Expectations for SNC2D

	A. SCIENTIFIC INVESTIGATION SKILLS AND CAREER EXPLORATION
	OVERALL EXPECTATIONS
	A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);
	A2. identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields.
	SPECIFIC EXPECTATIONS
	A1. Scientific Investigation Skills
	Initiating and Planning [IP]*
	A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research
	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
	A1.3 identify and locate print, electronic, and human sources that are relevant to research questions
	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 and disposal 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)
	Performing and Recording [PR]*
	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
	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
	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
	*Analysing and Interpreting [AI]**
	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
	A1.9 analyse the information gathered from research sources for reliability and bias
	A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions
	Communicating [C]*
	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)
	A1.12 use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units)
	A1.13 express the results of any calculations involving data accurately and precisely

	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
	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
	B. BIOLOGY: TISSUES, ORGANS, AND SYSTEMS OF LIVING THINGS
	OVERALL EXPECTATIONS
	B1. evaluate the importance of medical and other technological developments related to systems biology, and analyse their societal and ethical implications;
	B2. investigate cell division, cell specialization, organs, and systems in animals and plants, using research and inquiry skills, including various laboratory techniques;
	B3. demonstrate an understanding of the hierarchical organization of cells, from tissues, to organs, to systems in animals and plants.
	SPECIFIC EXPECTATIONS
	B1. Relating Science to Technology, Society, and the Environment
	B1.1 analyse, 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]
	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], microscopy, biophotonics) used in Canada in diagnosing or treating abnormalities in tissues, organs, and/or systems [AI, C]
	B1.3 describe public health strategies related to systems biology (e.g., cancer screening and prevention programs; vaccines against the human papillomavirus [HPV] and measles, mumps, and rubella [MMR]; AIDS education), and assess their impact on society [AI, C]
	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, stomate, and xylem [C]
	B2.2 examine cells under a microscope or similar instrument to identify the various stages of mitosis in plants and animals [PR, AI]
	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, C]
	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]
	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]
	B2.6 investigate, through a laboratory or computer-simulated dissection of a plant, worm, fish, or frog, the interrelationships 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]
	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]
	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
	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)
	B3.3 explain the links between specialized cells, tissues, organs, and systems in plants and animals (e.g., muscle cells 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)
	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)
	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
	C. CHEMISTRY: CHEMICAL REACTIONS
	OVERALL EXPECTATIONS
	C1. analyse a variety of safety and environmental issues associated with chemical reactions, including the ways in which chemical reactions can be applied to address environmental challenges;
	C2. investigate, through inquiry, the characteristics of chemical reactions;
	C3. demonstrate an understanding of the general principles of chemical reactions, and various ways to represent them.
	SPECIFIC EXPECTATIONS
	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]
	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]
	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]
	C2.2 construct molecular models to illustrate the structure of molecules in simple chemical reactions (e.g., C + O2 ? CO2; 2H2 + O2 ? 2H2O), and produce diagrams of these models [PR, C]
	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]
	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]
	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]
	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]
	C3. Understanding Basic Concepts
	C3.1 describe the relationships between chemical formulae, composition, and names of binary compounds (e.g., carbon dioxide, CO2, has two oxygen atoms and one carbon atom)

	C3.2 explain, using the law of conservation of mass and atomic theory, the rationale for balancing chemical equations
	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 precipitate, the production or absorption of heat, the production of light)
	C3.4 write word equations and balanced chemical equations for simple chemical reactions (e.g., 2H2 + O2 ? 2H2O)
	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)
	C3.6 describe the process of acid-base neutralization (i.e., an acid reacts with a base to form a salt and often water)
	C3.7 describe how the pH scale is used to classify solutions as acidic, basic, or neutral (e.g., a solution with a pH of 1 is highly acidic; a solution with a pH of 7 is neutral)
	C3.8 identify simple ionic compounds (e.g., NaCl), simple compounds involving polyatomic ions (e.g., KNO3, NaOH), molecular compounds (e.g., CO2, H2O, NH3), and acids (e.g., HCl(aq), H2SO4(aq)), using the periodic table and a list of the most common polyatomic ions (e.g., OH-, SO4-2), and write the formulae
	D. EARTH AND SPACE SCIENCE: CLIMATE CHANGE
	OVERALL EXPECTATIONS
	D1. analyse some of the effects of climate change around the world, and assess the effectiveness of initiatives that attempt to address the issue of climate change;
	D2. investigate various natural and human factors that influence Earth's climate and climate change;
	D3. demonstrate an understanding of natural and human factors, including the greenhouse effect, that influence Earth's climate and contribute to climate change.
	SPECIFIC EXPECTATIONS
	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]
	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]
	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]
	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]
	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]
	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 CO2 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]
	D2.5 investigate, through laboratory inquiry or simulations, the effects of heat transfer within the hydrosphere and atmosphere [PR, AI]
	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]
	D2.7 investigate, through research or simulations, the influence of ocean currents on local and global heat transfer and precipitation patterns [PR, AI]
	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]
	D2.9 compare different perspectives and/or biases evident in discussions of climate change in scientific and non_scientific media (e.g., with reference to knowledge, beliefs, and values) [AI, C]
	D3. Understanding Basic Concepts
	D3.1 describe the principal components of Earth's climate system (e.g., the sun, oceans, and atmosphere; the topography and configuration of land masses) and how the system works
	D3.2 describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents
	D3.3 describe the natural greenhouse effect, explain its importance for life, and distinguish it from the anthropogenic greenhouse effect
	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
	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)
	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
	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
	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)
	E. PHYSICS: LIGHT AND GEOMETRIC OPTICS
	OVERALL EXPECTATIONS
	E1. evaluate the effectiveness of technological devices and procedures designed to make use of light, and assess their social benefits;
	E2. investigate, through inquiry, the properties of light, and predict its behaviour, particularly with respect to reflection in plane and curved mirrors and refraction in converging lenses;
	E3. demonstrate an understanding of various characteristics and properties of light, particularly with respect to reflection in mirrors and reflection and refraction in lenses.
	SPECIFIC EXPECTATIONS
	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., eyeglasses, contact lenses, infrared or low light vision sensors, laser surgery), and evaluate its effectiveness [AI, C]
	E1.2 analyse a technological device that uses the properties of light (e.g., microscope, retro-reflector, solar oven, camera), and explain how it has enhanced society [AI, C]

	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]
	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]
	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]
	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]
	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]
	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]
	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])
	E3.2 identify and label the visible and invisible regions of the electromagnetic spectrum
	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
	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
	E3.5 describe the characteristics and positions of images formed by converging lenses (e.g., orientation, size, type), with the aid of ray diagrams
	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)
	E3.7 identify the factors, in qualitative and quantitative terms, that affect the refraction of light as it passes from one medium to another
	E3.8 describe properties of light, and use them to explain naturally occurring optical phenomena (e.g., apparent depth, shimmering, a mirage, a rainbow)