South Slave Divisional Education Council

Science 10

Curriculum Package

February 2012

2012

Energy and Matter in Chemical Change (Nature of Science Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
FOCUSING QUESTIONS How has knowledge of the structure of matter led to other scientific advancements? How do elements combine? Can these combinations be classified and the products be predicted and quantified? Why do scientists classify chemical change, follow guidelines for nomenclature and represent chemical change with equations?	
Describe the basic particles that make up the underlying structure of matter, and investigate related technologies	• Identify historical examples of how humans worked with chemical substances to meet their basic needs • Outline the role of evidence in the development of the atomic model consisting of protons and neutrons (nucleons) and electrons; i.e., Dalton, Thomson, Rutherford, Bohr • Identify examples of chemistry-based careers in the community
Explain, using the periodic table, how elements combine to form compounds, and follow IUPAC guidelines for naming ionic compounds and simple molecular compounds	• Illustrate an awareness of WHMIS guidelines, and demonstrate safe practices in the handling, storage and disposal of chemicals in the laboratory and at home • Explain the importance of and need for the IUPAC system of naming compounds, in terms of the work that scientists do and the need to communicate clearly and precisely • Explain, using the periodic table, how and why elements combine to form compounds in specific ratios • Predict formulas and write names for ionic and molecular compounds and common acids using a periodic table, a table of ions and IUPAC rules • Classify ionic and molecular compounds, acids and bases on the basis of their properties; i.e., conductivity, ph, solubility, state • Predict whether an ionic compound is relatively soluble in water, using a solubility chart • Relate the molecular structure of simple substances to their properties • Outline the issues related to personal and societal use of potentially toxic or hazardous compounds
Identify and classify chemical changes, and write word and balanced chemical equations for significant chemical reactions, as applications of Lavoisier's law of conservation of mass	• Provide examples of household, commercial and industrial processes that use chemical reactions to produce useful substances and energy • Identify chemical reactions that are significant in societies • Describe the evidence for chemical changes; i.e., energy change, formation of a gas or precipitate, colour or odour change, change in temperature • Differentiate between endothermic and exothermic chemical reactions • Classify and identify categories of chemical reactions; i.e., formation (synthesis), decomposition, hydrocarbon combustion, single replacement, double replacement • Translate word equations to balanced chemical equations and vice versa for chemical reactions that occur in living and nonliving systems • Predict the products of formation (synthesis) and decomposition, single and double replacement, and hydrocarbon combustion chemical reactions, when given the reactants • Define the mole as the amount of an element containing 6.02 × 1023 atoms (Avogadro's number) and apply the concept to calculate quantities of substances made of other chemical species • Interpret balanced chemical equations in terms of moles of chemical species, and relate the mole concept to the law of conservation of mass

Energy and Matter in Chemical Change (Nature of Science Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
SKILLS OUTCOMES: focus on scientific inquiry (embed throughout unit)	
Initiating and Planning: Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues	• Define and delimit problems to facilitate investigation • Design an experiment, identifying and controlling major variables • State a prediction and a hypothesis based on available evidence and background information • Evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring and decision making
Performing and Recording: Conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information	• Carry out procedures, controlling the major variables and adapting or extending procedures • Use library and electronic research tools to collect information on a given topic • Select and integrate information from various print and electronic sources or from several parts of the same source • Demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for the handling and disposal of laboratory materials • Select and use apparatus, technology and materials safely
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Describe and apply classification systems and nomenclature used in the sciences • Apply and assess alternative theoretical models for interpreting knowledge in a given field • Compare theoretical and empirical values and account for discrepancies • Identify and explain sources of error and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty • Identify new questions or problems that arise from what was learned
Communication and Team Work: Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Communicate questions, ideas and intentions; and receive, interpret, understand, support and respond to the ideas of others • Select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results
ATTITUDE OUTCOMES: (embed throughout the unit)	
Interest in Science: *Students will be encouraged to:*	• Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields
Mutual Respect: *Students will be encouraged to:*	• Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds
Scientific Inquiry: *Students will be encouraged to:*	• Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues
Collaboration: *Students will be encouraged to:*	• Work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas
Stewardship: *Students will be encouraged to:*	• Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment
Safety: *Students will be encouraged to:*	• Show concern for safety in planning, carrying out and reviewing activities

