

These lessons have been developed by teachers and geoscientists to complement teacher resource materials provided by the Saskatchewan Ministry of Education. Lesson plans can be downloaded from the SMA website saskmining.ca

Grade 4 Science: Rocks, Minerals and Erosion

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
RM4.1 Investigate physical properties of rocks and minerals, including those found in their local environment. [CP, SI]	
a) Pose questions about the properties of rocks and minerals (e.g., What is the difference between rocks and minerals? Where do we find rocks and minerals? Do rocks become minerals?).	
b) Document the locations and characteristics of rocks that exist in their local environment.	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Is There Potash Under My Feet? The Rock Cycle Journey and Mineral Deposits (Indirect)
c) Observe and record physical properties of rocks and minerals such as colour, texture, lustre, hardness, cleavage, transparency, and crystal structure..	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash
d) Use appropriate tools (e.g., hand lens, safety glasses, brush, rock pick, knife, and gloves) safely while making observations and collecting information on the physical properties of rocks and minerals.	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash
e) Demonstrate respect for all components of their environment when observing and collecting rocks and minerals.(e.g., do not remove rocks and minerals from private property without permission)	
f) Demonstrate processes for testing the hardness of rocks, including reference to guides such as Moh's scale of mineral hardness	Potash Solution Mining: Dissolving Potash
g) Record observations of rocks and minerals using jot notes, labelled diagrams, and charts.	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash
h) Compare the physical properties of rocks and minerals from their local environment with those from other geological areas.	
i) Develop their own classification scheme to organize their understanding of rocks and minerals.	
j) Account for any variation between their classification schemes of rocks and minerals and those of classmates, Elders, traditional knowledge keepers, geologists, or from other resources.	
k) Differentiate between rocks and minerals.	Potash Solution Mining: Dissolving Potash
l) Develop simple generalizations about the physical characteristics of rocks and minerals based on observation and research.	
RM4.2 Assess how human uses of rocks and minerals impact self, society, and the environment. [DM]	
a) Discuss ways in which people of different cultures value, respect, and use rocks and minerals, including First Nations and Metis connections to Mother Earth.	History of Mining Early Mining Saskatchewan Reference material The Rock Cycle Journey and Mineral Deposits (Extension 1.)
b) Identify objects in their local environment that are made from rocks and minerals (e.g., nickel, table salt, pottery, cement, brick, jewellery, bicycle, nutrients, battery, copper wiring, soda can, plumbing pipe, and sidewalk).	Potash, What is it? Rocks and Minerals in Your Life
c) Research historical (e.g., flint arrowheads, gold jewellery, paint pigments, and coal heating) and contemporary (e.g., fertilizer, building products, ceramics, glass, salt, silver fillings, and electronics) uses for rocks and minerals in Saskatchewan.	History of Mining Early Mining Saskatchewan Reference material

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
d) Suggest alternative materials that could be used to create everyday objects or propose new uses for rocks and minerals.	Rocks and Minerals in Your Life
e) Relate uses for rocks and minerals to characteristics such as functionality, mineral shape, cost, availability, and aesthetics.	
f) Identify locations where minerals, including potash, sodium sulphate, salt, kaolin, uranium, copper, coal, diamond, and gold, are extracted in Saskatchewan.	Potash Solution Mining Is There Potash Under My Feet? Mineral Potential and Mines in Saskatchewan The Rock Cycle Journey and Mineral Deposits
g) Discuss economic benefits associated with mineral extraction and refining, including related careers, in Saskatchewan.	Potash, What is it? Sustainability – Decision Making Finders, Miners? Careers in the Minerals Industry
h) Analyze issues related to the extraction and use of minerals from the perspectives of various stakeholders (e.g., company owner, employee, scientist, Elder, environmental group, and end user).	Sustainability – Decision Making (indirect) Finders, Miners?
i) Research ways in which products made from rocks or minerals can be recycled and reused.	
j) Suggest methods of reclaiming resource extraction sites (e.g., quarry, strip mine, open pit mine and hard rock mine) to reduce short-term and long-term impacts on communities and the environment.	Cookie Mining
k) Assess their own and their family's impact on natural resources based on their current lifestyle.	Potash, What is it? Sustainability – Decision Making (indirect)
RM4.3 Analyze how weathering, erosion, and fossils provide evidence to support human understanding of the formation of landforms on Earth.	
c) Explain how rocks can be classified as igneous, sedimentary, or metamorphic based on the process by which they form.	The Rock Cycle Journey and Mineral Deposits

