

## **Coded Expectations, Science, Grade 12, University/College Preparation, SNC4M**

### **Scientific Investigation Skills**

- SIS.01** - demonstrate an understanding of safety practices consistent with Workplace Hazardous Materials Information System (WHMIS) legislation by selecting and applying appropriate techniques for handling, storing, and disposing of laboratory materials (e.g., safely handle organic compounds);
- SIS.02** - select appropriate instruments and use them effectively and accurately in collecting observations and data (e.g., microscopes, electrical equipment, meters, data loggers);
- SIS.03** - demonstrate the skills required to plan and carry out investigations using laboratory equipment safely, effectively, and accurately (e.g., design and carry out an experiment to investigate the effectiveness of different antacids);
- SIS.04** - select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate scientific ideas, plans, and experimental results (e.g., draw and label a diagram of the structure of an organic molecule, identifying its active sites);
- SIS.05** - locate, select, analyse, and integrate information on topics under study, working independently and as part of a team, and using appropriate library and electronic research tools, including Internet sites;
- SIS.06** - compile, organize, and interpret data, using appropriate formats and treatments, including tables, flow charts, graphs, and diagrams (e.g., summarize in a chart the various modes of disease transmission);
- SIS.07** - communicate the procedures and results of laboratory investigations and research for specific purposes using data tables and laboratory reports (e.g., an investigation of physical and chemical properties of organic products in everyday life; an investigation concerning the application of solar power in battery-driven cars);
- SIS.08** - research and evaluate information on a specialized topic in science, and apply it to the world outside the school (e.g., conduct an impact survey on emerging global communication systems; assess the positive and negative aspects of the Human Genome Project);
- SIS.09** - select and use appropriate SI units;
- SIS.10** - identify and collect information on careers related to the science subject area under study (e.g., TV repair person, VCR technician).

### **Organic Products in Everyday Life**

#### **Overall Expectations**

- OPV.01** · describe the properties, benefits, and hazards of representative everyday organic products, and the use of these products in personal daily life, industry, and agriculture;
- OPV.02** · investigate the properties of everyday organic products, using appropriate laboratory procedures and equipment safely and accurately, and gathering and integrating information from print and electronic sources;
- OPV.03** · analyse the impact on society and the environment of the use of organic products.

## Specific Expectations

### Understanding Basic Concepts

- OP1.01** – define, with examples, terms such as: *soap, detergent, emulsion, emulsifying agent, herbicide, pesticide*;
- OP1.02** – compare the properties and structures of inorganic and organic substances (e.g., draw diagrams to show the similarities and differences between inorganic and organic molecules);
- OP1.03** – explain the scientific principles involved in the making and use of soaps and detergents (e.g., the principles of bonding related to the making of detergents);
- OP1.04** – explain, giving examples, the action of an emulsifying agent (e.g., the effect of dish detergent on fats);
- OP1.05** – explain the scientific principles involved in the separation of crude oil into its fractions (e.g., into diesel fuel, gasoline, petroleum jelly);
- OP1.06** – describe the properties of chemical fertilizers and pesticides, and their use in agriculture;
- OP1.07** – summarize, using scientific principles, the dangers of UV radiation and the role of sunscreens in protecting the skin;
- OP1.08** – explain the action of various pharmaceuticals, and their role in personal health-care products (e.g., draw flow charts to show the action and use of aspirin/ASA, antacids, and vitamins in personal health care).

### Developing Skills of Inquiry and Communication

- OP2.01** – illustrate the relationship between the structure and function of various organic products by constructing for each a simple model of its molecule and identifying its active parts (e.g., draw and label a diagram of a soap molecule, including its hydrophylic and hydrophobic parts);
- OP2.02** – investigate through experimentation the nature of emulsifiers and emulsions (e.g., conduct an experiment to make mayonnaise, or hand cream);
- OP2.03** – use laboratory investigation or computer simulation to illustrate the scientific principles upon which fractional distillation of petroleum products is based (e.g., conduct an experiment on the fractional distillation of oil);
- OP2.04** – compare, through research in print and electronic sources, the nature and action of chemical and natural fertilizers (e.g., draw a Venn diagram showing the similarities and differences in the action of chemical and natural fertilizers);
- OP2.05** – conduct a laboratory investigation into the chemical properties and chemical action of pharmaceutical products (e.g., into the function of antacids or aspirin/ASA).

