

Earth and Space Science: by Jenny Pollock

Earth and Space Science (ESS) is a new subject based on the Planet Earth and Beyond strand of the New Zealand curriculum (NZC). ESS will be assessed by standards derived from levels 6, 7 and 8 of the NZC.

All Level 1 ESS standards are part of the new Science matrix, are internally assessed and worth 4 credits each. Students do not need Level 1 ESS standards to take Levels 2 and 3 ESS, although courses assessed by these standards would give valuable background.

Many of the new ESS standards have considerable flexibility and could assess courses in astronomical, geological, marine and/or atmospheric contexts. Full year courses such as Earth and Space Science or Earth Sciences, or half year courses in Astronomy, Marine Science, and Antarctic studies, could be assessed.

The Levels 2 and 3 ESS standards replace the old Science standards at Level 2 and 3 NCEA.

Level One standards:

These standards can be assessed by written reports, posters, or power point presentations. 1.13, 1.14 and 1.15 could also be assessed by a formal test. The assessments can be done in stages if need be, and evidence accumulated and collected in portfolios.

Science 1.13: Demonstrate understanding of the formation of surface features in New Zealand

Students are assessed on the formation of surface features in New Zealand by linking external and internal geological processes.

The surface features can be chosen from any local or national features of interest. A field trip can form part of the assessment.

External geological processes involve erosion and weathering.

Internal processes involve relevant tectonic processes.

Science 1.14: Demonstrate understanding of carbon cycling

Students are assessed on the addition, removal and storage of carbon in short and long term biological, chemical and geological cycles.

Science 1.15: Demonstrate understanding of the effect on planet Earth of astronomical cycles

Students are assessed on how astronomical cycles directly affect different parts of the Earth's surface. These cycles result in day and night, seasons, phases of the Moon and tides. They also result in changes of temperature according to time of day, latitude, and season.

The heating effect of the Sun directly affects the formation and direction of winds and surface ocean currents.

Science 1.16: Investigate an astronomical or Earth science event

Investigating in the widest sense is assessed. Assessments may consist of practical investigations, field trips, research, or a combination of these.

Scientific evidence can be primary and/or secondary, and collected from a variety of sources such as direct observations, collection of experimental and/or field data, resource sheets, photos, videos, websites and reference texts.

An astronomical event can be selected from a historical or recent event, discovery or space probe exploration.

An Earth science event can be selected from a historical or recent event taken from geological science, marine science, atmospheric science or a combination of these.

Level Two standards:

ESS 2.1: Carry out a practical Earth and Space Science investigation

Internal, 4 credits

This assesses a practical investigation that can be a fair test, pattern seeking or modelling. Group development of the method and group collection of data is allowed.

ESS 2.2: Evaluate, from an Earth and Space Science perspective, information communicated to the public

Internal, 4 credits

Information presented to the public can be found in any forms of communication such as newspapers, books, journals, pamphlets, websites, television programmes, films, blogs, and advertisements.

ESS 2.3: Investigate geological processes in a New Zealand locality

Internal, 4 credits

A New Zealand locality is anywhere within the Zealandia continent.

Geological processes will include plate tectonics, the rock cycle and erosion.

ESS 2.4: Investigate how organisms survive in an extreme environment.

Internal, 4 credits

Organisms can be the same or different species including humans.

An extreme environment can be outer space, oceans, deep sea trenches, extremes of temperature or salinity, anaerobic conditions, excess exposure to radiation or toxic chemicals, geothermal vents.

Students are assessed on why the conditions of the extreme environment require special biological adaptations or technological modifications and how these allow the organism(s) to survive the extreme environment.

ESS 2.5: Demonstrate understanding of extreme Earth events

External, 4 credits

Extreme Earth events are naturally occurring geological, marine or atmospheric events or a combination of these.

Their effects on landforms and biological communities will be assessed.

ESS 2.6: Demonstrate understanding of stars and planetary systems

External, 4 credits

This standard assesses:

- characteristics of stars and their position on the Hertzsprung-Russel (HR) diagram
- stages in the birth, life and death of stars
- characteristics of planetary systems and stages in the formation of planets and moons

A planetary system refers to one star, its orbiting planets and associated moons

ESS 2.7: Demonstrate understanding of physical principles related to the Earth System.

External, 4 credits

Physical principles will be selected from

- Source and transport of solar and terrestrial heat
- Transmission, reflection, absorption, and scattering of visible and infra-red electromagnetic radiation
- Density
- Coriolis effect
- Cycling of matter

The Earth System consists of the hydrosphere, atmosphere, geosphere and biosphere.

Level Three standards:

ESS 3.1: Conduct a practical Earth and Space Science investigation

Internal, 4 credits

This assesses a practical investigation that can be a fair test, pattern seeking or modelling. Group development of the method and group collection of data is allowed.

ESS 3.2 Investigate a socio-scientific issue in an Earth and Space Science context

Internal, 4 credits

The investigation will be done by:

- selecting a range of scientific information on the issue
- describing the issue and the impact on individuals and society
- describing a personal and societal response to the issue

- reporting on the findings and recording resources in a traceable format

ESS 3.3: Investigate the evidence relating to geological event/s

Internal, 4 credits

Evidence may include the geological time scale, relative dating methods, stratigraphy, unconformities, fossils and fossil succession, radiometric dating, stable isotopes, ice cores, sediment cores, tree ring data, magnetism in rocks, rock composition.

The geological events can be chosen from New Zealand or global event/s.

ESS 3.4: Demonstrate understanding of aspects of interactions between ocean and atmosphere

External, 4 credits

Interactions between ocean and atmosphere will involve:

- the absorption, storage and release of heat
- the storage and exchange of water
- the storage, solubility and exchange of carbon

Aspects will be selected from a range including:

- carbon and water cycles
- carbon dioxide flux - biological pump, solubility pump
- role of solar energy in driving atmospheric and oceanic circulation
- temperature gradient and variations in atmosphere and ocean

ESS 3.5: Demonstrate understanding of the impact of human activity on the Earth System

External, 4 credits

Human activity could negative or positive such as fossil fuel combustion and sustainable practices.

Impacts may be consequences such as climate change, ocean acidification and the extinction of species.

ESS 3.6: Investigate an aspect of astronomy

Internal, 4 credits

An aspect can be events, discoveries, phenomena, principles or knowledge gained from space probes or telescopes

ESS 3.7: Demonstrate understanding of waves applied to Earth and Space contexts

External, 4 credits

Sound, electromagnetic radiation, earthquake and water waves will be assessed.