Grade 4 Social Studies: Resources and Wealth

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
RW4.3 Assess the impact of Saskatchewan resources and technological innovations on the provincial, national, and global communities	
a) Represent on a map the major resources in Saskatchewan (e.g., minerals, potash, oil, uranium, natural gas, lumber, water, crop, and livestock production).	Mineral Potential and Mines in Saskatchewan
b) Locate on a map the major industries in Saskatchewan (e.g., agriculture processing, mining, manufacturing, forestry products, energy refinement, tourism, livestock production).	Mineral Potential and Mines in Saskatchewan
c) Identify the natural resources and industries found in the local community, and analyze their impact upon the community.	Sustainability – Decision Making
d) Illustrate the goods made from the major natural resources, the consumers of those goods and the export destinations.	Rocks and Minerals in Your Life
f) Examine the environmental impact of the development of natural resources on the local community, the province, and the world	Sustainability – Decision Making

Grade 5 Science: Properties and Changes of Materials

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
MC5.3 Assess societal and environmental impacts that result from the production, use, and disposal of raw materials and manufactured products.	
c) Research a product to determine the raw materials from which it is made, and describe the changes required to the natural materials to manufacture the product.	Rocks and Minerals in Your Life

Grade 5 Social Studies: Resources and Wealth

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
RW5.1 Explain the importance of sustainable management of the environment to Canada's future.	
a) Differentiate between renewable resources (e.g., forests, fish, water) and non-renewable resources (e.g., oil, minerals) (Indirect)	Sustainability –Decision Making
b) Create an inventory of current non-sustainable practices (e.g., presence of plastics, packaging, dumping of waste into river systems). (Indirect)	Sustainability –Decision Making
c) List the possible consequences of non-sustainable practices related to the use of resources (e.g., lack of resources for future generations, endangered species, climate change).	Sustainability –Decision Making
d) Taking one resource as an example, illustrate how resource use and the extraction process of the resource affects the environment (e.g., forests, tar sands, coal, uranium, potash).	Sustainability –Decision Making
e.) Give examples of policies and actions that contribute to sustainability (e.g., water conservation, informed decisions by consumers, reusing materials).	Sustainability –Decision Making

Grade 6 Career Education: Connections to Communities

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
CC6.1 Investigate various aspects of careers and their requirements.	
b) Examine at least one occupation through an exploration of work information such as occupational description, working conditions, earnings, and education/training requirements.	Career Activity Investigating Careers in the Minerals Industry
c) Utilize various sources of information such as parents, relatives, community members, newspapers, and digital resources.	Career Activity Investigating Careers in the Minerals Industry
h) Describe various work roles (such as labourer, entrepreneur, manager) and settings (such as outside, office tower, manufacturing plant) of interest to oneself.	Career Activity Investigating Careers in the Minerals Industry

Grade 6 Social Studies: Resources and Wealth

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
RW6.1 Contribute to initiating and guiding change in local	

and global communities regarding environmental, social, and economic sustainability.	
a) Represent through visual art, music, dance, writing, or other representation the contribution of individuals and communities to initiate change that supports sustainability. (indirect)	Sustainability – Decision Making
b) Investigate how individual local consumer choices may affect people elsewhere in the world (e.g., child labour, enslavement, sweat shops, consumption of scarce resources, prosperity through employment). (indirect)	Sustainability – Decision Making

Grade 7 Science: Mixtures and Solutions

Saskatchewan Learning Outcomes and Indicators	Lesson and Activity Correlation
MS7.1 Distinguish between pure substances and mixtures (mechanical mixtures and solutions) using the particle model of matter. [SI, CP]	
a) Examine a variety of objects and materials, and record qualitative (e.g., colour, texture, and state of matter) and quantitative (e.g., density, melting point, and freezing point) physical properties of those objects in a chart or data table.	Potash Solution Mining: Dissolving Potash Physical Separation of Minerals Sizing and Separation of Mixtures
b) Describe the characteristics of pure substances, mechanical mixtures, and solutions.	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Potash Solution Mining: How Do We Know Its KCl? Physical Separation of Minerals
c) Construct a graphic organizer for the classification of matter that includes mixtures, pure substances, elements, compounds, mechanical mixtures, and solutions.	
d) Classify common substances (e.g., Kool-Aid, vinegar, bubble bath, soft drinks, juice, chocolate chip cookies, salad dressings, hand lotion, shampoos, tea, bread, soil, and concrete) as pure substances, mechanical mixtures, or solutions.	
e) Listen to and consider the ideas of classmates when classifying materials as pure substances or mixtures.	
f) Create mechanical mixtures and solutions using common materials and compare the physical properties of the original materials and the resultant mixture or solution.	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash
g) State the four main ideas of the particle model of matter.	
h) Create models and/or physical representations that depict the nature of particles in pure substances, mechanical mixtures, and solutions according to the particle model of matter.	
i) Analyze the usefulness of personally constructed representations of particles and the strengths and limitations of models in science generally.	Potash Solution Mining Model
j) Generate questions related to differences between mixtures and solutions and rephrase in a testable form (e.g., rephrase a question such as "How sweet is iced tea?" to "What is the most iced tea that can be dissolved in 500 mL of water at 23°C?").	
MS7.2 Investigate methods of separating the components of mechanical mixtures and solutions, and analyze the impact of industrial and agricultural applications of those methods. [SI, TPS]	
a) Describe methods used to separate the components of mechanical mixtures and solutions, including mechanical sorting, filtration, evaporation, distillation, magnetism, and chromatography.	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Potash Solution Mining: How Do We Know Its KCl? Potash Solution Mining Model Physical Separation of Minerals Sizing and Separation of Mixtures
b) Trace the historical development of a technology or process	

