DISCOVERING SCIENCE 7
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* 7 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 DATA, P. 455–458

- 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.

Drawing a Data Table

TEACHING STRATEGIES

- Numerical data are always easier to analyze or graph when organized in tabular form. If the data are to be graphed, the first column of numerical data should represent the independent variable. This is the variable that you can choose or manipulate. The values for the independent data are represented on the horizontal, or *x*, axis. The data for the dependent variable should be listed in the second column of numerical data. These data will be plotted on the vertical, or *y*, axis.
- Listing the data for the independent variable in ascending order will make it easier to graph. You cannot assume that the data for the dependent variable will also be ascending.
- Have the students look for a data table in their textbook or in another book. Have them read through the "Tips for Drawing Data Tables" and check the table to see if the tips were followed.
- Go through the Instant Practice problem or another set of data of your choice with the class. First, ask the students how many categories of data are given. In the Instant Practice problem, there are 4 categories of data: type of food, grams of carbohydrate, grams of protein, and grams of fat. Therefore, the table should have four columns. Next, ask the students how many complete sets of data are given. In the Instant Practice problem, there are 5 sets of data. Therefore, there should be 6 rows in the table, 5 rows for data and one row for headings.

Instant Practice Answer, p. 455

NUTRITIONAL CONTENT OF SEVERAL FOODS

Food (1 serving)	**Carbohydrate** (g)	**Protein** (g)	**Fat** (g)
Cooked pasta	15	3	0
Beef	0	7	5
Bananas	15	0	0
Milk	12	8	3
Tomatoes	5	2	0

Graphing

TEACHING STRATEGIES

- Go through the list of terms that are applied to graphs. Ensure that students understand the terms. Use the terms frequently when discussing graphs. Students need to hear a word used in context many times before it becomes part of their vocabulary.
- Some students find it difficult to interpret graphs. Select several graphs in the student text or from another source. Discuss the graphs with the class. Help the students to understand the concept that line graphs show a relationship between variables. For example, you might sketch a rough graph of age versus average height in humans (or some smaller group in the population). You could summarize the relationship between age and height by stating, "As age increases, height increases until the

age of about 12 to 18 years. At that time, height levels off and remains the same indefinitely."
Also try to find examples of graphs that show a trend. For example, you might find a graph of the average size of car that people drive. You might describe the trend as follows. "In the 1950s and 1960s, people preferred large cars. When gasoline became more expensive in the 1970s, the trend was toward smaller cars. Recently, the trend has changed to slightly larger cars."

Drawing a Line Graph

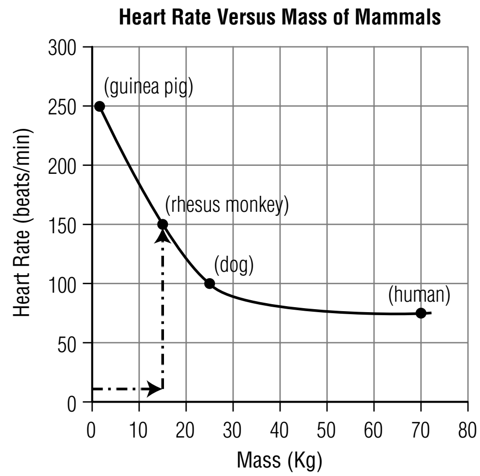
TEACHING STRATEGIES

- 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 mass and heart rate of a few mammals. 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 scale should go slightly beyond the range of the data. Mass goes to 70 kg and heart rate goes to 250 beats per minute. Let the scale for mass be on the x-axis and go from zero to 80 kg. Let the scale for heart rate be on the y-axis and go from zero to 300 beats per minute. Then discuss the method for plotting data points. In the example shown, dotted lines show how to plot the data point for the rhesus monkey. "Move your pencil along the x-axis until you reach the mass, 15 kg. Then move your pencil up until you reach the heart rate, 150 beats/min." 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.

