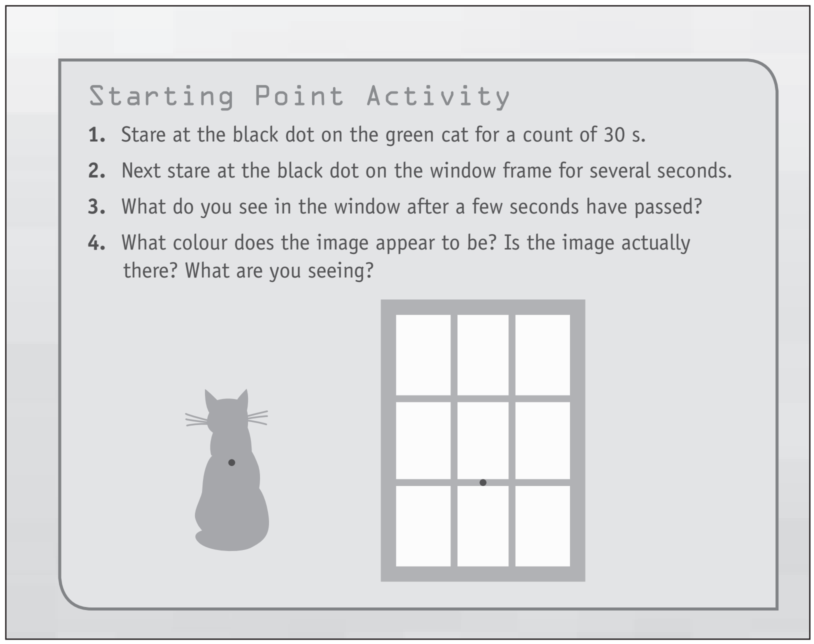
Overview of the *Science Links 10* Instructional Design

Science Links 10 has been developed to help you address the big ideas of the Ontario curriculum while meeting all of the specific expectations. Each unit of *Science Links 10* corresponds to a strand of Ontario's Grade 10 Science curriculum. Specific expectations related to Scientific Investigation Skills and Career Exploration are addressed in every unit. The Student textbook and Teacher's Resource together provide the tools and strategies you and your students will need for success.

Engaging Students

To prepare students for what they will learn, each unit of the student textbook begins with an introduction to an engaging STSE issue, a preview of the topics in the unit, and the big ideas for the strand. Suggestions for using this material, and all other features of the student textbook, are provided in the Teacher's Resource.

Within a unit, each inquiry based topic begins with a description of the key concepts that students will learn about, an engaging example of one of the big ideas, and an activity to get students thinking and wondering about the concepts they will learn in the topic.

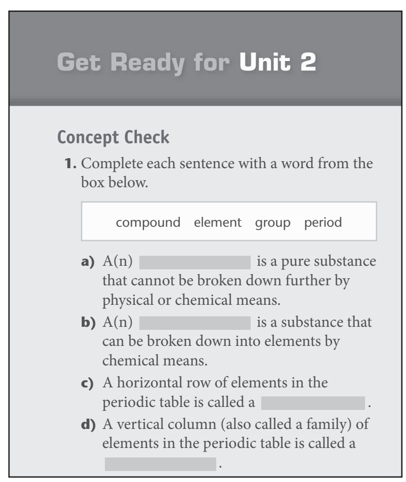


Assessment FOR Learning and Assessment AS Learning

Each unit begins with Get Ready—a chance to check that students have the science understandings, and the inquiry, literacy, and numeracy skills that they will require to succeed in the unit. In the Teacher's Resource, suggestions are provided for supporting learners who do not have these understandings and skills.

Each topic of *Science Links 10* includes Learning Checks—short sets of questions that students can learn to use themselves to see if they are understanding the key ideas of the topic. Strategies are provided in the Teacher's Resource to help students use Learning Check questions, as well as to help support students who have not yet understood the key concepts in the text.

Each topic of *Science Links 10* ends with a summary and a review. These reviews can help you see whether students are ready to move onto the next section or chapter, and can help students see what they still need to work on. Questions are linked to Ontario's achievement chart categories. The optional blackline master CD includes alternative versions of these reviews, suitable for students who need additional support reading and writing in English.

