Manitoba Rural Learning Consortium
Grade 9/10 Science
Essential Learning Document

Acknowledgements

This document has been developed by Senior Years teachers from across rural Manitoba. The Manitoba Rural Learning Consortium (mRLC) Grade 9 and 10 Science Essential Learning Cohort was made up of the following members:

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Introduction

A. What does it mean to be scientifically literate?

Science students utilize a scientific perspective when thinking critically, making informed decisions, and applying their understandings to the world around them. Students demonstrate the following:

- an interest in science and technology.
- a growing understanding of the big ideas of science in context and the rules that govern them.
- a skills set unique to science that will benefit future interests or studies.
- an ability to effectively communicate their ideas and appreciate other viewpoints.
- an ability to apply their scientific knowledge considering STSE and living sustainably.
- an ability to be innovative thinkers, capable of problem-solving, making informed decisions, and creating new knowledge.
- the confidence to ask, to test, to create, to take risks, and to interpret.

Science should be accessible to all. Therefore, we recognize that there are different levels of scientific literacy based on the above characteristics.

B. Essential Learning within the Clusters

How does a teacher assess and report on a student's scientific literacy? To our credit, there has been much conversation about high school science curricula in Manitoba over the last few years as we move to an outcomes-based approach. Primarily, we have had many discussions about what is essential learning in our discipline. In essence, the scientific literacy characteristics listed above are the essential learning. The question becomes what that looks like at the Grades 9 and 10 levels, as well as in each cluster. How do we organize teaching and learning opportunities so that students best meet outcomes and become scientifically literate?

i. Report Card Categories

The Manitoba Provincial Report Card (2012-2013) does not specify report card categories for high school, but does so for Grades 1-8. In early and middle years, those categories are knowledge and understanding, scientific inquiry process, and design process and problem solving. Given that students, parents, and teachers will be come familiar with reporting on such categories in the earlier grades, this committee felt it was worthwhile to explore the use of such categories in Grades 9 and 10. In doing so, continuity was the goal. The challenge became to determine what each of those categories looked like as we moved from middle years to senior years.

Knowledge and understanding is more than just the content of the course, it also involves the enduring understandings that we want students to demonstrate and the critical thinking skills that they will need for that interpretation. The scientific inquiry process might be thought of as what students do in the laboratory but inquiry is broader than that. Students need to ask good questions, investigate what puzzles them, and conduct fair tests both in the lab, in the field, and in the classroom. Finally, design process and problem solving has evolved into STSE and the decision-making process in Grade 9 and 10. Students continue to design and solve problems but they are now faced with more multi-dimensional situations. As they examine issues, they learn that there are often many stakeholders and various solutions. They should consider the science, technology, society, and environment (STSE) in each situation. The report card categories are simply a means to organize our assessment of student thinking. By using similar categories to the early and middle years report cards, we can talk with students and parents about their development in those areas.

ii. Essential Learning

It was not the mandate of this committee to rewrite curricula or to prioritize outcomes. We were very happy with the Manitoba Grade 9 and 10 Science curricula, finding them rich with detail and supports. What we did want to do was help teachers make sense of the idea of outcomes-based assessment for this course, especially in light of the report card categories. We felt that we could best do this by providing a new framework, a kind of filter through which to view the course. That filter was the **essential learning** in each cluster, organized by report card categories. The essential learning consists of the **enduring understandings** students should demonstrate and the skills they will use as they learn.

Enduring Understandings

In Science, we need to be clear about what our students need to know and what they need to understand. These are different things. Science has a certain set of terms, facts, and concepts that we want our students to know. Once we feel that our students have learned this concrete material, we test to be sure. We need to continue to do this, but then we should expect that our students put that new knowledge to good use. In the back of our minds is that nagging question of just how well have they learned it. Could they apply what they know to new situations? What will they remember a year from now? Do they really understand what is important about the concepts?

Consider the following situation. You have taught the steps of mitosis and meiosis to your students. Students have done their readings and taken notes, viewed the stages under the microscope, and worked with cell manipulatives. Although the students can clearly walk you through each of the stages, you wonder if they understand that the advantages and disadvantages of each process help determine reproductive success. Do they understand that species continuity depends on such reproductive success? These big ideas are enduring understandings from the Cluster One in Grade 9 Science. As teachers, we have enough background in the subject that these big ideas are obvious. They may be less obvious to our students, unless we teach with the enduring understandings in mind.

Skills

Students begin to understand when they use critical thinking skills. By analyzing, investigating, and discussing, they begin to make connections between concepts and see the underlying understandings. There are three skills sets that occur in each cluster: critical thinking skills, scientific inquiry process skills, and decision-making process skills. Although students are directed to use these skills throughout the cluster, inquiry and decision-making are somewhat more linear with particular skills required at certain steps in the process. The beauty is that we can address the same skills all year, giving students opportunities to practice them in each cluster. The curriculum guide provides useful rubrics that can be used again and again, in order to determine skill development.

Essential Questions

One way in which to direct students to think about the enduring understandings and use important skills is to present them with a few essential questions for each cluster. As each cluster is somewhat unique, essential questions were developed for the separate disciplines. There are, however, four unifying concepts outlined in the curricula and found in each cluster. These address similarities and difference, systems, change, and energy. You might consider these core questions for the courses …

In this cluster, why is it important to understand similarities and diversities?
In this cluster, what systems occur and how might they interact?
In this cluster, why are some characteristics constant while others change?
In this cluster, how is energy a driving force?

Specific Learning Outcomes

Teachers might wonder where the specific learning outcomes (SLOs) fit in with all this talk of essential learning, enduring understandings, and skill development. Our focus continues to be on the specific learning outcomes, within our framework. Can students talk about, write, or do what is expected of them in the course? Please see the curriculum guides for detail on how to teach and assess these. We have not gone into the same detail in this document.

Essential Vocabulary

The language of each cluster is presented under essential vocabulary and teachers are encouraged to use the terminology frequently with students. Teachers should also consider developing a focused list of key vocabulary that they will teach more directly, using various vocabulary-building strategies. Think of the focused list as the terms that you want students to use effectively as they answer the essential questions.

Grade 9 Science
Cluster 1: Reproduction

Report Card Suggested Subject Categories ↓	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
	Enduring Understandings Students should understand these ideas long after the teaching is done.	Skills Students need to demonstrate the following skills when learning the ideas in this cluster.	When students can answer these questions adequately, then there is evidence that they understand the bid ideas in this cluster.	Students need to meet these outcomes. In doing so, they will have enough basic knowledge to understand the big ideas.	Students need to understand these terms in context, and use them in their work.
Knowledge and Understanding	Species continuity is a result of reproductive success.	Critical Thinking Skills Illustrate Explain Observe Describe Investigate Compare and contrast Outline Collect Analyze Differentiate Discuss Classify Decide Interpret Document	Why do species use a variety of reproductive methods?	S1-1-01 Mitosis S1-1-02 Cell division S1-1-03 Asexual reproduction S1-1-05 Meiosis S1-1-07 Sexual vs. Asexual repro S1-1-08 Adaptations	Mitosis Chromosomes Cytoplasmic division Cell cycle Asexual reproduction Species Gametes Sexual reproduction Diploid cells Haploid cells Reproductive success Adaptations Female reproductive system Male reproductive system Hormones X and Y chromosomes Fetus Embryo Zygote Single trait inheritance Dominant traits Recessive traits Genotype Phenotype DNA Genes Sex-linked traits Pedigree Genetic mutation Human development Biotechnology
	Each method of reproduction has advantages and disadvantages.		How do sexual and asexual reproduction compare?	S1-1-03 Asexual reproduction S1-1-05 Meiosis S1-1-06 Mitosis vs. Meiosis S1-1-07 Sexual vs. Asexual repro	
	Asexual reproduction ensures species continuity at the expense of biodiversity.		How does agriculture use asexual reproduction to its advantage?	S1-1-04 Agricultural applications	
	Human continuity and diversity result from sexual reproduction. All organisms in a species are both similar and diverse because of genetic variation.		How can human beings be both similar to and different from their parents?	S1-1-06 Mitosis vs. Meiosis S1-1-09 Human repro systems S1-1-10 Human development S1-1-11 Single Trait Inheritance S1-1-12 Dominant & Recessive Traits S1-1-13 DNA, chromosomes, genes S1-1-14 Sex-linked traits S1-1-15 Mutation	
	Sexual reproduction can create new combinations of traits in future generations.		Why are organisms in a species not all alike?	S1-1-11 Single trait Inheritance S1-1-12 Dominant & Recessive Traits S1-1-13 DNA, chromosomes, genes S1-1-14 Sex-linked traits S1-1-15 Mutation	
	Advancements in reproductive biotechnology raise ethical considerations.		How does the use of biotechnology challenge society's ethics?	S1-1-16 Canadian repro technology S1-1-17 Biotechnology S1-1-18 Biotechnology issue	

