Pearson Education: Science 10 Curriculum Comparison

The following table outlines and compares the Knowledge and STS outcomes in the current Science 10 Program of Studies (Interim 1995) and the STS and Knowledge Outcomes in the new Science 10 Program of Studies (Interim 2003).

UNIT A

Italics = *new in Program of Studies* **[ ]** = in old but not in new

→ = in old and new

Current Program (Interim 1995) **Unit 3: Energy and Matter in Chemical Change**	**New Program (Interim 2003)** **Unit A: Energy and Matter in Chemical Change** *Nature of Science Emphasis*
Major Concept 2 **Matter has a well-defined underlying structure**	**STS and Knowledge General Outcome 1** **Describe the basic particles that make up the underlying structure of matter, and investigate related technologies**
• define atoms **[**isotopes**]**, ions and molecules • indicate relative size, charge, position and mass of electrons protons and neutrons • **[**indicate the relative sizes of atoms, ions and molecules**]** • **[**describe the extent to which we are able to "observe" chemical species with modern technology**]**	• *identify examples of how early 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*
Major Concept 1 **Matter is classified on the basis of its properties.**	**STS and Knowledge General Outcome 2** **Explain, using the periodic table, how elements combine to form compounds, and follow IUPAC guidelines for naming ionic compounds and simple molecular compounds**
• **[**matter is everything that has mass and occupies space**]** • predict properties of the elements from their position on the periodic table • explain the classification of the first 20 elements in the periodic table in terms of chemical properties • **[**identify the elements that are most prevalent in living systems**]**	• explain, using the periodic table, how and why elements combine to form compounds in specific ratios

Major Concept 3 **Elements combine to form a vast array of compounds.**	**STS and Knowledge General Outcome 2 contd.**
• handle and dispose of chemicals in a safe responsible manner	• 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 IUPAC in naming compounds (STS)	• 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
• name and write formulas of common ionic and molecular compounds and acids	• predict formulas and write names for ionic and molecular compounds and common acids, using a periodic table, a table of ions and IUPAC rules
• differentiate between ionic and molecular compounds on the basis of their properties (conductivity, pH) and also on the basis of their formulas	• classify ionic and molecular compounds, acids and bases on the basis of their properties, i.e., conductivity, pH, solubility, state
• use a solubility chart to determine if an ionic compound will dissolve in water	• predict whether an ionic compound is relatively soluble in water, using a solubility chart
• [identify the role of several compounds in living systems]	• *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*
Major Concept 4 **Energy is involved in each change that matter undergoes.**	**STS and Knowledge General Outcome 3** **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 evidence of chemical reactions • compare and contrast physical and chemical changes	• 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 exothermic and endothermic changes	• differentiate between endothermic and exothermic chemical reactions
• identify different types of chemical reactions: formation, decomposition, combustion, single replacement and double replacement [predicting products of reactions not required]	• classify and identify categories of chemical reactions; i.e., formation (synthesis), decomposition, hydrocarbon combustion, single replacement, double replacement

• write word equations for chemical reactions that occur in living and non-living systems • translate between word and formula equations	• 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*
Major Concept 5 **Matter is conserved in chemical changes.**	**STS and Knowledge General Outcome 3 contd.**
• [outline experiments that establish the law of conservation of mass] • write and balance equations in terms of chemical species and moles	• define the mole as the amount of an element containing 6.02 _ 10^{23} 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.

UNIT B

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Current Program (Interim 1995) **Unit 4: Change and Energy**	**New Program (Interim 2003)** **Unit B: Energy Flow in Technological Systems** *Science and Technology Emphasis*
Major Concept 1 **Energy is always associated with change.**	**STS and Knowledge General Outcome 1** **Analyze and illustrate how technologies based on thermodynamic principles were developed before the laws of thermodynamics were formulated.**
• illustrate, by use of examples, that energy exists in a variety of forms: e.g. mechanical, chemical, electrical, thermal, nuclear, solar • illustrate, by use of examples, that the Sun is the source of most energy forms on Earth. • STS connection: describe the functioning technologies that address the problem of providing current energy sources	• illustrate, by use of examples from natural and technological systems, that energy exists in a variety of forms (e.g. mechanical, chemical, thermal, nuclear, solar). • 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*
Major Concept 1 contd.	**STS and Knowledge General Outcome 2**

	Explain and apply concepts used in theoretical and practical measures of energy in mechanical systems
• define energy as the property of a system that is a measure of its capacity for doing work, and work as the transfer of energy • derive the SI unit of energy and work, the joule, from fundamental units • define kinetic energy as energy due to motion, and potential energy as energy due to position or condition • describe one-dimensional uniform motion, using words, graphs and formulas: e.g. $v=\frac{\Delta d}{\Delta t}$	• derive the SI unit of energy and work, the joule, from fundamental units • define kinetic energy as energy due to motion, and define potential energy as energy due to relative position or condition • investigate and analyze one-dimensional scalar motion and work done on an object or system, using algebraic and graphical techniques • *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*
Major Concept 2 **Energy can be transformed from one form to another**	**STS and Knowledge General Outcome 2 contd.**
• illustrate by use of examples, that energy transfers produce measurable changes in motion, shape, or temperature of matter • define gravitational potential energy as the work done on a mass against gravity, and quantify gravitational energy, using $E_p=mgh$. • recognize that potential energy is only useful when it is transformed to some form of kinetic energy • quantify kinetic energy , using $E_k=\frac{1}{2}mv^2$.	• describe evidence for the presence of energy i.e., observable physical and chemical changes, and changes to motion, shape or temperature • 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 or $\Delta E=W$ • quantify kinetic energy using $E_k=\frac{1}{2}mv^2$ and relate this