used to separate mixtures (e.g., settling, sifting, filtering, fusion, distillation, and chromatography).	
c) Describe common household examples of technologies that are used to separate components of mechanical mixtures or solutions (e.g., kitchen strainer, oil and air filters).	
d) Design and conduct an experiment to determine the effectiveness and/or efficiency of one or more methods of separating mechanical mixtures and solutions.	Potash Solution Mining Model Physical Separation of Minerals Sizing and Separation of Mixtures
e) Report the strengths and limitations of a chosen experimental design to determine the effectiveness and/or efficiency of one or more methods of separating mechanical mixtures and solutions.	Physical Separation of Minerals Sizing and Separation of Mixtures
f) Use tools and apparatus (e.g., safety glasses, glassware, and Bunsen burners) safely when conducting investigations into methods of separating mixtures.	
g) Demonstrate knowledge of WHMIS standards by using proper techniques for handling and disposing of lab materials and following warning label symbols, including common household product symbols, when separating mixtures.	
h) Describe the scientific principles underlying a past or present industrial technology designed to separate mixtures (e.g., petroleum refining, sewage treatment plant, recycling station, combine, and cream separator).	Potash Solution Mining Model
i) Discuss intended and unintended consequences of a particular industrial or agricultural technology or process used for separating materials.	Potash Solution Mining: Recovering Dissolved Potash Sustainability – Decision Making (indirect) Physical Separation of Minerals
j) Use a technological problem-solving process to design, construct, and evaluate a prototype of a process or device for separating a mechanical mixture or solution (e.g., purifying drinking water, separating household waste).	Potash Solution Mining Model Physical Separation of Minerals
k) Identify new questions and problems that arise from what was learned about solutions and mixtures (e.g., “Are there mixtures that cannot be separated?”, “What techniques are used to remove pollutants from air and water?”), including questions that science cannot answer.	
MS7.3 Investigate the properties and applications of solutions, including solubility and concentration. [SI, DM]	
a) Provide examples of solid, liquid, and gaseous solutions and identify which substance is the solute and which is the solvent in each solution.	Potash Solution Mining: Dissolving Potash
b) Describe the characteristics of solutions using the terms solute, solvent, soluble, and insoluble, based on the particle model of matter.	
c) Create and describe the concentration of student-prepared dilute, concentrated, saturated, and supersaturated solutions using those qualitative terms and quantitative measurements (e.g., parts per million [ppm], g/L, and g/100 mL).	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash
d) Value accuracy, precision, and honesty when collecting and reporting data related to concentrations of solutions.	
e) Investigate the factors that determine how quickly a solute dissolves in a solvent.	Potash Solution Mining: Dissolving Potash
f) Gather and interpret information from various resources (e.g., nutrition labels on foods, newspaper or magazine articles) related to solutions and concentrations of solutions.	
g) Design and implement an experiment to investigate the effect of temperature on the solubility of a solution.	
h) Predict the solubility of a solute by interpolating or extrapolating from student-generated solubility curves.	
i) Analyze the effects of technological inventions or processes related to solutions (e.g., water softeners, water treatment plants, solution mining, agricultural sprays, insecticides, bleaches, and drain cleaners) on self, community, and the environment.	Potash Solution Mining: Recovering Dissolved Potash
j) Research how various science disciplines and engineering fields study and apply scientific knowledge related to solutions.	Potash Solution Mining: How Do We Know Its KCl? Ext'n Exploring for Minerals in Saskatchewan: Stream Sediment and Soil Sampling
l) Assess environmental and economic impacts of past and current land use practices in Saskatchewan (e.g.,	Sustainability – Decision Making (indirect)

agriculture, urban development, recreation, and road construction), and describe intended and unintended consequences of those practices on self, society, and the environment, including soil degradation. (Indirect)	
--	--