Energy Flow in Technological Systems (Science and Technology Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
FOCUSING QUESTIONS Which came first, science or technology, and is it possible for technological development to take place without help from pure science? How did efforts to improve the efficiency of heat engines result in the formulation of the first and second laws of thermodynamics? How can the analysis of moving objects help in the understanding of changes in kinetic energy, force and work? Why are efficiency and sustainability important considerations in designing energy conversion technologies?	
Analyze and illustrate how technologies based on thermodynamic principles were developed before the laws of thermodynamics were formulated	• Illustrate, by use of examples from natural and technological systems, that energy exists in a variety of forms • Describe, qualitatively, current and past technologies used to transform energy from one form to another, and that energy transfer technologies produce measurable changes in motion, shape or temperature • Identify the processes of trial and error that led to the invention of the engine, and relate the principles of thermodynamics to the development of more efficient engine designs • Analyze and illustrate how the concept of energy developed from observation of heat and mechanical devices
Explain and apply concepts used in theoretical and practical measures of energy in mechanical systems	• Describe evidence for the presence of energy; i.e., observable physical and chemical changes, and changes in motion, shape or temperature • Define kinetic energy as energy due to motion, and define potential energy as energy due to relative position or condition • Describe chemical energy as a form of potential • Define, compare and contrast scalar and vector quantities • Describe displacement and velocity quantitatively • Define acceleration, quantitatively, as a change in velocity during a time interval: $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$ • Explain that, in the absence of resistive forces, motion at constant speed requires no energy input • Recall, from previous studies, the operational definition for force as a push or a pull, and for work as energy expended when the speed of an object is increased, or when an object is moved against the influence of an opposing force • Define gravitational potential energy as the work against gravity • Relate gravitational potential energy to work done using $E_p = mgh$ and $W = Fd$ and show that a change in energy is equal to work done on a system: $\Delta E = W$ • Quantify kinetic energy using $E_k = \frac{1}{2}mv^2$ and relate this concept to energy conservation in transformations $H_{fus} = \frac{Q}{n}$ • Derive the SI unit of energy and work, the joule, from fundamental units • Investigate and analyze one-dimensional scalar motion and work done on an object or system, using algebraic and graphical techniques
Apply the principles of energy conservation and thermodynamics to investigate, describe and predict efficiency of energy transformation in technological systems	• Describe, qualitatively and in terms of thermodynamic laws, the energy transformations occurring in devices and systems • Describe how the first and second laws of thermodynamics have changed our understanding of energy conversions • Define, operationally, "useful" energy from a technological perspective, and analyze the stages of "useful" energy transformations in technological systems

Energy Flow in Technological Systems (Science and Technology Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Apply the principles of energy conservation and thermodynamics to investigate, describe and predict efficiency of energy transformation in technological systems (Continued)	• Recognize that there are limits to the amount of "useful" energy that can be derived from the conversion of potential energy to other forms in a technological device explain, quantitatively, efficiency as a measure of the "useful" work compared to the total energy put into an energy conversion process or device • Apply concepts related to efficiency of thermal energy conversion to analyze the design of a thermal device • Compare the energy content of fuels used in thermal power plants in Alberta, in terms of costs, benefits, efficiency and sustainability • Explain the need for efficient energy conversions to protect our environment and to make judicious use of natural resources
SKILLS OUTCOMES: focus on scientific inquiry (embed throughout unit)	
Initiating and Planning: Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues	• Design an experiment, identifying and controlling major variables • Formulate operational definitions of major variables
Performing and Recording: Conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information	• Carry out procedures, controlling the major variables and adapting or extending procedures • Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data • Use library and electronic research tools to collect information on a given topic • Select and integrate information from various print and electronic sources or from several parts of the same source
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Compile and display evidence and information, by hand or using technology, in a variety of formats, including diagrams, flow charts, tables, graphs and scatterplots • Identify limitations of data or measurement • Interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables • Compare theoretical and empirical values and account for discrepancies • State a conclusion based on experimental data, and explain how evidence gathered supports or refutes the initial hypothesis • Construct and test a prototype of a device or system, and troubleshoot problems as they arise • Propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each and select one as the basis for a plan • Evaluate a personally designed and constructed device on the basis of self-developed criteria
Communication and Team Work: Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results • Work cooperatively with team members to develop and carry out a plan and to troubleshoot problems as they arise
ATTITUDE OUTCOMES: (embed throughout the unit)	
Interest in Science: *Students will be encouraged to:*	• Show interest in science-related questions and issues, and pursue personal interests and career possibilities within science-related fields
Mutual Respect: *Students will be encouraged to:*	• Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds

Energy Flow in Technological Systems (Science and Technology Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Scientific Inquiry: *Students will be encouraged to:*	• Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues
Collaboration: *Students will be encouraged to:*	• Work collaboratively in carrying out investigations and in generating and evaluating ideas
Stewardship: *Students will be encouraged to:*	• Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment
Safety: *Students will be encouraged to:*	• Show concern for safety in planning, carrying out and reviewing activities

Cycling of Matter in Living Systems (Nature of Emphasis)

FOCUSING QUESTIONS

How did the cell theory replace the concept of “spontaneous generation” and revolutionize the study of life sciences?
How do single-celled organisms carry out life functions?
How do plants use specialized cells and processes to accomplish the same functions as a single cell, but on a larger scale?
How does imaging technology further our understanding of the structure and function of cells?

