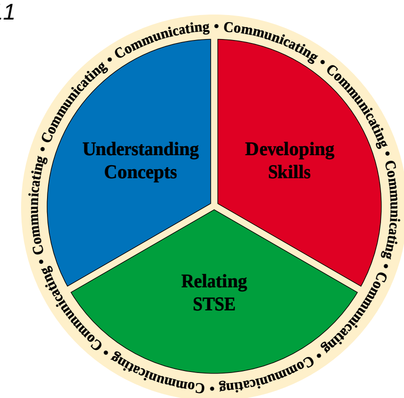
How does *Nelson Chemistry 11* match the curriculum?

Balanced Instruction and Assessment



- *Nelson Chemistry 11* reflects the overall aim of the secondary science program, which is to "ensure scientific literacy for every secondary school graduate." (*The Ontario Curriculum, Grades 11 and 12*, *Science*, p. 6), as well as the primary objective of the *Chemistry*, *Grade 11, University Preparation* curriculum, which is to "equip students with the knowledge and skills they need to meet the entrance requirements for university programs."

  The Ontario Curriculum, Grades 9 to 12 Program Planning and Assessment, p. 3

- *Nelson Chemistry 11* addresses 100% of the *Chemistry, Grade 11, University Science Preparation* (SCH3U) course curriculum expectations

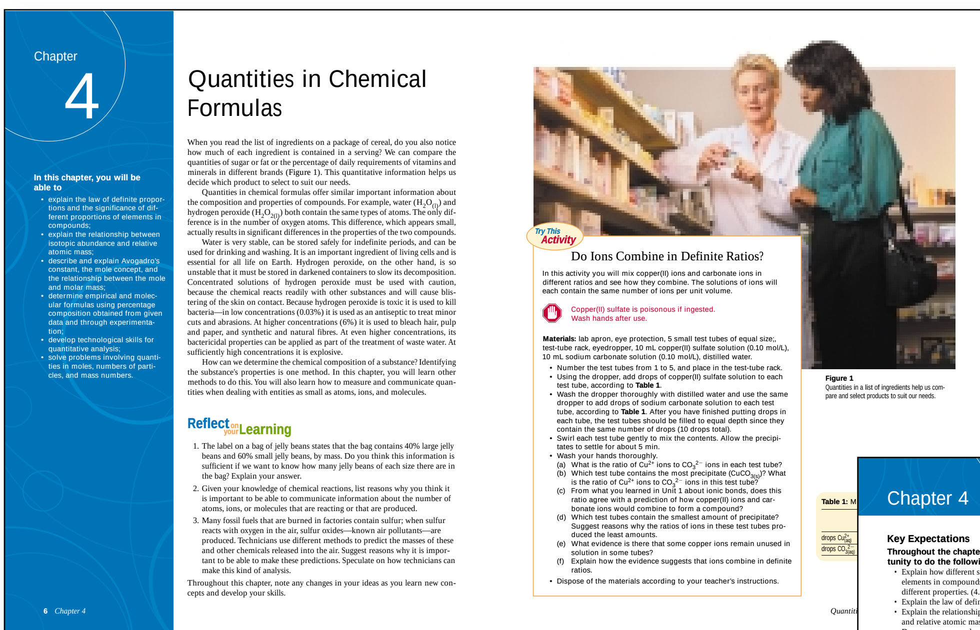
- *Nelson Chemistry 11* provides a balance of instruction and assessment, reflecting the three goals of secondary science curriculum, which are:

  A Understand the basic concepts of science

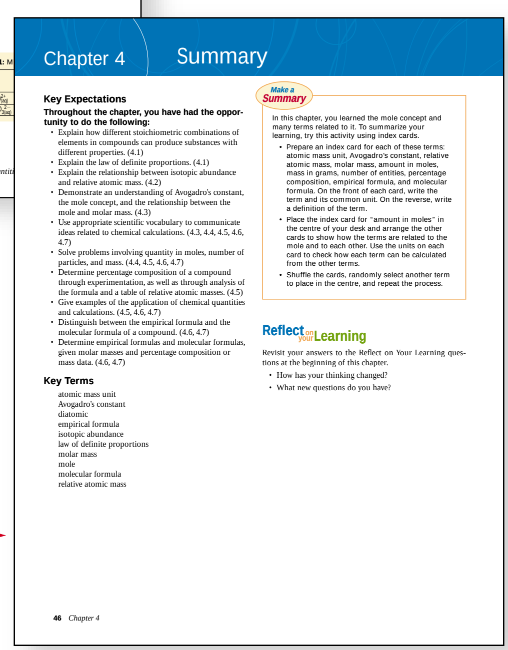
  B Develop the skills, strategies, and habits of mind required for scientific inquiry

  C Relate science to technology, society, and the environment

  The Ontario Curriculum, Grades 11 and 12, Science, p. 6



The **Chapter Opener** describes the key student expectations for the unit. Curricular expectations are synthesized into an easy-to-understand "student language" format.



