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Curriculum Centre

Chemistry and Biology NCEA NZC Level 1
Subject Learning Outcomes for Assessment of 1.1 and 1.3

Companion to the Chemistry and Biology 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 (92020): Demonstrate understanding of the relationship between a microorganism and the environment (5 Credits)

What is being assessed	Subject Learning Outcomes
Life processes of a microorganism	Students are able to: • describe a life process of a microorganism. This could include any physiological function of a microorganism, including (but not limited to) movement, respiration, sensitivity, growth, reproduction, excretion, or nutrition. The microorganism does not need to meet the full definition of 'living' but must undertake some of the processes which are characteristic of living organisms. A description could include drawing and labelling the structure of a microorganism, creating an annotated diagram to illustrate a process or structure, or describing an associated concept such as viral mutation, development of antibiotic resistance, or the equation for anaerobic or aerobic respiration. Examples of a life process include methods of gaining nutrients through hyphae in fungi, excretion of waste in bacteria, or replication of a virus. Examples of microorganisms include bacteria, fungus, virus, algae, and protozoa. ○ For higher levels of achievement, students are able to link the life process of the microorganism to a change in the environment. This might involve explaining, then analysing the interconnected relationship between a microorganism and the environment it lives in. For example, explaining then analysing how the respiration of decomposers changes the temperature of compost; or an algal population changes the oxygen available to other living things in waterways; or waste excreted by bacteria changes the pH of an environment. An explanation or analysis could include the use of models or graphs (such as growth curves of microorganisms) to explain phases in relation to changes in the environment.
Abiotic and biotic factors in an interconnected environment	Students are able to: • describe abiotic and/or biotic factors of an interconnected environment that affect the life process of a microorganism. Abiotic and biotic factors include (but are not limited to) water or oxygen availability, optimum temperature, optimum pH, nutrient availability, species interactions such as interspecific and intraspecific competition, and predation. Nutrient availability as an abiotic factor in an interconnected environment could include why nutrient cycles (such as the carbon and nitrogen cycles) are essential for an ecosystem to function. ○ For higher levels of achievement, students are able to demonstrate understanding of the interconnected environment by explaining how the life process of a microorganism affects an

	abiotic or biotic factor of the environment. Interconnected environments are those that support a community where a microorganism interacts as part of a system, such as the human body, a food production process, or an ecosystem.
Relationship between environment and microorganism	Students are able to: • describe the relationship between an abiotic or biotic factor of the interconnected environment and a life process of a microorganism. For example, how oxygen in the environment affects respiration, or how light intensity affects photosynthesis. Other examples of factors that affect life processes of microorganisms include moisture, pH, nutrient availability, salt concentration, sugar concentration, interspecific competition, and intraspecific competition. ○ For higher levels of achievement, students are able to explain, then analyse the two-way interrelationship between an environmental condition and a life process of a microorganism. This would include explaining how the environment affects a life process, and how the life process in turn affects an abiotic or biotic factor of the interconnected environment. For example, a student could discuss how a change to a life process results in an increase or decrease in the microorganism population by showing how increased nutrient levels in a compost heap have an effect on the rate of respiration or reproduction in decomposers. The decomposers will also affect the environment, causing an increase in temperature of the compost heap. Examples of other contexts include the spread and control of disease, microorganisms in wetland or pond ecosystems, and the use of fermentation for beverages and food such as making ginger beer, kombucha, poi, rēwena, yoghurt, or cheese.
Use of observations	Students are able to: • use observations to support a description of an abiotic or biotic factor that affects a life process of a microorganism. Observations could include primary and/or secondary data. For example, using observations from investigations they have done in class, or evidence from literary research, to illustrate changes or disruptions to the environment that affect the life process of the microorganism. ○ For higher levels of achievement, these observations should be matched to the underlying science of the microorganism and/or the effect of the microorganism on the environment.

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Achievement Standard 1.3 (92022): Demonstrate understanding of genetic variation in relation to an identified characteristic (5 Credits)

What is being assessed	Subject Learning Outcomes

The source and the nature of genetic variation	Students are able to:
	• describe a source as the origin or factor that significantly contributes to genetic variation, for an individual or population
	  ○ For an individual, examples of a source include mutation or sexual reproduction. This could link to concepts such as the species concept, the nature of a genetic code, the relationship between DNA, alleles, genes, chromosomes, and that heredity occurs because DNA is passed on to the next generation.
	  ○ Where applicable, students may be able to use deeper knowledge when describing the source and nature of genetic variation by linking this to concepts such as the discovery of heredity, DNA, and that DNA manipulations were the result of the work of many scientists over a long period of time.
	  ○ For a population, examples of a source of genetic variation include small population size (such that variation can occur at different rates and make populations different to each other, leading to variation in the species), migration or non-random mating, and differing rates of survival (when differences in the ability of individuals to survive is caused by the effect of the environment acting on different phenotypes).
	• identify the source and nature of genetic variation linked to an identified characteristic.
	  ○ The nature of genetic variation can be identified as the affect or outcome caused by changes in genetic variation over time, in an individual or population. For example, beneficial due to increased disease resistance for an individual or population, or negative due to increased predation resulting from increased prevalence of albinism in populations of wild animals.

How and why the genetic variation occurs	Students are able to: • use knowledge of the way in which genotype determines phenotype, and link the source and nature of variation to different phenotypes. This involves explaining how differences between the genetic code of individuals relate to genetic variation and explaining that there are different phenotypes (traits) within species. This may involve explaining how combinations of different alleles result in different phenotypes, whereas environmental change to phenotype is not inherited. For example, this could include variation

	that results from sexual reproduction and mutations, and relate to advantages and disadvantages of sexual reproduction. Explaining sexual reproduction may include the implications of paired chromosomes, independent assortment, and crossing over. Explaining mutation may include the effect of new phenotype(s) on the survival of individuals or populations. ○ For higher levels of achievement students are able to explain how and why the genetic variation occurs, in relation to an identified characteristic. For example, prevalence of a disease, identification of inbred populations, or finding specific individuals in a population, such as during a forensic investigation.
Identifying genetic relationships through the use of a gene tracking methodology	Students are able to: • use knowledge of the conserved nature of DNA structure to explain how genetic variation can be used to trace inheritable characteristics ○ For higher levels of achievement, students are able to discuss how tracking of genetic variation can meet a purpose, for example a potential health outcome. The discussion will evaluate the findings when identifying genetic relationships between individuals, populations, and/or communities for a purpose. For example, explaining why genetic variation is important to the survival of a population within a changing environment. A changing environment could be caused by factors such as pest infestation, disease, drought, or flood. • show that a gene or trait can be tracked across generations for a given purpose, with an understanding of how genetic variation of a population can change over time. For example, this might include descriptions of: ○ Punnett squares to predict results of monohybrid crosses, and genotypic and phenotypic ratios ○ phylogenetic trees to trace heredity ○ pedigree charts to trace heredity ○ genetic markers (DNA sequences) used in tracking inheritance of a trait ○ use of specific DNA sequences to identify the genetic source of a trait and/or compare relatedness of individuals with and across species.