

Resource Quick Tours

STUDENT BOOK QUICK TOUR

Unit Opening Material

Unit Preview and Big Ideas

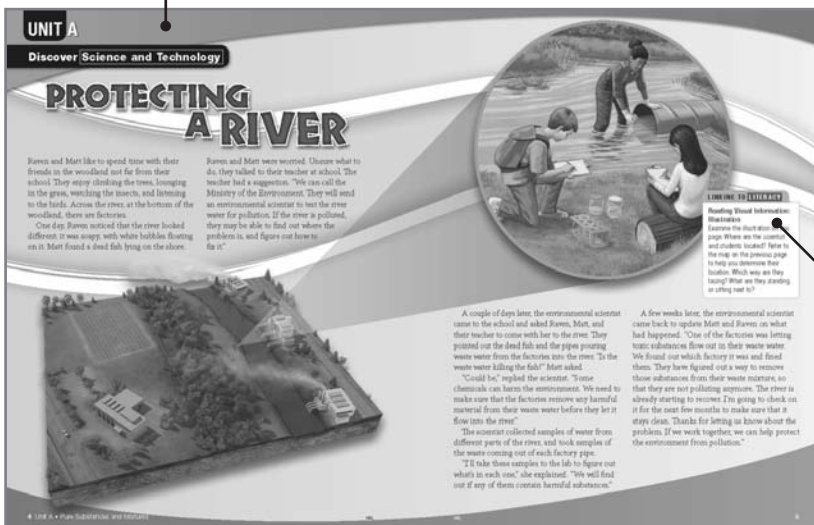
The Unit Preview highlights the Big Ideas, provides STSE context, and connects to the students' own experiences.

Unit Opener

A purposeful, engaging photo represents the Big Ideas visually and helps students connect to the topic of the unit.

Discover Science and Technology

A short narrative reflects STSE expectations through a motivating, real-world context.



Linking to Literacy

This feature provides familiar strategies to help students use literacy skills to enhance their understanding.

Let's Get Started

This activity accesses students' prior knowledge. It can be used as a diagnostic assessment tool and is an opportunity for differentiated instruction.

Unit Task Preview

This feature previews the Unit Task—a culminating activity that provides a context for learning. Students may be offered a variety of choices of tasks to complete to support individual learning.

The screenshot shows a textbook page with two main sections. On the left, under the heading 'Let's Get Started', is 'Exploring Matter'. It includes three figures: Figure 1 shows three beakers with different colored liquids; Figure 2 shows a hand pouring liquid from one beaker to another; Figure 3 shows a hand holding a small object over a beaker. On the right, under the heading 'Unit Task Preview', is 'Test a Sample of Industrial Waste'. It includes a photograph of a pile of dark, rocky waste and a small diagram of a separation process. Text boxes provide context for both sections.

Unit Task Icon

Throughout each unit, these icons indicate to students when a connection can be made between their learning and their Unit Task.

Assessment Box

Students are given a clear description of the assessment criteria for the Unit Task.

Chapter Opening Material

Chapter Opener

This is an advanced organizer which provides a structure for learning and questioning. An engaging image connects to the STSE-related narrative on the next page.

Looking Ahead

These statements summarize the key concepts and skills addressed in the chapter and reflect specific curriculum expectations in student-friendly language.

Vocabulary

This is a list of the key terms used in the chapter in the order in which they are introduced.

Reading Science and Technology

A unique reading activity uses a variety of literary styles and text forms to provide a source of discussion and connect to STSE. It focuses on the importance of reading to access information.

The screenshot shows a textbook page with two main sections. On the left, under the heading '1 Classifying Matter', is a 'Looking Ahead' section with a list of bullet points summarizing key concepts. Below it is a 'Vocabulary' section with a list of terms. On the right, under the heading 'Reading Science and Technology', is 'Take Our Kids to Work Day'. It includes a photograph of a scientist in a lab and a short story about a scientist's daughter. Text boxes provide context for both sections.

Chapter Content

Concept Development Sections

Each concept development section presents one of the basic concepts of the unit derived from a group of specific curriculum expectations. The text is divided into manageable chunks using subheadings. Learning is visually supported using diagrams, photos, and illustrations.

Vocabulary

Key terms are in bold print and highlighted in context. Students will find a reworded formal definition in the margin of the text and in the glossary. Pronunciation keys are provided in the glossary for difficult words.

Weblink Icon

This icon directs students to the Nelson Science website for an extension of learning opportunities using a variety of multimedia tools. The Nelson Science website can be found at www.nelson.com/perspectives

3.4

Protecting the Environment by Separating Mixtures

Think about the last time you visited a lake or a river. Was there a bad smell? Was there dirty white foam at the edge of the water? If you noticed either of these problems, the water may have been polluted. There are two main ways to avoid polluting water.

- Identify sources of pollution and find ways to stop or limit pollution from those sources.
- Treat any water that contains pollutants, such as waste from sinks and toilets, before it reaches lakes and rivers.

Sewage Treatment

The mixture of water and waste that you flush down the sink or toilet is called **sewage**. What happens to sewage after it is flushed? It goes through drains and pipes until it reaches a sewage treatment plant. It then goes through one or more stages of treatment to remove the solids, break down the organic material, and kill any disease-causing organisms. The number of treatment stages depends on many things, including space, cost, and end use. The three main stages are primary treatment, secondary treatment, and tertiary treatment.

Primary Treatment




Half the solids in sewage are removed from the mixture during the primary treatment. First, the sewage passes through a metal grid. This catches out objects that will not easily decompose, such as items made of fabric and plastic. Next, the sewage is poured into a large pool and allowed to settle for several hours (Figure 1). Most solids settle to the bottom, and floating components (such as oil and grease) rise to the top. The solids are removed, treated, and used as fertilizer, burned, or sent to a landfill.

Secondary Treatment

The remaining dirty water passes through tanks containing bacteria during the secondary treatment. Oxygen gas is bubbled through the mixture (Figure 2). The bacteria break down any remaining human waste and plant material. Next, the water is allowed to settle again. The bacteria settle to the bottom and are removed.

Tertiary Treatment

Pollutants like phosphorus and nitrogen are removed during the tertiary treatment (Figure 3). Various kinds of bacteria are encouraged to grow in the wastewater. The water may also pass through filters. Large stones bubbled through it, or be exposed to ultraviolet radiation. Finally, chlorine is added to the water to kill any remaining organisms. Now the water is clean enough to be returned to the ocean, lake, or river.

64 Chapter 3 • Separating Mixtures


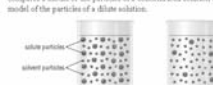
2.3

Concentration and Solubility

When you eat an apple, do you eat the seeds? Apple seeds contain a very tiny amount of cyanide (Figure 1). Cyanide is a poisonous chemical. Do not worry about being poisoned if you occasionally swallow some apple seeds. The cyanide is present in such tiny amounts that it will not harm you. Pure substances can be good or bad for you depending on how much of the substance you consume. For example, digitalis is a chemical found in foxglove plants. Doctors sometimes prescribe small amounts of digitalis as a medicine for heart disease. People used to drink 'foxglove tea'—a solution made by soaking parts of the foxglove plant in hot water—to cure some illnesses. But they had to be careful! Drinking foxglove tea with a small amount of digitalis in it could help a person with a weak heart. Drinking foxglove tea with a lot of digitalis in it, however, could harm or even kill a person by making the heart beat too fast. As this example shows, it is important to know how much of a substance there is in a solution. In this section, you will learn how to describe and calculate the quantity of solute in a solution.

