References and Resources

Math Toolkit Masters

Study Toolkit Masters

Connect to the Big Ideas Answers

ON Science 10 to Science, Grade 10 Academic (SNC2D)

Curriculum Outcome	Reference
Note: The curriculum outcomes are fundamental to the McGraw-Hill Ryerson ON Science program. Following are some points in the textbook where the curriculum outcomes are addressed. This is not an exhaustive list.	
A. Scientific Investigation Skills and Career Exploration	
A1. Scientific Investigation Skills	
A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research	Plan Your Own Investigation 2-A, Transpiration in Different Types of Plant Types, p. 77 Inquiry Investigation 2-B, Moving Nutrients Through the Stem, p. 78 Real World Investigation 6-B, The pH of Lakes Near Sudbury, pp. 248–249 Unit 2 Projects, Inquiry Project, "Mining" Copper in the Laboratory, p. 256 Plan Your Investigation 8-B, Comparing Heat Absorption of Water and Soil, p. 343 Inquiry Investigation 10-A, Applying the Laws of Reflection, p. 439 Inquiry Investigation 10-C, Testing for Real and Virtual Images, p. 442 Inquiry Investigation 12-C, Image Characteristics of a Converging Lens, pp. 512–513
A1.2 select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, pH paper) for particular inquiries	Plan Your Own Investigation 2-A, Transpiration in Different Plant Types, p. 77 Unit 1 Projects, Inquiry Project, Investigating Phases of Mitosis, p. 126 Plan Your Own Investigation 5-A, Evidence of Chemical Change, p. 207 Plan Your Own Investigation 6-A, What Is Your Exposure to Acids and Bases?, p. 247 Unit 2 Projects, Inquiry Project, "Mining" Copper in the Laboratory, p. 256 Plan Your Investigation 8-B, Comparing Heat Absorption of Water and Soil, p. 343 Unit 3 Projects, Inquiry Project, Reflecting on Land Use, p. 390 Unit 4 Projects, Inquiry Project, Design a Light Tunnel, p. 522
A1.3 identify and locate print, electronic, and human sources that are relevant to research questions	Real World Investigation 3-A, Heart Disease: Making the Public Aware, p. 116 Unit 1 Projects, An Issue to Analyze, Organ Donation, p. 127 Unit 2 Projects, An Issue to Analyze, Urban Gold "Mining," p. 257 Unit 3 Projects, An Issue to Analyze, Dealing with Climate Change, p. 391 Unit 4 Projects, An Issue to Analyze, LEDs Brighten Up the Darkness, p. 523
A1.4 apply knowledge and understanding of safe practices and procedures when planning investigations (e.g., appropriate techniques for handling, storing, and disposing of laboratory materials [following the Workplace Hazardous Materials Information System–WHMIS]; safe operation of optical equipment; safe handling of biological materials), with the aid of appropriate support materials (e.g., the Reference Manual on the WHMIS website; the Live Safe! Work Smart! website)	Inquiry Investigation 3-B, Frog Dissection, p. 117 Inquiry Investigation 4-B, Keep That Toothy Grin, p. 170 Inquiry Investigation 4-C, Comparing the Masses of Reactants and Products, p. 172 Activity 5-1, Foiled Again!, p. 177 Activity 5-4, "Taking Care" of Toxic Materials, p. 200 Plan Your Investigation 5-A, Evidence of Chemical Change, p. 207 Inquiry Investigation 5-B, Synthesis and Decomposition Reactions, p. 208 Inquiry Investigation 5-C, Displacement Reactions, p. 210 Activity 6-4, Air Pollution and Ontario's Lakes, p. 244 Plan Your Investigation 6-A, What Is Your Exposure to Acids and Bases?, p. 247 Inquiry Investigation 6-C, Neutralizing an Acid with a Base, p. 250 Problem Solving Investigation 8-C, Modelling the Greenhouse Effect, p. 344 Activity 10-1, Growing Slime, p. 401

A1.5 conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data	Inquiry Investigation 1-A, Examining Cell Structures, p. 46 Inquiry Investigation 1-B, Mitosis in Plant and Animal Cells, p. 48 Inquiry Investigation 2-B, Moving Nutrients Through the Stem, p. 78 Inquiry Investigation 3-B, Frog Dissection, p. 117 Inquiry Investigation 4-A, Monitoring Paper Recycling, p. 169 Inquiry Investigation 4-B, Keep That Toothy Grin, p. 170 Inquiry Investigation 4-C, Comparing the Masses of Reactants and Products, p. 172 Inquiry Investigation 5-B, Synthesis and Decomposition Reactions, p. 208 Inquiry Investigation 5-C, Displacement Reactions, p. 210 Inquiry Investigation 6-C, Neutralizing a Gas with a Base, p. 250 Inquiry Investigation 7-A, Specific Heat Capacity of Earth Materials, p. 300 Inquiry Investigation 10-A, Applying the Laws of Reflection, p. 439 Inquiry Investigation 10-B, Studying the Laws of Reflection, p. 440 Inquiry Investigation 10-C, Testing for Real and Virtual Images, p. 442 Inquiry Investigation 11-A, Investigating Refraction, from Air to Water, p. 476 Inquiry Investigation 11-B, Analyzing the Index of Refraction, p. 477 Inquiry Investigation 12-A, Image Characteristics of a Converging Lens, p. 512 Inquiry Investigation 12-B, I "Speye," p. 514 Inquiry Investigation 12-C, Make a Simple Telescope, p. 516
A1.6 gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams	Real World Investigation 3-A, Heart Disease: Making the Public Aware, p. 116 Activity 4-1, Making a Reaction Happen, p. 137 Inquiry Investigation 4-B, Keep That Toothy Grin, p. 170 Inquiry Investigation 4-C, Comparing the Masses of Reactants and Products, p. 172 Plan Your Own Investigation 5-A, Evidence of Chemical Change, p. 207 Inquiry Investigation 5-C, Displacement Reactions, p. 210 Plan Your Own Investigation 6-A, What is Your Exposure to Acids and Bases?, p. 247 Real World Investigation 6-B, The pH of Lakes Near Sudbury, p. 248 Inquiry Investigation 7-A, Specific Heat Capacity of Earth Materials, p. 300 Inquiry Investigation 11-A, Investigating Refraction, from Air to Water, p. 476 Inquiry Investigation 11-B, Analyzing the Index of Refraction, p. 477 Inquiry Investigation 12-A, Image Characteristics of a Converging Lens, p. 512
A1.7 select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., websites for public health organizations, federal and provincial government publications, reference books, personal interviews), using recommended formats and an accepted form of academic documentation	Real World Investigation 3-A, Heart Disease: Making the Public Aware, p. 116 Unit 1 Projects, An Issue to Analyze, Organ Donation, p. 127 Unit 2 Projects, An Issue to Analyze, Urban Gold "Mining," p. 257 Unit 3 Projects, An Issue to Analyze, Dealing with Climate Change, p. 391 Unit 4 Projects, An Issue to Analyze, LEDs Brighten Up the Darkness, p. 523
A1.8 analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty	Inquiry Investigation 1-A, Examining Cell Structures, p. 46 Plan Your Own Investigation 2-A, Transpiration in Different Plant Types, p. 77 Inquiry Investigation 2-B, Moving Nutrients Through the Stem, p. 78 Plan Your Own Investigation 5-A, Evidence of Chemical Change, p. 207 Real World Investigation 6-B, The pH of Lakes Near Sudbury, p. 248 Plan Your Own Investigation 8-B, Comparing Heat Absorption of Water and Soil, p. 343 Inquiry Investigation 10-C, Testing for Real and Virtual Images, p. 442 Real World Investigation 11-C, Saving Time, p. 478