MASS VERSUS HEART RATE OF VARIOUS MAMMALS

Mammal	Mass (kg)	Heart Rate (beats/min)
Guinea pig	0.850	250
Rhesus monkey	15	150
Dog	25	100
Human	70	72

- Ask the students to verbally describe the relationship between mass and heart rate of mammals. The answer should be, "As the mass of the mammal increases, the heart rate decreases."
- Determine the range of the data and decide on the scale. The scale should go slightly beyond the range of the data. Mass goes to 70 kg and heart rate goes to 250 beats per minute. Let the scale for mass be on the x-axis and go from zero to 80 kg. Let the scale for heart rate be on the y-axis and go from zero to 300 beats per minute.
- Discuss the method for plotting data points. In the figure below, dotted lines show how to plot the data point for the rhesus monkey. "Move your pencil along the x-axis until you reach the mass, 15 kg. Then move your pencil up until you reach the heart rate, 150 beats/min."
- Do not connect the dots. Draw a smooth curve through the points.
- Give the graph a title.



Drawing a Bar Graph

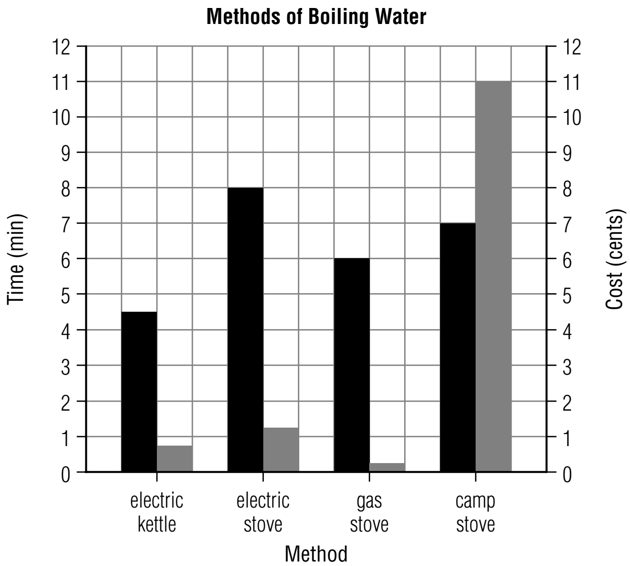
TEACHING STRATEGIES

- Go through the steps in the example with the students. Ensure that they understand the steps.
- Show students the bar graph below that graphs both the time required to boil 900 mL of water and the cost of the energy. Better yet, have students draw it themselves. The graph uses the data in Table 3, p. 457. Explain that the scale on the left axis is for the left bar for each item and the scale on the right axis is for the right bar for each item.

Interpolation and Extrapolation

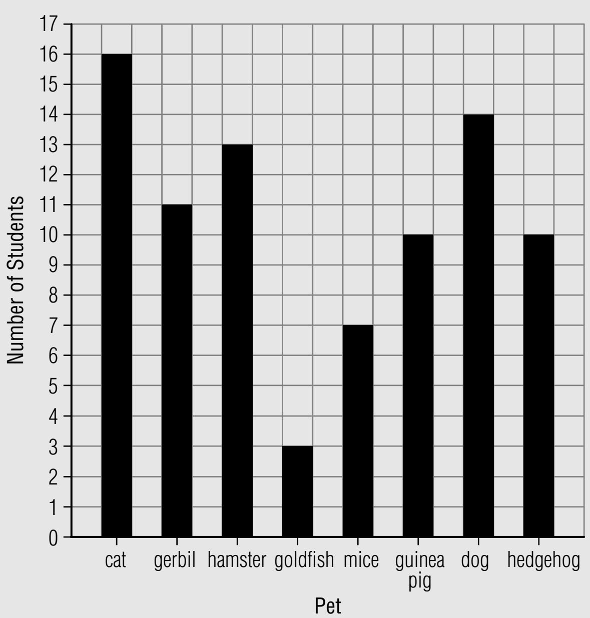
TEACHING STRATEGIES

- Explain to students that interpolation and extrapolation are ways of using graphs to make predictions. To help them remember the meanings, you could suggest that students think of **ex**trapolating as **ex**tending a graph line (making it extra or beyond the graph line). **In**terpolating is **in**serting data **in**side the graph.



- Ask students which method of boiling water is the most efficient. (electric kettle) Ask students which method is the most economical. (gas stove)
- Have the students complete the Instant Practice bar graph. Ask them if they think that the data are typical. Take data from the class about the animal they would choose for a pet and make a bar graph of the class data.