Explain the relationship between developments in imaging technology and the current understanding of the cell	• Trace the development of the cell theory: all living things are made up of one or more cells and the materials produced by these, cells are functional units of life, and all cells come from pre-existing cells • Describe how advancements in knowledge of cell structure and function have been enhanced and are increasing as a direct result of developments in microscope technology and staining techniques • Identify areas of cell research at the molecular level
Describe the function of cell organelles and structures in a cell, in terms of life processes, and use models to explain these processes and their applications	• Compare passive transport of matter by diffusion and osmosis with active transport in terms of the particle model of matter, concentration gradients, equilibrium and protein carrier molecules • Use models to explain and visualize complex processes like diffusion and osmosis, endo- and exocytosis, and the role of cell membrane in these processes • Describe the cell as a functioning open system that acquires nutrients, excretes waste, and exchanges matter and energy • Identify the structure and describe, in general terms, the function of the cell membrane, nucleus, lysosome, vacuole, mitochondrion, endoplasmic reticulum, Golgi apparatus, ribosomes, chloroplast and cell wall, where present, of plant and animal cells • Compare the structure, chemical composition and function of plant and animal cells, and describe the complementary nature of the structure and function of plant and animal cells • Describe the role of the cell membrane in maintaining equilibrium while exchanging matter • Describe how knowledge about semi-permeable membranes, diffusion and osmosis is applied in various contexts • Describe cell size and shape as they relate to surface area to volume ratio, and explain how that ratio limits cell size

Cycling of Matter in Living Systems (Nature of Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Analyze plants as an example of a multicellular organism with specialized structures at the cellular, tissue and system levels	• Explain why, when a single-celled organism or colony of single-celled organisms reaches a certain size, it requires a multicellular level of organization, and relate this to the specialization of cells, tissues and systems in plants • Describe how the cells of the leaf system have a variety of specialized structures and functions; i.e., epidermis including guard cells, palisade tissue cells, spongy tissue cells, and phloem and xylem vascular tissue cells to support the process of photosynthesis • Explain and investigate the transport system in plants; i.e., xylem and phloem tissues and the processes of transpiration, including the cohesion and adhesion properties of water, turgor pressure and osmosis; diffusion, active transport and root pressure in root hairs • Explain and investigate the gas exchange system in plants; i.e., lenticels, guard cells, stomata and the process of diffusion • Explain and investigate phototropism and gravitropism as examples of control systems in plants • Trace the development of theories of phototropism and gravitropism
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues	• Define and delimit problems to facilitate investigation • Design an experiment, identifying and controlling major variables • State a prediction and a hypothesis based on available evidence and background information • Identify the theoretical basis of an investigation, and develop a prediction and a hypothesis that are consistent with the theoretical basis • Formulate operational definitions of major variables
Performing and Recording: Conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information	• Carry out procedures, controlling the major variables and adapting or extending procedures • Use instruments effectively and accurately for collecting data • Estimate quantities • Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data) • Use library and electronic research tools to collect information on a given topic • Select and integrate information from various print and electronic sources or from several parts of the same source
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Compile and display, by hand or computer, evidence and information in a variety of formats, including diagrams, flow charts, tables, graphs and scatterplots • Interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables • State a conclusion based on experimental data, and explain how evidence gathered supports or refutes the initial hypothesis • Explain how data support or refute a hypothesis or prediction • Construct and test a prototype of a device or system, and troubleshoot problems as they arise • Identify new questions or problems that arise from what was learned

Cycling of Matter in Living Systems (Nature of Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Communication and Teamwork: Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Communicate questions, ideas and intentions; and receive, interpret, understand, support and respond to the ideas of others • Select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results
ATTITUDE OUTCOMES: (embed throughout the unit)	
Interest in Science: *Students will be encouraged to:*	• Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields
Mutual Respect: *Students will be encouraged to:*	• Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds
Scientific Inquiry: *Students will be encouraged to:*	• Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues
Collaboration: *Students will be encouraged to:*	• Work collaboratively in carrying out investigations and in generating and evaluating ideas
Stewardship: *Students will be encouraged to:*	• Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment
Safety: *Students will be encouraged to:*	• Show concern for safety in planning, carrying out and reviewing activities

Energy Flow in the Global Systems (Social and Environmental Contexts Emphasis)

FOCUSING QUESTIONS

Are there relationships between solar energy, global energy transfer processes, climate and biomes?
What evidence suggests our climate may be changing more rapidly than living species can adapt?
Is human activity causing climate change?
How can we reduce our impact on the biosphere and on global climate, while still meeting human needs?