### Relating Science to Technology, Society, and the Environment

- OP3.01** – analyse the costs and benefits of using organic products (e.g., most pesticides, phosphate detergents), and assess their global impact on the environment;
- OP3.02** – identify and describe strategies for pest control other than the use of organic products (e.g., research alternatives to pesticide use in agriculture and the home);
- OP3.03** – describe the use and production of representative organic products over time (e.g., cosmetics and other pharmaceutical products).

## Pathogens and Disease

### Overall Expectations

- PDV.01** · demonstrate an understanding of micro-organisms, their biological effects, the diseases they cause, and the metabolic and environmental barriers to the spread of disease;
- PDV.02** · investigate the nature and growth of representative pathogens, the response of the immune system to them, and the effect on them of various drug therapies and sterilization techniques, using appropriate laboratory procedures and equipment safely and accurately, and gathering and integrating information from print and electronic sources;
- PDV.03** · evaluate the measures available for the control of disease, including the role of public policy and the use of health-related technologies and scientific knowledge.

### Specific Expectations

#### Understanding Basic Concepts

- PD1.01** – define, with examples when appropriate, such terms as: *micro-organism, pathogen, parasite, disease, epidemiology, pathogenesis, vector*;
- PD1.02** – describe the characteristics and reproductive cycles of representative pathogens (e.g., lysogenic cycle, lytic cycle, infectious cycle of malaria);
- PD1.03** – describe the modes of transmission of diseases, including those that are insect-borne (e.g., malaria, encephalitis), airborne (e.g., influenza, tuberculosis), water-borne (e.g., cholera, poliomyelitis), sexually transmitted (STDs; e.g., AIDS), and food-borne (e.g., mad cow disease, trichinosis, food poisoning);
- PD1.04** – describe and explain the immune response of the body as a natural defence against infection (e.g., the immune response to salmonella food poisoning, or trichinosis);
- PD1.05** – describe the use of vaccines, antibiotics, antiseptics, and other drug therapies in the control of pathogenesis;
- PD1.06** – describe non-medicinal ways to protect oneself from contracting pathogenic diseases (e.g., aseptic techniques, personal hygiene).

#### Developing Skills of Inquiry and Communication

- PD2.01** – investigate experimentally, using aseptic techniques, the characteristics and growth of non-pathogenic bacteria (e.g., conduct an experiment to compare different types of bacteria, using commercially prepared slides);
- PD2.02** – present a comparative analysis, based on their own research, of the various modes of transmission of pathogens;
- PD2.03** – research and report on the nature of the immune response in the human body (e.g., summarize the steps in the human immune response to a typical pathogen);
- PD2.04** – identify, through laboratory investigation, the effects of various drug therapies on pathogenesis (e.g., ask a testable question, propose a hypothesis, and conduct an experiment related to the effect of mouthwash or penicillin on the growth of bacteria);
- PD2.05** – demonstrate, through laboratory investigation, the effect on pathogenesis of the use of sterile techniques (e.g., the effect on pathogenesis of the pasteurization of dairy products).

#### Relating Science to Technology, Society, and the Environment

- PD3.01** – describe some of the means used by agencies and governments to control the spread of disease, both locally and globally;
- PD3.02** – evaluate the impact on an individual and on society of the misuse of antibiotics in the control of infection (e.g., chart the cause-and-effect relationships between the use of antibiotics and vaccines and the development of viral mutations and resistant strains of bacteria);

- PD3.03** – research and explain the impact on disease control of technological advances in food preparation and preservation (e.g., the impact of freezing, pasteurization, radiation, and canning on food marketing);
- PD3.04** – describe aseptic techniques used in the workplace and explain their importance (e.g., the techniques used to prevent food poisoning or the spread of disease in a food preparation facility or a restaurant);
- PD3.05** – research and describe the impact on populations of the use of new technologies to control disease (e.g., gather and integrate information on community demographics and rates of infant survival to illustrate the effect over time of new vaccines and antibiotics).

## Energy Alternatives and Global Impact

### Overall Expectations

- EAV.01** · demonstrate an understanding of the scientific principles of energy production from conventional and alternative sources;
- EAV.02** · compare the practical value of a variety of alternative energy sources, through investigation and cost-benefit analysis;
- EAV.03** · assess conventional and alternative energy sources in terms of their ability to satisfy societal demand and of their environmental impact.