The chapter-ending **Summary** feature lists the specific Key Expectations addressed, and points to where the expectations have been addressed in the chapter. The expectations are expressed in the same language used in the curriculum document.

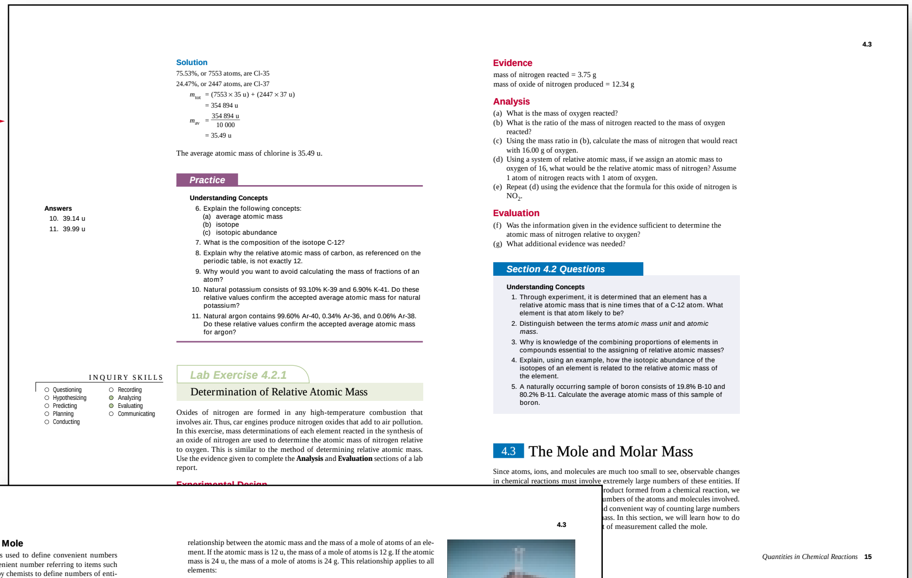
A Understand the Basic Concepts of Science

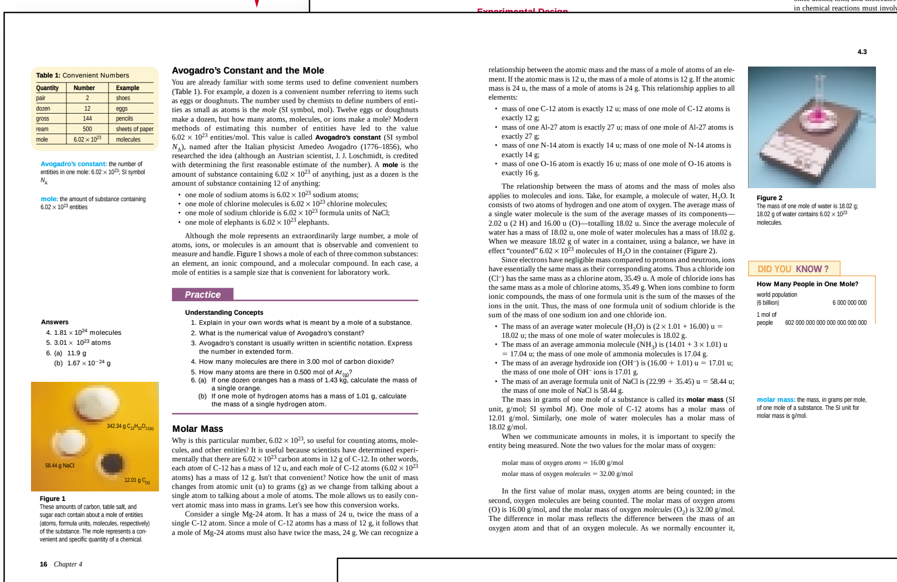
Nelson Chemistry 11 provides complete and accurate coverage of all content in Ontario's *Chemistry*, *Grade 11, University Preparation* Science Curriculum (SCH3U). The goal of the program is to adequately prepare students for success in *Chemistry, Grade 12, University Preparation* (SCH4U), and future post-secondary studies. Concepts fundamental to each strand in the curriculum are developed with text and images. Students learn to apply a number of strategies, such as using headings, reading labels, and interpreting diagrams to assist their understanding of concepts.

