DISCOVERING SCIENCE 8
TEACHER'S RESOURCE

SKILLS DEVELOPMENT

Table of Contents

McGraw-Hill Ryerson

THE VALUE OF THE SCIENCE SKILLS SECTION

The skills component of the *Discovering Science 8* program will be critical to you as you successfully deliver the curriculum. Thus, you will find the Science Skills Guide at the end of the book useful in providing students with the tools they need for further skills development (and remediation). They may refer to these tools throughout the program because they are built into the textbook as an integral part.

Each unit of the *Teacher's Resource* includes many useful ideas for your implementation. The skills development that your students will gain from using the Science Skills Guide at the end of the textbook will remind students of the importance of the processes of science, and its effect on their lives, whether they venture on into a science and/or technology career focus, or in a totally different direction.

SCIENCE SKILL 1 ORGANIZING AND COMMUNICATING SCIENTIFIC RESULTS WITH GRAPHS, pp. 469–473

- Data collected in science investigations need to be recorded into tables that organize the data into fields (rows and columns) of a variable (i.e., data on one variable are collected and recorded together). The table or data base will have several fields of related data organized either vertically or horizontally. The data should be in ascending (increasing) value of the manipulated variable or in rows of related data. Tabulated data can then be graphed to show potential relationships between data. Depending on the variables' relationships, different graphs are used. For example:
  - non-continuous words (or categories) and numbers: bar graph
  - continuous words and numbers: histogram
  - non-continuous comparison of numerical variables: line graph
  - continuous comparison of numerical variables: line graph.
  - percentages or portions making up a whole: circle graph

Drawing a Line Graph

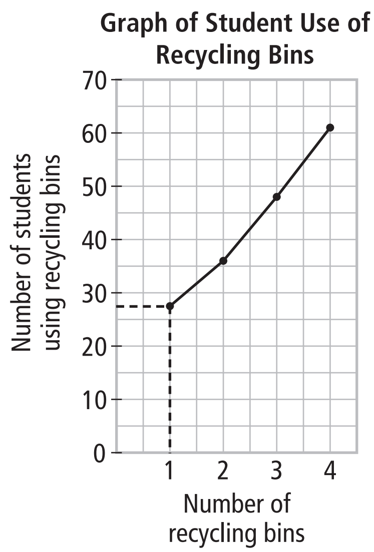
TEACHING STRATEGIES

- Go through the example of a line graph with the students. Emphasize the meaning of a "line of best fit." Stress the importance of not "connecting the dots."
- Give students the following data showing the number of students using recycling bins. Guide the students through the process of drawing a line graph. For example, tell students to determine the range of the data and decide on the scale.
  The number of recycling bins goes to 4 and the number of students goes to 62. Let the scale for number of recycling bins be on the x-axis and go from zero to 5. Let the scale for number of students be on the y-axis and go from 0 to 70. Then discuss the method for plotting data points. In the example shown, dotted lines show how to plot the data point for the number of students using recycling bin 1. "Move your pencil along the x-axis until you reach the number of recycling bins, 1. Then move your pencil up until you reach the number of students using 1 recycling bin, 28." Advise students not to just connect the dots. Instead, they should draw a smooth curve through the points. Also remind students to give the graph a title.

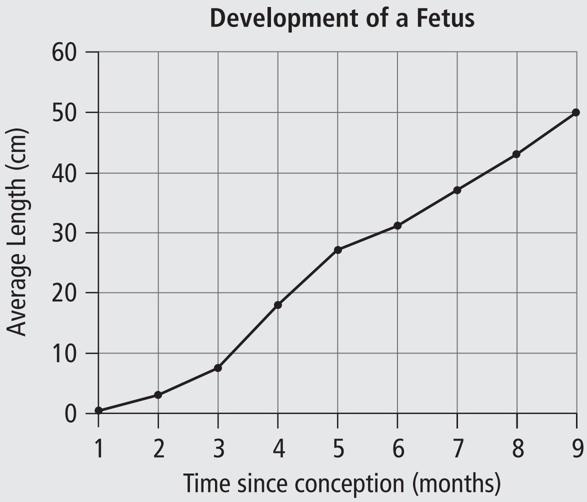
Table 1 Students Using Recycling Bins

Number of bins	Number of students using recycling bins
1	28
2	36
3	48
4	62

- Ask students to verbally describe the relationship between the number of recycling bins and the number of students using the recycling bins. The answer should be, "As the number of bins increases, the number of students using the bins increases."



Instant Practice Answer, p. 470

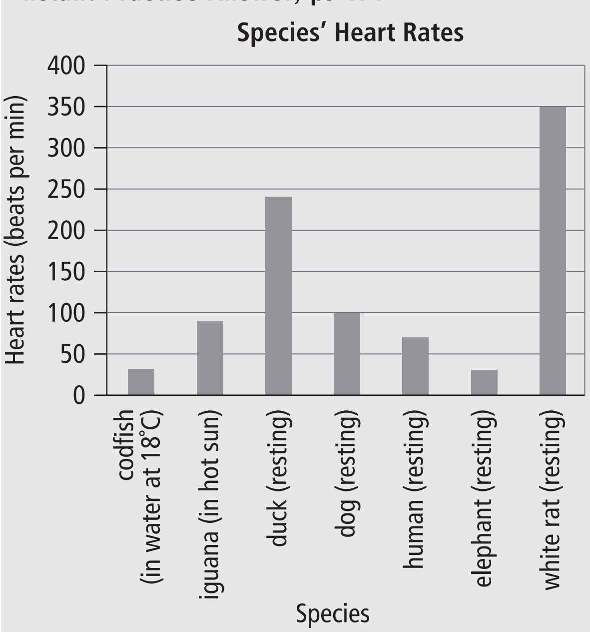


Constructing a Bar Graph

TEACHING STRATEGIES

- Go through the steps in the example with the students. Ensure that they understand the steps.
- Show students the bar graph in the student textbook that graphs the average number of days of fog per year in Canadian provinces and Territories. Better yet, have students draw it themselves.
- Ask students which province or territory had the greatest number of days of fog per year. Then ask which province or territory had the least number of days of fog per year.
- Have the students complete the Instant Practice bar graph.