Grade 7 Science: Earth's Crust and Resources

Saskatchewan Learning Outcomes and Indicators	Lesson and Activity Correlation
7ECR7.1 Analyze societal and environmental impacts of historical and current catastrophic geological events, and scientific understanding of movements and forces within Earth's crust.	
c) Construct a visual representation of the composition of Earth, including the crust, upper and lower mantle, core, and inner core. (Indirect)	Looking into the Earth: Seismic Surveys in Mineral Exploration (Pilot) Geophones: I Heard That! (Pilot)
h) Explain the operation of tools scientists use to measure and describe the effects of catastrophic geological events, including earthquakes and volcanoes (e.g., seismograph, Mercalli intensity scale, and Richter magnitude scale).(Indirect)	Looking into the Earth: Seismic Surveys in Mineral Exploration (Pilot) Geophones: I Heard That! (Pilot)
EC7.2 Identify locations and processes used to extract Earth's geological resources and examine the impacts of those locations and processes on society and the environment.	
a) Identify questions to investigate arising from practical problems and issues related to the study of Earth's geological resources (e.g., "What types of rocks are best for cement-making or road construction?" and "What are some environmental concerns related to open-pit mining?").	Potash Solution Mining Model
b) Distinguish between rocks and minerals using physical samples, pictures, and/or video recordings and identify the minerals most often found in rocks in Saskatchewan and around the world (e.g., quartz, calcite, feldspar, mica, hornblende).	Potash Solution Mining: Dissolving Potash Mineral Properties (MAP)
c) Classify rocks and minerals based on physical properties such as colour, hardness, cleavage, lustre, and streak.	Potash Solution Mining: Dissolving Potash Mineral Properties (MAP)
d) Identify locations of Saskatchewan's primary mineral resources (e.g., potash, gold, diamond, salt, uranium, copper, and graphite) and their primary uses.	Is There Potash Under My Feet? Mineral Potential and Mines in Saskatchewan Rocks and Minerals in Your Life Coal Mining – Surface Strip Mining The Rock Cycle Journey and Mineral Deposits Saskatchewan Resource Match (MAP)
e) Relate processes used to extract primary mineral resources in Saskatchewan (e.g., open-pit mining, underground mining, and solution mining) to the location, type, and depth of the resource.	Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Is There Potash Under My Feet? Potash Solution Mining Model Coal Mining – Surface Strip Mining Cookie Mining
f) Provide examples of technologies used to further scientific research related to extracting geological resources (e.g., satellite imaging, magnetometer, and core sample drilling).	Exploring for Minerals in Saskatchewan: Geophysics – Using Magnetics to Find a Mine. Exploring for Minerals in Saskatchewan: Stream Sediment and Soil Sampling. Finders, Miners? Mineral Exploration and Core Sampling Core Sampling and Ore Deposits Gold Exploration Looking into the Earth: Seismic Surveys in Mineral Exploration (Pilot) Geophones: I Heard That! (Pilot)
g) Evaluate different approaches taken to answer questions, solve problems, and make decisions when searching for geological resources within Earth (e.g., trial-and-error prospecting versus core sampling).	Exploring for Minerals in Saskatchewan: Geophysics – Using Magnetics to Find a Mine. Exploring for Minerals in Saskatchewan: Stream Sediment and Soil Sampling. Finders, Miners? Mineral Exploration and Core Sampling Core Sampling and Ore Deposits Gold Exploration
h) Provide examples of Canadian contributions to the	Rocks and Minerals in Your Life

scientific understanding and technological developments related to surface and sub-surface geology and mining, and identify societal and economic factors that drive such exploration and research.	Saskatchewan Resource Match (MAP) Looking into the Earth: Seismic Surveys in Mineral Exploration (Pilot) Geophones: I Heard That! (Pilot)
i) Suggest solutions to economic and environmental issues related to the extraction of geological resources in Saskatchewan (e.g., managing mine tailings and pollutants; reclaiming open pit mining sites; ecological impact of pipelines; resource depletion; maintaining water quality; and increasing urbanization).	Potash Solution Mining: Recovering Dissolved Potash Sustainability – Decision Making Finders, Miners?
j) Identify uses for rocks and minerals, such as healing, recuperative powers, and ceremonies, which include ideas not explained by science.	
k) Research Saskatchewan careers directly and indirectly related to resource exploration.	Career Activity Investigating Careers in the Minerals Industry Mineral Exploration and Core Sampling (MAP) Gold Exploration Core Sampling and Ore Deposits
EC7.3 Investigate the characteristics and formation of the surface geology of Saskatchewan, including soil, and identify correlations between surface geology and past, present, and possible future land uses. [DM, SI]	
c) Construct a visual representation of the rock cycle (e.g., formation, weathering, sedimentation, and reformation) and relate this representation to the surface geology of Saskatchewan and Canada.	The Rock Cycle Journey and Mineral Deposits