Concentrated and Dilute Solutions

The words 'concentrated' and 'dilute' are used to describe how much solute is in a certain volume of solution. A **concentrated solution** has a large amount of solute in a volume of solution. A **dilute solution** has a small amount of solute in a similar volume of solution. Figure 2 compares a model of the particles of a concentrated solution to a model of the particles of a dilute solution.

Calculating Concentration

The **concentration** of a solution is the quantity of solute in a certain volume of solution. The more solute dissolved, the greater the concentration. Suppose 100 mL of solution contains 5.0 g of sugar. The concentration of sugar in that solution is 5.0 g/100 mL. One way to express the concentration of liquids is as the mass of solute (in grams) per 100 mL of solution. The equation for this is:

$$\text{concentration} = \frac{\text{mass of solute in grams}}{100 \text{ mL of solution}}$$

The following Sample Problem shows how to calculate the concentration of a solution.

SAMPLE PROBLEM: Calculate Concentration

Suppose a solution contains 6.0 g of sugar in 200 mL of sugar-and-water solution. What is the concentration of the sugar-and-water solution? What is the concentration of the sugar-and-water solution?

Given: mass of solute = 6.0 g
volume of solution = 200 mL

Required: concentration of the solution

Analyze: concentration = $\frac{\text{mass of solute in grams}}{100 \text{ mL of solution}}$

Solve: concentration = $\frac{6.0 \text{ g}}{200 \text{ mL}}$
Remember to double both the numerator and the denominator by 2 to get concentration per 100 mL.
concentration = $\frac{3.0 \text{ g}}{100 \text{ mL}}$

Statement: The concentration of the sugar-and-water solution is 3.0 g/100 mL.

Practice: Calculate the concentration of a solution made by mixing 4.0 g of sugar with enough water to form 50.0 mL of solution. Remember that the formula calculates the concentration of 100 mL of solution, so you may have to change the volume in your calculation.

Saturated and Unsaturated Solutions

What would happen if you tried continued to add drink powder to the glass of fruit punch? Eventually, no more powder would dissolve. The solution would be saturated. A **saturated solution** is a solution in which the maximum amount of solute has been dissolved. An **unsaturated solution** is a solution that still has room for more solute to dissolve.

Concentrated and Dilute Solutions

A **concentrated solution** is a solution in which more solute can dissolve. An **unsaturated solution** is a solution in which more solute can be dissolved.

42 Chapter 2 • Solutions

Equation Box

Important equations are highlighted in a red box.

Sample Problems

This feature models how to solve numerical problems using the GRASS method. Practice problems are provided.

Try This Activity
 These are hands-on mini-investigations that use easy-to-find materials and do not require a lab.

Skills Icon
 The Skills Icon appears in Try This and other activities. It directs students to the section of the Skills Handbook that contains helpful information and tips.

Check Your Learning
 Each concept section ends with a Check Your Learning box. This is a formative assessment tool with questions designed to help students construct meaning and understanding from the section content.

1.4 Pure Substances and Mixtures

The apple juice in Figure 1 is labeled as 100% apple juice. Does this mean that the juice is made of only one kind of matter? Does it have only one kind of particle in it?

Apple juice is actually a mixture of water particles, sugar particles, flavor particles, and vitamin particles. Apple juice may look like one kind of matter, but it contains many kinds of particles all mixed together.

Pure Substances
 Most examples of matter in everyday life contain more than one kind of particle. Some types of matter, however, do contain only one kind of particle (Figure 2). A piece of aluminum foil contains only one kind of particle. Each aluminum particle is the same as every other aluminum particle. White table sugar is made of only sugar particles. Aluminum and table sugar are both examples of pure substances. A **pure substance** is a type of matter that contains only one kind of particle (Figure 3a). Other examples of pure substances include distilled water and salt. Chemists use to measure power devices to produce electricity is another pure substance.

Water from your tap is not a pure substance. It contains water particles and a number of other kinds of particles, too. Distilled water, however, has had all of the "non-water" particles removed; it is a pure water.

Mixtures
 When you stir a spoonful of sugar into a glass of distilled water, the sugar dissolves and the water turns sweet. Now there are two kinds of particles in the glass. The sweetened water is not a pure substance anymore. It is a mixture containing sugar particles and water particles. A **mixture** is a type of matter that contains more than one kind of particle. A mixture is made of two or more pure substances mixed together (Figure 3b).

Figure 3 (a) Pure substance contains identical particles. (b) Mixture contains more than one kind of particle.

20 Chapter 1 • Classifying Matter

TRY THIS! Test a Sample of Matter

SKILLS MENU: performing, observing, analyzing

You can test the salt in a black marker to determine if it is a pure substance.

Equipment and Materials: water, white table marker, solution, drinking glass or beaker, 10 cc pipette or 10 mL syringe, 10 cc water.

- Use the marker to draw a horizontal black line about 2 cm from the bottom of the cup of the glass.
- Put water into the glass to a depth of about 1 cm.
- Carefully place the strip of filter paper in the glass of water. The black line should be due to the water, but not touching it (Figure 4).

What happens in the black line on the paper after 1 hour? After 3 days?

Is the salt in the black marker a pure substance or a mixture? What evidence supports that?

Figure 4: Use the strip of the marker lid to hold the paper taut from the side of the glass.

SKILLS TIPS: Analyzing
 After Reading: Summarizing After you finish reading the section "Pure Substances and Mixtures," work with a partner to summarize all of the key ideas. The text summaries will help you guide your thinking. Drawing and labeling for each of the substances in the text.

Unit Think
 Think about the Unit Test. How will this information about pure substances and mixtures be useful to you when in the test?

CHECK YOUR LEARNING

- (a) What is a pure substance? Give three examples. (b) What is a mixture? Give three examples.
- In your notebook, draw a sample of matter that is a pure substance. Make sure you show the type of particles present in the pure substance. Explain why your drawing shows a pure substance and not a mixture.
- Is salt a pure substance or a mixture? Explain how you know.
- (a) Why do you not place your bottom in the regular garbage? (b) How should you dispose of batteries?

1.4 Pure Substances and Mixtures 21

AWESOME SCIENCE

Other States of Matter
 You have just learned about solids, liquids, and gases. Scientists have found other states of matter that have unique properties.

A gas that is electrically charged is called plasma. Plasma is sometimes considered to be a fourth state of matter. It is found mainly in stars and nebulae in outer space.

Plasma behaves in different from liquid plasma has some unusual properties for thousands of years. The northern hemisphere people for thousands of years (Figure 1). Traditionally, it has been believed that the northern lights were the result of spirits going south to a land of happiness and plenty.

Figure 1: The northern lights (aurora borealis).

Today, you can find plasma in many manufactured items, such as fluorescent lights, neon signs (Figure 2), and plasma television screens.

OPEN

Figure 2: Neon lights contain plasma.

According to the particle theory, particles move more slowly when they are cooled. Experiments have shown that this is true. Scientists have cooled particles until they almost stopped moving completely. If you draw a graph showing the movement of particles against temperature, the graph would indicate that the particles would stop moving at approximately -273°C. This temperature is known as absolute zero. Absolute zero is the coldest possible temperature that could ever exist. Scientists believe that even the coldest places in our universe are warmer than absolute zero.

In 1926, Albert Einstein predicted that if you cooled particles down to absolute zero, a new state of matter would form. In 1995, scientists Eric Cornell and Carl Wieman finally managed to cool down a sample of Rubidium atoms to a temperature very close to absolute zero. Scientists were right: the particles formed a new state of matter.

The cooling new state of matter is called a Bose-Einstein condensate. Scientists think that this discovery may lead to very tiny computer chips in the near future.

To read more about these exciting developments, visit www.ck12.org.