Instant Practice Answer, p. 471

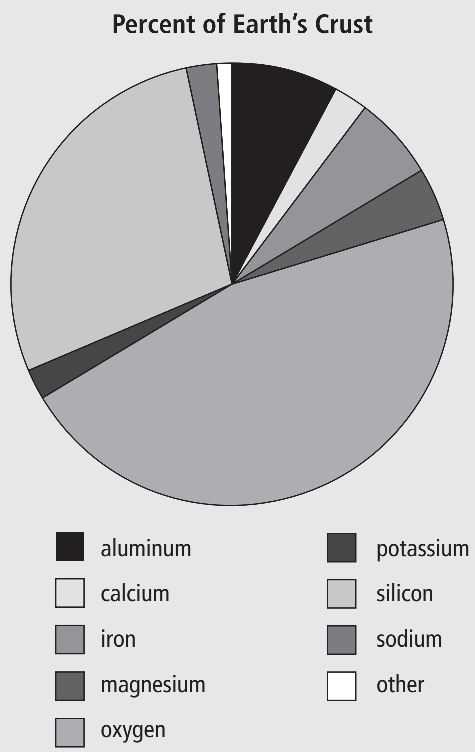


Constructing a Circle Graph

- Talk about the example of creating a circle graph with students. Emphasize how the circle graph represents 100%, combining all of the data together. This means that each category of data must be translated into a percent of the overall total data.
- As a class, have students construct a circle graph. Allow them to choose the data being represented. One possible example is the colour of students' shoes. Begin by creating a data table at the front of the class. It should have four columns: Colour of shoes; Number of pairs of shoes; Percent of total; and Degrees in "piece of pie." Work through the data collection by counting the number of pairs of shoes in different colours. The total will be the total number of students in the class. Determine the percent of the total number of each shoe colour using the formula in step 2 of the example. For example, if there are 28 students in the class, and 7 are wearing blue shoes, then the percent of all shoes that are blue is 7 blue pairs of shoes ÷ 28 pairs of shoes × 100 = 40%.
  The next step is to convert the percentage into degrees in the "piece of pie" that is represented by each colour of shoe. In this case, degrees in "piece of pie" can be found using the formula in step 3 of the example. 40% ÷ 100% × 360° = 144°. If the degree has a decimal, round the number up.
  Have each student construct a circle graph based on the class data using a compass and protractor. Ensure that students properly title and label the graph. Depending on the size of the pieces of pie, they will either write the labels inside the graph, or they will write the labels along one side with a line connecting the label to the correct piece of pie.
- It is important for students to understand that this data represents only the colours of shoes in their class. Ask students how the graph might change if they included another class's data along with theirs. Do they think the circle graph would stay the same or change? Have them explain their thinking.
- Have students list five different circle graphs they could make. Examples might include types of cars in the parking lot, favorite foods of students in the class, etc. Circle graphs can only represent percentages of a whole, so students' examples must be able to be combined to make a whole (e.g., all cars in the parking lot, all students in the class, etc.).
- Have students complete the Instant Practice circle graph. Remind them that data may be "raw" (unconverted) or may be already converted into

percentages. Either way, they will have to calculate the degrees of the “piece of pie.:

Instant Practice Answer, p. 472



SCIENCE SKILL 2 COMMUNICATING YOUR LAB WORK IN A LAB REPORT, pp. 474-475

TEACHING STRATEGIES

- Students can relate what they learn in Science Skill 2 to design and conduct experiments, which they will learn about in Science Skill 6.
- The method for communicating lab work outlined here is “generic,” intended for a broad audience, and is not intended to replace lab-reporting formats, favoured by individual teachers, which might differ in subtle ways. However, be sure to inform students why modifications, if any, are being made.

SCIENCE SKILL 3 SCIENTIFIC DRAWING, pp. 476–477

- Scientific drawing is an important part of communicating in science. Many procedures and results are complex and difficult to explain. Using scientific drawing as an alternative means of communicating allows the complex to become clear. Scientific drawing is an invaluable tool for students, as it easily communicates what they have done.
- Many students become concerned about their artistic talent, and believe that they will not be able to do scientific drawing well or perhaps at all. Other students may look forward to scientific drawing if art is a skill at which they excel. It is important to clarify the purpose of scientific drawing. The skill is not about artistic capability, it is about communicating. Scientific drawing is successful if it replaces verbal explanations. Instead of lengthy written descriptions, a simple line drawing can explain exactly what took place. While it may be nice to have a pretty coloured drawing, that is not a requirement. What is required is that the drawing allows someone who was not present to understand what was done or what was observed. Reassure students that the “artistic” quality of their drawings will improve as students practise.
- Emphasize that scientific drawing is about representing what was observed. Regardless of what the students expected to see, scientific drawing can only show what was seen. This result can be challenging for students. Remind them that they are not supposed to be copying illustrations from the textbook or lab manual, but rather they are supposed to be showing what they observed on their own, which makes labelling their drawing very important. It is acceptable to label features that the student cannot identify. For example, if they observe a cell part that they cannot identify, they should draw it and label it as an unidentified part. Doing so will allow them to refer to the unidentified part later, when they may be able to access different resources, such as the Internet or library books, which can help them figure out what the part is.
- Have students practise scientific drawing of common objects in the classroom. They should have real objects and not work from a drawing. A calculator, pencil case, or plant are all excellent objects to practise on. Have students follow the example in the textbook for making a scientific drawing. Have them draw two different aspects of the object, so they can appreciate that different views allow them to show different features.

  Have students imagine they are communicating with someone who is unfamiliar with the object that they have drawn. Have students write a description of the object that they drew. Then have them compare their drawing to their written description. Discuss their results. Some students may feel that the written description was adequate; others may feel it was completely unnecessary. Remind them that scientific drawings are used to communicate events to people who were not present during the experiment or investigation.