A1.9 analyse the information gathered from research sources for reliability and bias	Real World Investigation 3-A, Heart Disease: Making the Public Aware, p. 116 Unit 1 Projects, An Issue to Analyze, Organ Donation, p. 127 Section 3.3, Case Study, Childhood Vaccinations: Weighing the Risks, p. 110 Section 9.3, Case Study, Reduce, Re-use, Recycle, and Upgrade, p. 378
A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions	Inquiry Investigation 1-B, Mitosis in Plant and Animal Cells, p. 48 Inquiry Investigation 2-B, Moving Nutrients Through the Stem, p. 78 Investigation 4-A, Monitoring Paper Recycling, p. 169 Inquiry Investigation 4-B, Keep That Toothy Grin, p. 170 Inquiry Investigation 4-C, Comparing the Masses of Reactants and Products, p. 172 Plan Your Own Investigation 5-A, Evidence of Chemical Change, p. 207 Inquiry Investigation 5-A, Synthesis and Decomposition Reactions, p. 208 Inquiry Investigation 5-B, Displacement Reactions, p. 211 Real World Investigation 6-B, The pH of Lakes Near Sudbury, p. 248 Data Analysis Investigation 7-B, Comparing Ecoregions in Canada, p. 302 Data Analysis Investigation 7-B, Comparing the Effects of Climate Change on Vegetation in Canada, p. 304
A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models)	Activity 1-2, To Test or Not to Test, p. 21 Real World Investigation 3-A, Heart Disease: Making the Public Aware, p. 116 Unit 1 Projects, Inquiry Project, Investigation Phases of Mitosis, p. 126 Unit 1 Projects, An Issue to Analyze, Organ Donation, p. 127 Plan Your Own Investigation 5-A, Evidence of Chemical Change, p. 207 Unit 2 Projects, Inquiry Project, "Mining" Copper in the Laboratory, p. 256 Unit 2 Project, An Issue to Analyze, Urban Gold "Mining," p. 257 Unit 3 Project, Inquiry Project, Reflecting on Land Use, p. 390 Unit 3 Project, An Issue to Analyze, Dealing with Climate Change, p. 391 Unit 4 Projects, Inquiry Project, Design a Light Tunnel, p. 522 Unit 4 Projects, An Issue to Analyze, LEDs Brighten Up the Darkness, p. 523
A1.12 use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units)	Data Analysis Investigation 3-C, Who's Stubbing Out, p. 119 Inquiry Investigation 7-A, Specific Heat Capacity of Earth Materials, p. 300 Activity 8-3, Graphing Changes in Carbon Dioxide, p. 329 Real World Investigation 8-A, Recognizing the Effects of El Niño and La Niña on Southern Canada, p. 341 Plan Your Investigation 8-B, Comparing Heat Absorption of Water and Soil, p. 343 Data Analysis Investigation 9-A, Understanding Ice-Core Data, p. 382 Inquiry Investigation 11-A, Investigating Refraction, from Air to Water, p. 476 Inquiry Investigation 11-B, Analyzing the Index of Refraction, p. 477 Real World Investigation 11-C, Saving Time, p. 478 Inquiry Investigation 12-A, Image Characteristics of a Converging Lens, p. 512
A1.13 express the results of any calculations involving data accurately and precisely	Inquiry Investigation 6-C, Neutralizing an Acid with a Base, p. 250 Inquiry Investigation 7-A, Specific Heat Capacity of Earth Materials, p. 300 Inquiry Investigation 11-A, Investigating Refraction, from Air to Water, p. 476 Inquiry Investigation 11-B, Analyzing the Index of Refraction, p. 477 Real World Investigation 11-C, Saving Time, p. 478 Inquiry Investigation 12-A, Image Characteristics of a Converging Lens, p. 512

A2. Career Exploration	
A2.1 identify and describe a variety of careers related to the fields of science under study (e.g., meteorologist, medical illustrator, geochemist, optical physicist) and the education and training necessary for these careers	Chapter 3, Science at Work, pp. 124–125 Chapter 6, Science at Work, pp. 256–257 Chapter 9, Science at Work, pp. 388–389 Chapter 12, Science at Work, pp. 520–521
A2.2 identify scientists, including Canadians (e.g., Sheela Basrur, William Richard Peltier, Alice Wilson, Willard Doyle), who have made a contribution to the fields of science under study	Chapter 3, Science at Work, pp. 124–125 Chapter 6, Science at Work, pp. 256–257 Chapter 9, Science at Work, pp. 388–389 Chapter 12, Science at Work, pp. 520–521
B. Biology: Tissues, Organs, and Systems of Living Things	
B1. Relating Science to Technology, Society, and the Environment	
B1.1 assess, on the basis of research, ethical issues related to a technological development in the field of systems biology (e.g., cloning, stem-cell research, live organ transplants, transgenic transplants), and communicate their findings [IP, PR, AI, C]	Activity 1-2, To Test or Not to Test?, p. 21 Section 1.2 Case Study, Clones in the Kitchen, p. 24 Section 2.1 Case Study, Eliminating Wheat Rust with Transgenic Therapy, p. 66
B1.2 assess the importance to human health and/or society of medical imaging technologies (e.g., ultrasound, X-rays, computerized axial tomography [CT or CAT] scan, magnetic resonance imaging [MRI], microscope, biophotonics) used in Canada in diagnosing or treating abnormalities in tissues, organs, and/or systems [AI, C]	Section 3.2 Organs and Systems, pp. 93–107 Section 3.3 Maintaining Healthy Systems, pp. 108–115
B1.3 describe public health strategies related to systems biology (e.g., cancer screening and prevention programs; vaccines against human papillomavirus [HPV] and measles, mumps, and rubella [MMR]; AIDS education), and assess their impact on society	Section 3.3, Case Study, Childhood Vaccinations: Weighing the Risks, p. 110 Real World Investigation 3-A, Heart Disease: Making the Public Aware, p. 116 Data Analysis Investigation 3-C, Who's Stubbing Out?, p. 119
B2. Developing Skills of Investigation and Communication	
B2.1 use appropriate terminology related to cells, tissues, organs, and systems of living things, including, but not limited to: *absorption, anaphase, capillaries, concentration, differentiation, diffusion, meristematic, mesophyll, phloem, prophase, red blood cells, regeneration, stomata,* and *xylem* [C]	Unit 1, Tissues, Organs, and Systems of Living Things, pp. 2–131
B2.2 examine cells under a microscope or similar instrument to identify the various stages of mitosis in plants and animals [PR, AI]	Inquiry Investigation 1-B, Mitosis in Plant and Animal Cells, p. 48 Unit 1 Projects, Inquiry Project, Investigating Phases of Mitosis, p. 126
B2.3 examine different plant and animal cells (e.g., cheek cells, onion cells) under a microscope or similar instrument, and draw labelled biological diagrams to show how the cells' organelles differ [PR, AI]	Inquiry Investigation 1-A, Examining Cell Structures, p. 46 Activity 2-2 Inside a Leaf, p. 62 Activity 3-2 Tissue Sleuth, p. 89
B2.4 investigate, using a microscope or similar instrument, specialized cells in the human body or in plants, focusing on different types of cells (e.g., bone, muscle, leaf, root cells), and draw labelled biological diagrams to show the cells' structural differences [PR, C]	Inquiry Investigation 1-A, Examining Cell Structures, p. 46 Activity 2-2 Inside a Leaf, p. 62 Activity 3-2 Tissue Sleuth, p. 89