SCIENCE WORKS

Pharmaceuticals
 How do you take your medicine (usually)? A spoonful of cough syrup, some aspirin for an aching stomach, or a traditional hard tablet? All liquid medicines are solutions. Usually, the active ingredient in the medicine is the solid. The solvent is just there to keep the medicine well mixed, easy to measure, and easy to swallow (Figure 1).

Figure 1: Children often find it easier to swallow medicine as a liquid than as a pill.

In the early twentieth century, most medicines were made by pharmacists in their own shops. Now, big drug companies have taken over the role. These companies employ teams of doctors, pharmacists, chemical engineers, and lab technicians to develop and manufacture the medicines (Figure 2).

Figure 2: The development team makes sure that it is easy to take the correct dose.

Many liquid medicines contain water as the solvent. Sometimes, however, an active ingredient does not dissolve well in water. In that case, a different solvent has to be used, such as alcohol. The pharmaceutical industry selects solvents very carefully. They must dissolve the active ingredient without changing it, and the solvent must not be harmful to the patient taking the medicine.

Besides medicines that you take by mouth, you might have seen pharmaceuticals in liquid form that can be administered in other ways by injection, as topical applications, or eye drops or ear drops, or through nasal sprays or inhalers. For example, creams and ointments like sunscreen are other ways with oily solvents. These solvents help the active ingredients to stay on your skin longer than they would if the solvent were water.

The pharmaceutical industry and health Canada closely monitor the components and concentrations of most pharmaceutical solutions. The reasons are that the medicines are safe and effective.

To read more about pharmaceuticals and careers in the field, visit www.ck12.org.

Tech CONNECT

Sorting Solid Waste
 When you have finished with your household items and they are at the store used to you, you need to come to your discarded "stuff."

The flowchart shows the process of sorting solid waste. It starts with 'Solid Waste' and branches into 'recyclable items', 'compostable material', 'hazardous household waste', 'household appliances', 'electronics', 'textiles', 'furniture', 'large appliances', 'white goods', 'refrigerators', 'air conditioning units', 'HVAC units, etc.', 'oil', 'paints', 'pesticides', 'herbicides', 'fertilizers', 'chemicals', 'liquids', 'gases', 'solids', 'hazardous waste', 'non-hazardous waste', 'landfill', 'incineration', 'energy recovery', 'biogas', 'composting', 'landfill', 'incineration', 'energy recovery', 'biogas', 'composting', 'landfill', 'incineration', 'energy recovery', 'biogas', 'composting'.

To read more about waste management and careers in the field, visit www.ck12.org.

Magazine Features
 Each magazine feature illustrates a real-world connection to the science and technology students are learning using non-fiction text. **Awesome Science** focuses on exciting developments in science; **Science Works** examines science in everyday life and career links; **Tech Connect** has a technology focus.

Investigations and Activities

Perform an Activity

These are hands-on activities that provide students with an opportunity to perform non-experimental investigations. Students make observations and perform field studies, but are not expected to answer a testable question or develop a prediction or hypothesis.

2.4 PERFORM AN ACTIVITY

Solubility

In this activity, you will compare the solubility of ionic salts and table salt in both cold and hot water by preparing saturated solutions and taking careful measurements.

Purpose: To explore the relationship between solubility and temperature.

Equipment and Materials:

- 5 mL measuring spoon
- eye protection
- large beaker
- glass stirring rod
- thermometer
- graduated cylinder (50 mL)
- beaker (100 mL)
- balance
- spoon
- weighing paper
- electric kettle
- water
- ice cubes
- Epsom salts
- table salt

Procedure:

- In your notebook, draw a table similar to Table 1.
- Put on your apron and eye protection.
- Prepare cold water by placing some ice cubes in a glass or beaker of cold tap water and stirring until the water temperature is close to 5°C.
- Use a graduated cylinder to pour 50 mL of the ice-cold water into a 100 mL beaker.
- Measure the mass of the beaker and water on a balance and record the mass in Table 1.
- Scrap approximately 20 mL of Epsom salts onto a weighing paper.
- Place a small amount of the Epsom salts (enough to fit on the end of a spoon) in the water. Stir until all the crystals have dissolved.

Table 1: Analysis of Observations

Temperature (°C)	Mass of Beaker + Water (g)	Mass of Beaker + Saturated Solution (g)	Mass of Solute (g)	Volume of Solution (mL)	Concentration (g/100 mL)
5					
20					
35					
50					

Equipment and Materials

Activities include photos of equipment and materials to support visual learners and English Language Learners.

Conduct an Investigation

Students develop science process skills through an investigation that involves predicting, hypothesizing, experimentation, controlling variables, and fair testing. Students use the results of the experiment to answer a testable question.

1.3 CONDUCT AN INVESTIGATION

Testing the Particle Theory

In this investigation, you will explore what happens to the mass of a sample of matter when it changes state. You will also explore what happens when two samples of matter are added together. You will use the particle theory to explain your observations.

Testable Questions:

Part A: What happens to the mass of a solid when it melts?

Part B: How does mixing a solid and a liquid together (until the solid dissolves) affect the total mass of the mixture?

Hypothesis/Prediction: Write a hypothesis for each of the Testable Questions. Each hypothesis should include a prediction as well as a reason for your prediction based on the particle theory.

Experimental Design:

Part A: You will take measurements to compare the mass of a sample of frozen water with the mass of the same sample when it is liquid.

Part B: You will take measurements to compare the actual mass of a salt-and-water mixture with the predicted mass.

Equipment and Materials:

- eye protection
- eye apron
- beaker (100 mL)
- 100 mL graduated cylinder
- 5 L ice cubes
- water
- 20 g of salt
- eye protection
- spoon
- large beaker
- glass stirring rod
- thermometer
- graduated cylinder (50 mL)
- beaker (100 mL)
- balance
- weighing paper
- electric kettle
- water
- ice cubes
- Epsom salts
- table salt

Safety Precautions

Students are warned about potential safety hazards with a STOP icon and warnings in red type.

Explore an Issue Critically

These activities address STSE expectations by allowing students to examine and take action on social and environmental issues related to the content of the unit.

1.7 EXPLORE AN ISSUE CRITICALLY

Using Compact Fluorescent Light Bulbs

Pure substances and mixtures affect the world around you. Using pure substances and mixtures involves both benefits and costs. A benefit is a good or positive result. A cost is a bad or negative result. Some pure substances are harmful to the environment or to human health. Some mixtures contain pure substances that could pollute the air, soil, or water. Often, a mixture or product containing a mixture has both benefits and costs associated with it. For example, compact fluorescent light bulbs (CFLs) use much less energy than incandescent bulbs (Figure 1). However, CFLs contain a mixture of gases and mercury—a toxic pure substance that can pollute the environment when the bulb is thrown away (Figure 2). Are the benefits of using CFLs worth the cost?

Figure 1: A compact fluorescent light bulb (CFL).

Figure 2: Heavy metals, such as mercury, are poisonous and are toxic.

The Issue: The town council of a small Ontario town is having a meeting to discuss whether to promote the use of energy-saving CFLs and how to handle the disposal of CFLs. You are a concerned resident in the town. You and a small group of teenagers have been asked by the town council to research these issues. Your group has been asked to summarize your research and present it at the town council's next meeting. You are also expected to recommend a position on each issue.

To prepare for the meeting, you will research the benefits and costs of using CFLs in place of incandescent light bulbs. You should also research the disposal options for CFLs.

Solve a Technological Problem

These activities require students to develop, test, and implement a device, model, technique, or approach. Students use the technological problem-solving process to solve practical problems.

