

# Science 9 Year Review: “I Can” statements

## Biological Diversity

- I can describe and identify examples of biological diversity.
- I can describe, in general terms, the relative abundance of species on Earth and identify different environments of high or low biodiversity.
- I can distinguish between, and provide examples of, variation among different species (inter) and variation within a single species (intra).
- I can identify examples of both discrete and continuous intraspecies variation.
- I can distinguish between behavioural and structural adaptations that enable species to survive within their specific environments.
- I can identify examples of niches (broad and narrow), and describe the role of variation in enabling closely related living things to survive in the same ecosystem (resource partitioning).
- I can interpret relationships among species that link the survival of one species to the survival of others (for example: symbiosis, predator/prey relationships).
- I can identify the role of variation in species survival under changing environmental conditions (natural selection and evolution).
- I can distinguish between sexual and asexual reproduction and identify examples of each.
- I can compare sexual and asexual reproduction (advantages and disadvantages).
- I can distinguish those characteristics that are heritable from those that are not heritable, and identify characteristics for which heredity and environment may *both* play a role.
- I can investigate and identify examples of dominant or recessive inherited characteristics in offspring that are:
  - the same as the characteristics of only one of the parents or intermediate between parental characteristics or different from both parents.
- I can describe, in general terms, the relationship of chromosomes, genes and DNA; and interpret their role as sources of genetic information.
- I can distinguish between cell division that leads to identical daughter cells (mitosis), as in binary fission, and cell division that leads to formation of half cells (meiosis), as in gamete formation; and describe, in general terms, the synthesis of genetic materials that takes place during fertilization.
- I can describe, in simple terms, some of the newly emerging technologies for recombining genetic material (cloning, gene sequencing); and identify questions and issues related to their application.
- I can investigate and describe the use of biotechnology in environmental, agricultural or forest management (GMO's, artificial selection); and identify potential impacts and issues.
- I can distinguish between, and identify examples of, natural and artificial selection.
- I can describe ongoing changes in biological diversity through extinction and extirpation of native species, and investigate the role of environmental factors in causing these changes.
- I can appreciate the effects of human activities upon biodiversity in the environment.
- I can evaluate the successes and limitations of various local and global strategies for minimizing loss of species diversity.
- I can recognize that science can help us to assess our impact on the environment but it cannot accurately predict future events.

## **Matter and Chemical Change**

- I can demonstrate knowledge of WHMIS standards, by identifying and/or using proper techniques for handling and disposing of laboratory materials.
- I can investigate and describe physical and chemical properties of matter, and physical and chemical changes in matter.
- I can describe and apply different ways of classifying materials based on their composition and properties, including:
  - distinguishing between different types of pure substances (elements and compounds)
  - distinguishing between different types of mixtures (homogeneous solutions and heterogeneous mixtures such as mechanical mixtures, suspensions, colloids and emulsions).
- I can demonstrate understanding of the origins of the periodic table (Dmitri Mendeleev), and relate patterns in the physical and chemical properties of elements to their positions in the periodic table (focusing on the first 18 elements) including:
  - distinguishing between metals, metalloids and nonmetals
  - distinguishing between alkali metals, alkaline earth metals, halogens and noble gases
  - being able to describe, in general terms, the “periodic” trends in the table (the relationship between the structure of atoms in each group and the properties of elements in that group).
- I can distinguish between observation and theory, and provide examples of how models and theoretical ideas of atomic structure have been used in explaining experimental observations; I can appreciate that scientists have used models which are not always verifiable to further their research.
- I can use the periodic table to identify the number of protons, electrons, neutrons and other information about each atom; including creating a simple model for the structure of an atom.
- I can distinguish between ionic and molecular compounds, and describe the properties of some common examples of each.
- I can use the chemical formula for an ionic or molecular compounds to give the IUPAC name; and/or use the IUPAC name to provide the correct formula for these compounds.
- I can identify examples of combining ratios/number of atoms per molecule found in some common materials such as water, salt, carbon dioxide, oxygen, baking soda and vinegar (Law of definite composition).
- I can use information on ion charges to predict combining ratios in ionic compounds of two elements.
- I can draw simple models of molecular and ionic compounds.
- I can observe and describe patterns of chemical change, by:
  - identifying examples of exothermic and endothermic reactions
  - identifying conditions that affect rates of reactions (temperature, surface area, catalysts/inhibitors, concentration of reactants)
  - identifying evidence for the Law of conservation of mass (mass of reactants = mass of products).
- I can describe evidence of chemical change in reactions between familiar materials, by:
  - describing combustion, corrosion, respiration, photosynthesis
  - observing and inferring evidence of chemical reactions between familiar household materials
  - representing these reactions by using word equations and/or chemical formulas and by constructing models of reactants and products.