- Students may not be familiar with the use of stippling, or tiny dots, as a way to show shadow and contour. Allow students to practise stippling on simple drawings to see if they can make the objects appear more realistic.
- Drawing to scale is an important part of successfully communicating in a scientific drawing. The absolute size is less important that the relative size. This result is true for drawings of objects under a microscope, but also in other drawings. When students are drawing objects under the microscope, dividing the field of view into pieces and using those pieces as references for scale is an excellent technique. Students may want to work in pairs. One student can draw free hand what he or she sees, while the other draws what he or she sees using the divided field of view. Have them compare their drawings and see if there are any differences.
- For scientific drawings that are not representing objects seen under the microscope, have students be aware of scale. For example, if one piece of equipment (a lamp) is twice the size of another piece (such as a flask), the drawing should also show the lamp twice the size of the flask.

SCIENCE SKILL 4 USING A MICROSCOPE, PP. 478–480

Since extensive use of and instruction for the microscope begins in Grade 8, Science Skill 4 is provided to enhance students' use of this equipment in Chapters 1, 3, 6 and 10. Particular emphasis should be placed on students' safe and respectful use of this expensive and delicate piece of equipment.

TEACHING STRATEGIES

- To help students appreciate how delicate and precise a microscope is, engage them in a discussion about cameras and their photographic capabilities. It should quickly become clear that the better and more capable a camera, the more care and cost go into constructing it and the more delicate the interior mechanism. Students can reflect on how much more is involved in building an instrument that can view objects as clearly and precisely as the microscope can.
- Students may create a table, titled "The Com pound Light Microscope," with two columns, headed "Part" and "Function," and then enter the following subtitles: tube, eyepiece or ocular lens, objective lens, revolving nosepiece, arm, coarse- and fine-focus knobs, light source, stage, diaphragm, etc. Encourage them to use any strategy that helps them become more familiar with this instrument.
- If students are asked to do scale drawings, advise them to use a mathematical compass to draw their circle accurately. Rulers and other instruments that are used to draw lines and geometrical shapes are always preferred over freehand renderings.

Using the Microscope

- As a class, review the steps listed in the Using the Microscope section on page 479. Provide students with prepared slides, and have them perform the Instant Practice section on page 480. They may need to refer to the troubleshooting section if they are having problems.

  Once they have completed their sketch of the image they see in their field of view, have them create a list of any problems they encountered or observations they have about using the microscope. Their lists may include observations about how the microscope was stored, how to position the slide, or turning the eyepiece. Have students share their lists and create a checklist for using the microscope based on their own experiences. They can keep the list handy for whenever they need to use the microscope.

TROUBLESHOOTING

- Following are common microscope skill problems encountered by students and how to deal with them.

  Problem: The field of view is small and dark.

  Solution: Check the diaphragm. Ensure that the correct aperture is open.

  Problem: The image seen in the microscope is too large (i.e., it is outside the field of view).

  Solution: Change to the lower objective lens to bring the desired section into the field of view.

  Problem: The image cannot be seen well.

  Solution: Start with the low-power objective lens. Once the image is obtained and focussed in the low-power lens, students can move to a higher power without damaging the specimen or the lens.
- Additional troubleshooting tips:
  - When moving to the next higher objective lens, make sure students do not adjust the coarse-adjustment knob once the microscope is focussed at low power. There is a chance that the objective lens will crash into the specimen slide. The image should be adjusted with the fine-adjustment knob.
  - Ensure that students use the stage clips to hold the specimen slides.

– When changing the objective lens, have students pay attention to the lens as it moves into the lens groove and clicks into position. Remind them to listen for or feel the click.
– If there is any malfunction (e.g., poor focussing, loose knobs), remind the students that they must inform you; they should never try to repair any part of the microscope themselves.
– Remind students to report all damages and injuries to you (or to the teacher in charge).

How to Prepare Specimens for Viewing

- Slides, either prepared or wet mounts, are very delicate and easily breakable. Prepared slides are a valuable resource for students, and not always easy to replace if broken. Students need to be cautioned regularly about using slides one at a time. Many students will take a prepared slide while there is still a slide on the stage. When they exchange slides, the used slide is often put on the table rather than put away properly. To ensure that students respect the slides as important pieces of equipment, make up a class list of rules about using slides, cleaning them, and putting them away.
- It is a good idea to have a central location for the slides. They should be kept in this location, and monitored. Students can get a new slide in a series only when they bring the viewed slide back. Keep cleaning materials, such as glass cleaner and soft clothes, at this central location. If the slides get dirty, students can clean them at the front, rather than cleaning them on or near their microscopes. Make sure that students report any cracked or broken slides immediately. Not only is the slide no longer useful, but the glass is sharp and can be dangerous.
- Many prepared slides show specimens that would be dangerous for students to handle, such as blood smears or parasites. The specimens are stained with dyes to make particular features stand out. Explain to students that if they were to view prepared slides with no staining, the features of the specimen might be difficult to see or even invisible.

How to Make a Wet Mount

- Unlike prepared slides, wet mounts are fresh and often contain living samples. Extra caution must be used to keep spills from happening. As well, the cover slips are very fragile and easily breakable. Encourage students to use extra caution when preparing a wet mount. They can practise using the steps on page 480.
- One of the most common difficulties for students making wet mounts is to put too much of the specimen onto the slide. This action makes the cover slip unstable, and it will slide around. Have students practise using the dropper to let only one drop out at a time. If too much fluid is on the slide and the cover slip is floating around, students can draw water off of the slide by putting down the edge of a paper towel. The paper towel will absorb the extra water. Sometimes, students will inadvertently draw all of the water away using the paper towel. They may need to have a dropper of water nearby to replenish the wet mount.
- If you will be staining the wet mount, demonstrate how to put the stain on one side of the cover slip and use a paper towel to draw water from the other side. This process will pull the stain under the cover slip and spread it across the wet mount. Students should be shown how to do this step as they often use too much stain. Note that the stain will slow down, and ultimately kill, the specimens.