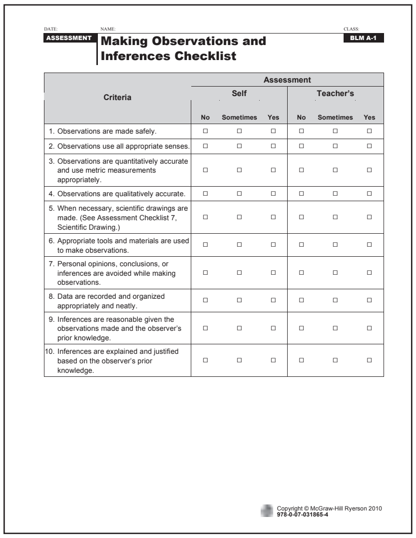


The Teacher's Resource includes suggestions for supporting learners who are still working toward success in demonstrating understanding in these formative assessments. It also includes additional strategies to help students think about their own learning, enabling them to become self-directed learners.

Assessment FOR Learning

Tool	Evidence of Learning	Supporting Learners
Activity 1.5, page 23 Learning Check, page 23 Review, question 3, page 37	Students explain why a cell must divide to survive.	• Dramatize the difference between transporting something in a large cell and in small cells by handing out papers or other items in class. Pass a class set of the item to one student near the front, and ask that student to take one and pass the rest on. Draw students' attention to how long the process takes, or have a student time it. Then divide the items to be distributed into three or four groups and give each group to one student, asking them to distribute the items to other students in their part of the classroom. Compare the times for the two processes and encourage students to make a connection to the difficulties large cells would face.
Learning Check, page 27 Learning Check, page 28, Investigation 1A, pages 32 and 33	Students state the purpose of cell division and describe the stages of the cell cycle, including the phases of mitosis.	• In question 2, on page 27, students can create their flowchart using **BLM G-43 Flowchart.** • Allow students to use a cooperative strategy such as think-pair-share to answer question 3, on page 27. • Students can complete **BLM 1-8 Stages of the Cell Cycle, BLM 1-9 The Cell Cycle, BLM 1-10 Steps of Mitosis,** and/or **BLM 1-11 Cell Growth and Division** with a classmate to provide further reinforcement of the concept.
Investigation 1A, pages 32 and 33	Students draw representations of cells that are thorough, clear, and accurate.	• Read Science Skills Toolkit 5, Scientific Drawing, on pages 350 and 351, with students.

Science Links 10 includes several blackline masters to help support formative assessment and to guide students in learning to assess themselves. Please see the accompanying CD.



DATE: NAME: CLASS:

ASSESSMENT **Making Observations and Inferences Checklist** BLM A-1

Criteria	Self No	Self Sometimes	Self Yes	Teacher's No	Teacher's Sometimes	Teacher's Yes
1. Observations are made safely.	☐	☐	☐	☐	☐	☐
2. Observations use all appropriate senses.	☐	☐	☐	☐	☐	☐
3. Observations are quantitatively accurate and use metric measurements appropriately.	☐	☐	☐	☐	☐	☐
4. Observations are qualitatively accurate.	☐	☐	☐	☐	☐	☐
5. When necessary, scientific drawings are made. (See Assessment Checklist 7, Scientific Drawing.)	☐	☐	☐	☐	☐	☐
6. Appropriate tools and materials are used to make observations.	☐	☐	☐	☐	☐	☐
7. Personal opinions, conclusions, or inferences are avoided while making observations.	☐	☐	☐	☐	☐	☐
8. Data are recorded and organized appropriately and neatly.	☐	☐	☐	☐	☐	☐
9. Inferences are reasonable given the observations made and the observer's prior knowledge.	☐	☐	☐	☐	☐	☐
10. Inferences are explained and justified based on the observer's prior knowledge.	☐	☐	☐	☐	☐	☐

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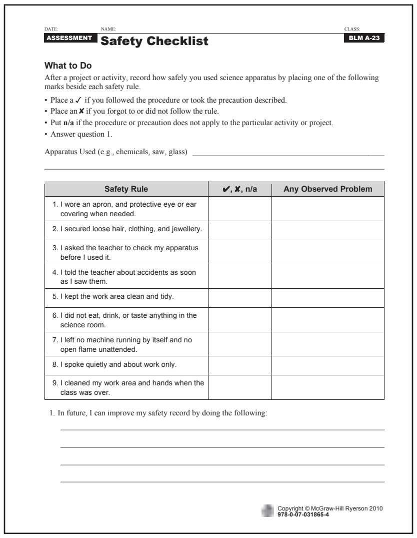

DATE: NAME: CLASS:

ASSESSMENT **Safety Checklist** BLM A-23

What to Do

After a project or activity, record how safely you used science apparatus by placing one of the following marks beside each safety rule.