## Environmental Chemistry

- I can distinguish between common nutrients that are essential to the health and growth of humans and other living things such as:
  - organic molecules (containing carbon chains and synthesized by plants and/or animals) such as:
    - proteins, lipids, carbohydrates, nucleic acids and vitamins, and
  - inorganic molecules (no carbon chains) such as:
    - minerals (calcium, magnesium, iron, potassium, Etc.), water, oxygen and salts.
- I can distinguish between and provide examples of macronutrients and micronutrients, and use these to illustrate the concept of optimal amounts.
- I can identify substrates and nutrient sources for living things within a variety of environments.
- I can describe and illustrate processes by which chemicals are introduced to the environment (e.g., agricultural run-off of fertilizers and pesticides, industrial pollution, oil spills).
- I can describe and illustrate processes by which the concentrations of chemicals are changed (e.g., dilution in streams, biomagnification through food chains).
- I can describe the uptake of materials by living things through ingestion (animals) or absorption (plants), and investigate and describe evidence that some materials are difficult for organisms to break down or eliminate (e.g., DDT, mercury).
- I can identify questions that may need to be addressed in deciding what substances—in what amounts—can be safely released into the environment.
- I can describe and illustrate the use of biological monitoring as one method for determining air, water, soil and atmospheric quality; including identification of characteristics, and examples, of useful bioindicator species.
- I can identify chemical factors in an environment that might affect the health and distribution of living things in that environment (e.g., available oxygen, pH, concentration of heavy metals, dissolved nutrients in the soil such as nitrogen, phosphorous and potassium).
- I can apply and interpret measures of chemical concentration in parts per million, billion or trillion.
- I can identify acids, bases and neutral substances, based on measures of their pH; and identify common examples of each type of substance.
- I can describe the effects of acids and bases on each other and on other substances (acid/base burns, acid-base neutralization).
- I can describe effects of acids and bases on living things (e.g., acid precipitation in fresh water systems).
- I can describe mechanisms for the transfer of pollutants through air, water and soil; identify factors that may accelerate or slow down the distribution of those materials; and distinguish between point and non-point sources of pollution.
- I can describe mechanisms for biodegradation, and interpret information on the biodegradability of different materials.
- I can interpret information on the biological impacts of hazardous chemicals on local and global environments (e.g., interpret LD50 data and other information on toxicity).
- I can describe and evaluate methods used to transport, store and dispose of hazardous household chemicals (sanitary landfill versus secure landfill).
- I can describe various methods for using technology to reduce the effects of environmental pollution (scrubbers, catalytic converters, acid-base neutralization to reduce effects of acid precipitation, landfill design).
- I can investigate and evaluate potential risks resulting from consumer practices and industrial processes, and identify processes used in providing information and setting standards to manage these risks.
- I can identify and evaluate information and evidence related to an issue in which environmental chemistry plays a major role; I can identify data, information and viewpoints that are relevant to the issue.
- I can defend a given position on an issue or problem, based on evaluating evidence and sources of information.