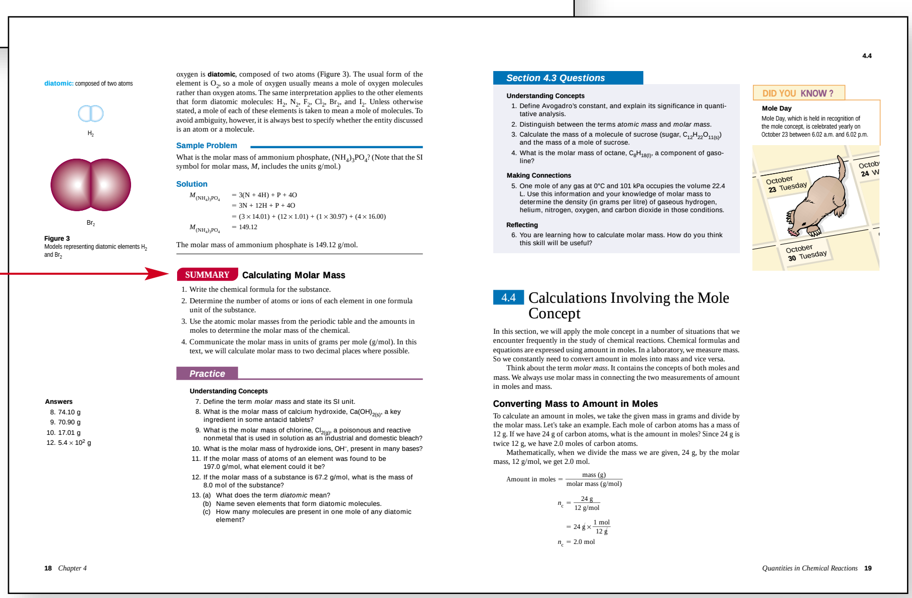
Specific Expectation Addressed

• demonstrate an understanding of Avagadro's number, the mole concept, and the relationship between the mole and molar mass.

The Ontario Curriculum, Grade 11 and 12, Science, pg. 48







Concept/Skill Summary

A point-form summary of the major concepts or skills presented in the section intended to aid in study. It could be a summary of the steps required to solve a particular class of problems.

B Develop the Skills, Strategies, and Habits of Mind Required for Scientific Inquiry

Investigations, Activities, Lab Exercises ("Dry labs"), and *Try This Activities* give students the opportunity to develop scientific inquiry and communications skills. "Directed" investigations strategically integrated throughout the text engage students in observing and experimenting. "Open-ended" investigations require students to plan and conduct their own investigations, form hypotheses, or choose their own questions to investigate. *Inquiry Skills Menus* indicate the skills being developed in investigations. Additional lab-based activities, including computer interface labs, are provided in the teacher support materials.

Inquiry Skills Menu

INQUIRY SKILLS

- Questioning
- Hypothesizing
- Predicting
- Planning
- Conducting
- Recording
- Analyzing
- Evaluating
- Communicating

Investigation 9.2.1
Pressure and Volume of a Gas

The purpose of this investigation is to determine the general relationship between the pressure and volume of a gas. Complete the **Design, Evidence, Analysis,** and **Evaluation** sections of the lab report.

Question

What effect does increasing the pressure have on the volume of a gas?

Experimental Design

(a) Using the Procedure and Figure 2, write a brief plan to summarize this experiment.
(b) Identify the independent, dependent, and two controlled variables.
(c) Design a table to record your observations.

