Te Poutāhū
Curriculum Centre

Chemistry and Biology NCEA NZC Level 1
Subject Learning Outcomes for Assessment of 1.2 and 1.4

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.

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Achievement Standard 92021 (1.2)	Demonstrate understanding of chemical reactions in context	Credits: 6
What is being assessed	**Specific Learning Outcome (Students are able to….)**	
Understanding the nature of the different particles involved in chemical reactions	• justify the charge on a monatomic ion when it is formed from an atom to achieve a stable (full) valence shell of electrons • justify the ratio of ions (monatomic and polyatomic) in the formula of ionic compounds, by explaining how the charges of the component ions cancel out to give an uncharged compound • recognise that ionic compounds are formed when non-metal atoms gain electrons from metal atoms so that both achieve stable (full) valence shell of electrons • recognise that molecules are formed by non-metal atoms sharing valence electrons to achieve stable (full) valence shells of electrons	
Interpreting chemical equations	• recognise the relevance of subscripts, brackets and coefficients in chemical formulae on the number of each type of atoms present • recognise that the ratio of reactants and products in a chemical reaction are represented by the coefficients in a balanced chemical equation • recognise that one reactant can determine the amount of product that is formed in a chemical reaction • recognise that different proportions of reactants sometimes change the products being formed	
Justifying conservation of mass	• recognise that atoms are neither created nor destroyed in chemical reactions but are rearranged to form new substances, as described by balanced chemical equations • recognise that total mass remains constant during a chemical reaction • analyse balanced chemical equations to show that there are the same number of atoms of each element on both sides of the equation	
Describing predictable patterns in a range of chemical reaction types (using observations and equations)	• link observations (primary or secondary data) to chemical species • identify a type of reaction from observations and provided equations (word or balanced chemical) • link a reduction in mass in a chemical reaction to the loss of a gaseous product • link an increase in mass in a chemical reaction to the inclusion of a gaseous reactant • link colour changes in a reaction to specific chemical species supported by use of a resource sheet • link colour change of litmus or universal indicator to a change in pH of a given solution • link a solid product when solutions are mixed to the formation of an insoluble precipitate	

	• use secondary tests to identify reaction products including carbon dioxide (limewater), oxygen (glowing splint) and water (cobalt chloride paper)
Interpreting patterns in neutralisation reactions	• use changes in pH to identify neutralisation reactions • link changes in pH to the relative concentrations of H^+ and OH^- present during a neutralisation reaction • link the formation of CO_2 gas to the presence of carbonate or hydrogen carbonate ions in a neutralisation reaction • explain the relationship between the acid and base reactants and the specific salt product of a neutralisation reaction
Interpreting patterns in combustion reactions	• contrast the flame colour and heat produced for complete and incomplete combustion reactions • relate the formation of carbon (“soot”), or colourless gases (carbon monoxide, carbon dioxide) to the extent of combustion occurring • justify using conservation of mass principles, how the amount of oxygen present can influence whether a fuel will undergo complete or incomplete combustion
Interpreting patterns in precipitation reactions	• relate solubility of ionic compounds to the relative strength of attractions between the ions and water molecules • use a table of solubility rules to predict the solubility of an ionic compound • predict and justify whether or not a precipitate will occur when two solutions of ionic compounds are mixed • identify the spectator ions present in a precipitation reaction
Interpreting patterns in combination reactions	• recognise that combination reactions between metal and non-metal elements will produce ionic compounds which are solids at room temperature • recognise that combination reactions between non-metal elements produce molecular compounds which are usually gaseous or liquid at room temperature
Interpreting patterns in decomposition reactions	• recognise that the products of a decomposition reaction depend on the types of atoms present in the reactant e.g. production of water requires H and O atoms and carbon dioxide requires C and O atoms to have been present • predict the products of a decomposition reaction using the generic equations provided e.g. a metal carbonate when heated produces a metal oxide and carbon dioxide
Justifying how each chemical reaction links to a context by referring to chemical equations,	• recognise that the impact of reactants and products in different contexts can depend on quantity and location eg; phosphates in soil can aid plant growth but run-off into waterways can cause algal blooms and the amount a cake rises depends on the quantity of baking soda added to the mixture.

