E. SOLUTIONS AND SOLUBILITY

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. analyse the origins and effects of water pollution, and a variety of economic, social, and environmental issues related to drinking water;

E2. investigate qualitative and quantitative properties of solutions, and solve related problems;

E3. demonstrate an understanding of qualitative and quantitative properties of solutions.

SPECIFIC EXPECTATIONS

E1. Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

E1.1 analyse the origins and cumulative effects of pollutants that enter our water systems (e.g., landfill leachates, agricultural run-off, industrial effluents, chemical spills), and explain how these pollutants affect water quality [AI, C]

Sample issue: Golf courses use fertilizer and irrigation systems to sustain the vegetation. However, chemical substances, when combined with water, may run off and pollute local water systems.

Sample questions: What pollutants might be found in untreated wastewater from a chicken farm or a poultry-processing plant? How do leachates from old landfill sites enter our water system? How might they affect the water quality of local streams? What are some of the sources and effects of mercury in water systems? What impact might this contaminant have on Aboriginal communities that depend on fishing as a source of food?

E1.2 analyse economic, social, and environmental issues related to the distribution, purification, or use of drinking water (e.g., the impact on the environment of the use of bottled water) [AI, C]

Sample issue: In developing countries, thousands of people, many of them children, die every year from drinking contaminated water. Many of these countries cannot afford to build water treatment plants. In North America, where safe water is generally available, we spend millions of dollars on bottled water, draining sources of fresh water and challenging waste-disposal systems.

Sample questions: What are the economic costs of building, maintaining, and monitoring water-purification plants? What are the social and environmental costs if these plants are not properly maintained and monitored? How effective are municipal wastewater treatment processes at removing pharmaceuticals such as hormones and antibiotics from our drinking water? What public health concerns are associated with the consumption of water bottled in plastic containers?

E2. Developing Skills of Investigation and Communication

By the end of this course, students will:

E2.1 use appropriate terminology related to aqueous solutions and solubility, including, but not limited to: *concentration, solubility, precipitate, ionization, dissociation, pH, dilute, solute,* and *solvent* [C]

E2.2 solve problems related to the concentration of solutions by performing calculations involving moles, and express the results in various units (e.g., moles per litre, grams per 100 mL, parts per million or parts per billion, mass, volume per cent) [AI, C]

E2.3 prepare solutions of a given concentration by dissolving a solid solute in a solvent or by diluting a concentrated solution [PR]

E2.4 conduct an investigation to analyse qualitative and quantitative properties of solutions (e.g., perform a qualitative analysis of ions in a solution) [PR, AI]

E2.5 write balanced net ionic equations to represent precipitation and neutralization reactions [AI, C]

E2.6 use stoichiometry to solve problems involving solutions and solubility [AI]

E2.7 determine the concentration of an acid or a base in a solution (e.g., the concentration of acetic acid in vinegar), using the acid–base titration technique [PR, AI]

E2.8 conduct an investigation to determine the concentrations of pollutants in their local treated drinking water, and compare the results to commonly used guidelines and standards (e.g., provincial and federal standards) [PR, AI]

E3. Understanding Basic Concepts

By the end of this course, students will:

E3.1 describe the properties of water (e.g., polarity, hydrogen bonding), and explain why these properties make water such a good solvent

E3.2 explain the process of formation for solutions that are produced by dissolving ionic and molecular compounds (e.g., salt, oxygen) in water, and for solutions that are produced by dissolving non-polar solutes in non-polar solvents (e.g., grease in vegetable oil)

E3.3 explain the effects of changes in temperature and pressure on the solubility of solids, liquids, and gases (e.g., explain how a change in temperature or atmospheric pressure affects the solubility of oxygen in lake water)

E3.4 identify, using a solubility table, the formation of precipitates in aqueous solutions (e.g., the use of iron or aluminum compounds to precipitate and remove phosphorus from wastewater)

E3.5 explain the Arrhenius theory of acids and bases

E3.6 explain the difference between strong and weak acids, and between strong and weak bases, in terms of degree of ionization