3.3 SOLVE A TECHNOLOGICAL PROBLEM

Separating Recyclables

We are all being asked to reduce the quantity of waste that we produce. Recycling programs are separating various materials. Recyclable materials are generally brought to a recycling depot all mixed together. The various parts must be separated before the materials can be turned into new, useful objects. How are the parts separated? Your challenge is to design and test equipment to separate a mixture of recyclable materials.

Scenario: Your school administration has asked your class to suggest ways to sort mixed recyclable materials. You will work in teams. You will be shown a sample of the kinds of materials that will be in the mixture. Each team will design and test their own separator, or series of separators.

Design Brief: Your challenge is to (a) plan a process, and then to (b) design, build, and test a separator for mixed recyclable materials. Your process should be efficient, with as few steps as possible. It should also have the least possible impact on the environment.

Research and Consider: Discuss, in your group, how to address the challenge. What separation methods would be most appropriate? What steps are required? What equipment and materials will you need? Do these supplies you need to research?

Plan and Construct:

- Write a detailed plan for processing the recyclable materials.
- Draw a flow chart to illustrate how your separator will work. (A sample flowchart is illustrated in the Tech Content on the previous page.)

Test and Modify: Using a sample of the recyclable mixture, test your separator. Does it meet the Design Brief? Make any necessary changes. Repeat your separator until it efficiently separates the mixture into the various categories, which you should collect in different containers.

Evaluate: Did your separator separate the mixture of recyclable materials as required? How could it be improved? How could it be made more efficient? How could it be less damaging to the environment?

Communicate: Create a poster about your separator. Include a large, labelled diagram, with notes on how the separator works. Explain why your design is efficient and why it has little negative impact on the environment.

Skills Menu

The Skills Menu identifies science process skills required for the activity. These skills are supported in the Skills Handbook.

Chapter Summary and Review Material

Looking Back

These statements review the Looking Ahead key concepts and skills from the Chapter Opener and elaborate on them.

Vocabulary

This list of terms is provided as a summary with page references for quick review.

Chapter Summary

This is a student study guide that consolidates what they have just learned in the chapter. It connects to and extends from the Chapter Opener.

Big Ideas

The Big Ideas addressed in the chapter are checked off.

Chapter Review

Questions are organized according to Bloom's Taxonomy and tagged according to the Science and Technology Achievement Chart categories. Questions range from lower order to higher order.

Self-Quiz Icon

There is an online self-assessment tool for each chapter on the Nelson Science website. The self-quiz provides immediate feedback to the student.

Unit Review Material

Unit Task

A culminating activity engages students and provides an opportunity to apply and extend their new learning. Students can demonstrate their learning in a variety of ways by being given a choice of product or task where possible.

UNIT A
Unit Task

Test a Sample of Industrial Waste

At the beginning of Chapter 1, you read about an environmental scientist testing the water in a river for contaminants—pure substances and mixtures that should not be there. Scientists use these tests to help stop pollution and to protect plants and animals living in natural ecosystems (Figure 1).

You will determine whether the factory waste contains pollutants that might be harmful to local wildlife. You will also suggest how the factory could remove these pollutants from its water before letting the water run into the river. Finally, you will consider the costs and benefits of your experiment.

Equipment and Materials
Several identical samples of contaminated river water are available for you to work with. Choose the equipment and materials for your procedure, including safety equipment.

Research and Consider
Examine the mixture and think about the characteristics of the components of the mixture. If necessary, place the mixture under bright light or stir it to explore its components further. You may want to use a magnifying glass.

Plan and Construct
1. Plan how you will separate a sample of the mixture into its components. Assume that the mixture may have components that you cannot see. You may choose to use the technique shown in Figure 2.

Figure 1 The environmental scientist is taking a sample of water to be tested.

Figure 2 The technique for removing water from a mixture.

Write a detailed procedure. You may use a flow chart.

3. Have your teacher check and approve your procedure.

4. Assemble your equipment and materials, and perform your procedure. Record your observations.

Test and Modify

- Did your procedure separate all possible components of the mixture?
- Should you change the sequence of steps in your procedure?
- Can you reduce the number of steps in your procedure?
- If necessary, modify your procedure and try it again.

Evaluate
Compare how well your procedure meets the requirements of the Design Brief.

- How well were you able to separate all of the components of the contaminated river water?
- What were the components?
- What characteristics of the components did you use to separate them?

Communicate
Draw a detailed flow chart showing all the steps that you used to separate the mixture's components. This should be an expansion of the one you created for Plan and Construct. Label each step with the following information:

- the separation method that you used
- the components that you obtained
- the characteristics of the components that allowed you to separate them from each other

Indicate, on your flow chart, which components may have been damaging to the environment, and how they should be removed from the factory's waste.

Present your findings in the form of a poster, report, or oral presentation.

Assessment

You will be assessed on how well you:

- identify characteristics of components that allow separation
- plan a procedure to separate the components that is
 - safe
 - efficient
 - affordable
- make any necessary changes to the procedure and Plan and Construct
- communicate what has been done to a flow chart
- identify dangerous components
- research a technique for removing dangerous components from the factory's waste
- test the procedure as planned

Assessment Box
The assessment criteria provided to students in the Unit Task Preview are expanded here.

Unit Review

Review questions allow students to demonstrate their understanding of and ability to apply key ideas, vocabulary, and skills. Questions are categorized according to Bloom's Taxonomy and labelled according to the Science and Technology Achievement Chart categories.

Make a Summary

A consolidation activity requires students to work together to create their own summary of their learning in the unit. This is an opportunity for both review and self-assessment.

UNIT A
Unit Review

Pure Substances and Mixtures

Make a Summary
Figure 1 shows the start of a concept map. Copy this onto the center of a large piece of paper. Work with a partner or small group to complete the concept map. Try to include all the vocabulary terms in this unit. The concept map should include explanations for the connections between terms.

Figure 1 Make a concept map starting with these terms.

Unit A Review Questions

What Do You Remember?

- Write a definition of matter.
- What is matter made of?
- Write, in your own words, the five main ideas of the particle theory.
- What is the difference between the particles of a solid and the particles of a liquid?
- What are the three states of matter?
 - Use the particle theory to describe each of the three states of matter.
- What is the difference between a pure substance and a mixture?
 - Give one example of each.
- Name the two types of mixtures and explain how they are different.
 - Give one example of each.
- Can you tell if a sample of matter is a pure substance or a mixture by looking at it? Explain why or why not.
- Name two substances that separate mixtures.

10. Can you tell if a mixture is a mechanical mixture by looking at it? Explain.

11. Identify each of the following kinds of matter as a pure substance, a mechanical mixture, or a solution.

- salt
- steel
- clear shampoo
- table sugar
- 14-karat gold
- oil

12. Draw a dot between homogeneous mixtures and a heterogeneous mixture.

13. Is air a solution or a pure substance? Explain your answer.

14. (a) What is the difference between a white and a white? (b) Give one example of each.

15. Draw a model that shows the particles of a gas. Explain your model.

16. Is a piece of paper a solid, a liquid, or a gas? Explain your answer.

17. List three different ways pollutants get into the river system.

18. (a) List three solutes in your house. (b) What is the solvent of each solution?

19. Detergent soap, "solutions" can be solids, liquids, or gases? Do you agree? Explain.

20. Describe what happens to the sewage that goes down your drain and toilet before it is released into the environment.

21. (a) Aluminum foil is a solid pure substance. Draw a model of the particles of a piece of aluminum. (b) It is not a solid solution. Draw a model of the particles of a piece of brass.

22. Distilled water is a pure substance. (a) Draw a model showing the particles of liquid distilled water. (b) Draw a model showing the particles of cold distilled water.