Instant Practice Answer, p. 458



Constructing a Histogram

TEACHING STRATEGIES

- A histogram differs from a bar graph in that the quantity on the x-axis is quantitative. The quantity could be time, temperature, age, or some other continuous quantity. The data, however, are grouped into a range of the quantity rather than at specific points.
- Go through the steps in the example with the students.

SCIENCE SKILL 2 DESIGNING AND CONDUCTING EXPERIMENTS, p. 459-463

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:** Emphasize the idea that an observation includes no interpretation. Use a system other than the one in the student text 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:** 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:** 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."
- **Predicting:** 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 310. 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, the humidity of the air, the 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.

Instant Practice Answers, p. 463

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 one. 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 3 METRIC CONVERSION AND SI UNITS, P. 464–466

The metric system is a decimal system of units based on the gram (g) as the unit of mass, the metre (m) as the unit of length, and the litre (L) as the unit of volume. Other units are formed from these base units by adding a prefix that indicates that the unit is multiplied or divided by a factor of ten.

The history of the development of units is complex. For example, the *foot* was the first recorded unit of length. It was supposed to be the length of a certain king's foot. Clearly, it was difficult to define a reproducible "foot." A very large number of units of measurement were defined throughout the ages. Even when the British Imperial units were carefully defined, they were not easily converted from one to another mathematically because they were not decimal units. For example, there are 12 inches in a foot, three feet in a yard, and 5280 feet in a mile. Since the metric system is based on the decimal system or multiples of ten, it is much easier to convert among units.

TEACHING STRATEGIES

- To illustrate the point about conflicting units of measurement, you might ask students questions such as, "How many fathoms are there in a furlong?" (Answer: 110; 1 fathom = 1.829 m; 1 furlong = 201.168 m) The furlong is still used in horse racing and the fathom is used to measure depth of water in the ocean. You might also ask, "How many scruples are there in a stone?" (Answer: 4900; 1 scruple is equivalent to 1.3 g; 1 stone is equivalent to 6.4 kg) In Great Britain and in Australia, people often report their weight in stones.
- Create a game that will help students remember the prefixes for the metric system. For example, say a unit such as "megametre" and see who is first to say "million metres."
- Note that the fact that all of the prefixes represent factors of ten makes converting units within the metric system much easier that in other systems.
- Point out the fact that the prefixes representing factors of 1000 are most commonly used. The only case in which the prefix centi- is commonly used is for length, that is, centimetres. For example, you rarely encounter the centigram (cg) or the centilitre (cL), but milligram (mg) and millilitre (mL) are common.
- Discuss the concept of cancelling as discussed in the Problem Tip. Emphasize the idea that anything — including units — when divided by itself, is equal to one. For example, a centimetre divided by a centimetre is one. Go through some examples on the board. The following steps might provide a method that will help students.

Example

Convert 152 cm to metres.

1. Write down the number and be ready to multiply by a fraction. $(152\text{ cm})\left(\frac{}{}\right)$
2. Place the unit into which you want to convert, in the numerator of the fraction. $(152\text{ cm})\left(\frac{\text{m}}{}\right)$
3. Write the unit that you want to cancel in the denominator. $(152\text{ cm})\left(\frac{\text{m}}{\text{cm}}\right)$
4. State the number of the small unit (cm) in one of the large units (m). Write that number in front of the small unit. $(152\text{ cm})\left(\frac{\text{m}}{100\text{ cm}}\right)$

5. Cancel units and complete the math.

$$(152 \not{cm}) \left(\frac{m}{100 \not{cm}}\right)$$

$$\frac{152}{100} \text{ m}$$

$$1.52 \text{ m}$$

Metric Unit Conversions Involving Squares or Cubes

Converting units that have an exponent can be difficult unless students understand the rules of mathematics. The most important rule is that both sides of an equality can be raised to any power and still have an equality. The student must remember that the entire side of the equation must be raised to the power.

TEACHING STRATEGIES

- Grade 7 students might not encounter problems in which they have to cancel units with an exponent greater than one. If you choose to avoid such problems, there is no need to study this topic.
- If you choose to practice problems in which units have an exponent greater than one, emphasize the third line of the examples in the text. Tell students to always put a bracket around the entire side of the equation that they are taking to an exponent greater than one. Every element inside the bracket must be taken to the exponent.