	concept to energy conservation in transformations
• recognize chemical energy as a form of potential energy: e.g. glucose, ATP, gasoline, lead-acid battery • [quantify electrical energy, using $E_e = Pt$] • [analyze units to describe the kilowatt hour as a unit of energy and the watt as a unit of rate of energy transfer or a unit of rate of doing work]	• describe chemical energy as a form of potential energy (e.g. energy stored in glucose, adenosine triphosphate (ATP), gasoline)
Major Concept 3 **Energy cannot be created or destroyed, only converted from one form into another.**	**STS and Knowledge General Outcome 3** **Apply the principles of energy conservation and thermodynamics to investigate, describe and predict efficiency of energy transformation in technological systems**
• state the law of conservation of energy as "the sum of initial energies is equal to the sum of final energies" • recognise the first law of thermodynamics as a statement of the law of conservation of energy • compare the mechanism of diffusion to thermal energy transfer according to the second law of thermodynamics • describe, by use of examples, that thermal energy will, of its own accord, flow from a hotter body to a cooler body, and recognize this as a formal statement of the second law of thermodynamics	• describe qualitatively, and in terms of thermodynamic laws, the energy transformations occurring in devices and systems • describe how the first and second law of thermodynamics have changed our understanding of energy conversions
Major Concept 4 **Useful energy diminishes during any energy transformation.**	**STS and Knowledge General Outcome 3 contd.**
• interpret empirical data from a study of energy conversions • explain that energy conversion processes have different efficiencies, based on total energy input compared to the net useful energy output • define efficiency as a measure of the useful work compared to the total energy put into an energy conversion process • define inefficiency as the fraction of energy lost as wasted heat in the conversion process • [describe techniques for reducing waste of energy, in a common household device]	• define, operationally, "useful" energy from a technological perspective, and analyze the stages of "useful" energy transformations in technological systems • 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*

→ = in old and new

Current Program (Interim 1995) Unit 2: Energy and Matter in Living Systems	New Program (Interim 2003) Unit C: Cycling of Matter in Living Systems *(Nature of Science Emphasis)*
Major Concept 1 **The cell is the basic unit of living systems.**	**STS and Knowledge General Outcome 1** ***Explain the relationship between developments in imaging technology and current understanding of the cell***
• structure and use of the compound microscope • calculate magnification / field of view • calculate size of a cell • examine electron micrographs	• *trace the development of the cell theory; (recognise that there are sub-cellular particles such as viruses and prions)* • *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 (compound, confocal, TEM, SEM)* • *identify areas of cell research at the molecular level (DNA mapping, transport)*
Major Concept 1 contd.	**STS and Knowledge General Outcome 2 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***
• identify and briefly describe the structure and function of the nucleus, [nucleoid] endoplasmic reticulum, Golgi apparatus, lysosome, vacuole, mitochondrion, chloroplast, ribosome, cytoskeleton and cell wall, where present in [bacteria], plant and animal cells • identify and briefly describe the structure and function of the cell membrane in relation to cell equilibrium, and active and passive transport • [describe the similarities and differences between prokaryotic and eukaryotic cells]	• 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 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 (fluid-mosaic model)* • compare the structure, chemical composition and function of plant and animal cells, and *describe the complementary nature of the structure and function of animal and plant cells*

Major Concept 3 **The cell is an open system exchanging energy and matter with the environment.**	**STS and Knowledge General Outcome 2 contd.**
• observing or researching nutrient acquisition	• describe the cell as a functioning open system that acquires nutrients, excretes waste, and exchanges matter and energy • describe the role of the cell membrane in maintaining equilibrium while exchanging matter
• diffusion/concentration gradients • osmosis / semi-permeability of cell membranes	• *describe how knowledge about semi-permeable membranes, diffusion and osmosis is applied*
• [describe how light energy is converted to chemical energy Briefly in Outcome 3] • [describe how CO_2 is fixed as carbohydrates Briefly in Outcome 3] • [describe how ATP is used to do the work of transporting substances]	• *use models to explain and visualize complex processes like diffusion and osmosis, endo- and exocytosis, and the role of the cell membrane in these processes*
• active transport, endocytosis and exocytosis	
• [describe how the energy for active transport is derived from photosynthesis and respiration in the form of ATP]	
• plasmolysis / deplasmolysis / tonicity / turgor pressure	• Moved to General Outcome 3
Major Concept 2 **Growth is a major feature of living systems, and a major limitation to growth is the surface area to volume ratio of the cell.**	**STS and Knowledge General Outcome 2 contd.**
• [fission / mitosis]	
• surface area to volume ratio as a possible limit to growth	• describe cell size and shape as they relate to surface area to volume ratio, and explain how that ratio limits cell size
Major Concept 2 contd.	**STS and Knowledge General Outcome 3** ***Analyze plants as an example of a multicellular organism with specialized structures at the cellular, tissue and system levels***
• explain the value of multicellularity / how division of labour in a single cell and, after the process of differentiation, in multicellular organisms • [compare metabolic rates from surface area to volume ratios in different organisms]	• explain why, when a single-celled organism or colony of single-celled organisms reaches a certain size, it requires a multicellular level of organisation, 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*
Major Concept 4 **[Organisms provide for energy and matter needs at a distance from the organism's interface with the environment [unicellular vs. multi-cellular]]**	
• [Compare how selected organisms transport nutrients and wastes over short and long distances] • [Compare how selected organisms acquire nutrients and remove wastes] • [Compare how selected organisms exchange gases] [emphasis of comparison of different types of organisms] • Explain the movement of water in plants due to polar nature of water →	briefly as an aspect of the transport system in plants