- Place a ✓ if you followed the procedure or took the precaution described.
- Place an ✗ if you forgot to or did not follow the rule.
- Put n/a if the procedure or precaution does not apply to the particular activity or project.
- Answer question 1.

Apparatus Used (e.g., chemicals, saw, glass) ______

Safety Rule	✓, ✗, n/a	Any Observed Problem
1. I wore an apron, and protective eye or ear covering when needed.		
2. I secured loose hair, clothing, and jewellery.		
3. I asked the teacher to check my apparatus before I used it.		
4. I told the teacher about accidents as soon as I saw them.		
5. I kept the work area clean and tidy.		
6. I did not eat, drink, or taste anything in the science room.		
7. I left no machine running by itself and no open flame unattended.		
8. I spoke quietly and about work only.		
9. I cleaned my work area and hands when the class was over.		

1. In future, I can improve my safety record by doing the following:

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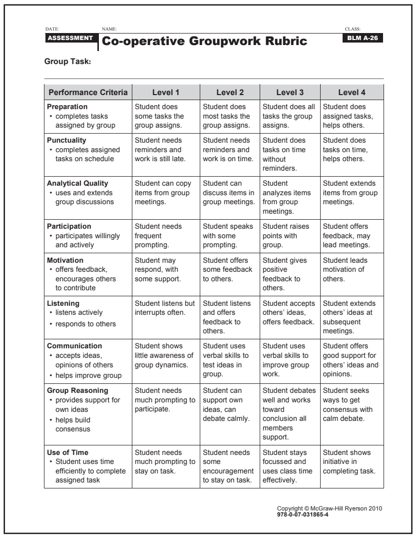

DATE: NAME: CLASS:

ASSESSMENT **Co-operative Groupwork Rubric** BLM A-26

Group Task:

Performance Criteria	Level 1	Level 2	Level 3	Level 4
Preparation • completes tasks assigned by group	Student does some tasks the group assigns.	Student does most tasks the group assigns.	Student does all tasks the group assigns.	Student does assigned tasks, helps others.
Punctuality • completes assigned tasks on schedule	Student needs reminders and work is still late.	Student needs reminders and work is on time.	Student does tasks on time without reminders.	Student does tasks on time, helps others.
Analytical Quality • uses and extends group discussions	Student can copy items from group meetings.	Student can discuss items in group meetings.	Student analyzes items from group meetings.	Student extends items from group meetings.
Participation • participates willingly and actively	Student needs frequent prompting.	Student speaks with some prompting.	Student raises points with group.	Student offers feedback, may lead meetings.
Motivation • offers feedback, encourages others to contribute	Student may respond, with some support.	Student offers some feedback to others.	Student gives positive feedback to others.	Student leads motivation of others.
Listening • listens actively • responds to others	Student listens but interrupts often.	Student listens and offers feedback to others.	Student accepts others' ideas, offers feedback.	Student extends others' ideas at subsequent meetings.
Communication • accepts ideas, opinions of others • helps improve group	Student shows little awareness of group dynamics.	Student uses verbal skills to test ideas in group.	Student uses verbal skills to improve group work.	Student offers good support for others' ideas and opinions.
Group Reasoning • provides support for own ideas • helps build consensus	Student needs much prompting to participate.	Student can support own ideas, can debate calmly.	Student debates well and works toward conclusion all members support.	Student seeks ways to get consensus with calm debate.
Use of Time • Student uses time efficiently to complete assigned task	Student needs much prompting to stay on task.	Student needs some encouragement to stay on task.	Student stays focussed and uses class time effectively.	Student shows initiative in completing task.

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Developing Understanding

By introducing students to what they will learn at the beginning of each unit and by engaging them in a related activity as they begin, the stage is set for learning. Within each topic, text has been organized into self-contained spreads, each of which helps students acquire the understandings and skills they will need to answer the question in the topic title, and each of which has been designed to promote understanding. Heads and subheads lead students through the topic; Key Terms are introduced in context and defined; and information is presented in tables, graphs, and other visuals.

Gas Exchange Takes Place in the Alveoli

Once air reaches the lungs, the actual exchange of gases occurs between the blood and the **alveoli**. Alveoli are clusters of tiny air sacs in the lungs. The wall of each alveolus is a single layer of cells.

Alveoli are surrounded by a network of tiny blood vessels called **capillaries**. The wall of each capillary also is a single layer of cells. The ultra-thin walls of both the alveoli and the capillaries allow the exchange of gases between the air and the blood, as shown in **Figure 1.20**.

Once the air enters the capillaries, oxygen from the air is taken up by the **red blood cells**. The red blood cells are responsible for transporting gases in the bloodstream. Oxygen diffuses through the walls of the alveoli, through the capillary walls, and into the red blood cells.