23. You dissolve 10 mL of sugar in 30 mL of water. The final volume is less than 40 mL. Use the particle theory to explain this observation.

24. Salt does not dissolve well in oil. The salt tends to settle to the bottom of the container. (a) What kind of mixture is this? (b) Draw a model showing the particles of a mixture of salt and oil.

What Do You Understand?

25. Describe one way to separate each of the following mixtures into its components. Describe the characteristics that make each separation possible. (a) iron filings and sand (b) sugar and water (c) tea leaves and water

26. (a) What methods does a flour mill use to separate wheat grain from other kinds of matter? (b) What method does a flour mill use to separate the different parts of the wheat grains when they are ground?

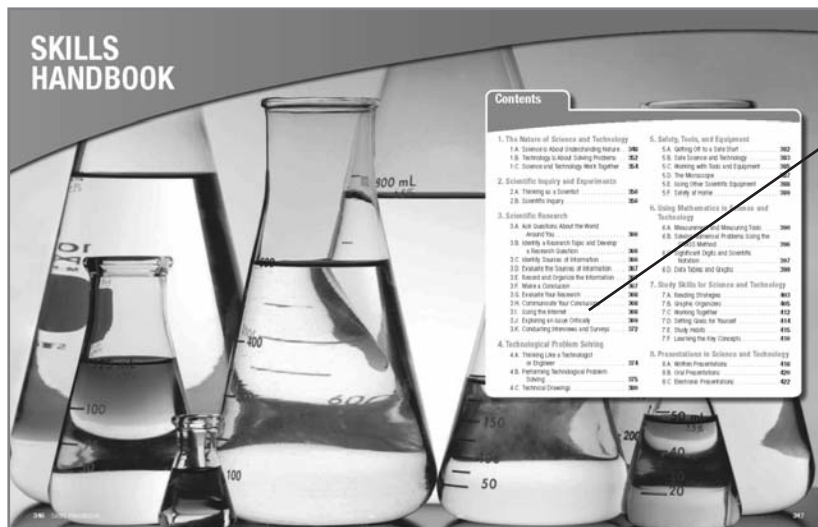
27. Use the particle theory to explain each of the following observations: (a) Sugar dissolves in water even if you do not stir or heat the mixture. (b) Stirring or heating makes a sugar dissolve in water faster. (c) You add a drop of red food coloring to a glass of water. You do not stir the mixture, but the food-coloring spreads throughout the water.

28. Give one reason why someone might want to separate a mechanical mixture.

29. "Pure orange juice" may contain water, pieces of orange pulp, sugar, vitamins C, potassium, protein, and fennel particles. (a) Is pure orange juice a pure substance, a mechanical mixture, or a solution? (b) Suggest two methods that could be used to separate some of the components of orange juice.

30. A hot oil droplet in a glass of water. Draw a picture of what the solution actually looks like, and then draw a model of the particles of the solution.

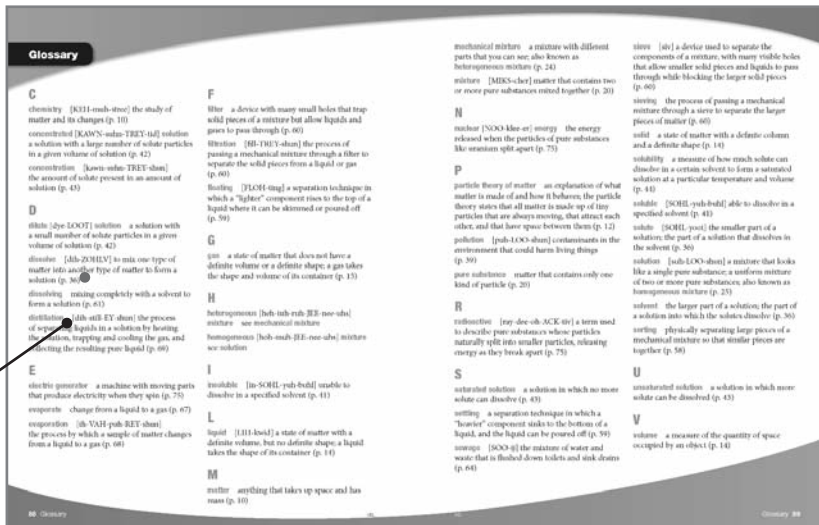
Reference Material



Skills Handbook
 The Skills Handbook is a reference tool to help students develop skills and understanding. Short Practice activities provide students with extra practice in developing certain skills. The Skills Handbook is cross-referenced in the Student Book with an icon that lists the section of interest for students.

Glossary
 This is a list of all vocabulary terms in the book in alphabetical order. The page on which the term first appears is provided at the end of each definition.

Pronunciation Key
 Keys are provided for words that are difficult to read or pronounce.



TEACHER RESOURCE QUICK TOUR

Every unit will have the following features to support student learning and teacher instruction and assessment.

At the Unit Level. . .

UNIT OVERVIEW

Introductory paragraphs provide a broad overview of the unit and summarize what students will be learning. Within the Unit Overview, teachers can find the following:

- Time expectations for completing the Unit.
- A chart summarizing the Fundamental Concepts and Big Ideas for each unit, correlated with each chapter of the Student Book.
- Curriculum Correlation charts correlating the Overall and Specific Expectations with each section of the Student Book.

The Unit Introduction follows the Equipment and Materials list and includes teaching notes and

suggestions for starting the unit. Teaching Notes include suggestions for the following features:

- Unit Preview
- Discover Science and Technology (Before, During, and After Reading, as well as Literacy

strategies)

- Let's Get Started
- Unit Task Preview
- Differentiated Instruction
- English Language Learners (ELL)

Unit Planning Chart

Use the Unit Planning Chart to preview important planning and assessment considerations for each section. In addition to an overview of the key terms, activities and skills, literacy links, and program resources, you will find a list of assessment and evaluation opportunities as well as the relevant Achievement Chart categories covered in each section in the unit.

UNIT PLANNING CHART – CHAPTER 1			
Section	Key Terms	Hands-on Activities and Skills	Literacy Links
Unit A Opening Material 15-20 min		Let's Get Started: Components of a Bicycle Race	Reading a Timeline
Chapter 1 Introduction Introducing Systems 10-20 min			Inferring from Pictures
1.1 Types of Systems 45-60 min	system physical system social system		Scanning
1.2 System Components 45-60 min	force input output side effect systems thinking		Reading a Table

Assessment/Evaluation Opportunities	Achievement Chart Categories*	Program Resources
<ul style="list-style-type: none"> • Completing a mind map • Assessment of prior knowledge and possible misconceptions 	K/U C	2H's Safety, Tools, and Equipment Nelson Science & Technology 8 website www.science.nelson.com
	K/U T/I C	BLM 0.0-0.6 Three-Column Table BLM 1.0-1.1 Types of Systems WS 1.1-2 Looking for Systems Nelson Science & Technology 8 website www.science.nelson.com
<ul style="list-style-type: none"> • Writing assignment systems in real life • Reading and Answering questions 	K/U T/I C	BLM 0.0-0.7 Four-Column Table WS 1.1-1.2 Types of Systems WS 1.2-2 Looking for Systems Assessment Rubric 1: Knowledge and Understanding Assessment Rubric 2: Communication Nelson Science & Technology 8 website www.science.nelson.com
<ul style="list-style-type: none"> • Poster and presentation assignment • Reading and answering questions 	K/U T/I C	BLM 0.0-0.7 Four-Column Table BLM 1.0-1.1 Types of Systems BLM 1.2-2 Examining Your School as a System WS 1.2-2 Looking for Systems WS 1.2-2 Taking Systems Apart Assessment Rubric 1: Knowledge and Understanding Assessment Rubric 2: Communication 2H's Safety, Tools, and Equipment Nelson Science & Technology 8 website www.science.nelson.com

Equipment and Materials

This table lists all the activities in the Student Book and the quantities for each equipment and materials item. Quantities reflect the groupings for each activity suggested in the specific sections.