Grade 7 Social Studies: Resources and Wealth

Saskatchewan Learning Outcomes and Indicators	Lesson and Activity Correlation
RW7.2 Investigate the influence of resources upon economic conditions of peoples in circumpolar and Pacific Rim countries.	
b) Identify the locations of natural resources of circumpolar and Pacific Rim countries using appropriate maps, and analyse the impact of the resources on local communities.	Mineral Potential and Mines in Saskatchewan – Indirectly
RW7.3 Assess the ecological stewardship of economies of Canada and the circumpolar and Pacific Rim countries.	
b) Define the word “sustainable”, and discriminate between the concepts of sustainable and unsustainable as they apply to resources and industry.	Sustainability – Decision Making
c) Examine the sustainability of the economies of a selection of circumpolar and Pacific Rim countries, and propose practices which might increase the level of sustainability. (Indirect)	Sustainability – Decision Making

Grade 7 Mathematics

Saskatchewan Learning Outcomes and Indicators	Lesson and Activity Correlation
N7.2 Expand and demonstrate understanding of the addition, subtraction, multiplication, and division of decimals to greater numbers of decimal places, and the order of operations.	
f) Solve a problem involving the multiplication or division of decimal numbers with more than a 2-digit multiplier or 1-digit divisor (whole number or decimal), with the use of technology.	Coal Mining – Surface Strip Mining
N7.4 Expand and demonstrate an understanding of percent to include fractional percents between 1% and 100%.	

c) Solve a problem that involves finding a percent.	Coal Mining – Surface Strip Mining
d) Solve a problem that involves finding percents of a value.	Coal Mining – Surface Strip Mining

Grade 7 Career Education: Connections to Communities

Saskatchewan Learning Outcomes and Indicators	Lesson and Activity Correlation
CC7.1 Reflect on and express insights about how knowledge and skill learned in school transfer to one's future life and work.	
a) Research to identify the skills, knowledge and abilities needed in specific economic sectors such as manufacturing, agriculture, business or mining.	Investigating Careers in the Minerals Industry Careers Activity
f) Research and report on some key occupations available in the various economic sectors in Canada as represented by sector councils	Investigating Careers in the Minerals Industry Careers Activity

Grade 7 Career Education: Life and Work Plan

Saskatchewan Learning Outcomes and Indicators	Lesson and Activity Correlation
LW7.1 Investigate and demonstrate the personal qualities and abilities needed to seek, obtain or create work.	
c) Compare advantages and disadvantages of secondary and post-secondary programs for the attainment of career goals including university, college, apprenticeship, and entrepreneurship.	Investigating Careers in the Minerals Industry Careers Activity

Grade 9 Science: Atoms and Elements

Saskatchewan Learning Outcomes and Indicators	Lesson and Activity Correlation
AE9.1 Distinguish between physical and chemical properties of common substances, including those found in household, commercial, industrial, and agricultural applications	
d) Investigate common materials and describe them in terms of their physical properties such as smell, colour, melting point, boiling point, density, solubility, ductility, crystal shape, conductivity, hardness, lustre, texture, and malleability.	Mineral Recipes
e) Classify substances found in household, commercial, industrial, and agricultural applications based on their physical and/or chemical properties.	Mineral Recipes
k) Provide examples to illustrate that scientific and technological activity related to chemistry takes place in a variety of individual and group settings within Saskatchewan. (indirect)	Mineral Recipes
AE9.3 Demonstrate an understanding of the classification of pure substances (elements and compounds), including the development and nature of the Periodic Table.	
a) Differentiate between elements, compounds, and mixtures (mechanical mixtures and solutions), with reference to the terms homogenous and heterogeneous.	Mineral Recipes
d) Identify examples of common elements (e.g., first 18 elements and K, Ca, Fe, Ni, Cu, Zn, I, Ag, Sn, Au, W, Hg, Pb, and U), and compare their atomic structure and physical and chemical properties.	Mineral Recipes

g) Write and interpret chemical symbols or formulae of common elements and compounds and identify the elements and number of atoms of each in a given compound (e.g., He, Na, C, H ₂ O, H ₂ O ₂ , CO, CO ₂ , CaCO ₃ , SO ₂ , FeO, NO ₂ , O ₃ , CH ₄ , C ₃ H ₈ , NH ₃ , NaHCO ₃ , KCl, HCl, H ₂ SO ₄ , ZnO, and NaCl).	Mineral Recipes
--	-----------------

Grade 9 Career Education: Connections to Community

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
CC9.1 Investigate and demonstrate the personal qualities and abilities needed to seek, obtain or create work.	
b) Demonstrate how education and training interests relate to various options regarding post-secondary programs, workplace training, and/or entry into the workforce	Investigating Careers in the Minerals Industry Careers Activity
CC9.2 Analyze and express one's own understanding of how societal and economic needs influence the nature of paid and unpaid work.	
a) Utilize career information resources such as occupation classification systems, labour market information, mass media, and Internet-based information delivery systems to analyze the realities and requirements of various work roles	Investigating Careers in the Minerals Industry Careers Activity

