates
	  ▪ science models that show relationships within and between spheres, such as the Earth's energy balance, the water cycle or carbon cycling
	• describe changes to Earth processes taking place within the Earth system by using relevant science symbols, language, and conventions. This could include using scientific representations such as graphs, flow charts, diagrams, and simulations. Examples include:
	  ○ the physical or chemical properties of carbon dioxide that are linked to changes in the energy balance of the atmosphere
	  ○ using food webs or pyramids of biomass to describe change to the local biosphere
	  ○ using models to represent the effect of changes in alluvial deposits
	• explain how human activity can result in changes to processes and natural cycles taking place that affect more than one sphere in the Earth system, and analyse the scientific implications of human-induced change by:
	  ○ applying and communicating science ideas in detail to explain how a human activity can cause change to the Earth system
	  ○ analysing evidence related to the effect of human-induced change to the Earth system
	  ○ answering questions and making predictions related to future implications to the Earth system.

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Achievement Standard 1.3 (92046): Demonstrate understanding of the effect on the Earth of interactions between the Sun and the Earth-Moon system (5 Credits)

What is being assessed	Subject Learning Outcomes

Observations of interactions between the Sun and the Earth-Moon system	Students are able to:
	• make direct and/or indirect observations of interactions. Examples may include:
	  ○ shadow length
	  ○ tide height
	  ○ day and night length
	  ○ where the Moon rises and sets
	• describe observations of interactions using a range of representations which may include those from mātauranga Māori and Pacific knowledge systems
	• describe observable features, patterns, variations, trends and generalisations related to an interaction. For example, the shadow length at different times of the day.

Science ideas related to observations and interactions	Students are able to:
	• support observations with science ideas that relate to the specific interaction being observed
	  ○ a science idea comes from the science body of knowledge. It is robust yet tentative and supported by verified evidence. Science ideas vary in complexity and can include theories, principles, or laws.
	• interpret observations and/or representations to describe an interaction between the Sun and Earth-Moon system
	• link science ideas and observations to explain the following interactions between the Sun and the Earth-Moon system:
	  ○ the spin of the Earth on its axis relative to the Sun
	  ○ the tilt of the Earth and its orbital position around the Sun
	  ○ the gravitational pull of the Moon and Sun on Earth
	  ○ orbital position of the Moon around the Earth
	  ○ lunar and solar eclipses.

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Effects on the Earth of interactions	Students are able to:
	• describe the effect(s) of interactions between the Sun and Earth-Moon system on Earth. For example, reasons for changes in daylength, shadow length, seasons, type of tide, moon phases and eclipses.
	• Link science ideas and observations to explain the following effect(s) on Earth:
	  ○ how the spin of the earth relative to the Sun leads to variation in solar angle, shadow length, and temperature
	  ○ characteristics of a season at a certain latitude by linking the tilt of the Earth's axis and its orbital position around the Sun
	  ○ effect on daylength at equinox, and summer and winter solstices
	  ○ how the Moon's gravitational pull on Earth results in a tidal force, causing high and low tides, and spring and neap tides around Aotearoa New Zealand and the Pacific region
	  ○ how the appearance of the Moon changes as it orbits around the Earth during a lunar month
	  ○ observable effects of different types of eclipse as seen from Earth. why your likelihood of seeing a lunar eclipse is higher in a particular location than seeing a solar eclipse.

Latitudinal and temporal variation in the observable effects of interactions on Earth	Students are able to:
	• integrate science ideas with observations to discuss the following latitudinal and temporal variations in the effect(s) of the interactions on Earth:
	  ○ differences in daylength and shadow length
	  ○ latitudinal differences in solar angle at the same time
	  ○ seasonal variation at different latitudes
	  ○ daylength variation between equinox and solstices
	  ○ temporal variation in tide times and/or heights, including variations in spring tide heights
	  ○ rising and setting of the Moon and its appearance, including size and shape
	  ○ observable differences of eclipses
	  ○ why in a particular location your likelihood of seeing a lunar eclipse is higher than a solar eclipse.