SCIENCE SKILL 5
COMMON LABORATORY EQUIPMENT, P. 481-482

Note: The safe and proper use of laboratory equipment should be administered in accordance with school board policy. Refer to the provincial science safety manual for additional and essential information.Teachers who have not received appropriate in-service training of safety measures and of the safe use of laboratory equipment should not attempt to use or demonstrate the use of laboratory equipment, and they should not attempt to instruct students in such usage.

TEACHING STRATEGIES

- Advise students to review Safety in Your Science Classroom on page xviii-xxi of the textbook before they look over Science Skill 5.
- Individually, in pairs, or in larger groups, students could match the items in each photograph with the descriptions.
- Gather a sampling of laboratory equipment to display for the class, and invite volunteers to approach and identify a particular item that you name. The volunteer must then briefly describe the function or purpose of the piece of lab equipment.

SCIENCE SKILL 6 DESIGNING AND CONDUCTING EXPERIMENTS, pp. 483-487

All scientific disciplines and specializations share one characteristic: they are based on an orderly, systematic process for asking questions and developing explanations for natural phenomena. The process is not a recipe, but it has several important features. The process is often more cyclical than linear and conclusive. For example, an experiment or investigation often stimulates new questions to explore.

TEACHING STRATEGIES

- **Observing and Inferring:** Emphasize the idea that an observation includes no interpretation. Use a system other than the one in the student textbook to discuss the concepts. For example, a mass on a spring is a good model and is quite similar to the pendulum. If possible, have a mass bouncing smoothly on the end of a spring. Ask the students what they observe. The answer should include no more than that the mass is bouncing up and down in a rhythmic motion. Inferring goes a step further than observing. To infer means to draw some kind of general conclusion about the observation. For example, the students could infer that some property of the system was determining the rhythm of the oscillation of the mass on the spring.
- **Hypothesizing and Predicting:** To hypothesize is to propose an answer to a broad, general question about a system or some facet of the natural world. A hypothesis must be stated in a way that can be tested. In the case of the mass on a spring, the question might be, "What determines the period of oscillation of a mass on a spring and how does it affect the period?" The students might hypothesize that the size of the mass on a spring is a determining factor in the period of oscillation of the mass. They could hypothesize that a larger mass would result in a shorter or longer period. For example, they might make the statement, "I hypothesize that as the mass is made larger, the period of oscillation of the spring becomes longer." A prediction is based on a hypothesis. A prediction applies to a specific situation or experiment where a hypothesis is a very general concept. The students might be working with a specific spring. They could predict that a 300-g mass on the spring will bounce with a longer period than a 200-g mass.
- **Variables:** Identifying and controlling the variables in an experiment are critical to the success of an experiment. The variables for a mass and spring system are straightforward. The size of the mass, the distance that you stretch the spring before releasing it, the nature of the spring itself, and the period of oscillation are the variables for the mass and spring system.

  Challenge the students to identify the variables represented in the illustration on page 485. Some of the obvious variables that might affect the time required for the water in the containers to evaporate are the surface area of the water, the temperature of the water, the volume of the water, and the composition of the containers. Some less obvious variables are the temperature of the air surrounding the containers, humidity of the air, air pressure above the containers, and movement of air above the containers. Be ready to discuss these variables with the class.
- **Independent, Dependent, and Controlled Variables:** Students might have some difficulty with the terms that describe different variables. Help them to see that the independent variable is the one for which they can choose values to work with. You could explain that some people call the independent variable the manipulated variable instead. It is the variable they work with (manipulate). For example, in the mass and spring system, they can choose and work with the size of the mass. They can choose and work with a spring and decide how far to stretch it before letting go.

  The dependent variable is the one that depends, or might depend, on the choice of a value for the independent variable. You could explain that some people call the dependent variable the responding variable instead. It is the variable that responds to the variable that is worked with (manipulated). For example, students cannot choose the period of oscillation of a mass on a spring — they can only observe it. It is the dependent (responding) variable.

  After students have chosen a variable to test, they must control the others. For example, if they chose to test the distance that they stretch the spring, they must control the mass and the spring. That is, they must use the same mass and the same spring. Notice that the mass, the spring, and the distance that they stretch the spring can be either independent or controlled variables. It depends on which variable students are testing in a specific experiment.
- **Control Sample:** Students might have difficulty understanding the difference between a control sample and controlled variables. A control sample is not required for all experiments. A control sample is needed when you are comparing the effects of two or more different treatments or methods.

In the examples given in the text, students are making such comparisons. In example (a), they are comparing the effectiveness of two quantities of cheesecloth for filtering. In example (b), they are comparing two different plant foods. In example (c), students are comparing different concentrations of acid. To decide whether they need a control sample, look for any comparisons that might be involved in the experiment.

Recording Data

- Recording data is one of the most important elements of conducting an experiment. Deciding which format to use to record data is often challenging for students. Have students consider how they expect to communicate their results before they begin an experiment. If students have difficulty deciding how they will set up their data tables, have them consider some hypothetical data that they may obtain. They can imagine running their experiment and taking measurements. Considering the way in which they will record those results, including what variables, units, and increments they will need to record, will help them decide how to design their data tables.
- The textbook recommends that students take at least four measurements and average them to come up with a data point. Have students include columns for those four individual measurements in their tables. Doing so, versus recording them separately and including only the average in a data table, will save confusion and error.

Summarize Results

- Students need to summarize their results in order to explain what happened during their experiment. The summary does not need to be long or complicated. In some cases, students have been so involved that they may have lost sight of exactly what was performed and why. Summarizing is an opportunity for them to stand back and give a plain-language summary of what they found during the experiment.
- Students should not include anything other than the results in their summary, and they should not interpret any of their findings in their summary. Their summary should be a short, concise explanation of what happened during the experiment.