EQUIPMENT AND MATERIALS

The quantity of equipment and materials required for the activities and investigations is based on the groupings suggested in the specific sections. The quantities listed are based on a standard class size of 32 students per class, broken down into pairs of students or groupings of four students. Where the term "quantity" is inappropriate, such as for a piece of tubing, masking tape, and so on, you will have to check the individual activity or investigation to obtain appropriate quantities. In the table below, "Equipment" refers to actual equipment or hardware (such as microscopes, metre sticks, glassware, etc.), and "Materials" refers to consumable items (such as chemicals, tape, water, or paper).

Most of the equipment and materials included in this list may be ordered from **Boreal Northwest Ltd.**, www.boreal.com (phone 1-800-387-9393 or fax 1-800-668-9106).

Investigation/Activity	Quantity	Equipment	Materials
1.3 Perform an Activity: Examining Physical Systems	1	<ul style="list-style-type: none"> • round-tipped scissors • nutcracker • flatfile 	
Student groupings: 8 groups of 4 students	1	<ul style="list-style-type: none"> • wind-up toy • hammer and board with nail partially embedded • salad tongs • adjustable wrench • portable hair dryer • musical instrument • microscope, cordless, LED, 4 × 10 × 40 	• other materials
1.4 Try This: A School Litter Management System	8	<ul style="list-style-type: none"> • map of school and school grounds 	• lined paper/notebook

At the Chapter Level. . .

Looking Ahead and Vocabulary

This table lists the Looking Ahead statements as well as the Vocabulary words found in the chapter of the Student Book.

Possible Misconceptions

This feature appears when concepts within the chapter or section are often misunderstood by students. Suggestions for identifying and clarifying students' understanding of these concepts are provided.

Skills and Processes

This is a checklist of the skills and processes addressed in each section of the chapter.

CHAPTER 1
Introducing Systems

POSSIBLE MISCONCEPTIONS

- Identify: Students may think that all systems are mechanical, and that only information systems, computer systems, and systems work with systems.
- Clarify: Have students look at the headings and photographs in the chapter to see examples of systems. Point out that a system is any group of parts that function together, and that we all interact with many different systems every day.
- Ask: *What They Think About*: At the end of the lesson ask, *What are some examples of systems that are not mechanical?* (employees working at a music store; the students, teachers, and administrators in a school; the performers and director of a school band; the bees in a colony)

Looking Ahead

Systems are composed of parts that work together to perform a function.

Systems may be physical (for example, telephones, electronic games, or organ systems) or social (for example, health care, transportation, education, justice force, or art and culture).

Systems have inputs, outputs, and side effects.

The role of systems can be used to study the inputs, outputs, and side effects of everyday systems.

The way we use systems affects society and the environment.

Vocabulary

output
side effect
system thinking
consumption

system
physical system
social system
force
input

TEACHING NOTES

- As an introduction to systems, have students look at the large Chapter Opener photos found on the first page of the chapter.
- Ask: *What is shown in the photograph?* (The photograph shows the gears on a bicycle.)
- Ask: *How do gears function with other parts of a bicycle to enable the bicycle to move?* (Pushing on the pedals turns the forward gear. The chain around the forward gear pulls on the rear gear, which turns the rear wheel and causes the bicycle to move.)
- Ask: *What would happen if any part of the bicycle did not function as it is supposed to?* (The bicycle would probably not move smoothly, and it may not move at all.)
- Have students read the **Key Question** on the chapter opener page. Encourage them to suggest answers to the question, and discuss others' suggestions.
- Have students read the **Looking Ahead** statements on the chapter opener page.
 - Ask: *Give an example of a system.* (The different parts work together to make the bicycle move.)

Reading Science and Technology

- This photo essay challenges students to go beyond a casual glance in order to gain a deeper understanding of how photos can help us infer additional information about the text.

Before Reading

- Have students look at the photos on the page. Encourage them to think about the different parts that make up the objects or scenes in each picture.

During Reading

- Explain to students that inferences are conclusions we make about a text that are not directly stated in that text. We can do make inferences about the figures that are present in a text. We do this by asking ourselves why the author included those specific figures, and how those figures are related to us to support the information in the text.
- Have students practice inferring from pictures by working through the activity the **Linking to Literacy** box in the Student Book. Have students read the instructions silently to themselves. They work through the first picture together as a class. Ask: *What is the main purpose that events serve in our society?* (They decide whether people are guilty of doing something wrong, and determine the appropriate punishment.) Ask: *What makes companies, or parts, do events continue that help them fulfill their purpose?* Explain that

Skills and Processes

	1.1	1.2	1.3	1.4	1.5
 inquiry Skills					
Observing					
Representing					
Predicting					
Planning					
Controlling Variables					
Performing					
Observing					
Analyzing			✓	✓	
Communicating					
 Decision-Making Skills					
Defining the Issue					
Researching					
Identifying Alternatives					
Analyzing the Issue					
Defining a Decision					
Communicating					
Evaluating					

Related Resources

Thurston, Martin. *Although Possible and Other Canadian Geography News Reportage*. Vancouver, University of Ottawa Press, 2007.

City Science and Technology 8 Curriculum Assessment Bank: City Science and Technology 8 Interactive Tools (2012). Nelson CN Science and Technology 8 website. www.science.nelson.com

Related Resources

Look for this feature in each section to find sources of additional science information, as well as related Ontario Science and Technology resources available from Nelson.

Teaching Notes

Provided here are suggested ways to activate students' prior knowledge, motivate thinking, and develop an understanding of the concepts in the chapter using features in the Student Book.

Reading Science and Technology

Here you will find teaching notes with Before, During, and After reading suggestions for the Reading Science and Technology feature found at the beginning of each chapter, as well as support for the Linking to Literacy activity that is part of each chapter narrative.

Solved Practice Problems

Solutions to the Practice Problems found in the Student Book are provided within the Explore and Explain subhead of the Teaching Notes. The solutions follow the GRASS method that students should be using to solve numerical problems.

Try This

Support for any Try This activities that appear in the Student Book is provided within the Explore and Explain subhead of the Teaching Notes.

Practice Problem 1: Determine Mechanical Advantage of a Wheelbarrow—Solutions

Given: effort arm length = 1.8 m
load arm length = 0.30 m

Required: mechanical advantage (MA)

Analysis: $MA = \frac{\text{effort arm length}}{\text{load arm length}}$

Solution: $MA = \frac{1.8 \text{ m}}{0.30 \text{ m}}$ $MA = 3.6$

Statement: The wheelbarrow has a mechanical advantage of 3.6.

Practice Problem 2: Determine Mechanical Advantage of a Pulley System—Solutions

Given: input distance = 4 m
output distance = 1 m

Required: mechanical advantage (MA)

Analysis: $MA = \frac{\text{input distance}}{\text{output distance}}$

Solution: $MA = \frac{4 \text{ m}}{1 \text{ m}}$ $MA = 4$

Statement: The mechanical advantage of pulley system is 4.

Practice Problem 3: Determine Actual Mechanical Advantage of a Lever—Solutions

Given: measured input force = 37 N
measured output force = 185 N

Required: actual mechanical advantage (MA)

Analysis: $MA = \frac{\text{measured output force}}{\text{measured input force}}$

Solution: $MA = \frac{185 \text{ N}}{37 \text{ N}}$ $MA = 5.0$

Statement: The actual mechanical advantage of the lever is 5.0 (using two significant digits).