Gr. 9 Reproduction (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
Scientific Inquiry Processes	Enduring Understandings Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.	Inquiry Skills S1-0 Initiate … Ask testable questions Justify methods Research … Select, integrate, evaluate and summarize information Plan… Make a hypothesis & rationale Identify variable relationships Make a plan Implement a Plan … Conduct a fair test Use safe work habits Work cooperatively with others Observe, Measure & Record… Use proper tools and methods Estimate and measure using SI units Record observations effectively Analyze & Interpret… Interpret trends Explain discrepancies Suggest plan improvements Conclude & Apply … Draw conclusions Reflect on original hypothesis Summarize learning Reflect on Science and Technology Demonstrate Positive Attitudes	How do you know that you have conducted a fair test? What have you learned from this inquiry?	S1-1-01, S1-0 LAB WORK -Observe, illustrate and explain the process of mitotic cell division of plants and animals in a lab activity. S1-1-02, S1-0 LAB WORK -Observe and reflect upon the dynamic nature of cell division. S1-1-03, S1-0 LAB WORK/FIELD TRIP -Investigate and reflect on various types of asexual reproduction in plant and animal species. S1-1-11, S1-0 LAB WORK -Observe, collect and analyze class data of single trait inheritance.	Mitosis Chromosomes Cytoplasmic division Cell cycle Asexual reproduction Species Gametes Sexual reproduction Diploid cells Haploid cells Reproductive success Adaptations Female reproductive system Male reproductive system Hormones X and Y chromosomes Fetus Embryo Zygote Single trait inheritance Dominant traits Recessive traits Genotype Phenotype DNA Genes Sex-linked traits Pedigree Genetic mutation Human development Biotechnology

Gr. 9 Reproduction (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
STSE and Decision-Making Processes	Enduring Understandings Scientific research should consider the science, technology, society and environment (STSE) in any situation. Effective decision-making requires careful consideration of a number of factors. Asexual reproduction ensures species continuity at the expense of biodiversity.	Decision-making Skills S1-0 Initiate … Ask STSE questions Identify stakeholders Research … Review past history Plan… Summarize arguments Determine decision criteria Present options Implement a Plan … Test out options with sample Observe, Measure & Record… Evaluate options using criteria Analyze & Interpret… Adjust options as needed Conclude & Apply … Decide on the best option Implement option Reflect on decision-making process Reflect on Science and Technology Demonstrate Positive Attitudes	What have you found out about STSE in this situation? What did you base your decision on? How does agriculture use asexual reproduction to its advantage?	S1-1-16, S1-0 STSE RESEARCH -Investigate Canadian and international contributions to research and technological development in the field of genetics and reproduction. S1-1-04, S1-0 CASE STUDY -Decide if certain agricultural applications that use asexual reproduction would be more advantageous for our society and/or environment.	Mitosis Chromosomes Cytoplasmic division Cell cycle Asexual reproduction Species Gametes Sexual reproduction Diploid cells Haploid cells Reproductive success Adaptations Female reproductive system Male reproductive system Hormones X and Y chromosomes Fetus Embryo Zygote Single trait inheritance Dominant traits Recessive traits Genotype Phenotype DNA Genes Sex-linked traits Pedigree Genetic mutation Human development Biotechnology
	Advancements in reproductive biotechnology raise ethical considerations.		How does the use of biotechnology challenge society's ethics?	S1-1-17, S1-0 CASE STUDY -Research potential applications and implications of biotechnologies including their effects upon personal and public decision-making. S1-1-18, S1-0 CASE STUDY -Use the decision-making process to address a current biotechnology issue.	

Grade 9 Science
Cluster 2: Atoms & Elements

Report Card Suggested Subject Categories ↓	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
	Enduring Understandings Students should understand these ideas long after the teaching is done.	Skills Students need to demonstrate the following skills when learning the ideas in this cluster.	When students can answer these questions adequately, then there is evidence that they understand the bid ideas in this cluster.	Students need to meet these outcomes. In doing so, they will have enough basic knowledge to understand the big ideas.	Students need to understand these terms in context, and use them in their work.
Knowledge and Understanding	The atomic structure of matter determines its physical and chemical properties.	Critical Thinking Skills Illustrate Explain Observe Describe Investigate Compare and contrast Outline Collect Analyze Differentiate Discuss Decide Interpret Document Classify	How are current atomic models an improvement on past models?	S1-2-01 Historic Models S1-2-02 Atomic Models S1-2-04 Atomic Structure S1-2-07 Metals & Non-metals S1-2-08 Families	Models Greek ideas Alchemy Lavoisier Atomic Model Dalton, Thomson Rutherford, Bohr Quantum model Common elements Element symbols Atomic structure Proton, electron, neutron Atomic number Atomic mass Periodic table Periods Families (groups) Characteristic properties Metals, non-metals, metalloids Reactivity Stability Alkali metals, alkaline earths, chalcogens, halogens, noble gases Compounds Atoms, molecules Chemical formulas Physical changes Chemical changes Indicators Technology
	The Periodic Table helps us understand matter based on similarities and differences.		How is the Periodic Table a useful tool?	S1-2-03 Element symbols S1-2-04 Atomic Structure S1-2-05 Bohr Atomic Models S1-2-06 Periodic Table S1-2-07 Metals & Non-metals S1-2-08 Families	
	We identify matter using a variety of systems.		What systems help us distinguish between elements and compounds?	S1-2-03 Element symbols S1-2-09 Compounds S1-2-10 Chemical formulas	
	Matter transfers energy, in order to try to reach equilibrium. Much of our technology use relies on our understanding of physical and chemical changes.		How is energy a driving force in physical and chemical changes?	S1-2-08 Families S1-2-09 Compounds S1-2-12 Physical & Chemical Changes S1-2-14 Technologies	