Conclusion

- The conclusion is the summation of the experiment. It should cover what students were looking for and whether or not their results supported their hypothesis. It is an interpretation of the results that explains whether or not the experiment found what it was intended to find.
- Have students complete the Instant Practice section on page 487. Depending on the time available, students can either perform the experiment, or they can do a simulation. If they do a simulation, recognize that their data may be completely inaccurate compared to what they would find in a real-world experiment. The value lies in students following through on the data recording, summary, and conclusion sections of the experiment.

Instant Practice Answers, p. 487

1. Answers will depend on the experiment that is selected. If the first suggestion is selected, the possible independent variables will be the length of the tubing, the radius of the inside of the tubing, and the difference in the pressure between the ends of the tubing (if the top and bottom of the tubing being tested is not the same vertical distance apart each time). The dependent variable will, of course, be the rate at which water flows through the tubing.

   If the second suggestion is selected, the possible independent variables will be the amount of water and the temperature of the water. Students might suggest that the amount or speed of stirring the water is a variable. Stirring the water will speed up the dissolving of sugar, but will not affect the total amount of sugar that will dissolve. The dependent variable is the total amount of sugar that will dissolve in the water.
2. The possible independent variables for the two suggested experiments are listed in the answer to question 1. The independent variable will be any one of those selected for a specific experiment.
3. If the first suggested experiment is selected, the dependent variable will be the rate at which water flows through the tubing. If the second suggested experiment is selected, the dependent variable is the total amount of sugar that will dissolve in the water.
4. The controlled variables are those possible independent variables that are not being tested in a specific experiment.
5. The answer to this question depends on the experimental design. For example, if the first suggested experiment is selected, to control the difference in the pressure between the ends of the tube, the ends of the tubing must be the same vertical distance apart in every trial. There are many other examples. It is critical, however, that the students know how

they will be controlling the variable before they start the experiment.

6. If the students select either of the suggested experiments, no control sample will be needed.
7. If the first suggestion is selected, the data will be the rate of flow of water through the tubing. The students should collect the water coming from the tube in a graduated cylinder. They should measure the time required for the water to flow into the cylinder. The data should then be in terms of volume per unit time or millilitres per second.

   If the second suggestion is selected, the data will be the mass of the sugar that dissolved in a given amount of water. The rate at which it dissolves is not significant.
8. Data tables should have room for at least three to five trials for each stage of the experiment. The values for each trial should then be averaged.
9. There should be a separate graph for each independent variable. On each graph, the independent variable should be on the horizontal axis and the dependent variable should be on the vertical axis.

SCIENCE SKILL 7 MEASUREMENT, pp. 488–491

Measuring Length

- Length is possibly the most fundamental type of measurement that anyone makes. Students should be aware, however, that a measurement is only as accurate as the measuring device.
- Regardless of the accuracy of the measuring device, all measurements are an estimate. The best possible measurement is an estimate of half the distance between the closest sets of measurements. For example, if a metre stick or ruler is marked in millimetres, estimate to half a millimetre.

TEACHING STRATEGIES

- Discuss possible errors in measurement. You might show several devices from simple rulers to calipers. If possible, find and demonstrate an ultrasonic measuring device and discuss how it works. You could also find several different sources of rulers or metre sticks and let the students see how much rulers may differ. Some poorly constructed rulers, when held beside each other, reveal significant differences in the markings.
- Discuss ways to obtain the best possible measurement with the available tools. For example, ask students where, on the dots in the Instant Practice exercise, they will place the zero point of the ruler. Will they estimate the centre of the dot or should they use the edge of the dot? Note that dots are more than a millimetre across.

Instant Practice Answers, p. 488

A to D: 7.4 cm
C to E: 1.5 cm
B to F: 4.7 cm

Measuring Area

- Area measurements cannot be direct. Students must measure the dimensions of an area and then calculate the area from the measurements.

TEACHING STRATEGIES

- Review the formulas for calculating areas from linear measurements. Some examples are given here.

  square: $A = s^2$; area = side squared

  rectangle: $A = l \times w$; area = length times width

  triangle: $A = \frac{1}{2} b \times h$; area = one half times the base times the height

  parallelogram: $A = l \times h$; area 5 length times height (perpendicular distance between parallel bases)

  trapezoid: $A = \frac{1}{2}(b_1 + b_2)h$; area = one half times the sum of the two parallel bases times the height (perpendicular distance between parallel bases)

  circle: $A = \pi r^2$: area = pi (3.14159) times the radius squared
- Challenge students to think of a way to estimate the area of an irregular, two-dimensional shape. Draw a shape on the board and ask them how they would estimate the area. One possible answer is to place a grid with squares of known size over the shape and count the squares. For squares that are not complete, count them as one if more than half the square is in the area and zero if less than half the square is in the shape. Another good way would be to draw the shape on paper and cut it out. Students could determine the mass of the paper on a balance and then compare it with a square of the same paper with a known area.

Instant Practice Answers, p. 488

1. For a wall mural, the most practical unit would be the metre.

2. Answers will vary. An example might be 9.5 m by 7.0 m.
3. For the example in answer 2, the area would be 66.5 m2.
4. To avoid converting the area of the 30 cm by 30 cm squares for the mural from square centimetres to square metres, convert the side length to metres before calculating the area. The calculation would then be 0.30 m × 0.30 m 5 0.090 m^2. To fill one square metre, you would need $\frac{1.0 \cancel{m^2}}{0.090 \cancel{m^2}}$ = 11.11 small squares.
5. For a wall of 66.5 m^2, you would need 66.5 m^2 × 11.11 = 738.888 or 739 small squares.

Measuring Volume

- Volumes of liquids can be measured directly using a graduated cylinder or other calibrated device.
- Volumes of solids can sometimes be measured by the displacement of fluids using a graduated cylinder or other calibrated device.
- Volumes of uniformly shaped solids can be calculated from the dimensions of the object.