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Current Program (Interim 1995) **Unit 1: Energy from the sun**	**New Program (Interim 2003)** **Unit D: Energy Flow in Global Systems** *Social and Environmental Contexts Emphasis*
Major Concept 1 **Energy from the Sun sustains life on Earth.**	**STS and Knowledge General Outcome 1** **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*
• energy from the Sun sustains life →	• identify the Sun as the source of all energy on Earth
• **[**define photosynthesis included in Unit C**]** • **[**define aerobic respiration included in Unit C**]**	
• **[**compare photosynthesis and respiration**]**	• describe the major characteristics of the atmosphere, the hydrosphere and the lithosphere, and explain their relationship to Earth's biosphere
• characteristics of the biosphere →	
• **[**explain how energy flow through the biosphere is facilitated by different types of organisms; i.e., producers, consumers and decomposers **]** →	• analyze in general terms the net radiation budget, using per cent; i.e., solar energy input, terrestrial energy output, net radiant energy
• define open, closed and isolated systems →	• moved to general outcome 3 and focus on biomes
• **[**various STS connections related to understanding the energy from the Sun sustains life in the 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*
Major Concept 2 **[The properties of water, relative to other forms of matter, profoundly influence the nature of life on Earth.]**	**STS and Knowledge General Outcome 2 & 3** **2. Analyze the relationships among net solar energy, global energy transfer processes—primarily radiation, convection and hydrologic cycle— and climate** **3. Relate climate to the characteristics of the world's major biomes, and compare biomes in different regions of the world**
• **[**properties of water**]**	
• calculate thermal energy in temperature and phase changes →	• investigate and explain how evaporation, condensation, freezing and melting transfer thermal energy

• relate hydrological cycle to solar energy • [indicate why ice forms on surfaces] • [properties of water and constant body temperature] • [properties of water and polar nature of molecule] • [effect of thermal energy on matter using KMT] • [describe temperature changes in terms of KE] • [describe phase changes using KMT] • $Q=mc\Delta T$ • [understand how properties of water have a profound influence on life on Earth]	• describe in general terms, how thermal energy is transferred through the atmosphere and through the hydrosphere from latitudes of net radiation surplus to latitudes of net radiation deficit, resulting in a variety of climatic zones • explain how thermal energy transfer through the atmosphere and hydrosphere affects climate • 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 of particulate distribution – See Major Concept 3 • *Investigate and interpret how variations in thermal properties of materials can lead to uneven heating and cooling* • use simple calculations of heat of fusion $H_{fus} = Q/n$, and vaporization $H_{vap} = Q/n$, and $Q=mc\Delta T$ to convey amounts of thermal energy involved, and link these processes to the hydrologic cycle • *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 to net radiant energy, climatic factors and topography* • analyze the climatographs of two major biomes—Skill outcomes from current program—and explain why biomes with similar characteristics can exist in different geographical locations, latitudes and altitudes • *identify the potential effects of climate change on environmentally sensitive biomes*
Major Concept 3 **Energy from the Sun determines climate and drives weather systems.**	**STS and Knowledge General Outcome 4** **Investigate and interpret the role of environmental factors on global energy transfer and climate change**
• energy from Sun determines climate and drives weather systems – see General Outcomes 2 & 3 • explain the factors that determine	• *investigate and identify human actions affecting biomes that have a potential to change climate and critically examine the evidence that these factors play a role in climate change*

climate – see General Outcomes 2 & 3
 	
• explain the significance of unequal global heating – see General Outcomes 2 & 3
 	
• [explain weather changes]
• [explain a local weather phenomenon]
• [STS connection: understand weather systems and the mechanisms that created them within the context of:
  ○ Weather technology
  ○ Limitations of weather predictions
  ○ Technology to monitor atmospheric gases
  ○ Evidence to examine a proposed theory]
	• *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 interpretinge 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*
	
	Note: The concept of climate change is introduced in the current program, but is not addressed to the depth expected in the new program.