B2.5 investigate the rate of cell division in cancerous and non-cancerous cells, using pictures, videos, or images, and predict the impact of this rate of cell division on an organism [PR, AI]	Data Analysis Investigation 1-C, Does the Patient Have Cancer?, p. 50
B2.6 investigate, through a laboratory or computer-simulated dissection of a plant, worm, fish, or frog, the interrelationship between organ systems of a plant or an animal (e.g., between the root system and leaf system in a plant; between the digestive system and circulatory system in an animal) [PR, AI]	Inquiry Investigation 3-B, Frog Dissection, p. 117
B2.7 use a research process to investigate a disease or abnormality related to tissues, organs, or systems of humans or plants (e.g., heart disease, tobacco mosaic virus, wheat rust) [IP, PR, C]	Real World Investigation 3-A, Heart Disease: Making the Public Aware, p. 116
B3. Understanding Basic Concepts	
B3.1 describe the cell cycle in plants and animals, and explain the importance of mitosis for the growth of cells and repair of tissues	Section 1.4 The Cell Cycle, pp. 40–50 Unit 1 Projects, Inquiry Project, Investigating Phases of Mitosis, p. 126
B3.2 explain the importance of cell division and cell specialization in generating new tissues and organs (e.g., the division of stem cells into specialized cells such as muscle cells or nerve cells in humans; the division of meristematic cells to expand and differentiate plant tissue)	Section 2.1 Plant Cells, Tissues, and Organs, pp. 57–69 Section 3.1 Cells and Tissues, pp. 85–92
B3.3 explain the links between specialized cells, tissues, organs, and systems in plants and animals (e.g., muscle cell and nerve cells form the tissue found in the heart, which is a component of the circulatory system; granum and thylakoid structures act as solar collectors in the chloroplast to produce carbohydrates for plant growth)	Section 2.1 Plant Cells, Tissues, and Organs, pp. 57–69 Section 2.2 Plant Organ Systems, pp. 70–78 Section 3.1 Cells and Tissues, p. 85–92 Section 3.2 Organs and Systems, pp. 93–107
B3.4 explain the primary functions of a variety of systems in animals (e.g., the circulatory system transports materials through the organism; the respiratory system supplies oxygen to and removes carbon dioxide from the body)	Section 3.2 Organs and Systems, pp. 93–107
B3.5 explain the interaction of different systems within an organism (e.g., the respiratory system brings oxygen into the body, and the circulatory system transports the oxygen to cells) and why such interactions are necessary for the organism's survival	Section 3.2 Organs and Systems, pp. 93–107 Section 3.3, Maintaining Healthy Systems, pp. 109–120
C. Chemistry: Chemical Reactions	
C1. Relating Science to Technology, Society, and the Environment	
C1.1 analyse, on the basis of research, various safety and environmental issues associated with chemical reactions and their reactants and/or product(s) (e.g., chemical reactions related to the use of cyanide in gold mining, the corrosion of metal supports on bridges, the use of different antibacterial agents such as chlorine and bromine in recreational pools) [IP, PR, AI, C]	Section 4.3, Case Study, Green Chemistry, p. 166 Inquiry Investigation 4-B, Keep That Toothy Grin, p. 170

C1.2 analyse how an understanding of the properties of chemical substances and their reactions can be applied to solve environmental challenges (e.g., renewing the Great Lakes, neutralizing acid spills, scrubbing smokestack emissions) [AI, C]	Section 4.3, Case Study, Green Chemistry, p. 166 Inquiry Investigation 4-A, Monitoring Paper Recycling, p. 169 Section 5.1, Case Study, Hydrogen: Fuel of the Future?, p. 182 Activity 5-4, "Taking Care" of Toxic Materials, p. 200 Section 6.3, Case Study, Update on Acid Precipitation, p. 240 Real World Investigation 6-B, The pH of Lakes Near Sudbury, p. 248
C2. Developing Skills of Investigation and Communication	
C2.1 use appropriate terminology related to chemical reactions, including, but not limited to: *compounds, product,* and *reactant* [C]	Unit 2 Chemical Reactions, pp. 132–261
C2.2 construct molecular models to illustrate the structure of molecules in simple chemical reactions (e.g., $C + O_2 \rightarrow CO_2$; $2H_2 + O_2 \rightarrow 2H_2O$), and produce diagrams of these models [PR, C]	Activity 5-2, Building Up and Breaking Down, p. 188 Activity 5-3 How Active Are the Non-Metals?, p. 194
C2.3 investigate simple chemical reactions, including synthesis, decomposition, and displacement reactions, and represent them using a variety of formats (e.g., molecular models, word equations, balanced chemical equations) [PR, AI, C]	Inquiry Investigation 5-B, Synthesis and Decomposition Reactions, p. 208 Inquiry Investigation 5-C, Displacement Reactions, p. 210
C2.4 use an inquiry process to investigate the law of conservation of mass in a chemical reaction (e.g., compare the values before and after the reaction), and account for any discrepancies [PR, AI]	Inquiry Investigation 4-C, Comparing the Masses of Reactants and Products, p. 172
C2.5 plan and conduct an inquiry to identify the evidence of chemical change (e.g., the formation of a gas or precipitate, a change in colour or odour, a change in temperature) [IP, PR, AI]	Plan Your Own Investigation 5-A, Evidence of Chemical Change, p. 207
C2.6 plan and conduct an inquiry to classify some common substances as acidic, basic, or neutral (e.g., use acid-base indicators or pH test strips to classify common household substances) [IP, PR, AI]	Plan Your Own Investigation 6-A, What Is Your Exposure to Acids and Bases?, p. 247
C3. Understanding Basic Concepts	
C3.1 describe the relationships between chemical formulae, composition, and names of binary compounds (e.g., carbon dioxide, CO_2, has two oxygen atoms and one carbon atom)	Section 4.1 Representing Ionic Compounds, pp. 139–151 Section 4.2, Representing Covalent Compounds, pp. 152–158
C3.2 explain, using the law of conservation of mass and atomic theory, the rationale for balancing chemical equations	Section 4.3 Conservation of Mass and Chemical Equations, pp. 159–172
C3.3 describe the types of evidence that indicate chemical change (e.g., changes in colour, the production of a gas, the formation of a precipitation, the production or absorption of heat, the production of light)	Section 5.1 Synthesis and Decomposition Reactions, pp. 179–189
C3.4 write word equations and balanced chemical equations for simple chemical reactions (e.g., $2H_2 + O_2 \rightarrow 2H_2O$)	Section 5.1 Synthesis and Decomposition Reactions, pp. 179–189 Section 5.2 Displacement Reactions, pp. 190–198

C3.5 describe, on the basis of observation, the reactants in and products of a variety of chemical reactions, including synthesis, decomposition, and displacement reactions (e.g., reactions occurring when magnesium burns or in the production of oxygen from hydrogen peroxide; the reaction of iron and copper sulphate; reactions occurring when fossil fuels burn)	Chapter 5 Classifying Chemical Reactions, pp. 176–215
C3.6 describe the process of acid-base neutralization (i.e., an acid reacts with a base to form a salt and often water)	Section 6.3 Reactions of Acids and Bases, pp. 236–250
C3.7 describe how the pH scale is used to classify solutions as acidic, basic, or neutral (e.g., solution with a pH of 1 is highly acidic; a solution with a pH of 7 is neutral)	Section 6.2, The pH Scale and Indicators, pp. 229–235
C3.8 identify simple ionic compounds (e.g., NaCl), simple compounds involving polyatmic ions (e.g., KNO_3, NaOH), molecular compounds (e.g., CO_2, H_2O, NH_3), and acids (e.g., HCl(aq), H_2SO_4 (aq)), using the periodic table and a list of the most common polyatomic ions (e.g., OH^-, SO_4^{-2}), and write the formulae	Section 4.1 Representing Ionic Compounds, pp. 139–151 Section 4.2 Representing Covalent Compounds, pp. 152–158
D. Earth and Space Science: Climate Change	
D1. Relating Science to Technology, Society, and the Environment	
D1.1 analyse current and/or potential effects, both positive and negative, of climate change on human activity and natural systems (e.g., loss of habitat for Arctic mammals such as polar bears and loss of traditional lifestyles for Inuit as Arctic ice shrinks; famine as arable land is lost to desertification; an increase in water-borne disease and human resettlement as coastal lands are flooded; expansion of the growing season in some regions [AI, C]	Section 7.3, Case Study, The Walkerton Water Tragedy, p. 294 Section 8.1, Case Study, Overheating the Ocean's Forests, p. 312
D1.2 assess, on the basis of research, the effectiveness of some current individual, regional, national, or international initiatives that address the issue of climate change (e.g., Drive Clean, ENERGY STAR, federal and provincial government rebates for retrofitting older buildings to be more energy efficient, carbon offset programs, community tree-planting programs, municipal recycling programs, Intergovernmental Panel on Climate Change [IPCC]), and propose a further course of action related to one of these initiatives [PR, AI, C]	Section 9.3 Taking Action to Slow Climate Change, pp. 370–384 Activity 9-1 Who is Responsible for Responding to Climate Change?, p. 349 Activity 9-4 Talking the Talk, Walking the Walk, p. 375 Section 9.3, Case Study, Reduce, Re-use, Recycle, and Upgrade, p. 378 Real World Investigation 9-B, Evaluating the "Food Miles" Initiative, p. 384 Unit 3 Projects, An Issue to Analyze, Dealing With Climate Change, p. 391
D2. Developing Skills of Investigation and Communication	
D2.1 use appropriate terminology related to climate change, including, but not limited to: *albedo, anthropogenic, atmosphere, cycles, heat sinks,* and *hydrosphere* [C]	Unit 3 Climate Change, pp. 262–392
D2.2 design and build a model to illustrate the natural greenhouse effect, and use the model to explain the anthropogenic greenhouse effect [IP, PR, C]	Problem Solving Investigation 8-C, Modelling the Greenhouse Effect, p. 344