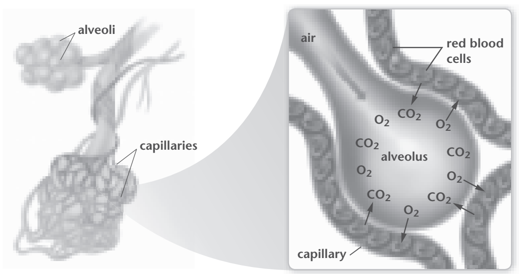
The blood also releases carbon dioxide into the lungs. The path that carbon dioxide follows is the reverse of the path that oxygen follows. Carbon dioxide diffuses from the blood through the capillary walls, through the walls of the alveoli, and into the alveoli. Once in the lungs, the carbon dioxide is exhaled with the next breath.

gas exchange: the process of taking in oxygen and releasing carbon dioxide

alveoli: air sacs in the lungs where gas exchange occurs (singular is alveolus)

capillary: the smallest blood vessel

red blood cells: blood cells that carry oxygen and carbon dioxide in the blood



▲ **Figure 1.20** Gas exchange occurs between the air in the alveoli and the blood in the capillaries.

The authors of *Science Links 10* recognize that students employ multiple intelligences to understand new content. They also recognize that it is important for students to develop comfort with using several learning intelligences in different contexts. The text, questions, and activities in *Science Links 10* have been developed to engage as many intelligences as possible. In the Teacher's Resource, suggestions are provided for differentiating instruction to support students with specific dominant intelligences, and to develop increased facility with learning in different ways. Many of these suggestions are highlighted for you with the icon **DI**. For further information on differentiating instruction, please see Teacher's Resource page TR-12.

Many students in Ontario schools are learning to communicate in the English language at the same time as they are learning science. The many visuals in *Science Links 10* will help English language learners to make sense of the text, the Key Term definitions will help them to develop English vocabulary, and the hands-on activities will provide them with a way to learn and to demonstrate what they have learned that does not depend heavily on English skills. The Teacher's Resource provides specific suggestions for supporting English language learners as they learn in every section of the program. These suggestions are highlighted with the icon **ELL**. For general teaching strategies that will help English language learners (as well as others) in your classroom, please see Teacher's Resource page TR-18.

Developing Skills

At the very beginning of the student textbook, students are reminded of safe practices in a science classroom, and introduced to the WHMIS symbols and the safety symbols used in activities in *Science Links 10*. By placing safety front and centre, all other activities take place in the context of these rules. Strategies for using these pages with students are provided on Teacher's Resource page TR-10.

Activities throughout *Science Links 10* have been carefully scaffolded to build a solid foundation of science, inquiry, literacy, and numeracy skills. Investigations provide opportunities for students to apply the skills they have been developing to investigate a larger issue. The key skills students will use in each investigation are identified right in the student textbook. Opportunities for extending these skills are also provided in each investigation. Strategies for helping students to develop and build on these skills are provided in the Teacher's Resource.

Investigation 3D

Skills

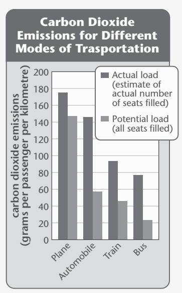
- initiating and planning
- ✓ **performing and recording**
- ✓ **analyzing and interpreting**
- communicating

Transportation Choices and Your Carbon Footprint

Transportation accounts for 27 percent of all anthropogenic greenhouse gas emissions in Canada. In this investigation, you will explore how your transportation choices affect your carbon footprint.

What To Do

1. Use the graph and the paragraph below to answer the questions.



Different modes of transportation produce different levels of greenhouse gases. The graph compares the carbon dioxide emissions per person for several modes of transportation. This value varies depending on whether the vehicle is full or not.

- *Potential capacity* refers to the amount of carbon dioxide emitted per person when all the seats are filled in a vehicle.
- *Actual load* refers to carbon dioxide emissions per person for a vehicle based on how many seats are filled in an average trip. On most trips, the vehicle you travel in will have some empty seats.

Carbon dioxide emissions are always lower when a vehicle is filled to potential capacity. This is because the same emissions are divided among more people.

What Did You Find Out?