Gr. 9 Atoms & Elements (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
Scientific Inquiry Processes	Enduring Understandings Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.	Inquiry Skills S1-0 Initiate … Ask testable questions Justify methods Research … Select, integrate, evaluate and summarize information Plan… Make a hypothesis & rationale Identify variable relationships Make a plan Implement a Plan … Conduct a fair test Use safe work habits Work cooperatively with others Observe, Measure & Record… Use proper tools and methods Estimate and measure using SI units Record observations effectively Analyze & Interpret… Interpret trends Explain discrepancies Suggest plan improvements Conclude & Apply … Draw conclusions Reflect on original hypothesis Summarize learning Reflect on Science and Technology Demonstrate Positive Attitudes	How do you know that you have conducted a fair test? What have you learned from this inquiry?	S1-2-07, S1-0 LAB WORK -Investigate the characteristic properties of metals, non-metals, and metalloids. S1-2-09, S1-0 LAB WORK -Examine the contents of household chemicals from their labels. S1-2-10, S1-0 LAB WORK -Determine the gaseous components of air. S1-2-10, S1-0 LAB WORK -Experiment to determine indicators of chemical change. S1-2-11, S1-2-12, S1-0 LAB WORK -Investigate the physical and chemical changes that occur when certain types of matter are mixed. S1-2-14, S1-0 FIELD WORK -Take a walking tour to observe applications of science or a career based on chemistry.	Models Greek ideas Alchemy Lavoisier Atomic Model Dalton, Thomson Rutherford, Bohr Quantum model Common elements Element symbols Atomic structure Proton, electron, neutron Atomic number Atomic mass Periodic table Periods Families (groups) Characteristic properties Metals, non-metals, metalloids Reactivity Stability Alkali metals, alkaline earths, chalcogens, halogens, noble gases Compounds Atoms, molecules Chemical formulas Physical changes Chemical changes Indicators Technology

Gr. 9 Atoms & Elements (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
STSE and Decision-Making Processes	Enduring Understandings Scientific research should consider the science, technology, society and environment (STSE) in any situation. Effective decision-making requires careful consideration of a number of factors. Much of our technology use relies on our understanding of physical and chemical changes.	Decision-making Skills S1-0 Initiate … Ask STSE questions Identify stakeholders Research … Review past history Plan… Summarize arguments Determine decision criteria Present options Implement a Plan … Test out options with sample Observe, Measure & Record… Evaluate options using criteria Analyze & Interpret… Adjust options as needed Conclude & Apply … Decide on the best option Implement option Reflect on decision-making process Reflect on Science and Technology Demonstrate Positive Attitudes	What have you found out about STSE in this situation? What did you base your decision on? How is energy a driving force in physical and chemical changes?	S1-2-07, S1-0 STSE RESEARCH - Research characteristic properties of metals and the field of metallurgy. - Research the useful applications of metals, non-metals and metalloids throughout history. S1-2-10, S1-0 STSE RESEARCH - Determine tests used to identify elements and compounds. S1-2-08, S1-0 CASE STUDY - Study the importance of metal reactivity to technology (such as fireworks), determining the suitability of certain elements. S1-2-14, S1-0 STSE RESEARCH - Research the STSE behind a modern technology that depends on chemical reactions. S1-2-11, S1-0 CASE STUDY - Study how certain products are made safer for human use (such as unleaded gasoline). Imagine that you were a particular stakeholder fighting for legislation for safer products. Examine what would have to be considered in such a decision-making process.	Models Greek ideas Alchemy Lavoisier Atomic Model Dalton, Thomson Rutherford, Bohr Quantum model Common elements Element symbols Atomic structure Proton, electron, neutron Atomic number Atomic mass Periodic table Periods Families (groups) Characteristic properties Metals, non-metals, metalloids Reactivity Stability Alkali metals, alkaline earths, chalcogens, halogens, noble gases Compounds Atoms, molecules Chemical formulas Physical changes Chemical changes Indicators

Grade 9 Science
Cluster 3: Nature of Electricity

Report Card Suggested Subject Categories ↓	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
	Enduring Understandings Students should understand these ideas long after the teaching is done.	Skills Students need to demonstrate the following skills when learning the ideas in this cluster.	When students can answer these questions adequately, then there is evidence that they understand the bid ideas in this cluster.	Students need to meet these outcomes. In doing so, they will have enough basic knowledge to understand the big ideas.	Students need to understand these terms in context, and use them in their work.
Knowledge and Understanding	There are similarities and differences between electrostatic and current electricity.	Critical Thinking Skills Illustrate Explain Observe Describe Investigate Compare and contrast Outline Collect Analyze Differentiate Discuss Decide Interpret Document Classify	What is electricity?	S1-3-01 charge S1-3-02 early models S1-3-03 discrepant events S1-3-08 electrostatics & current electricity	Charge One-fluid model Two-fluid model Particle model Neutral Attraction Electrostatics Current electricity Conduction, grounding Insulator Induction Electrostatic technology Pieplate electrophorus Discharge Charge per unit time Chemical, photo, thermo, electromagnetic and piezo sources Resistance Electric circuits Parallel, series Voltage, current, cells Safety Switches, fuses, circuit breakers, outlets Electrical power Power consumption Hydroelectric power Conservation Schematic diagrams
	The particle model of electricity explains electrostatic and current electricity.		How can the particle model explain both electrostatic and current electricity?	S1-3-01 charge S1-3-02 early models S1-3-03 discrepant events S1-3-04 particle model S1-3-05 electrostatics and models S1-3-08 electrostatics & current electricity	
	Electrical energy travels and is changed into other useful forms of energy.		How can we use electrical sources to do work for us?	S1-3-01 charge S1-3-06 electrostatic technologies S1-3-07 electrostatic apparatus S1-3-11 electrical sources	
	The movement of electrons through a circuit can be observed (qualitative) and measured (quantitative).		How can the movement of electrons be observed and measured?	S1-3-09 electrical current S1-3-10 voltage S1-3-12 resistance S1-3-13 electrical circuits S1-3-14 measuring S1-3-15 voltage &current S1-3-16 current, voltage, resistance S1-3-17 circuits	
	Safety is important when working with electrostatic and current electricity.		How can we work with electricity safely?	S1-3-06 electrostatic technologies S1-3-18 circuits and safety	
	Energy consumption impacts our ecosystems and societies.		How is electrical energy a driving force in our world	S1-2-20 electric power S1-3-21 domestic power consumption S1-3-22 energy consumption S1-2-23 energy conservation S1-2-24 electricity in Manitoba	

Gr. 9 Nature of Electricity (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
Scientific Inquiry Processes	Enduring Understandings Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement. Safety is important when working with electrostatic and current electricity. The movement of electrons through a circuit can be observed (qualitative) and measured (quantitative).	Inquiry Skills S1-0 Initiate … Ask testable questions Justify methods Research … Select, integrate, evaluate and summarize information Plan… Make a hypothesis & rationale Identify variable relationships Make a plan Implement a Plan … Conduct a fair test Use safe work habits Work cooperatively with others Observe, Measure & Record… Use proper tools and methods Estimate and measure using SI units Record observations effectively Analyze & Interpret… Interpret trends Explain discrepancies Suggest plan improvements Conclude & Apply … Draw conclusions Reflect on original hypothesis Summarize learning Reflect on Science and Technology Demonstrate Positive Attitudes	How do you know that you have conducted a fair test? What have you learned from this inquiry? How can we work with electrostatic phenomena or current electricity safely? How have you observed and measured the movement of electrons	S1-1-01, S1-0 LAB WORK -Investigate electrostatic phenomena. S1-3-13, S1-0 LAB WORK -Design and build a simple circuit. S1-3-14, S1-0 LAB WORK -Perform a lab measuring voltage, current and resistance. S1-3-21, S1-3-22 LAB WORK -Perform an energy audit for a household and determine domestic power consumption costs. S1-3-16, S1-0 LAB WORK -Investigate the qualitative relationship among current, voltage, and resistance in a simple circuit.	Charge One-fluid model Two-fluid model Particle model Neutral Attraction Electrostatics Current electricity Conduction, grounding Insulator Induction Electrostatic technology Pieplate electrophorus Discharge Charge per unit time Chemical, photo, thermo, electromagnetic and piezo sources Resistance Electric circuits Parallel, series Voltage, current, cells Safety Switches, fuses, circuit breakers, outlets Electrical power Power consumption Hydroelectric power Conservation Schematic diagrams