Instant Practice Answers, p. 466

1. 355 mL
2. 75 cm
3. 3.96×10^5 mg
4. 0.25 L
5. 6 m
6. 2.5 mL
7. 0.001525 m^3

SI Units

- Many people confuse SI units with metric units, believing that the two are the same. This is not the case. SI units were agreed upon to encourage scientists to use the same units. Chemists had begun to use the *cgs system* (centimetre, gram, second) and physicists typically used the *mks system* (metre, kilogram, second). This practice becomes very confusing when attempting to compare results. For example, the joule (J) is the unit of energy in the mks system, while the erg is the unit of energy in the cgs system. There are 10^7 ergs in a joule. Since 10^7 is not a factor of 1000, it is difficult to remember.
- When a group of scientists met in Paris in 1960, they defined SI units to encourage scientists to consistently use one system. SI units are closest to the mks system. The base units in the SI system are the metre (m), kilogram (kg), second (s), ampere (A, electric current), kelvin (K, for temperature), mole (mol, for amount of a compound), and candela (cd, light intensity). Units such as the newton (N), that are made up of a combination of base units (newton = kilogram metre per second squared), are called derived units.
- Base units with metric prefixes are *not* SI units.
- Although most of the base and derived SI units are metric, not all are. There are no metric units for time yet the second (s) is the SI unit of time.

TEACHING STRATEGIES

- Explain the difference between SI units and metric units as discussed above.
- Students are often required to report answers to numerical problems in SI units unless the problem states that the answer is to be given in another specified unit.

Instant Practice Answers, p. 466

1. 0.00702 kg
2. 1920 s
3. 8.13×10^3 m
4. 25.961 m
5. 2236.25 m
6. 11 700 s

SCIENCE SKILL 4 MEASUREMENT, p. 467–470

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. 467

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 = 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. 467

1. For a wall, 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 m^2.
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 = 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.

TEACHING STRATEGIES

- Review terms such as *graduated cylinder* and *meniscus*. Discuss the technique for using a graduated cylinder that is presented on page 298. Have students practice 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 = 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 seven 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 practice using a triple beam balance. If you have a different type of balance in your classroom, give them directions for its use.
- The student text 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. 469

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 practice using thermometers before completing the Instant Practice.

Instant Practice Answers, p. 470

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 5 QUALITATIVE AND QUANTITATIVE OBSERVATIONS, p. 471

TEACHING STRATEGIES

- The distinction between qualitative and quantitative numbers is fairly straightforward for most students. If necessary, change the terms to their noun form, quality and quantity, to help students focus on those observations that involve numbers or specific amounts (quantities) and those that do not (qualities).

Instant Practice Answers, p. 471

(a) Qual, Quan; (b) Qual, Quan; (c) Quan, Quan; (d) Quan, Qual; (e) Quan, Qual; (f) Quan, Quan

SCIENCE SKILL 6 COMMUNICATING YOUR LAB WORK IN A LAB REPORT, p. 472-473

TEACHING STRATEGIES

- Advise students to review Science Skill 2, Designing and Conducting Experiments, before they look over 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, that might differ in subtle ways. However, be sure to inform students why modifications, if any, are being made.

SCIENCE SKILL 7 COMMON LABORATORY EQUIPMENT, p. 474-475

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 7.
- 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 8 USING A MICROSCOPE, p. 476–478

Although extensive use of and instruction for the microscope begins in grade 8, Science Skill 8 is provided to enhance students' possible use of this equipment in Chapters 1, 7, and 12. Particular emphasis should be placed on students' safe and respectful use of this expensive and delicate piece of equipment.

TEACHING STRATEGIES

- To help students to 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 Compound 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.

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).

SCIENCE SKILL 9 USING GRAPHIC ORGANIZERS, P. 479–480

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

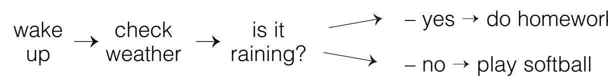
- Explain that a network tree looks like an upside-down tree with the “trunk” at the top. The “trunk” is the central concept. The branches are subdivisions of the major concept.