Instant Practice. p. 489

1. 94 mL; 15 mL; 88 mL

TEACHING STRATEGIES

- Review terms such as graduated cylinder and meniscus. Discuss the technique for using a graduated cylinder that is presented on page 489. Have students practise the method. Be sure that they understand how to identify the bottom of the meniscus.
- Discuss and, if possible, demonstrate the use of measuring devices such as volumetric flasks, serological pipettes, volumetric pipettes, and micropipettes. Mention that micropipettes can accurately measure one millionth of a litre (microlitre). (People who use micropipettes often call a microlitre a lambda (λ) and will often refer to the pipettes as lambda pipettes.)
- Review formulas for the volume of some common shapes such as those listed below.

cube: $V = s^3$; volume = side cubed

rectangular prism: $V = l \times w \times h$; volume = length times width times height

rectangular pyramid: $V = \frac{1}{3}(l \times w \times h)$; volume 5 one third times the length times the width times the height (height is perpendicular distance from the rectangular base to the point of the pyramid)

Measuring Mass

- Mass and weight are two different quantities. Mass is a property of an object. Weight is the force of gravity acting on the object. An object will have the same mass regardless of its location — on Earth, the moon, or in space. The same object will have a different weight on Earth and on the moon. The weight of an object can actually vary depending on the location on Earth. For example, a student's weight at the top of Mt. Everest will be slightly different than it is at sea level.
- The SI unit of mass is the kilogram (kg). The derived SI unit of weight is the newton (N). Although it is commonly done, it is technically incorrect to report weight in kilograms. On Earth's surface, an object with a mass of 1.0 kg weighs approximately 9.81 N (about 2.2 lb).

TEACHING STRATEGIES

- Students in grades much higher than Grade 8 often have difficulty understanding the difference between mass and weight. Even if your students have trouble after you've explained the concept, always use the terminology correctly. For example, never tell them to "weigh" an object when you want the answer in units of mass. Always say something like "determine (or measure) the mass of the object." If students pick up bad habits early, it will be difficult for them to correct the habits later.
- Give students the opportunity to practise using a triple beam balance. If you have a different type of balance in your classroom, give them directions for its use.
- The student textbook provides a method for determining the mass of an unknown amount of a substance such as sugar. Challenge the students to develop a method for measuring out a specific amount of sugar. For example, ask them to put 50 g of sugar in a beaker.

Instant Practice Answers, p. 490

1. Notice that the question is asked in terms of an amount of "muscle." The question does not ask which "weighs" more than the other. Also, depending on the type of calculator and the size of the paperback book, either one could have the greater mass. Encourage students to make a guess before determining the masses.
2. One method might be to determine the mass of an empty beaker, add the juice, and determine the combined mass of the beaker plus juice. Then subtract the mass of the empty beaker from the combined mass of the beaker plus juice.

Measuring Temperature

- Temperature scales are chosen arbitrarily. As stated in the text, the Celsius scale is based on the freezing and boiling points of water. Originally, the Celsius scale defined 0° as the boiling point and 100° as the freezing point of water. Carolus Linnaeus inverted the values to those used today. It should be noted, however, that the water must be pure and under standard atmospheric pressure. If something such as salt is dissolved in the water, or if the pressure over the water is increased or decreased, the melting and boiling points change.
- The Fahrenheit scale, currently used in the United States, has a unique basis. Its development is somewhat complex. Basically, zero degrees was set as the coldest temperature that could be generated in laboratories at the time (around 1700). One hundred degrees was defined as the warmest temperature experienced in Europe.
- The only property of temperatures that is not arbitrary is absolute zero, the coldest possible temperature. The Kelvin scale sets 0 K at a temperature of absolute zero. Absolute temperature is the theoretical temperature at which all motion stops. As well, this temperature is theoretically unattainable. Scientists have reduced the temperature of some materials to nearly 0 K.

TEACHING STRATEGIES

- Some students might know that salt causes ice to melt when the temperature is below zero. Explain that salt changes the properties of the ice (water) and zero degrees is the temperature at which pure water freezes.
- Give students the opportunity to practise using thermometers before completing the Instant Practice.

Instant Practice Answers, p. 491

4. Answers will vary because: students might have touched the thermometer bulb to the walls of the container, or students might not have left the thermometer in the water long enough to reach equilibrium with the water temperature. The angle at which the student looks at the thermometer scale could affect the reading.

SCIENCE SKILL 8
USING YOUR TEXTBOOK AS A STUDY TOOL, p. 492

Using Your Textbook to Read for Information

- Remind students that textbooks were designed to help them learn. The information is organized in a way that helps them understand concepts and make connections. The features in the textbook, such as summaries and section headings, make it easier for students to design their own review and study notes.
- As a class, review the key concepts that students will need to know for any assessment opportunities. They will need to organize their study notes to match what they will be assessed on, and sometimes, material is taught in a different order to that in the textbook. This change in order can be a big challenge for students, especially if they are at all unclear on the concepts.
- With the class, do a "tour of the textbook" to highlight all of the features that are described in the textbook. Practise using the visuals to predict what the section text is about. Point out how the summary is advance notice about the information in the section. Take one section that the students are familiar with and read the summary as a class. Then have students skim the section. Discuss how the summary reflected the information to come.
- Have students practise each of the strategies suggested in the textbook. For example, have them rewrite the section headings and subheadings as questions, and then find the answers. As they work through the strategies, they can record any difficulties they have. In this way, you can create a class list of tested and successful strategies.

Using Your Textbook Visuals

- Students should practise using the visuals to predict what a section is about. Assign students a section of the textbook that they are unfamiliar with, and have them write down what they think the section is about based on the visuals. Have them compare their predictions with those of other students. They do not have to read the section to see if they are correct; however, you should provide feedback so they can assess how correct they are. If students' answers are off base, analyze what they are looking at how and how they interpret the visual. If students are correct, ask what it is about the visual that gives them the clues they can use to predict.

Using the Glossary

- One of the biggest challenges for students is learning new vocabulary. Have them identify a boldface word in the textbook and then find that word in the Glossary. Discuss the different ways that students can record new vocabulary. They may wish to make a separate glossary of their own, or they may wish to keep a running list in their notes.