Gr. 9 Nature of Electricity (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
STSE and Decision-Making Processes	Enduring Understandings Scientific research should consider the science, technology, society and environment (STSE) in any situation. Effective decision-making requires careful consideration of a number of factors. Energy consumption impacts our ecosystems and societies.	Decision-making Skills S1-0 Initiate … Ask STSE questions Identify stakeholders Research … Review past history Plan… Summarize arguments Determine decision criteria Present options Implement a Plan … Test out options with sample Observe, Measure & Record… Evaluate options using criteria Analyze & Interpret… Adjust options as needed Conclude & Apply … Decide on the best option Implement option Reflect on decision-making process Reflect on Science and Technology Demonstrate Positive Attitudes	What have you found out about STSE in this situation? What did you base your decision on? How is electrical energy a driving force in our world?	S1-3-20, S1-3-24, S1-0 STSE RESEARCH -Research the effects that the development of hydro-electrical generation station would have on a community. S1-3-23, S1-0 -Recognize and explain the importance of incorporating principles of electrical energy conservation into the decision-making process. S1-3-21, S1-3-22, S1-0 CASE STUDY -Will the replacement of incandescent bulbs with fluorescent lights reduce energy consumption enough to justify the added cost? S1-3-23, S1-2-24, S1-0 CASE STUDY -Use the decision-making process to address an issue associated with the generation and transmission of electricity in Manitoba. CASE STUDY -Should Manitoba Hydro focus more effort on the development of energy from renewable sources? CASE STUDY -Is nuclear power a viable alternative to coal fired power plants?	Charge One-fluid model Two-fluid model Particle model Neutral Attraction Electrostatics Current electricity Conduction, grounding Insulator Induction Electrostatic technology Pieplate electrophorus Discharge Charge per unit time Chemical, photo, thermo, electromagnetic and piezo sources Resistance Electric circuits Parallel, series Voltage, current, cells Safety Switches, fuses, circuit breakers, outlets Electrical power Power consumption Hydroelectric power Conservation Schematic diagrams

Grade 9 Science
Cluster 4: Exploring the Universe

Report Card Suggested Subject Categories ↓	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
	Enduring Understandings Students should understand these ideas long after the teaching is done.	Skills Students need to demonstrate the following skills when learning the ideas in this cluster.	When students can answer these questions adequately, then there is evidence that they understand the bid ideas in this cluster.	Students need to meet these outcomes. In doing so, they will have enough basic knowledge to understand the big ideas.	Students need to understand these terms in context, and use them in their work.
Knowledge and Understanding	Cultural and historical perspectives of celestial objects help enhance our understanding of our universe.	Critical Thinking Skills Illustrate Explain Observe Describe Investigate Compare and contrast Outline Collect Analyze Differentiate Discuss Decide Interpret Document Classify	When early humans looked up at the sky, how did they use the position of celestial objects to help them?	S1-4-01 Coordinate system S1-4-03 navigation by cultures S1-4-07 Origin of universe	Coordinate system Astrolabe Celestial object Altitude Azimuth Motion Cultures Navigation Earth Space Geocentric model Heliocentric model Sun, stars, planets, moon Daily rising and setting Seasonal constellations Retrograde motion Astronomical unit Light year Origin & evolution of universe Comets, asteroids Nebulae, galaxies Black holes Technologies Space research
	Discrepant events lead us to change our understanding of the universe.		How have discrepant events helped us change our understanding of the universe?	S1-4-02 Celestial motion S1-4-04 Geocentric & Heliocentric S1-4-05 Motion	
	Due to its size, we need unique systems and technologies to measure and interpret the universe.		How can we measure and interpret the universe when it is so large?	S1-4-06 Units for astronomy S1-4-09 Space technologies	
	There are similarities and differences between scientific and cultural theories on the evolution of the universe.		How similar are scientific and cultural theories on the evolution of the universe?	S1-4-07 Origin of universe S1-4-08 Components of universe	
	Canada's contribution to space research has impacted society by advancing technology.		How has Canada's contribution to space research impacted society?	S1-4-09 Space technologies S1-4-10 Canadian space research S1-4-11 Space science impacts	

Gr. 9 Exploring the Universe (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
Scientific Inquiry Processes	Enduring Understandings Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.	Inquiry Skills S1-0 Initiate … Ask testable questions Justify methods Research … Select, integrate, evaluate and summarize information Plan… Make a hypothesis & rationale Identify variable relationships Make a plan Implement a Plan … Conduct a fair test Use safe work habits Work cooperatively with others Observe, Measure & Record… Use proper tools and methods Estimate and measure using SI units Record observations effectively Analyze & Interpret… Interpret trends Explain discrepancies Suggest plan improvements Conclude & Apply … Draw conclusions Reflect on original hypothesis Summarize learning Reflect on Science and Technology Demonstrate Positive Attitudes	How do you know that you have conducted a fair test? What have you learned from this inquiry?	S1-4-01, S1-0 LAB WORK -Measure and record the altitude of celestial objects using an astrolab. -Experiment with indirect techniques to observe the sun. S1-4-02, S1-0 LAB WORK -Analyze data in order to predict the location of the moon at a particular time. S1-1-04, S1-0 LAB WORK -Collect and plot position data on a simplified star chart, in order to observe retrograde motion. S1-2-10, S1-0 LAB WORK -Experiment to determine indicators of chemical change.	Coordinate system Astrolabe Celestial object Altitude Azimuth Motion Cultures Navigation Earth Space Geocentric model Heliocentric model Sun, stars, planets, moon Daily rising and setting Seasonal constellations Retrograde motion Astronomical unit Light year Origin & evolution of universe Comets, asteroids Nebulae, galaxies Black holes Technologies Space research

Gr. 9 Exploring the Universe (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
STSE and Decision-Making Processes	Enduring Understandings Scientific research should consider the science, technology, society and environment (STSE) in any situation. Effective decision-making requires careful consideration of a number of factors. Canada's contribution to space research has impacted society by advancing technology.	Decision-making Skills S1-0 Initiate … Ask STSE questions Identify stakeholders Research … Review past history Plan… Summarize arguments Determine decision criteria Present options Implement a Plan … Test out options with sample Observe, Measure & Record… Evaluate options using criteria Analyze & Interpret… Adjust options as needed Conclude & Apply … Decide on the best option Implement option Reflect on decision-making process Reflect on Science and Technology Demonstrate Positive Attitudes	What have you found out about STSE in this situation? What did you base your decision on? How has Canada's contribution to space research impacted society?	S1-4-07, S1-0 STSE RESEARCH -Research origins of the universe from the perspectives of various cultures. S1-4-09, S1-4-10, S1-4-11, S1-0 RESEARCH -Research Canadian contributions to space technology and space programs. S1-4-10, S1-0 CASE STUDY -Investigate ways in which Canada participates in space research and in international space programs, and then use the decision-making process to address a related issue. S1-4-11, S1-0 CASE STUDY -Evaluate the impact of space science and technologies in terms of their benefits and risks to humans.	Coordinate system Astrolabe Celestial object Altitude Azimuth Motion Cultures Navigation Earth Space Geocentric model Heliocentric model Sun, stars, planets, moon Daily rising and setting Seasonal constellations Retrograde motion Astronomical unit Light year Origin & evolution of universe Comets, asteroids Nebulae, galaxies Black holes Technologies Space research

Sample Grade Book Grade 9 Science
Cluster 3: Nature of Electricity

4	Thorough understanding
3	Very good understanding
2	Basic understanding
1	Limited understanding
ND	Not yet demonstrated

This is a sample of how a **grade book** could be organized by class.