Practice Problem 4: Determine Actual Mechanical Advantage of a Pulley System—Solutions

Given: measured input force = 10 N
measured output force = 48 N

Required: actual mechanical advantage (MA)

Analysis: $MA = \frac{\text{measured output force}}{\text{measured input force}}$

Solution: $MA = \frac{48 \text{ N}}{10 \text{ N}}$ $MA = 4.8$

Statement: The actual mechanical advantage of the pulley system is 5 (using one significant digit).

TRY THIS: MECHANICAL ADVANTAGE OF A LEVER

Purpose

- Students will determine the ideal and actual mechanical advantage of a lever.

Notes

- Refer students to Skills Handbook section 8.A, Measurements and Measuring Tools to review the proper method for measuring length and measuring weight with a spring scale. Students can also refer to Skills Handbook section 8.C.1, Copying a Sketch for help with sketching lever arrangements.
- Ensure that the students have set up a class lever. Use a fulcrum to get up the right angle of a wheelbarrow as in the book.
- Students can find the ideal mechanical advantage by using the formula $MA = \frac{\text{input arm length}}{\text{output arm length}}$.
- If time is available, allow students to try different arrangements of this class 2 lever or to try a class 3 lever.
- Encourage students to think about any possible sources of error in their measurements and report these in their conclusions.

Sample data:

input arm length	0.25 m
output arm length	0.10 m
input force	4.0 N

Ideal mechanical advantage = $\frac{\text{input arm length}}{\text{output arm length}} = \frac{0.25 \text{ m}}{0.10 \text{ m}} = 2.5$
Actual mechanical advantage = $\frac{\text{measured output force}}{\text{measured input force}} = \frac{10.0 \text{ N}}{4.0 \text{ N}} = 2.5$

Expected Answers

- Sample answer: The actual mechanical advantage was slightly less than the ideal mechanical advantage because of the friction between the fulcrum in the system that may be negligible. Small differences may be attributable to errors in reading the spring scale and the force scale.
- Sketches should resemble the sketch below.

Class 2 Lever

Check Your Learning

Suggested answers to the Check Your Learning questions are provided for each section.

Differentiated Instruction

Found throughout this Teacher Resource, this feature includes practical suggestions that are specific to the needs of students who require extra support in understanding concepts, or of students who require extra challenge. These include suggestions for alternative ways to record evidence of learning and extension of material covered in the section. You will also find a reference to relevant material in the Student Success Workbook.

Linking to Literacy

This feature suggests ways in which teachers can encourage students to use the Linking to Literacy features in the Student Book to better access information in a particular section. This feature appears in sections where a Linking to Literacy strategy is found in the Student Book.

Have students complete the Check Your Learning questions.

CHECK YOUR LEARNING—SUGGESTED ANSWERS

1. See Sample answer. This diagram can include two of waves and the correct number of molecules. The wave is a pulse. The term pulse is not used in the text.

2. Sample answer: I think out of the wheel and axle system that I think is the best because it allows me to get a lot of force when I use the wheel and axle system. The load force is the force that the input force must overcome in order to lift the load. The load force is the force that the input force must overcome in order to lift the load.

Simple machine	Example	How workers use it to make life easier
inclined plane	ramp	allows workers to move heavy objects up and down
wedge	axe	allows workers to split wood
lever	crowbar	allows workers to lift heavy objects
gear	gears in a car	allows workers to move heavy objects
wheel and axle	axle in a wheel	allows workers to move heavy objects
pulley	block and tackle	allows workers to lift heavy objects

Reading a Diagram

- Explain to students that diagrams are drawings of things that are described in the text. Reading diagrams involves looking back and forth between the text and the diagram. They may appear in the margin or in the main text.
- Have students read the diagram by reading the text first and then the diagram. Ask: What does the diagram tell you about the text? (The first is used to move heavy objects. The second is used to move heavy objects. The third is used to move heavy objects. The fourth is used to move heavy objects. The fifth is used to move heavy objects.)

Visuals

- Explain to students that visualizing is creating pictures in our mind about what we are reading.
- Read the word "lever" and show with students the picture that comes to your mind. For example, see the picture of a lever in the Student Book. Ask: What does the picture tell you about the word "lever"?
- Have students practice visualizing by asking them to describe what they imagine when they read or hear the words "wheel and axle," "gear," and "pulley."

Class 2 Lever

English Language Learners

Look for this feature to find teaching suggestions aimed at helping English language learners understand concepts or complete activities.

Labelled Diagrams

- Explain to students that labelled diagrams typically combine information in captions with key terms and labels in the diagram. Labelled diagrams in general, reading labelled diagrams involves moving back and forth between the labels and the information in the surrounding text.
- Have students read the diagram by reading the text first and then the diagram. Ask: Why do you think the labels are placed in the diagram? (They are important parts of the diagram but they may be unfamiliar to English learners. If you can see the labels, you can see the diagram.)

Collaborative Activities

Extra Support

- Bring in or create examples of simple machines to demonstrate to students how they make certain tasks easier. The lever, ramp and wheel and axle are the easiest to find and to demonstrate. Have students observe the difference the machine makes.
- Students who need extra support in reading and understanding the concepts presented in this section will benefit from the alternative reading selection and answer activities found in the Student Success Workbook.
- ES 2.1.1 Physical Science: Simple Machines
- ES 2.1.2 Analyzing Simple Machines

Extra Challenge

- Have students read each early use of machines and write a brief report on how one ancient culture used machines to make work easier.

ELL

- Provide English language learners with several copies of *ESM 0.9.11 Science Like You* to help them build their vocabulary and understand the concepts in the section.
- A similar option is to help English language learners build their vocabulary and understand the concepts in this section by using the *ESM 0.9.11 Science Like You* graphic organizer. The chart can be easily adapted to follow the *ESM 0.9.11 Science Like You* graphic organizer by adding the lower two boxes, change examples of the vocabulary words change "formal" to "informal Characteristics," and have students list several characteristics that distinguish the vocabulary word from other objects in class.

EVIDENCE OF LEARNING

What to Look For

- Students can identify a simple machine.
- Students can explain the simple machine, give examples, and explain how they work.
- Students can describe the simple machine in the text of the text and give simple machines.

Class 2 Lever

Evidence of Learning

This feature tells teachers what students should know and be able to do after completing the section.

Investigations and Activities. . .

Teaching Notes

Teaching Notes for investigations and activities include information about things that can go wrong, tips, alternate equipment, and tasks that students may need help with. Subheadings correspond to those found in the Student Book, and they focus on the science of the activity and the results that students should observe.

Student Safety

Student Safety boxes highlight safety concerns and cautions that both the teacher and student should be aware of.

Related Resources

Science, Technology, Engineering, and Other Student Resources
 Nelson ON Science & Technology 8 website
www.science.nelson.com

TEACHING NOTES

Student Safety

- Although the materials used in this investigation are not dangerous, they can cause injury if misused. Caution students against any behaviour that is not part of the investigation.

Assessment Opportunities

This may continue with parts of students in the development of suitable hypotheses, and record assessment comments in your assessment journals regarding student development of hypothesis-writing skills.

Equipment and Materials

Have an assessment matrix and a number of worksheets available for students to use. You may wish to assign a specific mass or number of weights to each group.

3.4 Conduct an Investigation: Examining Efficiency

OVERALL EXPECTATIONS

- investigate an understanding of different types of systems and the factors that contribute to their use and efficiency operation.