reactants, products, predictable patterns and observations.	• link neutralisation reactions to people or the environment e.g. treating indigestion, soil and ocean acidification • link combustion reactions to people or the environment e.g. forest fires, LPG burners • compare and contrast the energy efficiency of complete and incomplete combustion e.g cars, Bunsen burner • link precipitation reactions to people or the environment e.g. water treatment processes, formation of kidney stones or stalactites • link combination reactions to people or the environment e.g. formation of rust or the production of SO_2 from the combustion of fossil fuels • link decomposition reactions to people or the environment e.g. baking or lime production, carbonic acid in sodas

Achievement Standard 92023 (1.4)	**Demonstrate understanding of how the physical properties of materials inform their use**	**Credits: 4**
What is being assessed	**Specific Learning Outcome (Students are able to….)**	
Describing physical properties of materials	• relate the position of an element in the periodic table to its metal or non-metal character • relate melting and boiling points to physical state (at a specified temperature) • relate melting and boiling points to the strength of attractions between particles • describe the physical properties of a material (density, thermal and electrical conductivity, melting/boiling points, solubility in water, malleability and hardness)	
Explaining the physical properties of molecular substances in terms of the arrangement of particles and the relative strength of attractive forces between them.	• describe the structure and bonding of a molecular substance as discrete molecules containing non-metal atoms held together by strong covalent bonds but with only weak attractions between the molecules • explain lack of electrical conductivity in terms of the absence of mobile, charged particles • relate low melting point and softness to the energy needed to overcome weak attractions between molecules • explain solubility in terms of the relative strength of attractions between particles and water molecules	
Explaining the physical properties of metallic solids in terms of the arrangement of	• describe the structure and bonding of a metallic solid as a 3-D network consisting of metal cations attracted to a common pool of delocalised, valence electrons • explain high density in terms of the close packed arrangement of the cations (atoms)	

particles and the relative strength of attractive forces between them.	• explain conductivity (thermal and electrical) in the solid and liquid states of metals in terms of the mobility of their delocalised, valence electrons • relate malleability to the ability of the layers of cations (atoms) to slide past each other without disrupting the metallic bond • recognise that properties of alloys such as hardness and melting point differ because the different sized cations (atoms) change the packing arrangement of the metal • relate high melting points and hardness to the strength of the metallic bond
Explaining the physical properties of ionic materials in terms of the arrangement of particles and the relative strength of attractive forces between them.	• describe the structure and bonding of an ionic solid as 3-D networks consisting of oppositely charged ions held together by strong electrostatic attractions • explain high density in terms of the close packed arrangement of the ions • explain electrical conductivity when molten or dissolved in water, in terms of the presence of charged ions that are free to move • describe solubility in terms of the relative strengths of attractions between particles and water molecules • explain brittleness in terms of the change in ionic interactions when a stress is applied • relate high melting points to the strength of the electrostatic attractions between oppositely charged ions
Explaining the physical properties of natural and synthetic polymers in terms of the arrangement of particles and the relative strength of attractive forces between them.	• describe the structure and bonding of polymers as large chain molecules made from repeating units with strong covalent bonds between atoms within the chain, but weaker attractions between the chains • relate melting points to the stronger intermolecular attractions between larger molecules • explain lack of electrical conductivity in terms of the absence of mobile, charged particles • link malleability to the ability of the chains to slip past each other relatively easily
Explaining the physical properties of covalent networks in terms of the arrangement of particles and the relative strength of attractive forces between them.	• describe the structure and bonding of covalent network solids such as diamond and silica as 3-D (or graphite as 2-D) networks consisting of atoms held together by strong covalent bonds • relate the very high melting points and hardness to the strength of the network of strong covalent bonds (with the exception of graphite's softness resulting from the weak attractions between the 2-D layers) • explain lack of electrical conductivity in terms of the absence of mobile, charged particles (with the exception of graphite's delocalised valence electrons between the 2-D layers) • relate insolubility to the strength of the covalent bonds compared to the weak attractions to water molecules

Evaluating the use of a material for a specific purpose	• relate the use of materials to their physical properties • evaluate the most appropriate material for a specific purpose • justify why a material is used for a specific purpose