	Knowledge & Understanding					Scientific Inquiry Processes					STSE and Decision-making Processes				
	- We demonstrate our enduring understandings when we examine the content of the cluster using critical thinking skills. - There are similarities and differences between electrostatic and current electricity. - The particle model of electricity explains electrostatic and current electricity. - Electrical energy travels and is changed into other useful forms of energy. - The movement of electrons through a circuit can be observed (qualitative) and measured (quantitative). - Safety is important when working with electrostatic and current electricity. - Energy consumption impacts our ecosystems and societies.					- Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement. - Safety is important when working with electrostatic and current electricity. - The movement of electrons through a circuit can be observed (qualitative) and measured (quantitative).					- Scientific research should consider the science, technology, society and environment (STSE) in any situation. - Effective decision-making requires careful consideration of a number of factors. - Energy consumption impacts our ecosystems and societies.				
	Evidence of Learning					Evidence of Learning					Evidence of Learning				
Students	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)

Sample Grade Book Grade 9 Science

This is a sample of how a **grade book** could be organized by individual student.

Student Name _____ (see specific enduring understandings for each cluster)	Cluster 1: Reproduction					Cluster 2: Atoms and Elements					Cluster 3: Nature of Electricity					Cluster 4: Exploring the Universe				
	Evidence of Learning					Evidence of Learning					Evidence of Learning					Evidence of Learning				
	Assess 1	Assess 2	Assess 3	Assess 4	Overall (Mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)
Knowledge and Understanding - We demonstrate our enduring understandings when we examine the content of the cluster using critical thinking skills.																				
Scientific Inquiry Processes - Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.																				
STSE & Decision-making Processes - Scientific research should consider the science, technology, society and environment (STSE) in any situation. - Effective decision-making requires careful consideration of a number of factors.																				

Grade 10 Science
Cluster 1: Dynamics of Ecosystems

Report Card Suggested Subject Categories ↓	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
	Enduring Understandings Students should understand these ideas long after the teaching is done.	Skills Students need to demonstrate the following skills when learning the ideas in this cluster.	When students can answer these questions adequately, then there is evidence that they understand the bid ideas in this cluster.	Students need to meet these outcomes. In doing so, they will have enough basic knowledge to understand the big ideas.	Students need to understand these terms in context, and use them in their work.
Knowledge and Understanding	Ecosystems are influenced by natural cycles and the flow of energy.	<u>Critical Thinking Skills</u> Illustrate Explain Observe Describe Investigate Compare and contrast Outline Collect Analyze Differentiate Discuss Decide Interpret Document	How are populations affected when nutrient cycles are disrupted?	S2-1-01 biogeochemical cycles S2-1-02 disruptions in cycles S2-1-03 bioaccumulation S2-1-04 carrying capacity S2-1-05 limiting factors S2-1-06 population dynamics graphs S2-1-09 sustainability	Biogeochemical cycles Carbon cycle Nitrogen cycle Oxygen cycle Ecosystems Bioaccumulation Natural events Human activities Carrying capacity Limiting factors Population dynamics Density-dependent factors Density-independent factors Graphs Introduced species Species extinction Biodiversity Sustainability Human impact Dynamic equilibrium
	Populations are diverse, interacting with each other and with their environment. Biodiversity ensures that ecosystems are more likely to remain in equilibrium and be sustainable.		When can the introduction of new species benefit an ecosystem?	S2-1-07 introduced species S2-1-08 biodiversity S2-1-09 sustainability	
	In ecosystems, healthy populations are in a dynamic equilibrium.		What conditions are necessary for a population in an ecosystem to be stable and self-sustaining?	S2-1-04 carrying capacity S2-1-05 limiting factors S2-1-06 population dynamics graphs S2-1-09 sustainability	
	Both human decisions and natural systems can exert a change on the environment, which may impact the existence of species.		How do we influence whether or not species are healthy and/or continue to exist?	S2-1-02 disruptions in cycles S2-1-03 bioaccumulation S2-1-07 introduced species S2-1-10 human impact	

Gr. 9 Dynamics of Ecosystems (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
Scientific Inquiry Processes	Enduring Understandings Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.	Inquiry Skills S2-0 Initiate … Ask testable questions Justify methods Research … Select, integrate, evaluate and summarize information Plan… Make a hypothesis & rationale Identify variable relationships Make a plan Implement a Plan … Conduct a fair test Use safe work habits Work cooperatively with others Observe, Measure & Record… Use proper tools and methods Estimate and measure with SI units Record observations effectively Analyze & Interpret… Interpret trends Explain discrepancies Suggest plan improvements Conclude & Apply … Draw conclusions Reflect on original hypothesis Summarize learning Reflect on Science and Technology Demonstrate Positive Attitudes	How do you know that you have conducted a fair test? What have you learned from this inquiry?	S2-1-01, S2-01 LAB WORK -Create a closed ecosystem to investigate the cycling of nutrients. S2-1-02, S2-01 LAB WORK -Investigate the effect of fertilizer on plant growth. S2-1-06, S1-0 LAB WORK -Culture a yeast, bacterial, or paramecium population and interpret the resulting population growth data. S2-1-08, S2-0 FIELD WORK -Conduct a population study in a local ecosystem. Students may be introduced to quadrat sampling, transects, use of field guides, etc. Involve local resource partners to help with the process (Manitoba Government, Conservation Districts, Universities, etc.	Biogeochemical cycles Carbon cycle Nitrogen cycle Oxygen cycle Ecosystems Bioaccumulation Natural events Human activities Carrying capacity Limiting factors Population dynamics Density-dependent factors Density-independent factors Graphs Introduced species Species extinction Biodiversity Sustainability Human impact Dynamic equilibrium

Gr. 9 Dynamics of Ecosystems (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
STSE and Decision-Making Processes	Enduring Understandings Scientific research should consider the science, technology, society and environment (STSE) in any situation. Effective decision-making requires careful consideration of a number of factors. Both human decisions and natural systems can exert a change on the environment, which may impact the existence of species.	Decision-making Skills S2-0 Initiate … Ask STSE questions Identify stakeholders Research … Review past history Plan… Summarize arguments Determine decision criteria Present options Implement a Plan … Test out options with sample Observe, Measure & Record… Evaluate options using criteria Analyze & Interpret… Adjust options as needed Conclude & Apply … Decide on the best option Implement option Reflect on decision-making process Reflect on Science and Technology Demonstrate Positive Attitudes	What have you found out about STSE in this situation? What did you base your decision on? How do we influence whether or not species are healthy and/or continue to exist?	S2-1-07, S2-0 STSE RESEARCH -Examine the STSE impact of introducing a new species into an area (use historic or current context). S2-1-03, S2-0 CASE STUDY/ROLE-PLAY -Examine a historic or current bioaccumulation issue in light of STSE. Each student takes on the role of a particular stakeholder and highlight the decision-making process. S2-10, S2-0 CASE STUDY/ROLE-PLAY -Use the decision-making process to examine a local land-use issue. As an example, consider how a new park plan might be developed for Spruce Woods Provincial Park after the flood of 2011. Several other examples are given in the curriculum guide.	Biogeochemical cycles Carbon cycle Nitrogen cycle Oxygen cycle Ecosystems Bioaccumulation Natural events Human activities Carrying capacity Limiting factors Population dynamics Density-dependent factors Density-independent factors Graphs Introduced species Species extinction Biodiversity Sustainability Human impact Dynamic equilibrium