Grade 10 Science: Chemical Reactions

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
SC10-CR1 Explore the characteristics of a variety of chemical reactions, including the role of energy	
c. Observe and describe a variety of chemical reactions, including synthesis, decomposition, combustion, single replacement, double replacement and acid base neutralization	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)
g. Research practical examples of chemical reactions involving acids and bases, including neutralization reactions such as those involved in chemical spills, soda-acid fire extinguishers, and antacids	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)
SC10-CR2 Name and write common formulas for common ionic and molecular chemical compounds, including acids and bases	
k. Describe how the pH scale is used to classify substances as acidic, basic or neutral	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)

Grade 10 Science: Climate and Ecosystems Dynamics

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
SCI10-CD1 Assess the consequences of human actions on the local, regional, and global climate and the sustainability of ecosystems.	Sustainability – Decision Making
a. Pose questions or problems relating to the effects of human actions on global climate change and the sustainability of ecosystems that arise from personal research. (Indirect)	Sustainability – Decision Making
b. Reflect upon your personal view of humanity's relationship	Sustainability – Decision Making

with the environment. (Indirect)	
e. Discuss why it is important to consider economic, social justice, and environmental perspectives when examining sustainability.	Sustainability – Decision Making
f. Select, integrate, and analyze the validity of information from various human, print, and electronic sources (e.g., government publications, community resources, and personally collected data), with respect to sustainability, sustainable development, and education for sustainable development.	Sustainability – Decision Making

Environmental Science 20:

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
Career Exploration	
ES20-CE1 Analyze and explore environmental science related career paths in Saskatchewan, Canada and the world	Investigating Careers in the Minerals Industry Careers Activity
Human Population and Pollution	
ES20-HP1 Investigate technologies and processes used for mitigating and managing resource use, waste generation and pollution associated with a growing human population.	
c. Investigate technologies which support sustainability in industries such as agriculture, forestry, aquaculture, and mining. (indirect)	Sustainability – Decision Making
d. Identify mitigation technologies and processes that have been developed to minimize the impacts of mining operations on water quality and quantity. (Indirect)	Sustainability – Decision Making
g. Describe technologies and processes that have been developed to minimize the impacts of mining, forestry and/or agricultural operations on air, water and soil quality and quantity.	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)
Atmosphere and Human Health	
ES20-AE2 Assess the importance of maintaining healthy water for humans and the environment.	
g. Research the sources, effects, and management and mitigation strategies of contaminants such as pathogens, organic matter, heavy metals, sediment, heat, petrochemicals and inorganic chemicals such as pesticides in aquatic and/or marine ecosystems.	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)

Physical Science 20:

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
Science in Saskatchewan	
PS20-SS1 Analyze and explore physical-science related career paths in Saskatchewan, Canada and the world	Investigating Careers in the Minerals Industry Careers Activity

Foundations of Chemistry	
PS20-FC1 Predict products of the five basic types of chemical reactions and evaluate the impact of these reactions on society	
a. Observe and analyze synthesis, decomposition, combustion, single replacement and double replacement (including acid base neutralization) reactions.	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)
k. Research examples of the uses of the five types of reactions relevant to industry, mining, and/or agriculture in Saskatchewan.	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)
PS20-FC2 Construct an understanding of the mole as a unit for measuring the amount of substance	
h. Prepare solutions of known concentration using molarity and dilution calculations (<i>applicable if students make their own solutions</i>)	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)
i. Research the application of solutions in industry, mining, and agriculture.	Uranium Processing - Removing Heavy Metals from the Wastewater (Raffinate)
PS20-FC3 Use stoichiometry to determine the relative amounts of substances consumed and produced in chemical reactions.	Potash Solution Mining Lesson Plans: See Chemistry 30 Solubility and Solutions and Grade 7 Mixtures and Solutions

Earth Science 30: (August 2016)

Saskatchewan Learning Outcomes and Indicators	Lesson and Activity Correlation
Career Exploration	
ES30-CE1 Analyze and explore earth-science related career paths in Saskatchewan, Canada and the world	Investigating Careers in the Minerals Industry Careers in the Minerals Industry Activity
Foundations of Earth Science	
ES30-FO1 Examine the multi-disciplinary nature of earth science.	
f. Provide examples of how earth scientists collect evidence using analytical, field, theoretical, experimental and modeling studies. (STSE)	Exploring for Minerals in Saskatchewan: Geophysics – Using Magnetics to Find a Mine. Exploring for Minerals in Saskatchewan: Stream Sediment and Soil Sampling. Mineral Exploration and Core Sampling Core Sampling and Ore Deposits Gold Exploration Looking into the Earth: Seismic Surveys in Mineral Exploration (Pilot) Geophones: I Heard That! (Pilot)Gold Exploration Activity
g. Identify how earth scientists draw upon principles and processes from scientific fields such as biology, chemistry, computer science, geology, mathematics, and physics in order to address their questions. (STSE)	Exploring for Minerals in Saskatchewan: Geophysics – Using Magnetics to Find a Mine. Exploring for Minerals in Saskatchewan: Stream Sediment and Soil Sampling. Gold Exploration Looking into the Earth: Seismic Surveys in Mineral Exploration (Pilot) Geophones: I Heard That!
Lithosphere	
ES30-LS1 Analyze surface geography as a product of weathering, erosion and mass wasting.	
h. Apply mapping techniques such as creating and interpreting topographic profiles and translating between 2-D surface maps/cross-sections and 3-D box diagrams to represent	Core Sampling and Ore Deposits