D2.3 analyse different sources of scientific data (e.g., lake cores, tree rings, fossils and preserved organisms, ice cores) for evidence of natural climate change and climate change influenced by human activity [PR, AI, C] [PR, AI, C]	Activity 9-2 Analyzing Tree Rings, p. 352 Data Analysis Investigation 9-A, Understanding Ice-Core Data, p. 382
D2.4 investigate a popular hypothesis on a cause-and-effect relationship having to do with climate change (e.g., the combustion of fossil fuels is responsible for rising global temperatures; the concentration of atmospheric CO_2 is responsible for rising global temperatures; global temperatures have been on the increase since the industrial revolution; the severity of cyclones, hurricanes, and tornadoes increases as atmospheric temperatures increase), using simulations and/or time-trend data that model climate profiles (e.g., data from Statistics Canada and Environment Canada) [PR, AI, C]	Activity 8-3 Graphing Changes in Carbon Dioxide, p. 329 Data Analysis Investigation 9-A, Understanding Ice-Core Data, p. 382
D2.5 investigate, through laboratory inquiry or simulations, the effects of heat transfer within the hydrosphere and atmosphere [PR, AI]	Inquiry Investigation 7-A Specific Heat Capacity of Earth Materials, p. 300
D2.6 investigate, through laboratory inquiry or simulations, how water in its various states influences climate patterns (e.g., water bodies moderate climate, water vapour is a greenhouse gas, ice increases the albedo of Earth's surface) [PR, AI]	Inquiry Investigation 7-A Specific Heat Capacity of Earth Materials, p. 300
D2.7 investigate, through research on simulations, the influence of ocean currents on local and global heat transfer and precipitation patterns [PR, AI]	Real world Investigation 8-A Recognizing the Effects of El Niño and La Niña, p. 341
D2.8 classify the climate of their local region using various tools or systems (e.g., Ecoregions of Canada, bioclimate profiles), and compare their region to other regions in Ontario, Canada, and the world [AI, C]	Data Analysis Investigation 7-B Comparing Ecoregions of Canada, p. 302
D2.9 compare different perspectives and/biases evident in discussions of climate change in scientific and non-scientific media (e.g., with reference to knowledge, beliefs, and values) [AI, C]	Activity 7-1, Views on Climate Change, p. 267 Unit 3 Projects, An Issue to Analyze, Dealing With Climate Change, p. 391
D3. Understanding Basic Concepts	
D3.1 describe the principal component's of Earth's climate system (e.g., the sun, oceans, and atmosphere; the topography and configuration of land masses) and how the system works	Section 7.1 Factors That Affect Climate Change, pp. 269–278
D3.2 describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents	Section 8.1 Energy Transfer in the Climate System, pp. 311–322
D3.3 describe the natural greenhouse effect, explain its importance for life, and distinguish it from the anthropogenic greenhouse effect	Section 7.1 Factors That Affect Climate Change, pp. 269–278

D3.4 identify natural phenomena (e.g., plate tectonics, uplift and weathering, solar radiance, cosmic ray cycles) and human activities (e.g., forest fires, deforestation, the burning of fossil fuels, industrial emissions) known to affect climate, and describe the role of both in Canada's contribution to climate change	Section 7.3 Indicators and Effects of Climate Change, pp. 269–278 Section 8.2 Greenhouse Gases and Human Activities, pp. 323–332
D3.5 describe the principal sources and sinks, both natural and/or anthropogenic, of greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide, halocarbons, water vapour)	Section 8.2 Greenhouse Gases and Human Activities, pp. 323–332 Section 8.3 Cycling of Matter and the Climate System, pp. 333–344
D3.6 describe how different carbon and nitrogen compounds (e.g., carbon dioxide, methane, nitrous oxide) influence the trapping of heat in the atmosphere and hydrosphere	Section 8.3 Cycling of Matter and the Climate System, pp. 333–344
D3.7 describe, in general terms, the causes and effects of the anthropogenic greenhouse effect, the depletion of stratospheric and tropospheric ozone, and the formation of ground-level ozone and smog	Section 8.2 Greenhouse Gases and Human Activities, pp. 323–332
D3.8 identify and describe indicators of global climate change (e.g., changes in: glacial and polar ice, sea levels, wind patterns, global carbon budget assessments)	Section 9.1 Discovering Past Climates, pp. 351–359 Section 9.2 Monitoring and Modelling Climate Change, pp. 360–369
E. Physics: Light and Geometric Optics	
E1. Relating Science to Technology, Society, and the Environment	
E1.1 analyse a technological device or procedure related to human perception of light (e.g, eye-glasses, contact lenses, infrared or low light vision sensors, laser surgery), and evaluate its effectiveness [AI, C]	Section 11.3, Case Study, Protecting Your Eyes from UV Radiation, p. 472 Section 12.3, Case Study, Laser Eye Surgery: Shaping Vision, p. 508
E1.2 analyse a technological device that uses the properties of light (e.g., microscope, retroreflector, solar oven, camera), and explain how it has enhanced society [AI, C]	Section 10.3, Case Study, Saved by the Sun, p. 428
E2. Developing Skills of Investigation and Communication	
E2.1 use appropriate terminology related to light and optics, including, but not limited to: *angle of incidence, angle of reflection, angle of refraction, focal point, luminescence, magnification, mirage,* and *virtual image* [C]	Unit 4 Light and Geometric Optics, pp. 396–524
E2.2 use an inquiry process to investigate the laws of reflection, using plane and curved mirrors, and draw ray diagrams to summarize their findings [PR, C]	Inquiry Investigation 10-B Studying the Laws of Reflection, p. 440
E2.3 predict the qualitative characteristics of images formed by plane and curved mirrors (e.g., location, relative distance, orientation, and size in plane mirrors; location, orientation, size, type in curved mirrors), test their predictions through inquiry, and summarize their findings [PR, AI, C]	Inquiry Investigation 10-A, Applying the Laws of Reflection, p. 439

E2.4 use an inquiry process to investigate the refraction of light as it passes through media of different refractive indices, compile data on their findings, and analyse the data to determine if there is a trend (e.g., the amount by which the angle of refraction changes as the angle of incidence increases varies for media of different refractive indices) [PR, AI, C]	Activity 11-2 Investigating Properties of Light, p. 459 Inquiry Investigation 11-A, Investigating Refraction, from Air to Water, p. 476
E2.5 predict, using ray diagrams and algebraic equations, the position and characteristics of an image produced by a converging lens, and test their predictions through inquiry [PR, AI, C]	Inquiry Investigation 12-A, Image Characteristics of a Converging Lens, p. 512
E2.6 calculate, using the indices of refraction, the velocity of light as it passes through a variety of media, and explain the angles of refraction with reference to the variations in velocity [PR, C]	Inquiry Investigation 11-B, Analyzing the Index of Refraction, p. 477
E3. Understanding Basic Concepts	
E3.1 describe and explain various types of light emissions (e.g., chemiluminescence, bioluminescence, incandescence, fluorescence, phosphorescence, triboluminescence; from an electric discharge or light-emitting diode [LED])	Section 10.1 Sources and Nature of Light, pp. 400–402
E3.2 identify and label the visible and invisible regions of the electromagnetic spectrum	Section 10.1 Sources and Nature of Light, pp. 400–402
E3.3 describe, on the basis of observation, the characteristics and positions of images formed by plane and curved mirrors (e.g., location, orientation, size, type), with the aid of ray diagrams and algebraic equations, where appropriate	Section 10.2 Properties of Light and Reflection, pp. 411–418 Section 10.3 Images in Concave Mirrors, pp. 419–430 Section 10.4 Images in Convex Mirrors, pp. 431–442
E3.4 explain the conditions required for partial reflection/refraction and for total internal reflection in lenses, and describe the reflection/refraction using labelled ray diagrams	Section 11.1 Refraction of Light, pp. 449–456 Section 11.2 Partial Refraction and Total Internal Reflection, pp. 457–467
E3.5 describe the characteristics and positions of images formed by converging lenses (e.g., orientation, size, type), with the aid of ray diagrams	Section 12.2 Images Formed by Lenses, pp. 494–501
E3.6 identify ways in which the properties of mirrors and lenses (both converging and diverging) determine their use in optical instruments (e.g., cameras, telescopes, binoculars, microscopes)	Section 12.3 Lens Technologies and the Human Eye, pp. 502–516
E3.7 identify the factors, in qualitative and quantitative terms, that affect the refraction of light as it passes from one medium to another	Section 11.1 Refraction of Light, pp. 449–456
E3.8 describe properties of light, and use them to explain naturally occurring optical phenomena (e.g., apparent depth, shimmering, a mirage, a rainbow)	Section 11.3 Optical Phenomena in Nature, pp. 468–480

Suggested Course Materials Summary

The following chart lists the items you may wish to use for a class of 30 using the *ON Science 10* program. The activities can be carried out by pairs or small groups of students, unless the instructions clearly specify that students should work on their own. Suppliers of science lab materials and equipment are listed in the suppliers' section of this *Teacher's Resource*.