Grade 10 Science
Cluster 2: Chemistry in Action

Report Card Suggested Subject Categories ↓	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
	Enduring Understandings Students should understand these ideas long after the teaching is done.	Skills Students need to demonstrate the following skills when learning the ideas in this cluster.	When students can answer these questions adequately, then there is evidence that they understand the bid ideas in this cluster.	Students need to meet these outcomes. In doing so, they will have enough basic knowledge to understand the big ideas.	Students need to understand these terms in context, and use them in their work.
Knowledge and Understanding	We use standard classification systems and a variety of experimental procedures to help us identify matter.	<u>Critical Thinking Skills</u> Illustrate Explain Observe Describe Investigate Compare and contrast Outline Collect Analyze Differentiate Discuss Decide Interpret Document Classify	When you look at a chemical formula, what can it tell you about a substance?	S2-2-01 Elements on Periodic Table S2-2-02 Bonding S2-2-03 Binary Ionic Compounds S2-2-04 Molecular Compounds S2-2-08 Acids and Bases	Element Periodic table Valence Alkali metals Alkaline earth metals, Chalcogens Halogens, Noble gases Lewis dot diagrams Bohr models Specific ratios Compounds Ionic bonds, Covalent bonds Formulas and names Binary ionic compounds IUPAC Guidelines Molecular compounds Prefixes: mono, di, tri, tetra Law of Conservation of Mass Balanced Chemical Equations Word Equations Chemical reactions Synthesis, Decomposition Single displacement Double displacement Combustion Acids and bases Indicators, pH Reactivity with metals Biological systems Industrial processes Domestic applications Safety and health considerations Neutralization, salt, water WHMIS Air pollution, emissions Acid rain
	Matter reacts in order to become more stable. Matter is similar in atomic structure by diverse in reactivity.		Why do substances react? How do you predict possible product(s)?	S2-2-01 Elements on Periodic Table S2-2-02 Bonding S2-2-07 Chemical Reactions S2-2-10 Neutralization	
	Regardless of the type of chemical reaction, atoms cannot be created nor destroyed and mass must be conserved.		Why is balancing chemical equations a critical skill for a chemist?	S2-2-05 Law of Conservation of Mass S2-2-06 Balancing S2-2-07 Chemical Reactions S2-2-08 Acids and Bases	
	Our quality of life is impacted by chemical changes.		How is chemical use pervasive in modern society?	S2-2-09 Acids and Bases in Systems S2-2-11 Air pollution S2-2-12 Reducing Emissions	

Gr. 10 Chemistry in Action (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
Scientific Inquiry Processes	Enduring Understandings Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.	Inquiry Skills S2-0 Initiate … Ask testable questions Justify methods Research … Select, integrate, evaluate and summarize information Plan… Make a hypothesis & rationale Identify variable relationships Make a plan Implement a Plan … Conduct a fair test Use safe work habits Work cooperatively with others Observe, Measure & Record… Use proper tools and methods Estimate and measure with SI units Record observations effectively Analyze & Interpret… Interpret trends Explain discrepancies Suggest plan improvements Conclude & Apply … Draw conclusions Reflect on original hypothesis Summarize learning Reflect on Science and Technology Demonstrate Positive Attitudes	How do you know that you have conducted a fair test? What have you learned from this inquiry?	S2-2-05, S2-0 LAB WORK -Conduct an experiment to demonstrate the law of conservation of mass. S2-2-07, S2-0 LAB WORK -Investigate and classify chemical reactions through teacher demonstrations and/or student experiments. S2-2-08, S2-0 -Investigate the occurrence and role of acids and bases through experimentation with household products. S2-2-09, S2-0 -Investigate the practical use acids and bases by making soap, testing antacids or determining the pH of household products. S2-2-10, S2-0 -Conduct a neutralization reaction and monitor pH with indicators. S2-2-11, S2-0 -Perform an experiment the effects of acid precipitation on organisms and buildings.	Element Periodic table Valence Alkali metals Alkaline earth metals, Chalcogens Halogens, Noble gases Lewis dot diagrams Bohr models Specific ratios Compounds Ionic bonds, Covalent bonds Formulas and names Binary ionic compounds IUPAC Guidelines Molecular compounds Prefixes: mono, di, tri, tetra Law of Conservation of Mass Balanced Chemical Equations Word Equations Chemical reactions Synthesis, Decomposition Single displacement Double displacement Combustion Acids and bases Indicators, pH Reactivity with metals Biological systems Industrial processes Domestic applications Safety and health considerations Neutralization, salt, water WHMIS Air pollution, emissions Acid rain

Gr. 10 Chemistry in Action (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
STSE and Decision-Making Processes	Enduring Understandings Scientific research should consider the science, technology, society and environment (STSE) in any situation. Effective decision-making requires careful consideration of a number of factors. Our quality of life is impacted by chemical changes.	Decision-making Skills S2-0 Initiate … Ask STSE questions Identify stakeholders Research … Review past history Plan… Summarize arguments Determine decision criteria Present options Implement a Plan … Test out options with sample Observe, Measure & Record… Evaluate options using criteria Analyze & Interpret… Adjust options as needed Conclude & Apply … Decide on the best option Implement option Reflect on decision-making process Reflect on Science and Technology Demonstrate Positive Attitudes	What have you found out about STSE in this situation? What did you base your decision on? How is chemical use pervasive in modern society?	S2-2-05, S2-0 STSE RESEARCH - students design and implement a game that teachers WHMIS principles or consumer labeling. S2-2-09, S2-0 - research the STSE implications of acids and bases in biological systems, industrial processes, and domestic applications. S2-2-11, S2-2-12, S2-0 STSE RESEARCH - research the STSE implications of various forms of air pollution. - investigate technologies that could reduce air pollutant emissions. S2-2-12, S2-0 CASE STUDY/DEBATE - use the decision-making process to determine if older vehicles (which pollute more) should remain on the road.	Element Periodic table Valence Alkali metals Alkaline earth metals, Chalcogens Halogens, Noble gases Lewis dot diagrams Bohr models Specific ratios Compounds Ionic bonds, Covalent bonds Formulas and names Binary ionic compounds IUPAC Guidelines Molecular compounds Prefixes: mono, di, tri, tetra Law of Conservation of Mass Balanced Chemical Equations Word Equations Chemical reactions Synthesis, Decomposition Single displacement Double displacement Combustion Acids and bases Indicators, pH Reactivity with metals Biological systems Industrial processes Domestic applications Safety and health considerations Neutralization, salt, water WHMIS Air pollution, emissions Acid rain

Grade 10 Science
Cluster 3: In Motion

Report Card Suggested Subject Categories ↓	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
	Enduring Understandings Students should understand these ideas long after the teaching is done.	Skills Students need to demonstrate the following skills when learning the ideas in this cluster.	When students can answer these questions adequately, then there is evidence that they understand the bid ideas in this cluster.	Students need to meet these outcomes. In doing so, they will have enough basic knowledge to understand the big ideas.	Students need to understand these terms in context, and use them in their work.
Knowledge and Understanding	In order to understand the nature of motion, we observe, measure, and analyze the movement of objects.	Critical Thinking Skills Illustrate Explain Observe Describe Investigate Compare and contrast Outline Collect Analyze Differentiate Discuss Decide Interpret Document Classify	How do you like to show the relationships between displacement, velocity, acceleration and time best (using graphs, visuals, symbols, or numbers)?	S2-3-01 velocity S2-3-02 displacement data S2-3-03 acceleration S2-3-05 Inertia S2-3-12 Calculate braking distance	Displacement Time and Velocity Uniform motion Visual, numeric, graphical, symbolic analyses Displacement data Position and Origin Acceleration Ticker-tape Constant rate Force Natural motion Aristotle, Galileo, Newton Newton's 1st, 2nd, & 3rd Laws Car collisions, bumpers, restraints, air bags Inertia Restrained or unrestrained No force, constant force, mass Momentum and Impulse Conservation of Energy Kinetic energy Heat energy Sound Friction Weather conditions Braking distance Reaction time Speed, Driver Driving Safely
	There are basic laws of motion that describe how objects move and interact with other objects.		How did Newton change our understanding of motion?	S2-3-04 Newton's First Law S2-3-06 Newton's Second Law S2-3-07 Newton's Third Law S2-3-08 Momentum and Impulse	
	The energy of an object in motion can be transformed and transferred to another object and is always conserved.		What would our world be like if energy was not conserved?	S2-3-05 Inertia S2-3-09 Conservation of Energy	
	When driving, friction can work to our advantage or disadvantage.		When driving, how does friction work to our advantage and disadvantage?	S2-3-10 Friction	
	Safe driving results from factors that influence braking distance.		How do you determine a safe braking distance for various situations?	S2-3-11 Braking distance S2-3-12 Calculate braking distance S2-3-13 Safe driving conditions	
	Students are more likely to drive safely if they understand the principles and laws governing force and motion.		In terms of driving safely, what was the most important idea that you learned about motion	S2-3-13 Safe driving conditions	