Flow Chart

- A flow chart describes a non-linear sequence of steps. It is often used in planning. Although steps in some flow charts 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. Flow charts 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.



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 to, 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 to 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

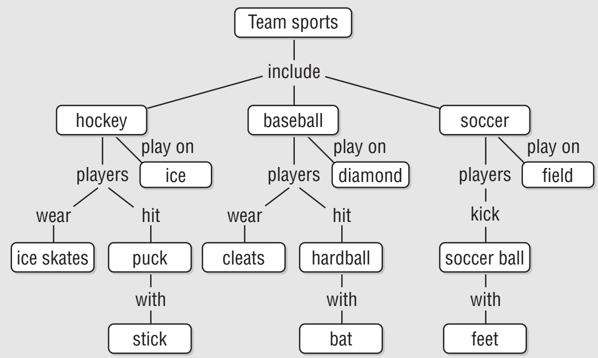
- A Venn diagram is a visual form of an answer to a "compare and contrast" question. Venn diagrams consist of circles or other shapes that overlap. The items or descriptors that fit more than one category — compare — are in the overlapping parts of the shapes. The items or descriptors that are contrasting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

TEACHING STRATEGIES

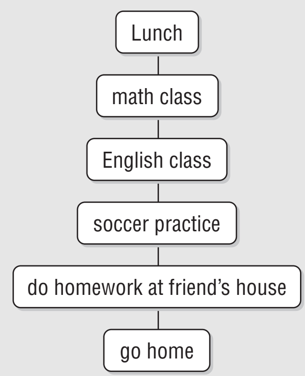
- Draw three large, overlapping circles on the board. Be sure that there is an area where all three circles overlap and areas where each pair of circles overlap. Label the circles, "Hockey or Ringette," "Baseball or Softball," and "Soccer." Ask all students who have played sports in all three categories 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. 480

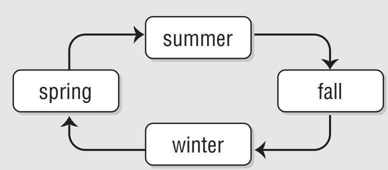
1. Reasoning: All terms apply to sports. Look for the most all-encompassing term. That term is "team sports." Names of each team sport come next. Finally, the objects that are associated with a team sport follow the sport. The following figure is an example. Student maps will vary.

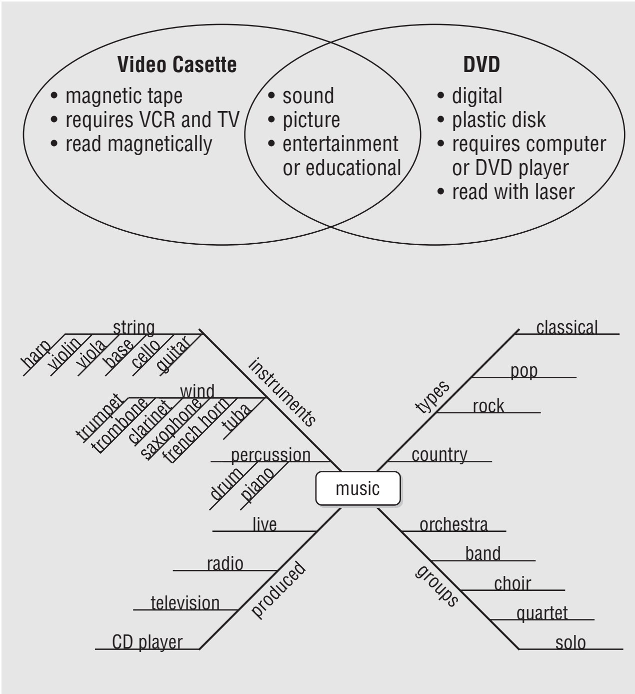


2. The following is an example of an events chain.



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




Video Casette
• magnetic tape
• requires VCR and TV
• read magnetically
• sound
• picture
• entertainment or educational
DVD
• digital
• plastic disk
• requires computer or DVD player
• read with laser
music
instruments
string
harp
violin
viola
base
cello
guitar
wind
trumpet
trombone
clarinet
saxophone
french horn
tuba
percussion
drum
piano
types
classical
pop
rock
country
produced
live
radio
television
CD player
groups
orchestra
band
choir
quartet
solo