surface geographical features. (K)	
ES30-LS2 Examine the processes that lead to the formation of rocks and minerals.	
a. Differentiate the three main rock groups (i.e., sedimentary, igneous and metamorphic) by their processes of formation, including the roles of time, heat and pressure. (K)	The Rock Cycle Journey and Mineral Deposits
i. Explain how current potash (evaporite) and conventional oil deposits formed from inland shallow seas. (K)	See Grade 7 Earth's Crust and Resources for lesson plans: Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Is There Potash Under My Feet? Potash Solution Mining Model
j. Recognize the Precambrian deposits of uranium in the Athabasca Basin are erosional remains of the Hudsonian Mountains. (K)	Rock Cycle and Mineral Deposits
ES30-LS3 Investigate the processes and technologies used to locate and extract mineral resources and fossil fuels locally, provincially and globally.	
a. Identify the sub-surface geologic features associated with major mineral (e.g., gold, diamond, rare earth elements, copper, zinc, kaolin, potash, uranium, sodium sulphate and salt), building stone, aggregate and fossil fuel resources of Saskatchewan. (K, STSE)	Rock Cycle and Mineral Deposits
b. Identify the location, method of extraction, uses and economic impact of major fossil fuel and mineral (e.g., gold, diamond, rare earth elements, copper, zinc, kaolin, coal, potash, uranium, salt, and sodium sulphate) resources. (STSE)	Mineral Potential and Mines in Saskatchewan Rocks and Minerals in Your Life See Gr. 7 Earth's Crust and Resources for potash lesson plans: Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Is There Potash Under My Feet? Potash Solution Mining Model Coal Mining – Surface Strip Mining (See Gr. 7 Earth's Crust and Resources) Cookie Mining Gold Exploration Saskatchewan Resource Match
c. Investigate how the location of major mineral and fossil fuel resources in Saskatchewan are influenced by their depositional setting and geologic history including depth of deposit and geological stability/instability. (K)	See Gr. 7 Earth's Crust and Resources for potash lesson plans: Potash What is it? Is There Potash Under My Feet?
d. Contrast the operation and utility of different imaging methods (e.g., gravity, magnetics, electromagnetics and seismic) for locating hard rock and soft rock resource deposits. (K)	Exploring for Minerals in Saskatchewan: Geophysics – Using Magnetics to Find a Mine. Looking into the Earth: Seismic Surveys in Mineral Exploration (Pilot) Geophones: I Heard That! (Pilot)
e. Identify anomalies from actual geophysical surveys and geologic maps and relate them to structural features and resource deposits. (S)	Exploring for Minerals in Saskatchewan: Geophysics – Using Magnetics to Find a Mine. Gold Exploration
f. Explain how applications of seismic body waves (i.e., longitudinal p-wave and transverse s-wave) and the laws of reflection and refraction are used to determine gross and fine structure of the earth. (K)	Looking into the Earth: Seismic Surveys in Mineral Exploration Geophones: I Heard That
g. Model a seismic survey using tools such as an ultrasonic sensor (e.g., Vernier GoMotion). (S)	Geophones: I Heard That! Seismic Surveys in Mineral Exploration (introductory activity)
h. Recognize the importance of obtaining core samples to examine the physical characteristics and geochemistry of potential ore bodies and natural resource deposits. (STSE)	Mineral Exploration and Core Sampling (introductory activity) Core Sampling and Ore Deposits Gold Exploration
k. Recognize the importance of water in enhanced oil recovery and in various mining techniques such as solution mining. (K, STSE)	See Gr. 7 Earth's Crust and Resources for potash lesson plans: Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Potash Solution Mining Model Lesson Plan Potash Solution Mining Model PowerPoint (PDF)
l. Explain extraction technologies and their associated environmental impacts for mining and resources such as oil sands and shale oil. (K, STSE)	See Gr. 7 Earth's Crust and Resources for potash and coal lesson plans: Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Potash Solution Mining Model Lesson Plan Potash Solution Mining Model PowerPoint (PDF) Coal Mining – Surface Strip Mining
m. Research and investigate solutions to economic and environmental issues (e.g., managing mine tailings and	Sustainability -Decision Making

pollutants, reclaiming open pit mining sites, ecological impact of pipelines, resource depletion and maintaining water quality) related to the extraction of geological resources in Saskatchewan. (STSE	
--	--