Gr. 10 In Motion (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
Scientific Inquiry Processes	Enduring Understandings Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement. In order to understand the nature of motion, we observe, measure, and analyze the movement of objects.	Inquiry Skills S2-0 Initiate … Ask testable questions Justify methods Research … Select, integrate, evaluate and summarize information Plan… Make a hypothesis & rationale Identify variable relationships Make a plan Implement a Plan … Conduct a fair test Use safe work habits Work cooperatively with others Observe, Measure & Record… Use proper tools and methods Estimate and measure with SI units Record observations effectively Analyze & Interpret… Interpret trends Explain discrepancies Suggest plan improvements Conclude & Apply … Draw conclusions Reflect on original hypothesis Summarize learning Reflect on Science and Technology Demonstrate Positive Attitudes	How do you know that you have conducted a fair test? What have you learned from this inquiry? How do you like to show the relationships between displacement, velocity, acceleration and time best (using graphs, visuals, symbols, or numbers)?	S2-3-01, S2-0 LAB WORK investigate uniform motion using a toy car/cart and ticker tape recording. S2-3-02, S2-3-03, S2-0 LAB WORK investigate accelerated motion using a toy car/cart and ticker tape recording. Build the velocity versus time graph and analyze. S2-3-05, S2-0 LAB WORK - experiment to illustrate the effects of inertia in car collisions. S2-3-06, S2-0 LAB WORK - investigate Newton's Second Law of Motion in the lab (relating force to motion). S2-3-07, S2-0 DESIGN - design and build a balloon-powered car to illustrate Newton's Third Law of Motion. S2-3-08, S2-0 DESIGN - design and build a device that protects an egg when dropped from a height. S2-3-11, S2-3-12, S2-0 LAB WORK - investigate the relationship between speed and braking distance using a toy car/cart. Build the distance versus velocity graph and analyze. Determine the impact of friction.	Displacement Time and Velocity Uniform motion Visual, numeric, graphical, symbolic analyses Displacement data Position and Origin Acceleration Ticker-tape Constant rate Force Natural motion Aristotle, Galileo, Newton Newton's 1st, 2nd, & 3rd Laws Car collisions, bumpers, restraints, air bags Inertia Restrained or unrestrained No force, constant force, mass Momentum and Impulse Conservation of Energy Kinetic energy Heat energy Sound Friction Weather conditions Braking distance Reaction time Speed, Driver Driving Safely

Gr. 10 In Motion (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
STSE and Decision-Making Processes	Enduring Understandings Scientific research should consider the science, technology, society and environment (STSE) in any situation. Effective decision-making requires careful consideration of a number of factors. Students are more likely to drive safely if they understand the principles and laws governing force and motion.	Decision-making Skills S2-0 Initiate … Ask STSE questions Identify stakeholders Research … Review past history Plan… Summarize arguments Determine decision criteria Present options Implement a Plan … Test out options with sample Observe, Measure & Record… Evaluate options using criteria Analyze & Interpret… Adjust options as needed Conclude & Apply … Decide on the best option Implement option Reflect on decision-making process Reflect on Science and Technology Demonstrate Positive Attitudes	What have you found out about STSE in this situation? What did you base your decision on? In terms of driving safely, what was the most important idea that you learned about motion?	S2-3-09, S2-0 STSE RESEARCH -Investigate conservation of energy in a motor vehicle collision. S2-3-10, S2-0 STSE RESEARCH -Investigate conditions that illustrate the effects of friction on motion. S2-3-11, S2-0 STSE RESEARCH -Investigate factors that impact braking distance considering STSE. S2-3-08, S2-0 CASE STUDY -Use the decision-making process to plan a safety campaign for use of safety equipment (helmets, car seats, air bags, etc.) S2-3-13, S2-0 CASE STUDY -Use the decision-making process to address a STSE issue related to safe driving conditions.	Displacement Time and Velocity Uniform motion Visual, numeric, graphical, symbolic analyses Displacement data Position and Origin Acceleration Ticker-tape Constant rate Force Natural motion Aristotle, Galileo, Newton Newton's 1st, 2nd, & 3rd Laws Car collisions, bumpers, restraints, air bags Inertia Restrained or unrestrained No force, constant force, mass Momentum and Impulse Conservation of Energy Kinetic energy Heat energy Sound Friction Weather conditions Braking distance Reaction time Speed, Driver Driving Safely

Grade 10 Science
Cluster 4: Weather Dynamics

Report Card Suggested Subject Categories ↓	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
	Enduring Understandings Students should understand these ideas long after the teaching is done.	Skills Students need to demonstrate the following skills when learning the ideas in this cluster.	When students can answer these questions adequately, then there is evidence that they understand the bid ideas in this cluster.	Students need to meet these outcomes. In doing so, they will have enough basic knowledge to understand the big ideas.	Students need to understand these terms in context, and use them in their work.
Knowledge and Understanding	Weather is a result of the composition and organization of the atmosphere and hydrosphere.	Critical Thinking Skills Illustrate Explain Observe Describe Investigate Compare and contrast Outline Collect Analyze Differentiate Discuss Decide Interpret Document Classify	Where does weather come from?	S2-4-01 Hydrosphere & atmosphere	Hydrosphere Atmosphere Salt water Fresh water Polar ice caps/glaciers Troposphere Stratosphere Earth's radiation budget Solar radiation Cloud cover Albedo Absorption Reflection Latitude Heat transfer Coriolis effect Atmospheric convection Prevailing winds Jet streams El Nino/La Nina Severe weather Meteorological data and maps Satellite imagery Climate change Technology Evidence Consequences Impacts Doppler radar Global warming Global energy budget
	The movement and transfer of energy results in a diversity of weather systems that affect our climate.		How does the Earth's radiation budget influence weather and climate?	S2-4-02 Earth's radiation budget S2-4-03 Heat transfer S2-4-04 Formation of Severe Weather S2-4-06 Impact of Severe Weather	
	Technology is a useful tool for collecting and interpreting data on severe weather events and climatic change.		How effective are we at using meteorological data to predict severe weather?	S2-4-05 Meteorological data S2-4-06 Impact of Severe Weather S2-4-07 Climate change evidence	
	Human interactions and natural processes can change climatic systems. Individuals can have both a positive and negative impact on climate change.		How effective are we at interpreting and acting on climate change indicators? How do your actions affect climate change	S2-4-02 Earth's radiation budget S2-4-03 Heat transfer S2-4-07 Climate change evidence S2-4-08 Climate change consequences	