Item Description	Suggested Quantity	Needed for These Units
NON-CONSUMABLE		
acetate (optional)		4
apron, lab	30	1 2
aquarium, small (5 L to 10 L)		3
artist's paintbrush	15	2
balance		2
basin or tub	15	3
beaker	15	2
beakers (50 mL)	45	3
beakers (100 mL)	45	2
beakers (250 mL)	30	2
beakers (600 mL)	45	3
bucket (or sink)	15	4
calculator		3 4
cardboard paper-towel tubes or shoe boxes (optional)		4
cardboard, white		4
clock, watch, or stopwatch		1 3
chemical cards, set of	15	2
coin	15	4
compound microscope	15	1
computer with Internet access		1 2 3
concave mirrors with three different curvatures		4
containers, clear, plastic	30	3
container, small	15	1
converging lens in a holder	15	4
converging lens, large, with a long focal length	15	4

converging lenses, several different	15	4
converging lens, small, with a short focal length	15	4
convex mirror		4
cup	15	2 4
cup, plastic or paper	15	3
cutting board	15	1
dissection tray	15	1
diverging lens, small, with a short focal length	15	4
dropping bottles		2
elastic bands		1 3
Erlenmeyer flask (200 mL)	15	2
Erlenmeyer flask (250 mL)	30	2
flashlight	15	4
forceps	15	1
glass block	15	4
glass jars	45	3
gloves, safety	30	1 2
goggles, safety	30	1 2
graduated cylinder	30	2 3
graduated cylinder (25 mL)	15	2
graduated cylinder (100 mL)	30	2
kitchen tablespoon with two shiny, reflective surfaces	15	4
knife, sharp		1
lamp or light bulb socket with clamp	15	3
laser pointer (optional)		4
light source in a holder	15	4
map of Canadian ecozones	15	3
map of Ontario ecoregions	15	3
measuring cups (500 mL)	30	4
measuring spoons or cups		1 4

measuring spoon (5 mL)	15	3
medicine dropper	15	1
measuring tape, soft	15	4
microviewer		1
mirror stands	15	4
molecular modelling kit	15	2
MSDS for ammonium carbonate, copper(II) carbonate, magnesium, sulfuric acid, calcium hydroxide		2
overhead light with clamp	15	3
overhead projector (or another light source)		3
paper clips		1
pennies or other small markers	3000	3
pins		1
pipe cleaners		1
pipettes (10 mL)	30	2
pipette, plastic	15	2
pipette bulb or pump		2
pitcher	15	3
plane (flat) mirrors	30	4
plane mirror, small (about 5 cm x 15 cm), with support stand	15	4
plastic bags, large enough to fit over small plants (clear)		1
plastic bags, resealable (1 L)	15	2 4
plastic bag, small (clear)	15	1
plastic block, retangular	15	4
plastic bottle, clear	15	4
plastic container, small resealable	15	1
plastic container, clear, semicircular (one with cover)	60	4
potato chip bags (empty) or another material to simulate a reflective surface (optional)		4
prepared slide of *Elodea* (or similar) leaf cells	15	1
prepared slide of human skin cells	15	1
prepared slide of leaf cross sections	15	1
prepared slide of onion root tip	15	1
prepared slides of various tissues from human body		1

prepared slide of whitefish embryo	15	1
preserved frog	15	1
preserved frog	15	1
probe	15	1
protractor	15	4
putty (if mirror stand is unavailable)		4
ray box		4
ray box (single slit)		4
razor blade, single-edged		1
remote control for a television		4
retort stand	15	3
ring stands (optional)	45	3
ring stand with clamp	15	3
room with a window		4
ruler, metric	30	3 4
seeds of pinto or kidney beans (soaked overnight)		1
scalpel	15	1
scissors	15	1 4
scoops	30	2
scoopula	15	3
screen in a holder	15	4
small circular objects (such as washers or coloured paper reinforcements) in bag		2
soft-drink bottles (2 L) (optional)		4
soft-drink bottles, transparent (of the same size and shape)	30	3
spoon	15	2 4
stir stick	15	4
stoppers	45	2
straight pins	75	4
striker		2
string		1
support stands		4
targets		4

television		4
test tubes	90	2
test tube, small	15	2
test-tube rack	15	2
thermometers or temperature probes	45	3
thermometer clamps (optional)		3
thread		1
thumbtack	15	4
toothpicks		1
tongs	15	2 3
tongue depressors		1
tree stump (sawn off) or other cross section of a tree		3
twist-ties		1
watch or timer		1
wire gauze pad	15	2
yarn, several colours		1
CONSUMABLE		
aluminum foil		2
ammonium carbonate solution		2
baking soda		2
barium hydroxide solution		2
Borax solution (4%), saturated		4
cabbage juice, purple		2
cabbage juice, red		2
cardboard, small pieces of	30	3
calcium chloride		2
calcium hydroxide, saturated		2
celery stalks (with leaves on the end)	15	1
chalk or eggshell, pieces of	45	3
chalk dust		2 4
citric acid		2
coffee creamer		3
copper(II) carbonate		2

copper(II) chloride solution		2
copper(II) chloride solution (0.02 mol/L)		2
copper(II) chloride solution, saturated		2
copper(II) sulfate crystals (fine)		2
duct tape		4
egg, hard-boiled	15	2
egg, hard-boiled (stained)	15	2
ethyl alcohol		4
glow-in-the-dark paint powder		4
glue		1
glue gel		4
glycerol		4
hydrochloric acid, 0.1 mol/L		2
hydrogen peroxide solution (3%)		2
iron (steel wool, about 3 cm x 3 cm)	15	2
lemon juice		2
lemon juice, (concentrated)		2
light bulb (100 W)	30	3
magnesium		2
magnesium ribbon (15 cm)	15	2
markers		1 2 3 4
marker, permanent		2
masking tape		3 4
non-dairy creamer		4
notebook	30	3
paper		1 3 4
paper, chart		3
paper, (coloured)		1
paper, graph		1 2 3

paper (letter-sized)		4
paper, poster		2
paper towel		1 2
paper-pulp waste water		2
pencils		1 2 3 4
pencils, coloured (red and blue)		3
pens		1 2 3 4
pens, coloured		3
photographs (showing different carbon stores)		3
pH paper		2
plastic wrap, clear		3 4
polar graph paper		4
potassium iodide/starch solution		2
potted plants, small (different kinds)		1
red food colouring		1
samples of foods, beverages, cosmetics, soaps, and cleaning materials		2
silver nitrate solution		2
soap shavings, "natural" or Ivory™		2
sodium carbonate		2
sodium carbonate solution (0.1 mol/L)	0.3 L	2
sodium hydroxide solution (0.1 mol/L)		2
sodium phosphate solution, saturated		2
soft drink		3
soil, dark-coloured (100 mL)	15	3
soil, dark, dry		3
soil, light-coloured (100 mL)	15	3
sticky notes		3
sticky notes, blue	15	3
sticky notes, pink	15	3

sticky notes, yellow	150	3
sulfuric acid solution (0.5 mol/L)		2
sulfuric acid solution, dilute		2
tape (optional)		4
teeth whitener strips, 2 different brands		2
toothpaste, 2 different brands (with fluoride)		2
universal indicator		2
vinegar		2
water		1 2 3 4
water, cold		3
water, warm		2
wax pencil		2
wooden safety match		2
yeast		2