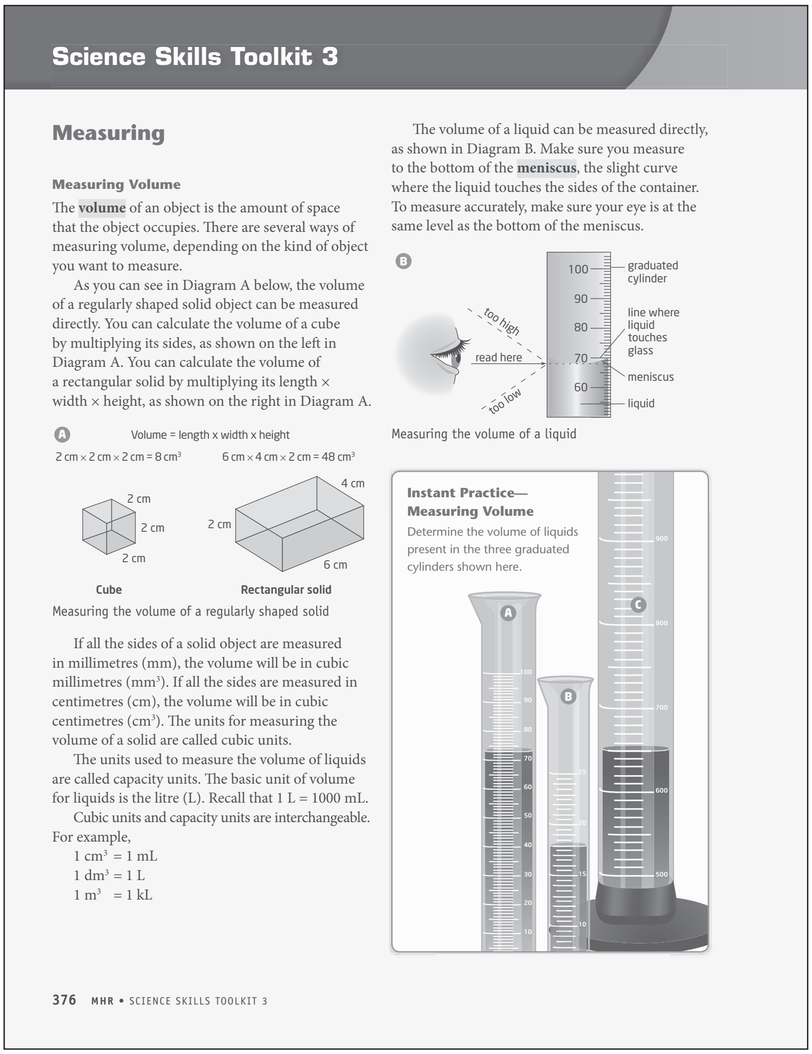
1. Which mode of transportation has the highest carbon dioxide emissions? Which has the lowest?
2. **a)** Explain why the potential capacity of carbon dioxide emissions is so much lower than the actual load emissions.
   b) Why do you think this is especially true for automobiles, trains, and buses, but not for airplanes?
   c) Explain how it is possible for carbon dioxide emissions to be lower for travel by automobile than by bus.
3. To travel to an after-school job, you can either take a bus that is only partly filled (actual load) or get a ride in a full car with three other employees (potential load). In which case would your carbon footprint be smaller?
4. With a partner, brainstorm ways that your carbon footprint is affected by transportation. Use these ideas to create a plan to reduce your carbon footprint. Hint: Think about the transportation-related choices you make each day. Even if you walk or bike everywhere, the food you eat and the goods you buy need to be transported to you.

256 MHR • UNIT 3 EARTH'S DYNAMIC CLIMATE

In addition to skills development in activities and investigations, students have access to three Skills Toolkits at the back of the student textbook:

- Science Skills Toolkit
- Numeracy Skills Toolkit
- Literacy Skills Toolkit

These toolkits can be used to provide students with details about the skills they will need to use, such as how to use electrical meters properly. They also can be used to review skills that students may have used in previous years. Notes in the Teacher's Resource suggest appropriate times to refer to one of these toolkits. The Teacher's Resource includes instructional strategies for helping students to make the most of each one of the Science Skills and Numeracy Skills in the toolkits. See page TR-69.



Science Skills Toolkit 3

Measuring

Measuring Volume

The **volume** of an object is the amount of space that the object occupies. There are several ways of measuring volume, depending on the kind of object you want to measure.

As you can see in Diagram A below, the volume of a regularly shaped solid object can be measured directly. You can calculate the volume of a cube by multiplying its sides, as shown on the left in Diagram A. You can calculate the volume of a rectangular solid by multiplying its length × width × height, as shown on the right in Diagram A.