Gr. 10 Weather Dynamics (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
Scientific Inquiry Processes	Enduring Understandings Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.	Inquiry Skills S2-0 Initiate … Ask testable questions Justify methods Research … Select, integrate, evaluate and summarize information Plan… Make a hypothesis & rationale Identify variable relationships Make a plan Implement a Plan … Conduct a fair test Use safe work habits Work cooperatively with others Observe, Measure & Record… Use proper tools and methods Estimate and measure with SI units Record observations effectively Analyze & Interpret… Interpret trends Explain discrepancies Suggest plan improvements Conclude & Apply … Draw conclusions Reflect on original hypothesis Summarize learning Reflect on Science and Technology Demonstrate Positive Attitudes	How do you know that you have conducted a fair test? What have you learned from this inquiry?	S2-4-01, S2-0 LAB WORK -Experiment with factors which influence the Earth's radiation budget. S2-4-03, S2-0 LAB WORK -Investigate the formation and behavior of convection currents in water. -Investigate the role of pressure gradients in wind formation. S2-4-05, S2-0 LAB WORK -Collect, interpret, and analyze meteorological data related to a severe weather event.	Hydrosphere Atmosphere Salt water Fresh water Polar ice caps/glaciers Troposphere Stratosphere Earth's radiation budget Solar radiation Cloud cover Albedo Absorption Reflection Latitude Heat transfer Coriolis effect Atmospheric convection Prevailing winds Jet streams El Nino/La Nina Severe weather Meteorological data and maps Satellite imagery Climate change Technology Evidence Consequences Impacts Doppler radar Global warming Global energy budget

Gr. 10 Weather Dynamics (cont'd)	Essential Learning		Essential Questions	Specific Learning Outcomes	Essential Vocabulary
STSE and Decision-Making Processes	Enduring Understandings Scientific research should consider the science, technology, society and environment (STSE) in any situation. Effective decision-making requires careful consideration of a number of factors. Human interactions and natural processes can change climatic systems. Individuals can have both a positive and negative impact on climate change.	Decision-making Skills S2-0 Initiate … Ask STSE questions Identify stakeholders Research … Review past history Plan… Summarize arguments Determine decision criteria Present options Implement a Plan … Test out options with sample Observe, Measure & Record… Evaluate options using criteria Analyze & Interpret… Adjust options as needed Conclude & Apply … Decide on the best option Implement option Reflect on decision-making process Reflect on Science and Technology Demonstrate Positive Attitudes	What have you found out about STSE in this situation? What did you base your decision on? How effective are we at interpreting and acting on climate change indicators? How do your actions affect climate change?	S2-4-05, S2-4-06, S2-0 STSE RESEARCH - interview a community elder regarding weather/ climate knowledge and local impacts. S2-4-06, S2-0 STSE RESEARCH - investigate the social, economic, and environmental impacts of a recent severe weather event. - investigate the STSE implications of the carbon-credit system. S2-4-07, S2-0 CASE STUDY - investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities. S2-4-07, S2-4-08, S2-0 CASE STUDY - using the decision-making process, predict possible consequences of climate change. - use the decision-making process to determine what personal action(s) can reduce the consequences of climate change.	Hydrosphere Atmosphere Salt water Fresh water Polar ice caps/glaciers Troposphere Stratosphere Earth's radiation budget Solar radiation Cloud cover Albedo Absorption Reflection Latitude Heat transfer Coriolis effect Atmospheric convection Prevailing winds Jet streams El Nino/La Nina Severe weather Meteorological data and maps Satellite imagery Climate change Technology Evidence Consequences Impacts Doppler radar Global warming Global energy budget

Sample Grade Book Grade 10 Science
Cluster 1: Dynamics of Ecosystems

This is a sample of how a **grade book** could be organized by class.

4 Thorough understanding
3 Very good understanding
2 Basic understanding
1 Limited understanding
ND Not yet demonstrated

	Knowledge & Understanding					Scientific Inquiry Processes					STSE and Decision-making Processes				
	- Ecosystems are influenced by natural cycles and the flow of energy. - Populations are diverse, interacting with each other and with their environment. - Population diversity ensures that ecosystems are more likely to remain in equilibrium and be sustainable. - In ecosystems, healthy populations are in a dynamic equilibrium. - Both human decisions and natural systems can exert a change on the environment, which may impact the existence of species.					- Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.					- Scientific research should consider the science, technology, society and environment (STSE) in any situation. - Effective decision-making requires careful consideration of a number of factors. - Both human decisions and natural systems can exert a change on the environment, which may impact the existence of species.				
	Evidence of Learning					Evidence of Learning					Evidence of Learning				
Students	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)

Sample Grade Book Grade 10 Science

This is a sample of how a **grade book** could be organized by individual student.

Student Name _____ (see specific enduring understandings for each cluster)	Cluster 1: Dynamics of Ecosystems					Cluster 2: Chemistry in Action					Cluster 3: In Motion					Cluster 4: Weather Dynamics				
	Evidence of Learning					Evidence of Learning					Evidence of Learning					Evidence of Learning				
	Assess 1	Assess 2	Assess 3	Assess 4	Overall (Mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)	Assess 1	Assess 2	Assess 3	Assess 4	Overall (mode)
Knowledge and Understanding - We demonstrate our enduring understandings when we examine the content of the cluster using critical thinking skills.																				
Scientific Inquiry Processes - Valid scientific inquiry follows particular steps and requires specific skills. The process is always open to improvement.																				
STSE & Decision-making Processes - Scientific research should consider the science, technology, society and environment (STSE) in any situation. - Effective decision-making requires careful consideration of a number of factors.																				

Grade 9/10 Science Definitions –
Provincial Report Card Categories

Knowledge and Understanding

This report card category focuses on student progress related to learning experiences in which students demonstrate understanding of grade-specific science concepts.

Scientific Inquiry

This report card category focuses on student progress related to learning experiences in which students ask questions, generate possible explanations, collect and analyze evidence, and reach conclusions based on evidence. Scientific inquiry also involves the use of the science process skills, including: questioning, observing, classifying, measuring, communicating, inferring, predicting, hypothesizing, experimenting; and collecting, analyzing, and interpreting data.

Design Process/Problem Solving

This report card category focuses on student progress related to learning experiences in which students apply science knowledge to seek solutions to practical problems. Students solve scientific problems and/or use the steps related to the design process. The design process steps are:

1. Identify a need
2. Create a plan
3. Develop a product
4. Communicate the results.

The design process includes the proposing, creating, and testing of prototypes, products, and techniques in an attempt to reach an optimal solution to a given problem.

References:
The Manitoba Report Card Support Document. Manitoba Education. 2012.
Kindergarten to Grade 4 Science: Manitoba Curriculum Framework of Outcomes. Manitoba Education. 1999.

Essential Learning Terminology

Enduring understanding
"Enduring understandings are statements summarizing important ideas and core processes that are central to a discipline and have lasting value beyond the classroom. They synthesize what students should understand….as a result of studying a particular content area. Moreover, they articulate what students should "revisit" over the course of their lifetimes in relationship to the content area."

Key performance skills
Key performance skills draw on a variety of skills. Performance skills develop within the individual and grow in sophistication over time. Some examples of key performance skills include problem solving, critical thinking and inquiry, design process etc.

Values/attitudes/dispositions
Students need to develop the values and attitudes that assist them in understanding each discipline with some depth, then knowing how to communicate their understanding while seeing the relationship between each discipline.

Essential questions
Questions that are not answerable with finality in a brief sentence…their aim is to stimulate thought, provoke inquiry and spark more questions. *Wiggins/McTighe 2005*

Concepts
The broad concept provides a frame through which students filter information *(Erickson*). When a concept is truly understood it can be explained and is transferrable, or applied to problem-solving. *Wiggins/McTighe 2005*

Essential vocabulary
Vocabulary is introduced when needed to clarify experiences and ideas rather than in a list of new terms that start the unit. Essential vocabulary consists of figurative language, nuances in word meaning, roots, affixes, context clues, dictionary, thesaurus, pronunciation, parts of speech. *Wiggins/McTighe 2005*