Activity Planner

Activity/ Investigation/Project	Advance Preparation and Alternative Materials	Apparatus/Materials	Time Required
Chapter 1: Cells and More Cells			
Activity 1-1 Did You Get the Message?		None	• 10 min
Activity 1-2 To Test or Not to Test		- Chart paper (optional)	• 10 min to prepare • 2 periods to complete
Activity 1-3 Modelling Mitosis	- You may wish to have students pre-select materials and gather them from home	- Coloured paper - Poster paper - Scissors - Markers - Glue - Construction materials such as toothpicks, string, twist-ties, paper clips, pipe cleaners, tongue depressors, yarn, elastic bands, thread	• 20 min to gather materials • 10 min to perform
Inquiry Investigation 1-A Examining Cell Structures	- Ensure microscopes are in working order - Order or ensure availability of Elodea (or similar) leaf cell and human skin cell prepared microslides	- Compound microscope - Prepared slide of *Elodea* (or similar) leaf cells - Prepared slide of human skin cells - Prepared slide of onion (optional) - Prepared slide of tomato (optional) - Electron microscope micrographs of a human skin cell (optional) - **BLM G-14 Using a Microscope** (optional)	• 60 min in class • 20 min prep
Inquiry Investigation 1-B Mitosis in Plant and Animal Cells	- Ensure microscopes are in working order - Order or ensure availability of onion root tip and whitefish embryo prepared microslides - The day before, prepare slides.	- Compound microscope - Prepared slide of whitefish embryo - Prepared slide of onion root tip - **BLM G-14 Using a Microscope** (optional)	• 20 min prep • 80 min in class
Data Analysis Investigation 1-C Does the Patient Have Cancer?		- Graph paper or graphing software - Cell growth data set from student textbook - Coloured pencils (optional)	• 60 min

Chapter 2: Plants: From Cells to Systems			
Activity 2-1 Observing Plant Growth	- Ensure that enough soil is available and it is of good potting quality - Transparent bags or containers are best - Have students set up an observation table on Day - Include space for written and pictorial observations	- Seeds (pinto or kidney; green beans or string beans will also work) - Clear plastic bags or resealable plastic containers - Paper towels - Small container - Water Soil	• Day 1, 15 minutes class time • Day 5, 30–40 minutes; Days 5 to 19, 15 minutes each day
Activity 2-2 Inside a Leaf	- Week before: Ensure microscopes/ microviewers are working and micrographs can be easily obtained - Day before: Collect prepared microslides and microscopes and microviewer - Order or ensure availability of prepared leaf cross sections. Ideally there should be one cross section for each microscope	- Microscopes/microviewers - Microslides - Micrographs - Biological drawings - Stains	• 45 min in class • 10 minutes to assemble a set of materials beforehand, and 10 minutes to discuss biological drawings
Activity 2-3 The Flow of Phloem		None	
Plan Your Own Investigation 2-A Transpiration in Different Plant Types	- Students should be given enough notice to create their hypotheses and plans in advance. - About one month before beginning the chapter, obtain small, cost-effective, potted plants from a local vendor or have students begin to bring plants or plant cuttings into class to allow sufficient time for the plants to adjust to the environment	- A variety of small potted plants - Modelling compound (optional) - Clear waterproof plastic bags -Potometer (optional) - Elastic bands (optional)	• Investigation can take place in one period or over a couple of days. • Consider planning shorter lessons to allow for plant analysis and data • recording each day of the investigation.

Inquiry Investigation 2-B Moving Nutrients Though the Stem	- Two days before: collect materials	- Three 100 mL beakers Small plastic bag - 2 medicine droppers - Elastic - 3 celery stalks - Single-edged razor blade or sharp knife - Cutting board or other cutting surface - Red (or blue) food colouring	• Option 1: Use half of day one to set up the investigation and the rest of the time for other content development. • Option 2: Use half of day one to set up the investigation and the rest of the time for students to continue to work in lab groups to prepare data
Chapter 3: Animals: From Cells to Systems			
Activity 3.1 More Than a Covering		- None	• 10–20 min
Activity 3.2 Tissue Sleuth	- Ensure microscopes/ microviewers are working - Order or ensure availability of prepared slides of various tissues from the human body for Activity 3-2	- Microviewer or compound microscope - Unidentified, prepared slides or various tissues from the human body	• 40 min
Activity 3.3 Changing Your Pulse Rate	- Ensure that each student or group has access to a clock or watch if there is not a watch or clock being used for the entire class	- Watch or timer	• 10–20 min
Real World Investigation 3-A Heart Disease: Making the Public Aware	None	- Pens and markers - Poster board - Computers with Internet access	• 60 min outside class for student planning • 60 min outside class to produce the product • 60 min in class for presentations

Inquiry Investigation 3-B Frog Dissection	- Order or ensure availability of preserved frogs for Inquiry Investigation 3-B. Ideally, there should be one frog per student or groups of students as required. - Ensure that complete dissection kits (tray, pins, scissors, forceps, scalpel, and probe) are available for each student or group of students as required for Investigation 3-B. - Ensure the availability of safety materials for Inquiry Investigation 3-B, including laboratory gloves, goggles and aprons. - Before beginning the investigation, make sure there are enough paper towels handy for clean-up and any spills that may occur	- Gloves, goggles, and lab apron - Preserved frog - Water - Dissection tray - Pins - Paper towel for clean up - Forceps, scissors, scalpel - Probe - A computer-simulated dissection (optional)	60 min in class 60 min outside class to answer questions
Inquiry Investigation 3-C Who's Stubbing Out?		- Pens - Graphing software (optional) - Graph paper	45 min
Unit 1 Projects			
Inquiry Project: Investigating Phases of Mitosis	- Ensure microscopes are in working order	- Knife - Microscope slide - Paper towel - Cover slip - **BLM G-14 Using a Microscope** - Green onion, or yellow onion that has been allowed to grow in water for a few days - 1 M hydrochloric acid - Stain (such as 1% toluidine blue) - Water - Microscope - Graph paper	• 30 min to plan and initiate • 30 min to perform and record • 30 min to communicate
An Issue to Analyze: Organ Donations	- Book a computer lab - Book a library period	- Sources such as newspapers, magazines, Internet, and people	• 2 weeks (in and out of class) for research • 1 or 2 periods for presentations

Chapter 4: Developing Chemical Equations			
Activity 4-1 Making a Reaction Happen	- Begin gathering materials one week before.	- baking soda - citric acid - scoops - water - resealable plastic bags	• 25 min
Activity 4-2 Take My Electron–Please!		- paper - small circular objects to mimic electrons - **BLM G-1 Safety Contract** (optional) - **BLM 4-7 Take My Electron–Please!** (optional)	• 30 min in class
Activity 4-3 Electron, Anyone?	- One or two days before: prepare small bags with at least 10 objects each	- paper - small circular objects to mimic electrons -molecular modelling kits - **BLM 4-13 Electron, Anyone?**	• 30 min
Inquiry Investigation 4-A Monitoring Paper Recycling	- One or two days before: gather materials and prepare waste water samples and dropper bottles of testing solutions	- 50 mL paper-pulp waste water - 25 mL graduated cylinder - 6 test tubes - test-tube rack - potassium iodide/starch(aq) in dropper bottle - silver nitrate(aq) in dropper bottle - barium hydroxide(aq) in dropper bottle - 0.5 mol/L sulfuric acid(aq) in dropper bottle - universal indicator(aq) in dropper bottle - **BLM 4-4 Monitoring Paper Recycling**	• 45 min for class time
Inquiry Investigation 4-B Keep That Toothy Grin	- One or two days before: buy toothpaste, teeth whitener, eggs, and lemon juice - Day before: hard boil the eggs and stain one third of the eggs with strong black tea, divide the teeth whitener and toothpaste samples into four sets of Petri dishes, make copies of the BLM (optional)	- 2 brands of toothpaste with fl uoride artist's paintbrush - 2 brands of teeth whitener 300 mL lemon juice - permanent marker 2 cups or beakers - 2 hard-boiled eggs tea for stains - **BLM 4-10 Keep That Toothy Grin** (optional)	• 45 min in class, plus 10 min to observe on two more days