- Have students practise writing their own definitions of glossary terms. If they cannot come up with a definition in their own words, have them create examples using the word in a sentence. The most important thing is that students consider the word and its meaning out of the context of "memorization."

Using the Review Questions

- Explain to students that the review questions are a tool that they can use to quickly determine if they have learned the material. You may wish to suggest that students work in study groups to answer review questions. Working in groups can speed up the process of answering, and can also allow students to share their learning with each other.
- Explain to students that being unable to answer a review question does not mean that they do not know the answer. The question may be asking them to look at information in a different way. As an example, use a difficult question to show students the process of considering what the question is asking, and how they can use what they know to answer it.
- For many students, Chapter and Unit Review questions are the most difficult because it is not obvious where the information can be found. As a class, go through the Chapter or Unit Reviews and discuss cues that can be used to figure out what section the information is in.

SCIENCE SKILL 9 SOCIETAL DECISION MAKING, pp. 492–495

TEACHING STRATEGIES

- One of the key features of societal decision making is the multiple points of view that must be taken into account. Many students need significant practice identifying different stakeholders in any societal issue. The concept that each stakeholder may have an opposing yet justified position on the issue is challenging. In some cases, the issue may not be understanding the multiple points of view, but deciding which view to support. In other cases, the problem may be less with the issue itself than with the person or people supporting a point of view. This dilemma is very common if influential people are involved in the decision making.
- As an extension, have students research what lobby groups and lobbyists are and what they do. Lobbyists are people paid to influence decision makers who are usually at a high political level. Have students discuss the pros and cons of hiring a lobby group to represent a point of view on a societal issue.

Identifying the Issue

- As shown in the example in the textbook, many students do not consider their point of view to be an issue until they meet or read about an alternative point of view. It takes practice for students to recognize that societal decisions affect many different people in many different ways. In some cases, it may be environmental or ethical views that are in conflict. Some people have different tolerances for the result of a decision. Wind farms, for example, often divide people based on whether they can tolerate the sound and the look of the windmills, rather than issues with trying to develop renewable energy resources.
- Have students practise identifying an issue. Cut some headlines out of your local community newspaper that highlight issues taking place in your local area. An example of an issue could be the amount of space for dogs to run free in a local park. Hand out the headlines, but not the stories, to groups of students. Have students identify the issue and list alternate points of view that might occur around the issue.
- Have a class discussion about issues and points of view. Have students ever been in a situation like the one described in the textbook on page 493? Were they surprised when they considered another point of view. Did the issue ever get resolved? Guide students to the understanding that issues are issues because there is more than one valid point of view.

Gathering Information

- A critical piece of any societal decision making is to understand the facts behind points of view. In some cases, once information is gathered, it may be easy to change your point of view. The example in the textbook suggests designing and performing an investigation. Depending on the issue, more or less research may be needed.
- When gathering information, students should be encouraged to look for any information about similar issues in other places. In many cases, it is possible to see what happened after a decision was made. In some cases, an anticipated issue did not occur. In others, the decision led to negative results. Finding out how the decisions that others have made turned out sets the "precedent," and it can be very strong support for a point of view.

Making a Decision

- Making the decision can be more difficult than identifying the issue and gathering information, because regardless of how much information is gathered and how good that information is, some points of view cannot be changed. Discuss how important it is for students to follow through with well thought-out decisions, even if their point of view is in conflict with other people's points of view.
- Making a decision may result in other people trying to persuade students to change their minds. Discuss the meaning of a well supported decision. Did students take all available information into account? Are they considering how important this decision may be to other people? If so, then encourage them to stand behind their decision.

A Process for Societal Decision Making

- Discuss the flowchart shown in the textbook on page 495. Refer students back to the headlines they looked at earlier, and have them discuss whether or not they followed any or all of the steps in the flowchart. For many students, the flowchart is logical, but for others, they may not have considered all steps.
- Have students answer the Instant Practice questions. These questions have many possible answers, so more important than the content of students' answers is the process they use to arrive at them. Refer students to the flowchart outlining the process for societal decision making. For each question in the Instant Practice section, have students identify which stage of the flowchart is being completed. Discuss any difficulties the students may have placing the questions into a stage on the flowchart.

Instant Practice Answers, p. 495

1. (a) For example, dam building has brought hydroelectric power to large numbers of people, and created jobs.
   (b) For example, supertankers have created jobs and a way to transport large amounts of oil which is used for fuel, heat, and to make chemicals.
   (c) For example, mass production of the automobile has created jobs and a way to safely transport people and goods across great distances.
   (d) For example, mass production of computers has created jobs and a way to organize, transfer, and obtain information.
   (e) For example, harnessing nuclear reactions has created jobs and ways to produce clean energy.
2. (a) For example, dam building has destroyed ecosystems and flooded cities and towns.
   (b) For example, supertankers have led to oil spills which destroy the environment, and are a huge expense.
   (c) For example, mass production of the automobile has created an increase in air pollution and caused a dependence on expensive fuel.
   (d) For example, mass production of computers has created a dependence on technology and a decrease in human interaction.
   (e) For example, harnessing nuclear reactions has created the ability to produce nuclear weapons and the fear of radioactive contamination and waste.
3. Students might suggest listing all the pros and cones and assigning a weight to each, and then adding up the total for pro and the total for con.
4. Students may include an understanding of water pressure, an understanding of electricity, and a knowledge of what features help structures withstand large forces.
5. Both (a) and (b) are important. Students may decide that it is important to know who proposes a solution in order to consider who might benefit most from it.

SCIENCE SKILL 10 USING GRAPHIC ORGANIZERS, pp. 496–497

Network Tree

- A network tree is usually used when one concept can be broken down into subcategories, which can be again broken down into smaller subcategories.

TEACHING STRATEGIES

- Explain that a network tree looks like an upside-down tree with the "trunk" at the top. The "trunk" is the central concept. The branches are subdivisions of the major concept.