Measuring the volume of a regularly shaped solid

If all the sides of a solid object are measured in millimetres (mm), the volume will be in cubic millimetres (mm^3). If all the sides are measured in centimetres (cm), the volume will be in cubic centimetres (cm^3). The units for measuring the volume of a solid are called cubic units.

The units used to measure the volume of liquids are called capacity units. The basic unit of volume for liquids is the litre (L). Recall that 1 L = 1000 mL.

Cubic units and capacity units are interchangeable. For example,

$1\ cm^3 = 1\ mL$

$1\ dm^3 = 1\ L$

$1\ m^3 = 1\ kL$

The volume of a liquid can be measured directly, as shown in Diagram B. Make sure you measure to the bottom of the **meniscus**, the slight curve where the liquid touches the sides of the container. To measure accurately, make sure your eye is at the same level as the bottom of the meniscus.

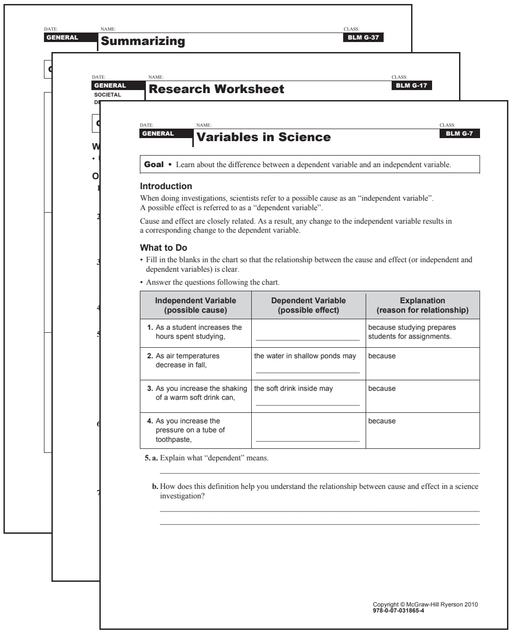
Measuring the volume of a liquid

Instant Practice—Measuring Volume

Determine the volume of liquids present in the three graduated cylinders shown here.

376 MHR • SCIENCE SKILLS TOOLKIT 3

Literacy skills are central to learning in any subject area, including science. A Literacy Skills Toolkit at the back of the student textbook reviews some key strategies for students to use in this program. Suggestions for introducing students to these skills and for using them as additional support for learners who require it appear throughout the Teacher's Resource. For more information about literacy skills and scientific literacy in general, see page TR-19 of this Teacher's Resource.



DATE: NAME: CLASS:
GENERAL **Summarizing** BLM G-37

DATE: NAME: CLASS:
GENERAL SOCIETAL **Research Worksheet** BLM G-17

DATE: NAME: CLASS:
GENERAL **Variables in Science** BLM G-7

Goal • Learn about the difference between a dependent variable and an independent variable.

Introduction

When doing investigations, scientists refer to a possible cause as an "independent variable". A possible effect is referred to as a "dependent variable".

Cause and effect are closely related. As a result, any change to the independent variable results in a corresponding change to the dependent variable.

What to Do

- Fill in the blanks in the chart so that the relationship between the cause and effect (or independent and dependent variables) is clear.
- Answer the questions following the chart.

Independent Variable (possible cause)	Dependent Variable (possible effect)	Explanation (reason for relationship)
1. As a student increases the hours spent studying,	______	because studying prepares students for assignments.
2. As air temperatures decrease in fall,	the water in shallow ponds may ______	because
3. As you increase the shaking of a warm soft drink can,	the soft drink inside may ______	because
4. As you increase the pressure on a tube of toothpaste,	______	because

5. a. Explain what "dependent" means.

b. How does this definition help you understand the relationship between cause and effect in a science investigation?

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Science Links 10 includes several blackline masters to help students develop and apply science, numeracy, and literacy skills. See the accompanying CD.

Assessment OF Learning

Because authentic assessment is a core part of *Science Links 10*, each unit ends with two projects that students can use to show what they have learned. The activities and investigations within the unit prepare students to complete the projects. Assessment criteria are provided right in the student textbook so that students are aware of them. Rubrics for the projects are provided in the Teacher's Resource and as blackline masters. You may choose to distribute these rubrics, to help students plan their work. So that students are aware of the projects they will be completing as they work through the unit, the projects are introduced at the beginning of the unit, on the same pages as Get Ready.

Each Unit Review provides another opportunity for student assessment, and helps students show what they have learned in the unit as it relates to the big ideas of the curriculum, and the achievement chart categories: Knowledge and Understanding, Thinking and Investigation, Communication, and Application.