Inquiry Investigation 4-C Comparing the Masses of Reactants and Products	- Day before: prepare solutions and separate into four sets	- 20 mL 0.1 mol/L sodium hydroxide solution - 15 mL 0.1 mol/L iron(III) nitrate solution - 200 mL Erlenmyer fl ask - stopper - small test tube (to fit inside flask) - balance - tongs - 50 mL graduated cylinder (optional) - **BLM G-13 Data Table** (optional)	• 30 min
Chapter 5: Classifying Chemical Reactions			
Activity 5-1 Foiled Again!	- Begin gathering materials a few weeks before	- 50 mL saturated copper(II) chloride solution - Two 250 mL beakers 10 × 10 cm aluminum foil - Water - Paper towel - Spoon or other hard object	• 20 min
Activity 5-2 Building Up and Breaking Down	- Gather molecular model kits one or two days before. Ensure all parts are present and that you know what each part represents	- Molecular model kit - **BLM 5-4 Building Up and Breaking Down** (optional)	• 30 min
Activity 5-3 How Active Are the Non-Metals?	None	- Molecular model kit - Coloured pencils (optional) - **BLM 5-7 How Active Are the Non-Metals?**	• 40 min
Activity 5-4 "Taking Care" of Toxic Materials	-Two days before: prepare solutions and place in dropping bottles	- 110 mL 0.020M copper(II) chloride solution - 20 mL saturated sodium phosphate solution - 100 mL graduated cylinder Two - 250 mL beakers - 2 droppers or dropper bottles - Coloured pencils (optional)	• 20 min
Plan Your Own Investigation 5-A Evidence of Chemical Change	- One week before: prepare solutions and make copies of the BLM and MSDS for each material	- MSDS for each material - Ammonium carbonate solution - Copper(II) carbonate solution - Magnesium ribbon - Dilute sulfuric acid - Universal indicator solution - Saturated calcium hydroxide solution - Scoopula - Test tubes - Test-tube rack - Tongs - Utility knife (optional) - **BLM 5-3 Evidence of Chemical Change**	• 60 min

Inquiry Investigation 5-B Synthesis and Decomposition Reactions	- One day before: prepare samples of materials and copies of BLMs	- 3 × 3 cm steel wool - 250 mL beaker - 60 mL 3% hydrogen peroxide solution - Pinch of yeast - Insulated gauze pad - Tongs - Striker - **BLM 5-5 Synthesis and Decomposition Reactions**	• 30 min
Inquiry Investigation 5-C Displacement Reactions	- One or two days before: gather materials and make copies of BLMs	- 3 test tubes - 3 rubber stoppers - 15 cm magnesium ribbon - Fine copper(II) sulfate crystals - Calcium chloride Sodium carbonate - 30 mL warm water - Pencil - **BLM 5-8 Displacement Reactions** (optional)	• 45 min
Data Analysis Investigation 5-D Reactivity Trends in the Periodic Table	None	None	• 40 min
Chapter 6: Acids and Bases			
Activity 6-1 Cabbage Detector	- Day before: shred soap and collect the juice from boiled, shredded red cabbage - Divide the lemon into two samples on the day of the lab	- 10 mL red cabbage juice - Lemon juice - 2 test tubes - "Natural " or Ivory™ soap shavings - Test-tube rack	• 10 min for preparation • 20 min class time
Activity 6-2 Chemical Card Games	- Day before: copy BLM and cut apart cards	- **BLM 6-3 Acid Playing Cards**	• 30 min
Activity 6-3 Universal Rainbow	- Two days before: prepare solutions and fill universal indicator bottles. Make copies of the BLM	- 2 test tubes - test-tube rack - Marker or wax pencil - 20 mL 0.1 mol/L hydrochloric acid - 20 mL 0.1 mol/L sodium carbonate - Plastic pipette - **BLM 6-6 A Universal Rainbow**	• 30 min
Activity 6-4 Air Pollution and Ontario's Lakes	- Day before: gather materials and make copies of the BLM	- 50 mL water - Universal indicator solution - Two 250 mL Erlenmeyer flasks - tongs - Wooden safety match - Pinch of chalk dust - **BLM 6-10 Air Pollution and Ontario's Lakes**	• 30 min

Plan Your Own Investigation 6-A What Is Your Exposure to Acids and Bases?	- Day before: gather materials. You may wish to ask students to bring in samples form home in the original containers - Day of the lab: put solutions into small beakers and divide them among stations around the classroom	- Universal indicator or pH paper - Samples of foods, beverages, cosmetics, soaps, and cleaning materials - Equipment (as needed) - **BLM 6-7 Testing pH of Common Substances** (optional)	• 20 min to prepare • 30 min to perform
Real World Investigation 6-B The pH of Lakes Near Sudbury	- Book computer lab or library for research	- **BLM 6-9 Investigation 6-B Data Analysis** (optional)	• 75 min
Inquiry Investigation 6-C Neutralizing an Acid with a Base	- Day before, collect the juice form boiled, shredded purple cabbage	- Two 25 mL graduated cylinders -1 mL purple cabbage juice - 35 mL 0.1 mol/L hydrochloric acid - Pipette bulb or pump - 35 mL 0.1 mol/L sodium hydroxide - Two 100 mL beakers - Two 10 mL pipettes	• 75 min
Unit 2 Projects			
Inquiry Investigation: "Mining" Copper in the Laboratory	- Arrange time in the library for book or Internet research	- **BLM A-3 Designing an Experiment Checklist** (optional)	• 2 weeks (in and out of class) for research • 1 or 2 periods for presentations
An Issue to Analyze: Urban Gold "Mining"	- Arrange time in the library for book or Internet research	- **BLM G-17 How to Do a Research-Based Project** (optional) - **BLM G-19 Research Worksheet** (optional) - **BLM G-4 Analyzing Issues–Science, Technology, Society, and the Environment** (optional)	• 2 weeks (in and out of class) for research • 1 or 2 periods for presentations
Chapter 7: Earth's Climate System			
Activity 7-1 Views on Climate Change	- Begin gathering materials several days in advance. - Ensure you have enough for the number of groups you will have. Have backup sticky notes	- Chart paper - Markers or pens - Sticky notes - Stopwatches - **BLM G-43 Venn Diagram**	• 20–30 min
Activity 7-2 Modelling the Effects of Volcanoes on Climate	- Ensure adequate counter or desk space for the aquarium and the light source	- Overhead projector (or another light source) - Water - Small aquarium (5 L to 10 L) - 20 mL coffee creamer - 5 mL measuring spoon	• 20 min
Activity 7-3 How to Make a Climatograph		- Red and blue pencils - Rulers - Graph paper	• 25 min in class

Activity 7-4 Acidity and Coral Reefs	- One or two days before, ask students to collect eggshells at home	- 3 glass jars or 50 mL beakers - 20 mL water - 20 mL vinegar - 20 mL soft drink - 3 pieces of chalk or eggshell - Graduated cylinder - Tongs	• 30–45 min • 5 min to observe over the next two days
Inquiry Investigation 7-A Specific Heat Capacity of Earth Materials	- One week before the investigation, obtain dark-coloured soil and light-coloured sand. – Make sure that the sand and soil are dry. Gather the materials. Check that the light bulbs are working. - One day before the investigation, photocopy **BLM 7-6 Specific Heat Capacity of Earth Materials**	- 3 600 mL beakers - Scoop - 100 mL dark-coloured soil - 100 mL light-coloured sand - 100 mL cold water - 100 W light bulb - Lamp or light bulb socket with clamp - 3 thermometers or temperature probes - 4 ring stands (optional) - 3 thermometer clamps (optional) - Clock, watch, or stopwatch - Graph paper - Coloured pens or pencils (optional)	• 40–60 min
Data Analysis Investigation 7-B Comparing Ecoregions of Canada	None	- Maps of Canadian ecozones and Ontario ecoregions	• 30–40 min
Data Analysis Investigation 7-C Comparing the Effects of Climate Change on Vegetation in Canada	None	- Maps of Canadian ecozones and Ontario ecoregions	• 30–40 min
Chapter 8: Dynamics of Climate Change			
Activity 8-1 Modelling Balance in Systems	None	- Basin or tub - Plastic or paper cup - Ruler - 1 L of water in a pitcher - Pencil with point	• 20–30 min
Activity 8-2 What Heats the Atmosphere?	None	None	• 20–30 min
Activity 8-3 Graphing Changes in Carbon Dioxide	None	- Graph paper - Coloured pencils and pens	• 20–30 min
Activity 8-4 Modelling Carbon Stores	None	Per group: - 10 yellow sticky notes - 1 pink sticky note - 1 blue sticky note - 5 photographs of carbon reservoirs (rocks, ocean, oil, trees, sky)	• 20–30 min