Materials

Boyle's law apparatus or 35-mL plastic syringe
large rubber stopper
cork borer
5 textbooks or equal masses (1 kg)
utility stand
mass balance

Procedure

1. Pull out the syringe plunger so that 30 mL of air is inside the cylinder.
2. If a syringe cap is not provided, bore a small hole deep enough in the rubber stopper so that the tip of the syringe is inside the stopper. This should be a tight fit. Make sure the tip of the syringe does not leak.
3. Hold the syringe barrel vertical and measure the initial volume. Clamp the syringe on a retort stand.
4. While holding the syringe securely, carefully place one textbook or mass on the end of the plunger (Figure 2). (Your partner should balance the mass and be prepared to catch it if it starts to tilt.) Record the mass and new volume of air.
5. Repeat step 4 for a total of 4 or 5 books or masses.
6. If time permits, repeat steps 3 to 5 for an additional one or two trials.

Analysis

(d) Plot a graph of gas volume (or average volume from trials) versus mass added and draw a best-fit line.
(e) How does changing the mass on the syringe plunger affect the pressure on the air inside the syringe?
(f) According to the evidence you have collected, what effect does increasing pressure have on the volume of a gas?

Evaluation

(g) What are some sources of experimental error or uncertainty in this experiment? In your judgment, are these major or minor problems?
(h) How does your graph provide some indication of experimental errors or uncertainties in this experiment?
(i) Suggest some improvements that might raise the quality of the Evidence. Be as specific as possible.

The Relationship Between Pressure and Volume

Analysis of the evidence produced in an investigation similar to Investigation 9.2.1 suggests an inverse variation between the pressure and the volume of a gas; that is, as the pressure increases, the volume decreases (Figure 3). Using the evidence given in SI units in Table 4, you can see that when the pressure is doubled (100 kPa to 200 kPa), the volume is halved (3.00 L to 1.50 L). If the pressure is tripled, the volume is reduced to one-third. Check the other values to see similar results.

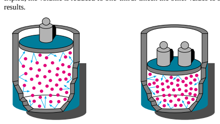


Figure 3
As the pressure on a gas increases, the volume of the gas decreases.

Table 4: Pressure and Volume of Gas Samples

Pressure (kPa)	Volume (L)	pv (kPa.L)
100	3.00	300
200	1.50	300
300	1.00	300
400	0.75	300
500	0.60	300

If p_1 and v_1 represent the initial conditions, the other values of pressure and volume from Table 4 may be stated as follows:

$$(p_1, v_1) \quad (2p_1, \tfrac{1}{2}v_1) \quad (3p_1, \tfrac{1}{3}v_1) \quad (4p_1, \tfrac{1}{4}v_1) \quad (5p_1, \tfrac{1}{5}v_1)$$

For all the conditions listed above, the product of the pressure and volume is equal to p_1v_1. Mathematically, the relationship is represented as $pv = k$, where k is a constant. This simple relationship was first determined by Robert Boyle in 1662 (Figure 4). **Boyle's law** states that *as the pressure on a gas increases, the volume of the gas decreases proportionally, provided that the temperature and amount of gas remain constant*. In other words, the volume of a gas is inversely proportional to the pressure of the gas, providing that the temperature and amount of gas are held constant. Boyle's law can be conveniently written comparing any two sets of pressure and volume measurements:

$$p_1v_1 = p_2v_2 \quad \textit{(Boyle's law)}$$

This can also be expressed as a calculation of a new pressure inversely related to the volumes ratio:

$$p_2 = \frac{p_1v_1}{v_2}$$

Boyle's law: as the pressure on a gas increases, the volume of the gas decreases proportionally, provided that the temperature and amount of gas remain constant; the volume and pressure of a gas are inversely proportional

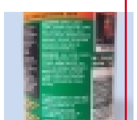


Figure 5
Gatorade is a drink that its manufacturer recommends to athletes, to restore electrolytes to the body.

evaporation of water. Sweating removes water and the substances dissolved in the water, such as salts and other electrolytes. We replace lost electrolytes by eating and drinking. By law the ingredients of a food item are required to be placed on the label in decreasing order of quantity, as they are in Gatorade (**Figure 5**), a noncarbonated drink.

(a) Classify the ingredients of Gatorade as electrolytes or nonelectrolytes. How does the number and quantity of electrolytes and nonelectrolytes compare?
(b) Which ingredients contain sodium ions? Which contain potassium ions? Are there more sodium or potassium ions in the drink?
(c) Does the most energy in the drink come from proteins, carbohydrates, or fats (oils)?
(d) What three chemical needs does the drink attempt to satisfy?