A table in the Teacher's Resource helps you identify the key signs that a student has achieved the overall expectations for the unit, and provides suggestions for supporting students who are working toward achieving them.

Assessment OF Learning for Unit 1		
Activity	**Evidence of Learning**	**Supporting Learners**
Unit 1 Inquiry Investigation, page 98	Models of a diseased and a healthy organ are detailed and accurate. Students describe how several organs are affected by the disease, and how to treat and prevent the disease.	• Review Activities 1.13 and 1.15, in which students built models of specialized cells and tissues. Have students consider what materials worked well to represent the qualities of the cell or tissue. • Students can use **BLM G-43 Flowchart** and **BLM G-39 Cause-and-Effect Map** to show these relationships.
Unit 1 An Issue to Analyze Project, page 99	Students list government resources that educate about healthy lifestyles and describe several costs and benefits of adopting a healthy lifestyle.	• Students can use **BLM G-46 PMI Chart** to organize their analysis. Have a variety of Canadian resources promoting healthy lifestyles available in the library or classroom for students to refer to.

Because students in Grade 10 will write the Grade 10 Literacy Test, each unit also concludes with a relevant piece of text and a set of questions that students can use to practise their literacy skills in the context of a particular science strand.

Additional STSE Features

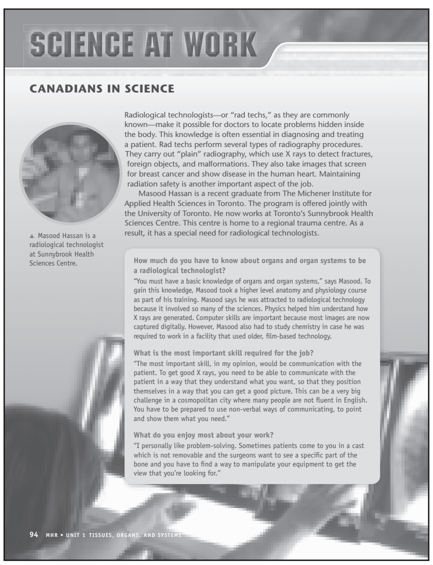
Students are growing up in a world where issues related to Science, Technology, Society, and the Environment are becoming more and more important. For this reason, STSE issues are integrated throughout the topics and activities of *Science Links 10*. In addition, *Science Links 10* includes the following features:

STSE Case Studies appear in every unit to help students see the connections among science, technology, society, and the environment, and to allow students to apply the science skills and understandings they are learning to real and compelling issues.

Making a Difference, in every unit, introduces students to real people who have used science to make a difference in their world, locally and internationally.

Science at Work, near the end of every unit, features real people in careers that use science to address issues. A variety of careers that use the science students have just learned about are described, and students are encouraged to select one that interests them and learn more about it.

The following pages provide additional information about some of the key issues that inform the instructional design of *Science Links 10*.



SCIENCE AT WORK

CANADIANS IN SCIENCE

Radiological technologists—or "rad techs," as they are commonly known—make it possible for doctors to locate problems hidden inside the body. This knowledge is often essential in diagnosing and treating a patient. Rad techs perform several types of radiography procedures. They carry out "plain" radiography, which use X rays to detect fractures, foreign objects, and malformations. They also take images that screen for breast cancer and show disease in the human heart. Maintaining radiation safety is another important aspect of the job.

Masood Hassan is a recent graduate from The Michener Institute for Applied Health Sciences in Toronto. The program is offered jointly with the University of Toronto. He now works at Toronto's Sunnybrook Health Sciences Centre. This centre is home to a regional trauma centre. As a result, it has a special need for radiological technologists.

▲ Masood Hassan is a radiological technologist at Sunnybrook Health Sciences Centre.

How much do you have to know about organs and organ systems to be a radiological technologist?

"You must have a basic knowledge of organs and organ systems," says Masood. To gain this knowledge, Masood took a higher level anatomy and physiology course as part of his training. Masood says he was attracted to radiological technology because it involved so many of the sciences. Physics helped him understand how X rays are generated. Computer skills are important because most images are now captured digitally. However, Masood also had to study chemistry in case he was required to work in a facility that used older, film-based technology.