### Specific Expectations

#### Understanding Basic Concepts

- EA1.01** – define, with examples when appropriate, terms such as: *joule, rad, watt, fission, fusion, chain reaction, activation energy, renewable/non-renewable resources, conventional/alternative energy sources*;
- EA1.02** – compare and contrast conventional and alternative energy sources with respect to criteria such as availability, renewability, cost, and environmental impact (e.g., draw a Venn diagram showing similarities and differences between the use of fossil fuels and geothermal energy);
- EA1.03** – describe technologies created in response to dwindling non-renewable energy resources (e.g., windmills, solar panels, electric cars);
- EA1.04** – compare the relative amounts of energy released in various physical, chemical, and nuclear transformations (e.g., create charts to compare the energy released in condensation of water vapour, combustion of gasoline, and splitting of the atom);
- EA1.05** – describe the scientific principles of fission and a chain reaction and their applications in nuclear generating stations (e.g., the scientific principles applied in the CANDU reactor);
- EA1.06** – compare and contrast nuclear fission and nuclear fusion according to such criteria as feasibility, costs, and energy efficiencies.

#### Developing Skills of Inquiry and Communication

- EA2.01** – analyse data to determine which human activities consume the most energy, and how changing patterns of behaviour can reduce the total amount of energy consumed;
- EA2.02** – gather and analyse data, experimentally or through research, to evaluate alternative and emerging technologies as examples of responsible energy use (e.g., technologies related to wind power, solar power, electric cars, ethanol fuel, or the fermentation of waste products);
- EA2.03** – evaluate arguments for the use of nuclear technology, based on research into its advantages and disadvantages (e.g., production of greenhouse gases from fossil fuels is reduced but production of nuclear waste is increased);

- EA2.04** – present an argument, based on research and scientific analysis, for the use of an alternative energy system (e.g., a solar cooker, or a solar collector);
- EA2.05** – design a system that uses an alternative energy source (e.g., design, build, and test a working model of a wind generator, or a solar-powered car).

### **Relating Science to Technology, Society, and the Environment**

- EA3.01** – identify, based on information integrated from print and electronic sources, short- and long-term environmental effects of by-products from nuclear generating stations;
- EA3.02** – identify new energy applications inspired by traditional energy sources (e.g., battery-operated cars including those powered by fuel cells);
- EA3.03** – evaluate the environmental impact of a specific alternative source of energy (e.g., conduct an environmental impact survey that covers such issues as costs and waste production/management);
- EA3.04** – analyse the costs and benefits to society of alternative energy systems, and assess the impact of their use on a global scale (e.g., wind generators, or tidal power plants);
- EA3.05** – evaluate the suitability of alternative energy sources, using research into the regional availability of natural resources in Canada (e.g., draw a correlation map for Canada showing regional energy systems and the distribution of natural resources, including water, fossil fuels, heat sinks, and wind and tides).

## **Communications Systems**

### **Overall Expectations**

- CSV.01** · explain the fundamental scientific principles that are applied in modern communications systems;
- CSV.02** · explain, on the basis of their findings from laboratory investigations, how modern communications systems function;
- CSV.03** · evaluate the advantages and disadvantages of modern communications systems, for both the individual and society.

### **Specific Expectations**

#### **Understanding Basic Concepts**

- CS1.01** – define, with examples when appropriate, terms such as: *wave, wavelength, frequency, semi-conductor, electromagnetic spectrum, fibre optic cabling*;
- CS1.02** – identify and describe the technologies involved in various communications systems (e.g., technologies involved in the Global Positioning System [GPS], or the Internet);
- CS1.03** – explain the fundamental scientific principles related to the use of a communications technology (e.g., fibre optics in a communications system);
- CS1.04** – explain, based on information from print and electronic sources, how electromagnetic radiation, as a form of energy, is produced and transmitted (e.g., radio waves);
- CS1.05** – identify and describe (e.g., outline, in a concept diagram) the properties and applications of the various regions of the electromagnetic spectrum;
- CS1.06** – identify and describe the applications of the electromagnetic spectrum in communications systems (e.g., radio, television, telephone, radar, satellites, fibre optics, or converters);
- CS1.07** – identify and explain the application of semi-conductors in communications systems (e.g., the use of semi-conductors in computers and graphic projection devices);
- CS1.08** – explain the energy transformations that take place to permit the transmission and reception of signals in communications systems;
- CS1.09** – describe how sound energy is received, analysed, and reproduced electronically (e.g., energy transformations in the functioning of a microphone).