INQUIRY SKILLS

- Questioning
- Hypothesizing
- Predicting
- Planning
- Conducting
- Recording
- Analyzing
- Evaluating
- Communicating

Lab Exercise 6.1.1
Identification of Solutions

For this investigation assume that the labels on the four containers have been removed (perhaps washed off in a flood). Your task as a laboratory technician is to match the labels to the containers, using a litmus indicator and conductivity apparatus to identify the solutions.

You are provided with the **Evidence** gathered. Complete the **Analysis** section of this report.

Question

Which of the solutions labelled 1, 2, 3, and 4 is hydrobromic acid, which is ammonium sulfate, which is lithium hydroxide, and which is methanol?

Experimental Design

Each solution is tested with both red and blue litmus paper and with conductivity apparatus. The temperatures of the solutions and the procedures are controlled.

Evidence

Table 4: Properties of the Unknown Solutions

Solution	Red litmus	Blue litmus	Conductivity
1	red	blue	none
2	red	red	high
3	red	blue	high
4	blue	blue	high

Analysis

(a) Analyze the Evidence and use it to answer the Question: Which of the solutions labelled 1, 2, 3, and 4 is hydrobromic acid, which is ammonium sulfate, which is lithium hydroxide, and which is methanol? Justify your answer.

Specific Expectation Addressed
• determine through experimentation the quantitative and graphical relationships among the pressure, volume, and temperture of an ideal gas.
Ontario Curriculum, Grades 11 and 12, Science, p. 51

Lab Exercises (Dry Labs) give students an opportunity to analyze experimental evidence and answer questions based on the evidence supplied. The students do not actually carry out a "real" experiment. Students may be asked to evaluate the procedure, the experimental design, provide alternatives, and possibly even arrive at a synthesis of ideas using knowledge gained from various previous experiences.

Try This Activity boxes are short hands-on activities using readily available materials. These activities appear periodically throughout each chapter and give students an informal opportunity for skill development.

Try This Activity

What Makes Popcorn Pop?

In each kernel of popping corn, there is a small drop of water in a circle of soft starch. When heated, the water expands and builds up pressure against the hard outer surface, eventually exploding and turning the kernel inside out.

Materials: popping corn, hot-air popcorn popper, balance

- Measure the mass of some unpopped popping corn.
- Pop the popping corn.
- Allow the popcorn to cool and measure the mass again.
- Assume that any difference in masses is caused by loss of water from the kernels. Calculate the percentage of water in the sample of popcorn.
- Repeat the activity with kernels of popping corn that have been cut in half either lengthwise or crosswise.
- Record the percentage of popped kernels from each cutting method.

(a) Do the results confirm the given reason why popcorn pops? Explain.

C Relate Science to Technology, Society, and the Environment

The important goal of relating science to technology, society, and the environment (STSE) is integrated throughout the student text and is linked to students' learning of scientific concepts and skills in real-world contexts.

Specific Expectation Addressed
- give examples of the application of chemical quantities and calculations

Ontario Curriculum, Grades 11 and 12, Science, p. 48

4.7

Explore an Issue

Debate: Are Natural Vitamins Better for Your Health?

- Visit a health food store and a drugstore and note the sources and costs of different brands of vitamin and mineral supplements. If possible, interview the owner of the store, the pharmacist, and several consumers to find out their opinions.
- In small groups, discuss the issue from several perspectives. Keep notes and organize your ideas into supportive arguments for each side.
- Your teacher will divide the class into two teams for the debate on the resolution "Natural vitamins are better for your health."
- Return to your first group; discuss the issue again and arrive at a position that is agreed upon by every member of the group.
  (a) Prepare a one-page summary of your group's position on the issue.

Follow the links from Nelson Chemistry 11, 4.7.

GO TO www.science.nelson.com

DECISION-MAKING SKILLS
- Define the Issue
- Identify Alternatives
- Research
- Analyze the Issue
- Defend the Position
- Evaluate

Decision Making Skills Menu

Investigation 4.7.1

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IN...
- Questioning

Specific Expectation Addressed
- identify technological products and safety concerns associated with compressed gases."

Ontario Curriculum, Grades 11 and 12, Science, p. 52

9.2

Making Connections

7. For a typical geyser (**Figure 14**), underground water seeps into a deep narrow shaft in the ground and is heated from below. Because of the depth, the pressure on the water is high so the water at the bottom of the shaft boils at a much higher temperature than normal.
   (a) What happens to the volume of a 1.0-L bubble of water vapour at 130°C and 305 kPa when it reaches the surface, where the conditions are 93°C and 101 kPa?
   (b) Why is a narrow shaft necessary to produce the geyser effect?