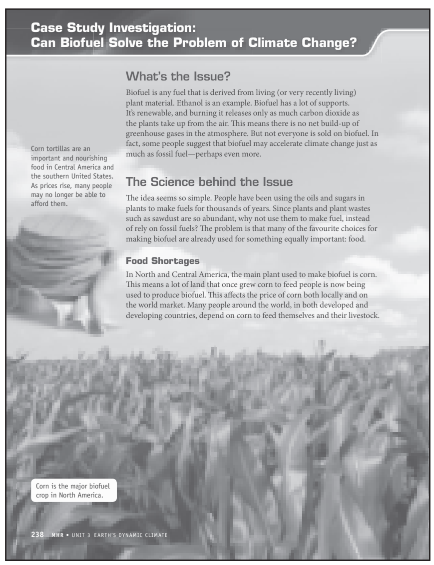
What is the most important skill required for the job?

"The most important skill, in my opinion, would be communication with the patient. To get good X rays, you need to be able to communicate with the patient in a way that they understand what you want, so that they position themselves in a way that you can get a good picture. This can be a very big challenge in a cosmopolitan city where many people are not fluent in English. You have to be prepared to use non-verbal ways of communicating, to point and show them what you need."

What do you enjoy most about your work?

"I personally like problem-solving. Sometimes patients come to you in a cast which is not removable and the surgeons want to see a specific part of the bone and you have to find a way to manipulate your equipment to get the view that you're looking for."

94 MHR • UNIT 1 TISSUES, ORGANS, AND SYSTEMS



Case Study Investigation:
Can Biofuel Solve the Problem of Climate Change?

What's the Issue?

Biofuel is any fuel that is derived from living (or very recently living) plant material. Ethanol is an example. Biofuel has a lot of supports. It's renewable, and burning it releases only as much carbon dioxide as the plants take up from the air. This means there is no net build-up of greenhouse gases in the atmosphere. But not everyone is sold on biofuel. In fact, some people suggest that biofuel may accelerate climate change just as much as fossil fuel—perhaps even more.

Corn tortillas are an important and nourishing food in Central America and the southern United States. As prices rise, many people may no longer be able to afford them.

The Science behind the Issue

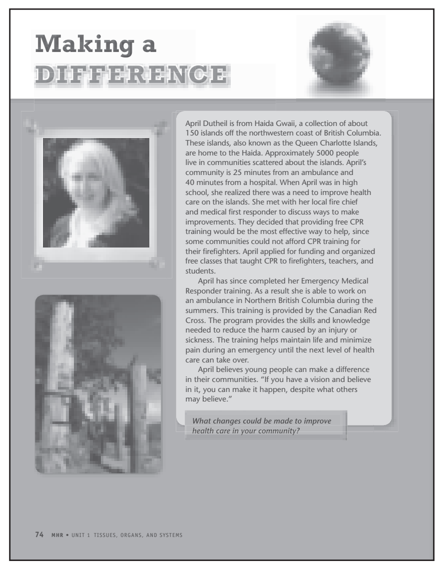
The idea seems so simple. People have been using the oils and sugars in plants to make fuels for thousands of years. Since plants and plant wastes such as sawdust are so abundant, why not use them to make fuel, instead of rely on fossil fuels? The problem is that many of the favourite choices for making biofuel are already used for something equally important: food.

Food Shortages

In North and Central America, the main plant used to make biofuel is corn. This means a lot of land that once grew corn to feed people is now being used to produce biofuel. This affects the price of corn both locally and on the world market. Many people around the world, in both developed and developing countries, depend on corn to feed themselves and their livestock.

Corn is the major biofuel crop in North America.

238 MHR • UNIT 3 EARTH'S DYNAMIC CLIMATE



Making a DIFFERENCE

April Dutheil is from Haida Gwaii, a collection of about 150 islands off the northwestern coast of British Columbia. These islands, also known as the Queen Charlotte Islands, are home to the Haida. Approximately 5000 people live in communities scattered about the islands. April's community is 25 minutes from an ambulance and 40 minutes from a hospital. When April was in high school, she realized there was a need to improve health care on the islands. She met with her local fire chief and medical first responder to discuss ways to make improvements. They decided that providing free CPR training would be the most effective way to help, since some communities could not afford CPR training for their firefighters. April applied for funding and organized free classes that taught CPR to firefighters, teachers, and students.

April has since completed her Emergency Medical Responder training. As a result she is able to work on an ambulance in Northern British Columbia during the summers. This training is provided by the Canadian Red Cross. The program provides the skills and knowledge needed to reduce the harm caused by an injury or sickness. The training helps maintain life and minimize pain during an emergency until the next level of health care can take over.

April believes young people can make a difference in their communities. "If you have a vision and believe in it, you can make it happen, despite what others may believe."

What changes could be made to improve health care in your community?

74 MHR • UNIT 1 TISSUES, ORGANS, AND SYSTEMS