### **Developing Skills of Inquiry and Communication**

- CS2.01 – explain and analyse scientific principles related to communications systems (e.g., the Internet) using appropriate terminology;
- CS2.02 – describe and follow procedures for the safe and accurate use of electrical equipment as outlined in the Occupational Health and Safety Act and the Fire Code (e.g., describe the safety measures followed in an experiment involving the use of electrical equipment);
- CS2.03 – design, construct, and test a simple device that transforms energy (e.g., sound, light) from one form to another (e.g., design, construct, and test a prototype of a photovoltaic cell, loudspeaker, or doorbell);
- CS2.04 – identify and describe, through experimentation, how common communications equipment functions (e.g., conduct an experiment related to the design and functioning of a telephone or radio).

### **Relating Science to Technology, Society, and the Environment**

- CS3.01 – assess the impact of new communications systems (e.g., cell phones) on individual lifestyles and on home and workplace environments;
- CS3.02 – assess the impact of new communications systems (e.g., the Internet, surveillance technologies) on the privacy of individuals and communities, focusing on risks and benefits;
- CS3.03 – forecast and assess the future effects of the use of new communications systems, locally and globally (e.g., the effects on time management, networking, and world trade).

## **Science and Contemporary Societal Issues**

### **Overall Expectations**

- SSV.01 · demonstrate an understanding of how scientific knowledge has evolved and continues to evolve through scientific discoveries, past and present;
- SSV.02 · assess the strengths and limitations of scientific knowledge and procedures as means for resolving contemporary societal issues;
- SSV.03 · evaluate the social and environmental implications and technological applications of contemporary scientific discoveries, and consider different cultural and societal perspectives on the discoveries.

### **Specific Expectations**

#### **Understanding Basic Concepts**

- SS1.01 – formulate definitions of scientific terms such as: *principle, law, theory, fact, observation, concept, inference, causality*;
- SS1.02 – explain how scientific knowledge evolves as new evidence comes to light and as theories are modified (e.g., draw a timeline chart to outline the historical relationship between experimental evidence, scientific inference, and accepted theory);
- SS1.03 – explain how evidence, theories, and paradigms contributed to a recent scientific discovery (e.g., write a report on James Watson and Francis Crick’s work in establishing the physical structure of DNA, describing the relationship between scientific ways of thinking, experimental evidence, and the nature of the resulting theory);
- SS1.04 – explain how a scientific discovery can lead to a paradigm shift in responses to a problem (e.g., conduct a media search on how the discovery of stomach bacteria changed the treatment of “lifestyle” diseases such as stomach ulcers);
- SS1.05 – identify technologies that have been developed as a result of a scientific discovery (e.g., the standard tungsten incandescent bulb or the tungsten-halogen bulb following research into high-resistance filaments);
- SS1.06 – identify examples of the growth of scientific knowledge as a result of a technological invention (e.g., compile and display recent data on distant galaxies obtained by the Hubble Space Telescope).

### **Developing Skills of Inquiry and Communication**

**SS2.01** – demonstrate, through laboratory investigation, case study, or computer simulation, the habits of mind appropriate to scientific investigation, including objectivity, tentativeness, accuracy, and consistency (e.g., collect, record, and analyse data related to a case study involving the possible impact of the physical environment on genetic expression in humans);

**SS2.02** – analyse and interpret, through laboratory investigation, case study, or computer simulation, scientific evidence relevant to a contemporary societal issue (e.g., ask a testable question and propose a hypothesis related to the cause-and-effect relationship between water chlorination and formation of organo-chlorides);

**SS2.03** – research and defend, from a scientific perspective, a particular view of a contemporary societal issue as reported in the media (e.g., summarize the point of view presented in a magazine article on government support for hepatitis sufferers, and assess its merit from a scientific perspective);

**SS2.04** – evaluate, through interview and research, differing cultural perspectives on a contemporary subject or issue to which science is also relevant (e.g., a First Nations' perspective on maintaining natural balance through the use of alternative medicines).

### **Relating Science to Technology, Society, and the Environment**

**SS3.01** – explain how a particular technological application of a scientific discovery is perceived by various interest groups in the community (e.g., present the views of different groups on the risks and benefits of using bovine growth hormone in milk production);

**SS3.02** – assess the possible positive and negative effects of a scientific discovery on society and the environment (e.g., positive and negative aspects of the Human Genome Project);

**SS3.03** – analyse ways in which societal needs or demands influence scientific and technological endeavours (e.g., relate levels of funding for AIDS research over time to societal influences);

**SS3.04** – describe the processes by which the private and public sectors have cooperated to establish and fund some Canadian research projects in science and technology.