Figure 14
Geysers are unusual and dramatic examples of geothermal energy used to heat water in a confined space.

9.3 Compressed Gases

Not only are gases a major part of our lives, but compressed gases, that is, gases at pressures above atmospheric pressure, are particularly useful:

- The tires of vehicles contain pressurized air.
- Many people use gas barbecues with a pressurized propane fuel tank.
- Aerosol cans contain a propellant that carries the contents of the can out the nozzle; the propellant is a pressurized gas.
- Major surgery usually involves oxygen administered from a pressurized oxygen tank and is often accompanied by an anesthetic, which may also be a pressurized gas, such as dinitrogen monoxide.

Certain occupations require some work with pressurized gases. In the medical field, paramedics and doctors use oxygen tanks. Firefighters use compressed air tanks like those used by underwater divers. Some welders use oxyacetylene torches (Figure 1). This form of welding requires both a pressurized oxygen tank and a pressurized acetylene tank. Many scientists and their graduate students routinely use pressurized gases for research because the gas is part of the reaction system or because it provides an inert (nonreactive) environment. Noble gases, such as argon, are also used to provide an inert environment in the computer chip industry, where oxygen would cause undesirable reactions.

The chemical safety hazards of some gases are similar to those of many other chemicals, which may be corrosive, toxic, flammable, dangerously reactive, or oxidizing agents. What makes compressed gases much more dangerous is the physical hazard of a potential rocket. In commercial gas cylinders, gas pressures can be as high as 15 MPa (about 150 atm). The hole in the tank, to which the valve stem and valve are connected, is the diameter of a pencil. If the gas is suddenly released through such a small opening, the very great pressure propels the tank, making it a formidable projectile. If the tank is mishandled, dropped, or falls over and the valve stem breaks, the tank can fly through solid brick walls and cause considerable damage.

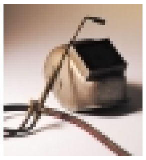


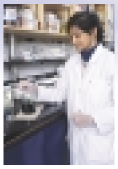
Figure 1
The use of a controlled mixture of oxygen and acetylene provides the best combustion and very high temperatures necessary for cutting or welding metal. Note the two hoses leading to the torch.

The Gas State 31

CAREER

Career Solutions

The training requirements for careers that involve solutions vary from high school chemistry for a job as a tree-planter to a Ph.D. degree in chemistry for a career in pure research chemistry.



Water-Quality Analyst
A water-quality analyst or technician in a water treatment plant works with aqueous solutions every day. Physical and chemical tests are routinely done to determine the treatment of the raw water and to monitor the quality of the final treated water. Many chemical tests (such as the analysis of dissolved iron ions, calcium ions and chlorine) require the preparation of other reagent (reactant) solutions to conduct the tests. Both solution preparation and reactions in solution are important parts of the job of a water-quality analyst.

Chemistry Teacher
A chemistry or physical science teacher must have a knowledge of solutions, and be able to handle them safely. In this course and many of your previous science courses, you will have seen and used solutions on many occasions. At most schools, the teachers prepare the solutions that you use, plan the reactions that you do, and sometimes need to be very resourceful in cleaning some stains from glassware by reacting the stain with other chemicals such as acids and bases. Chemistry and other physical science teachers need a good understanding of solutions in order to prepare for lab activities. These teachers are in great demand in schools and universities.

Environmental Chemist
Environmental chemists often specialize in particular aspects of the air, water, or soil. Many of them use solutions as either reactants or samples in chemical analysis. The concentrations of these samples is usually critically important. This career requires a higher degree of chemistry training than technicians and teachers. To be an environmental researcher requires considerable perseverance and optimism as well as an ability to ask questions and design experiments. Some of the research involves understanding the components and processes in the environment and some research may focus on the nature and effects of pollution.

Practice

Making Connections

2. Choose one of the careers discussed that you might be interested in and use the Internet to research this career. What are the specific educational requirements? Does this occupation require certification by some organization? If so, state the organization. What are the job prospects in this area?

Follow the links for Nelson Chemistry 11, 8.3.

GO TO www.science.nelson.com

Specific Expectation Addressed
- identify and describe science- and technology-based careers related to the Solutions and Solubility.

Ontario Curriculum, Grades 11 and 12, Science, p. 45