Real World Investigation 8-C Recognizing the Effects of El Niño and La Niña on Canada	None	- Graph paper - Coloured pencils (red and blue)	• 60 min
Plan Your Own Investigation 8-B Comparing Heat Absorption of Water and Soil		- Retort stand - Ruler - 2 clear plastic containers - Overhead light with clamp - 2 thermometers Watch or clock - Water - Dark, dry soil - Masking tape	• 45 min
Problem-Solving Investigation 8-C Modelling the Greenhouse Effect		For each group: - 2 glass jars or transparent pop bottles (same size and shape) - Light bulb - Socket with clamp - 2 thermometers or temperature probes - Watch, stopwatch, or clock - Clear plastic wrap - Elastic band Graph paper - 2 small pieces of cardboard – Masking tape	• 40–45 min
Chapter 9: Addressing Climate Change			
Activity 9-1 Who Is Responsible for Addressing Climate Change?	None	None	• 20–30 min
Activity 9-2 Analyzing Tree Rings	None	- Ruler - Paper or notebook - Pencil - Tree stump (sawn off) or other cross section of a tree	• 20–30 min
Activity 9-3 Pennies from Heaven	None	- About 200 pennies or other small markers - Large surface	• 20–30 min
Activity 9-4 Talking the Talk, Walking the Walk	None	- Computers with Internet access	• 20–30 min
Data Analysis Investigation 9-A Understanding Ice-Core Data	None	- Calculator	• 60 min
Inquiry Investigation 9-B Evaluating the "Food Miles" Initiative	None	- Calculator	• 45–60 min

Unit 3 Projects			
Inquiry Investigation: Reflecting on Land Use	- Ground cover materials might include: grass or leaves, dark and light roofing shingles, cement and asphalt, water, dirt, and sand - A large area will be required in order for all students to lay their test samples out in the sunshine.	- variety of "ground cover" materials as identified by students - thermometers - containers for sample material	• 20 min to prep • 60 to 90 min to design and carry out
An Issue to Analyze: Dealing with Climate Change	None	None	• 60 to 120 min
Chapter 10: Light and Reflection			
Activity 10-1 Growing Slime	- One or two days before: gather materials. You may wish to have students bring a flashlight from home	- Two 500 mL measuring cups - Measuring spoons - 15 mL glue gel - 45 mL warm water - 1 mL glow-in-the-dark paint powder - Flashlight - 10 mL 4% (saturated) borax solution - Spoon - Resealable plastic bag	• 15 min
Activity 10-2 A Reflection Obstacle Course		- Targets - 2 plane (fl at) mirrors - 2 mirror stands - Flashlight - Remote control for a television - Television	• 10 min to set up • 30 min to perform
Activity 10-3 Reflection from the Concave Surface of a Spoon	None	- Metal spoon - Coloured pencils	• 15 min
Activity 10-4 Reflection from the Convex Surface of a Spoon	None	- Metal spoon	• 15 min
Inquiry Investigation 10-A Applying the Laws of Reflection	- The day before, ask students to bring suitable pointed objects to class	- Blank sheet of letter size paper - Pencil - Ruler - small plane mirror - Putty (or support stand) - Ray box - small object shorter (e.g., pencil) - Protractor	• 25 min

Inquiry Investigation 10-B Studying the Laws of Reflection		- Blank sheet of letter size paper - Pencil - Ruler 5 cm × 15 cm plane mirror - Putty (or support stand) - Ray box - Pointed object shorter than the mirror - Protractor	15 min to prep 30 min in class
Inquiry Investigation 10-C Testing for Real and Virtual Images	None	- 3 concave mirrors with different curvatures - Plane mirror - Convex mirror - White cardboard for screen - Window	45 min
Chapter 11: Refraction			
Activity 11-1 The Re-appearing Coin	- The day before, collect cups and coins.	- Cup or another container with opaque sides	• 10 min
Activity 11-2 Investigating Properties of Light	- The day before, gather the materials and make copies of the BLM or assign as homework the task of preparing a data table.	- Glass block - Sheet of paper - ray box (single slit) - pencil - ruler - protractor	• 5 min
Activity 11-3 The Fountain of Light		- Clear plastic bottle (remove the label if necessary) - Duct tape - Thumbtack - Masking tape - Water - Bucket - Flashlight - Scissors	• 10 min
Activity 11-4 Apparent Depth	- The day before, gather materials and copy the BLM.	- Rectangular plastic block (clear) - Thick piece of cardboard - Sheet of blank paper - 5 straight pins - Ruler - **BLM 11-11 Apparent Depth Data Analysis**	• 5 min
Inquiry Investigation 11-A Investigating Refraction, from Air to Water	- The day before, gather materials and make copies of BLM.	- Tap water - Clear, semicircular plastic container - Non-dairy creamer or chalk dust - Stir stick - Ray box - Polar graph paper - **BLM 11-3 Investigating Refraction Data Analysis** (optional)	• 60 min

Inquiry Investigation 11-B Analyzing the Index of Refraction		- Marker - Masking tape - 4 semicircular plastic containers - Cover for one container - Water - Ethyl alcohol - Glycerol - Glass block - Ray box - Protractor - **BLM 11-4 Analyzing the Index of Refraction** (optional)	• 10 min to prepare • 60 min in class
Real World Investigation 11-C Saving Time	- The day before, make copies of the BLM.	- Calculator - **BLM 11-5 Saving Time Data Analysis**	• 60 min
Inquiry Analysis Investigation 11-D Investigating Total Internal Reflection	- The day before, gather materials and make copies of the BLM.	- Tap water - Clear, semicircular plastic container - Non-dairy creamer or chalk dust - Stir stick - Ray box - Polar graph paper - **BLM 11-8 Investigating TIR in Water** - **BLM 11-9 Build a Periscope** (optional)	• 60 min
Chapter 12: Lenses and Lens Technologies			
Activity 12-1 The Disappearing Finger		- Oversized protractor	• 5 min
Activity 12-2 Hocus Focus		- Several different converging lenses - Sheet of paper - Metric ruler	• 60 min
Inquiry Investigation 12-A Image Characteristics of a Converging Lens	None	- Screen in a holder - Metric ruler - Support stands - Light source in a holder - Converging lens in a holder - **BLM 12-3 Image Characteristics of a Converging Lens** (optional)	• 60 min
Data Analysis Investigation 12-B I "Speye"	None	- Soft measuring tape - Piece of paper	• 20 to 60 min
Inquiry Investigation 12-C Make a Simple Telescope	None	- Converging lens (large, with a long focal length) - Converging lens (small, with a short focal length) - Diverging lens (small, with a short focal length) - Long cardboard tubes (optional)	• 60 to 90 min

Unit 4 Projects			
Inquiry Investigation: Design a Light Tunnel	None	– 2 concave mirrors – 2 convex mirrors – 2 diverging lenses – 2 converging lenses – Triangular prism – Light source – Acetate, plastic wrap, or glass – Cardboard tubes – Foil – **BLM 12-12 Design a Light Tunnel**	• 30 min to plan (could be homework) • 30 min to construct • 20 to 30 min to draw ray diagrams • 1 class period for presentations
An Issue to Analyze: LEDs Brighten Up the Darkness	The day before, have students research how LEDs produce light and what makes them so much more efficient than incandescent bulbs, and even CFLs.	– Sources such as newspapers, maps, magazines, and Internet	• 2 weeks (in and out of class) for research • 1 or 2 periods for presentations

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This list of suppliers includes suppliers of science equipment and materials, and also suppliers of technology materials that may be useful to you and your students for Investigations and for Unit Projects, in which students are encouraged to use their own ideas and plans to design and build devices and/or systems that provide a solution to a problem or challenge.

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