Describe how the relationships among input solar energy, output terrestrial energy and energy flow within the biosphere affect the lives of humans and other species	• Explain how climate affects the lives of people and other species, and explain the need to investigate climate change • Identify the sun as the source of all energy on earth • Analyze, in general terms, the net radiation budget, using per cent; i.e., solar energy input, terrestrial energy output, net radiant energy • Describe the major characteristics of the atmosphere, the hydrosphere and the lithosphere, and explain their relationship to earth's biosphere • Describe and explain the greenhouse effect, and the role of various gases—including methane, carbon dioxide and water vapour—in determining the scope of the greenhouse effect
Analyze the relationships among net solar energy, global energy transfer processes—primarily radiation, convection and hydrologic cycle—and climate.	• Describe, in general terms, how thermal energy is transferred through the atmosphere and through the hydrosphere • Investigate and describe, in general terms, the relationships among solar energy reaching Earth's surface and time of year, angle of inclination, length of daylight, cloud cover, albedo effect and aerosol or particulate distribution • Explain how thermal energy transfer through the atmosphere and hydrosphere affects climate • Investigate and interpret how variations in thermal properties of materials can lead to uneven heating and cooling

Energy Flow in the Global Systems (Social and Environmental Contexts Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Analyze the relationships among net solar energy, global energy transfer processes—primarily radiation, convection and hydrologic cycle—and climate. (Continued)	• Investigate and explain how evaporation, condensation, freezing and melting transfer thermal energy; i.e., use simple calculations of heat of fusion $H_{fus} = \frac{Q}{n}$ and vaporization $H_{vap} = \frac{Q}{n}$, and $Q = mc\Delta t$ to convey amounts of thermal energy involved, and link these processes to the hydrologic cycle
Relate climate to the characteristics of the world's major biomes, and compare biomes in different regions of the world	• Describe a biome as an open system in terms of input and output of energy and matter and exchanges at its boundaries • Relate the characteristics of two major biomes (i.e., grassland, desert, tundra, taiga, deciduous and rain forest) to net radiant energy, climatic factors (temperature, moisture, sunlight and wind) and topography (mountain ranges, large bodies of water) • Analyze the climatographs of two major biomes (i.e., grasslands, desert, tundra, taiga, deciduous and rain forest) and explain why biomes with similar characteristics can exist in different geographical locations, latitudes and altitudes • Identify potential effects of climate change on environmentally sensitive biomes
Investigate and interpret the role of environmental factors on global energy transfer and climate change	• Investigate and identify human actions affecting biomes that have a potential to change climate • Identify evidence to investigate past changes in earth's climate • Describe and evaluate the role of science in furthering the understanding of climate and climate change through international programs • Describe the role of technology in measuring, modelling and interpreting climate and climate change • Describe the limitations of scientific knowledge and technology in making predictions related to climate and weather • Assess, from a variety of perspectives, the risks and benefits of human activity, and its impact on the biosphere and the climate
SKILLS OUTCOMES:	
Initiating and Planning: Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues	• Identify questions to investigate that arise from practical problems and issues • Design an experiment, and identify specific variables • Formulate operational definitions of major variables
Performing and Recoding: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Compile and display, by hand or computer, evidence and information in a variety of formats, including diagrams, flow charts, tables, graphs and scatterplots • Identify and apply criteria for evaluating evidence and sources of information, including identifying bias • Interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables • Identify limitations of data, evidence or measurement • State a conclusion based on experimental data, and explain how evidence gathered supports or refutes the initial hypothesis • Explain how data support or refute a hypothesis or a prediction • Propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each, and select one as the basis for a plan (e.g., design a home for a specific • Climate; analyze traditional aboriginal home designs for their suitability in particular climates)

Energy Flow in the Global Systems (Social and Environmental Contexts Emphasis)

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Compile and display, by hand or computer, evidence and information in a variety of formats, including diagrams, flow charts, tables, graphs and scatterplots • identify and apply criteria for evaluating evidence and sources of information, including identifying bias • Interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables • Identify limitations of data, evidence or measurement • State a conclusion based on experimental data, and explain how evidence gathered supports or refutes the initial hypothesis • Explain how data support or refute a hypothesis or a prediction • Propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each, and select one as the basis for a plan
Communication and Teamwork: Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results • Synthesize information from multiple sources or from complex and lengthy texts, and make inferences based on this information • Identify multiple perspectives that influence a science-related decision or issue • Develop, present and defend a position or course of action, based on findings
ATTITUDE OUTCOMES: (embed throughout the unit)	
Interest in Science: *Students will be encouraged to:*	• Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields
Mutual Respect: *Students will be encouraged to:*	• Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds
Scientific Inquiry: *Students will be encouraged to:*	• Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues
Collaboration: *Students will be encouraged to:*	• Work collaboratively in carrying out investigations and in generating and evaluating ideas
Stewardship: *Students will be encouraged to:*	• Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment
Safety: *Students will be encouraged to:*	• Show concern for safety in planning, carrying out and reviewing activities