Flowchart

- A flowchart describes a non-linear sequence of steps. It is often used in planning. Although steps in some flowcharts are all in a straight line, this is not necessary. For example, at some step, there might be a decision. The step might be written in the form of an answer to a question. If the answer is yes, the process will take one direction and if the answer is no, the process will take another direction. Flowcharts can be used to write the directions of a process or experiment.

TEACHING STRATEGIES

- Have students make a flowchart for their activities over a weekend. Start with the following steps and then have them complete it. They could insert their own activities but must include a yes/no step.

wake up → check weather → is it raining? ↗ – yes → do homework
↘ – no → play softball

Events Chain

- An events chain is usually used for a linear presentation of a sequence of events. One event is often, though not always, the cause of the next event. In many cases, one event is necessary before the next event can occur. It might not cause the following event, but the following event cannot occur in the absence of the preceding event.

TEACHING STRATEGIES

- Challenge the students to make an events chain as the basis for a funny story. It could start with a scenario like, "When I was fixing breakfast this morning, the lights went out and caused me to drop the milk. We didn't have any more milk so I... ." Have the students think of a scenario that has at least five cause-and-effect steps.

Cycle Map

- As the name implies, a cycle map must represent a repeating sequence of events such as morning, afternoon, evening, and night. Some cycle maps diverge at one step but recombine at another. For example, a flower on a plant produces both pollen and ova, which would be written as branches from the flower. The pollen would then fertilize an ovum to eventually form a seed, and bring the branches back together.

TEACHING STRATEGIES

- Ask the students to think of things that they do over and over. For example, they might think of waking up, eating breakfast, going to school, and, after a few more steps, going to bed. Another example might be wearing clothes, washing clothes, ironing clothes, and then wearing the clothes again.

Spider Map

- A spider map has one central concept that can be categorized in several different ways. The "legs" on the spider represent the various ways in which the central concept or topic can be broken down into smaller parts.
- Spider maps are similar, but not identical, to "mind maps." A mind map can be considered as a visualization of the learning process applied to a new concept. It usually looks similar to a spider map, but is more personalized. A mind map shows how a student develops ideas about the topic as he or she is learning about it. Mind maps can also be used to make notes while a group is brainstorming. Mind maps often have cross connections between items on the different "legs" of the spider map.

TEACHING STRATEGIES

- Separate the class into groups. Tell each group to make a spider map with the central topic of "food." Give a little guidance by encouraging them to think of general types of food such as vegetables, fruits, meat, cheese, and other types. When the groups have completed their spider maps, compare them. Help the students understand that no specific map is correct or incorrect. Spider maps are tools to help students organize their thoughts.
- Have groups make another spider map with the central topic of "animal." Do not give guidance this time. Evaluate the students' ability to use spider maps.

Venn Diagram

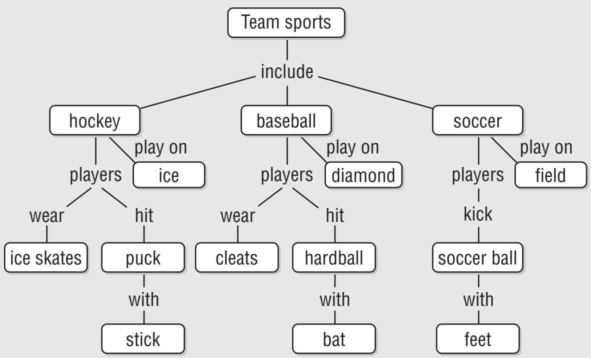
- A Venn diagram is a visual form of an answer to a "compare and contrast" question. Venn diagrams consist of circles or other shapes that overlap. The items or descriptors that fit more than one category — compare — are in the overlapping parts of the shapes. The items or descriptors that are contrasting go in the non-overlapping parts of the shapes.

TEACHING STRATEGIES

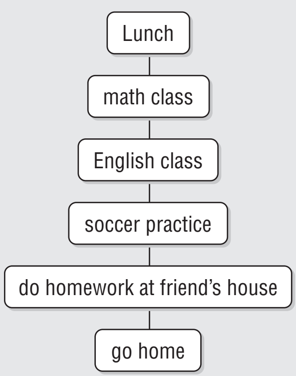
- Draw three large, overlapping circles on the board. Be sure that there is an area where all three circles overlap and areas where each pair of circles overlap. Label the circles, "Hockey or Ringette," "Baseball or Softball," and "Soccer." Ask all students who have played sports in all three categories to write their names in the centre where all three circles overlap. Ask students who play or have played two of the three types of sports, to write their names in the parts of the circles that overlap with each other but not with the third circle. Have students who play or have played only one of the types of sports to write their names in the parts of the circles that do not overlap with any other circle. Ask the students what they have learned about Venn diagrams by filling in the circles.

Instant Practice Answers, p. 497

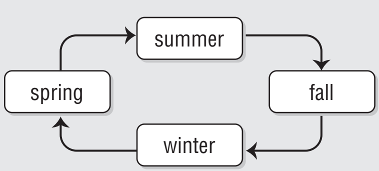
1. Reasoning: All terms apply to sports. Look for the most all-encompassing term. That term is "team sports." Names of each team sport come next. Finally, the objects that are associated with a team sport follow the sport. The following figure is an example. Student maps will vary.



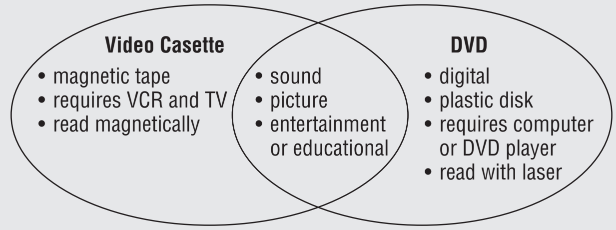
2. The following is an example of an events chain.



3. There is no beginning or end. Use arrows to indicate direction of flow of terms, as shown.



4. The following is an example of a Venn diagram.



5. The following is an example of a spider map for part (b), music. Spider maps for (a), (c), and (d) need not be so elaborate unless students are motivated by the task.