## Electrical Principles and Technologies

- I can distinguish between static and current electricity.
- I can identify electrical conductors and insulators, and compare the resistance of different materials.
- I can predict the effects of using different switches and resistors to control electrical flow.
- I can develop, test and troubleshoot circuit designs (e.g., parallel versus series) for a variety of specific purposes, based on low voltage circuits.
- I can investigate toys, models and household appliances; and draw circuit diagrams to show the flow of electricity through them (e.g., safely dismantle discarded devices, such as heating devices or motorized toys, and draw diagrams to show the loads, conductors and switching mechanisms).
- I can describe, using models, the nature of electrical current; and explain the relationship among current, resistance and voltage (describe flow of current using the flow of water as an analogy).
- I can measure and/or calculate current (I), voltage (V) and amperage (R or  $\Omega$ ) in circuits using Ohm's law
- I can identify, describe and interpret examples of energy transfer between mechanical, chemical, thermal (heat) and electrical energy.
- I can describe the Law of conservation of energy.
- I can evaluate the use of different chemicals (electrodes and electrolyte), chemical concentrations and designs (parallel versus series cell combinations) for electrical wet cells.
- I can identify devices for transforming mechanical energy into electrical energy (generators) and for transforming electrical energy into mechanical energy (electric motors).
- I can identify and describe the function of the components of a simple DC electric motor/generator.
- I can modify the design of an electrical device, and evaluate the resulting changes in energy transfer (e.g., investigate the effect of changes in the orientation and placement of magnets, commutator and armature in a St. Louis motor).
- I can assess the potential danger of electrical devices, by referring to the voltage and current rating (amperage) of the devices; and distinguish between safe and unsafe activities.
- I can apply appropriate units, measures and devices in determining and describing quantities of energy transformed by an electrical device:
  - measure amperage and voltage, and calculate the number of watts consumed by an electrical device, using the formula  $P = IV$  [power (watts) = current (amps) x voltage (volts)]
  - calculate the quantity of electric energy, in joules, transformed by an electrical device, using the formula  $E = Pt$ . [energy (joules) = power (watts) x time (in seconds)]
- I can identify the forms of energy inputs and outputs in a device or system.
- I can compare energy inputs and outputs of a device, and calculate its efficiency.
- I can apply the concepts of conservation of energy and efficiency to the analysis of energy devices.
- I can investigate and describe techniques for reducing waste of energy in common household devices.
- I can identify and evaluate alternative sources of electrical energy besides the three most common (combustion of coal/oil/gas, nuclear and hydroelectric); including biomass, wind, waves, cogeneration and thermocouples/thermopiles.
- I can describe the by-products of electrical generation and their impacts on the environment.
- I can identify examples of electrical technologies, and evaluate technologies in terms of benefits and impacts.
- I can identify concerns regarding conservation of energy resources, and evaluate means for improving the sustainability of energy use.

## **Space Exploration**

- I can identify different traditional perspectives on the nature of Earth and space, based on culture and science.
- I can describe the contributions of technological advances—including optical telescopes, spectral analysis, radio telescopes and space travel—to a scientific understanding of space.
- I can describe, in general terms, the distribution of matter in space (e.g., universe, galaxies, nebulae, solar systems, stars, planets, planetoids).
- I can describe the position of objects in space, using azimuth altitude coordinates.
- I can explain, in general terms, the operation of optical telescopes (reflecting and refracting), including telescopes that are positioned in space environments (Hubble).
- I can explain the role of radio and optical telescopes in determining characteristics of stars and star systems:
  - radio telescopes expand our view outside of the visible light portion of the electromagnetic spectrum
  - optical telescopes can be used with spectral (dark line) analysis to determine element composition.
- I can describe and apply techniques for determining the position and motion of objects in space, including:
  - interpreting drawings and physical models that illustrate the motion of objects in space
  - describing techniques used to estimate distances of objects in space (triangulation, parallax)
  - describing techniques used to determine the motion of objects in space (spectral red/blue shift).
- I can describe the development of artificial satellites, and explain the major purposes for which they are used (e.g., communication, GPS—global positioning system, weather observation).
- I can describe and interpret, in general terms, the technologies used in global positioning systems and in remote sensing satellites (e.g., use triangulation to determine the position of an object).
- I can describe characteristics of, and compare, bodies that make up our solar system (terrestrial and jovian planets); and compare their characteristics with those of Earth.
- I can recognize risks associated with space exploration and the challenges that must be met to survive in space.
- I can describe technologies for space travel, and interpret the scientific principles involved.
- I can identify materials, processes and technologies developed to meet needs in space, and identify related applications (technology “spin-offs” for private consumers/businesses).
- I can describe Canadian contributions to space research and development, and to the astronaut program.
- I can identify and analyze factors that are important to decisions regarding space exploration and development of technologies developed for space travel (e.g., identify examples of costs and potential benefits for humankind that may be considered; investigate and describe political, environmental and ethical issues related to space exploration e.g., the ownership and use of resources in space).