Chemistry 30 (NEW)

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
Chemical Equilibria	
CH30-EQ1 Consider the characteristics and applications of equilibrium systems in chemical reactions	
a) Discuss the criteria that characterize an equilibrium system (e.g., closed system, constancy of properties, equal rates of forward and reverse reactions)	Uranium Processing - Removing Heavy Metals from the Water (Raffinate)
c) Write the equilibrium constant (K_{eq}) expression for a variety of chemical reactions.	Uranium Processing - Removing Heavy Metals from the Water (Raffinate)
CH30-EQ2 Analyze aqueous solution equilibria including solubility-product constants	
a) Discuss conditions necessary for the establishment of equilibrium in aqueous solutions.	Uranium Processing - Removing Heavy Metals from the Water (Raffinate)
b) Analyze how temperature and the common ion effect influence the solubility of substances in aqueous solution.	Uranium Processing - Removing Heavy Metals from the Water (Raffinate) Potash Mining: How to Separate the KCl from the Ore
c) Research applications of solution equilibria in Saskatchewan agriculture, resource extraction, manufacturing and chemical industries.	Potash Mining: How to Separate the KCl from the Ore
d) Design and carry out a procedure to collect data in order to construct solubility graphs representative of the effects of temperature on the change in solubility of chemical compounds in water.	Potash Mining: How to Separate the KCl from the Ore
e) Interpret solubility curves of selected substances.	Potash Mining: How to Separate the KCl from the Ore
g) Calculate the solubility of a solution, given K_{sp} .	Uranium Processing - Removing Heavy Metals from the Water (Raffinate) Potash Mining: How to Separate the KCl from the Ore
CH30-EQ3 Observe and analyse phenomena related to acid-base reactions	
a) Identify examples of acid-base reactions in the manufacture and use of consumer products, industrial and agricultural processes.	Uranium Processing - Removing Heavy Metals from the Water (Raffinate)
g) Solve problems involving pH, pOH, $[H^+]/[H_3O^+]$, $[OH^-]$, K_w , K_a and K_b .	Uranium Processing - Removing Heavy Metals from the Water (Raffinate)

PAA Energy and Mines 10, 20, 30

<i>Saskatchewan Learning Outcomes and Indicators</i>	<i>Lesson and Activity Correlation</i>
Module 1: Introduction to Energy and Mines	
Module 3: Saskatchewan Geology and Geological History	
Module 4: Sustainability	Sustainability – Decision Making
Module 11: Electricity: Workplace Safety, Environmental Safety and Careers	Investigating Careers in the Minerals Industry Careers Activity
Module 12: Uranium – Formation, Location and Exploration	Mineral Potential and Mines in Saskatchewan Exploring for Minerals in Saskatchewan: Geophysics – Using

	<p>Magnetics to Find a Mine. Exploring for Minerals in Saskatchewan: Stream Sediment and Soil Sampling. Finders, Miners? Core Sampling</p>
Module 13: Uranium - Production and Processing	Physical Separation of Minerals
Module 14: Uranium – Refinement, Distribution and Uses	<p>Rocks and Minerals in Your Life Investigating Careers in the Minerals Industry Physical Separation of Minerals</p>
Module 15: Uranium – Workplace Safety, Environmental Safety and Careers	Investigating Careers in the Minerals Industry Careers Activity
Module 16: Coal – Formation, Location and Exploration	See Grade 7 Earth's Crust and Resources: Coal Mining – Surface Strip Mining
Module 17: Coal – Mining Methods, Production and Uses	<p>See Grade 7 Earth's Crust and Resources: Coal Mining – Surface Strip Mining Rocks and Minerals in Your Life</p>
Module 18: Coal – Workplace Safety, Environmental Safety and Careers	Investigating Careers in the Minerals Industry
Module 22: Potash – Formation, Location and Exploration	<p>See Grade 7 Earth's Crust and Resources: Is There Potash Under My Feet? Mineral Potential and Mines in Saskatchewan</p>
Module 23: Potash – Mining and Production	<p>See Grade 7 Mixtures and Solutions/Earth's Crust and Resources: Potash Solution Mining: Dissolving Potash Potash Solution Mining: Recovering Dissolved Potash Potash Solution Mining: How Do We Know Its KCl?</p> <p>See Chemistry 30: Potash Mining: How to Separate the KCl from the Ore</p> <p>Physical Separation of Minerals</p>
Module 24: Potash – Refinement, Distribution, Use and Economic Significance	Rocks and Minerals in Your Life
Module 25: Potash – Workplace Safety, Environmental Safety and Careers	Investigating Careers in the Minerals Industry Saskatchewan Resource Match