SPECIFIC EXPECTATIONS

Developing Investigation and Communication Skills

- follow established safety procedures for working with apparatus, tools, materials, and electrical systems
- use technological problem-solving skills to investigate a process that performs a function or meets a need
- use appropriate science and technology vocabulary including "mechanical advantage," "input," "output," "friction," "force," and "efficiency" in oral and written communication

Understanding Basic Concepts

- understand and use the formula work = force \times distance ($W = F \times d$) to establish the relationship between work, force, and distance moved parallel to the force in simple systems
- explain why in which mechanical systems produce heat, and describe ways to make these systems more efficient

SCIENCE BACKGROUND

How We Use Pulleys

- Of the ten ancient wonders, the crane is probably the one that could be made by the hand of man. It is the crane that has changed the face of the world. At least that's what the ancient Greeks would tell you. However, cranes have three types of simple pulleys from the crane to the crane.
- The most common use of pulleys are for moving heavy objects. The crane is used to move objects around factories.
- Some cranes are on tracks to get the job done. For example, some cranes are on a set of wheels that run on a set of rails. These cranes are used to move heavy objects around a factory. They are used to move heavy objects around a factory. They are used to move heavy objects around a factory.

Investigation Summary

A margin box summarizes the time needed to complete the investigation, as well as the skills and processes that are addressed in the investigation. Lesson materials and program resources are also included.

Procedure

- Use the data refer students to Skills Handbook section 4.C: Technical Drawings.
- Sample sketch of a single fixed pulley system

Table 1 Mechanical Efficiency of a Single, Fixed Pulley System

Input Force (N)	Output Force (N)	Distance moved by input (m)	Distance moved by output (m)	Work input (J)	Work output (J)	Efficiency (%)
1.0	0.7	0.2	0.2	0.2	0.14	70
2.0	1.4	0.2	0.2	0.4	0.28	70
3.0	2.1	0.2	0.2	0.6	0.42	70

Analyze and Evaluate

(a) If work input = force \times distance = $2.0 \text{ N} \times 0.2 \text{ m} = 0.4 \text{ N}\cdot\text{m}$ (trial #1)
 work input = force \times distance = $4.0 \text{ N} \times 0.2 \text{ m} = 0.8 \text{ N}\cdot\text{m}$ (trial #2)
 work input = force \times distance = $6.0 \text{ N} \times 0.2 \text{ m} = 1.2 \text{ N}\cdot\text{m}$ (trial #3)
 work output = force \times distance = $1.0 \text{ N} \times 0.2 \text{ m} = 0.2 \text{ N}\cdot\text{m}$ (trial #1)
 work output = force \times distance = $2.0 \text{ N} \times 0.2 \text{ m} = 0.4 \text{ N}\cdot\text{m}$ (trial #2)
 work output = force \times distance = $3.0 \text{ N} \times 0.2 \text{ m} = 0.6 \text{ N}\cdot\text{m}$ (trial #3)
 efficiency = $\frac{\text{work output}}{\text{work input}} \times 100\% = \frac{0.2 \text{ N}\cdot\text{m}}{0.4 \text{ N}\cdot\text{m}} \times 100\% = 50\%$ (trial #1)
 efficiency = $\frac{\text{work output}}{\text{work input}} \times 100\% = \frac{0.4 \text{ N}\cdot\text{m}}{0.8 \text{ N}\cdot\text{m}} \times 100\% = 50\%$ (trial #2)
 efficiency = $\frac{\text{work output}}{\text{work input}} \times 100\% = \frac{0.6 \text{ N}\cdot\text{m}}{1.2 \text{ N}\cdot\text{m}} \times 100\% = 50\%$ (trial #3)

(b) Sample answer: The observations supported my hypothesis. The observations showed that as the load force increased the mechanical efficiency of the system decreased.

(c) Sample answer: I would have liked to repeat the trial over more time. I am not certain we took careful measurements of the distance the string moved. A different measurement will affect our calculation of the work and the efficiency.

Investigation Summary

A margin box summarizes the time needed to complete the investigation, as well as the skills and processes that are addressed in the investigation. Lesson materials and program resources are also included.

Sample Data and Suggested Answers

Sample sketches and sample data are provided for all activities where applicable. Suggested answers to Analyze and Evaluate and Apply and Extend questions are also included.

Blackline Masters. . .

Reading Science BLMs

Reading Science blackline masters are provided for each of the Reading Science and Technology features in the Student Book.

Blackline Master 1.0.1
Name: _____ Date: _____

Reading Science and Technology: More Than Meets the Eye

AFTER YOU READ
Use the table below to compare the objects and scenes shown in the photo essay. Add your own example of an object or scene in the last row. Then, make inferences based on the pictures to explain how all systems are similar.

Picture in Student Book	How it is like the other pictures	How it is different from the other pictures
camera		
carcass		
coast crane		
blue box		
ambulance		

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Try This BLMs

Additional Try This activities are provided, where suitable, as blackline masters to supplement the content in the Student Book.

Blackline Master 1.2.1
Name: _____ Date: _____

Try This: Identifying and Analyzing Systems

Skills Menu: performing, observing, analyzing, evaluating, communicating

How can you identify a system? Both physical and social systems are made of parts that work together to perform a specific task. Analyzing a system means using systems thinking to decide how the parts of the system work together. How does the system affect people? How does it affect other organisms and the environment?

In this activity, you will work with a small group of students to produce a poster that identifies and analyzes four systems.

Equipment and Materials: a variety of newspapers and old magazines; scissors; glue; construction paper; poster board; coloured markers

1. Work with others in your group to look through newspapers and old magazines and identify photographs or other images of different systems. Remember that systems may be either physical or social, and they may be either natural or human-made.
2. Choose four systems to analyze. Cut out the photographs of the systems and arrange them on poster board.
3. Create a poster display that represents and describes the systems. You may include both words and images in your descriptions. You may cut out or draw the images you use.
4. Consider the following characteristics of systems as you prepare your poster:
 - the purpose of each system and the tasks it accomplishes
 - the parts and subsystems that make up each system and how they work together
 - whether each system is physical or social, natural or human-made

A. Identify the inputs, outputs, and side effects of each of the systems you chose.

B. What questions do you have for other groups about how they analyzed their systems?

C. Present your poster to the class. Explain how you used systems thinking to analyze each system.

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Chapter Quiz BLMs

A chapter quiz blackline master is provided for each chapter. The chapter quiz consists of questions and activities to assess students' understanding of the key ideas.

Blackline Master 1.2.2
Name: _____ Date: _____

Chapter 1 Quiz

Part A: Modified True/False
Indicate whether each statement is true or false. If the statement is false, change the sentence to make it true.

1. A system is a group of random objects that do similar tasks.
2. Industries consist of physical systems and social systems.
3. Systems change over time in response to changes in inputs or other conditions.

Part B: Completion
Complete each sentence given below.

4. Considering how the parts of a system work together and affect one another, other systems, and the environment is called _____.

5. All systems have _____ and _____.

Part C: Matching
Match each term in the left column with an example of the term from the right column.

6. social system	(a) construction
7. physical system	(b) jazz band
8. industry	(c) airplane

Part D: Multiple Choice
Circle the letter beside the answer that best answers the question.

9. Which of the following is the best example of a physical system?
(a) a city (b) a school (c) a hospital (d) a television

10. A scientist is studying a natural social system. Which of the following systems is the scientist most likely studying?
(a) a volcano (b) a hospital (c) a herd of deer (d) a subway train

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Sample Procedure BLMs

Sample Procedure blackline masters are provided for each of the student-directed activities and investigations in the Student Book.

Blackline Master 2.6.1
Name: _____ Date: _____

Less Work or Easier Work?—Investigating Levers: Sample Procedure

For Conduct an Investigation 2.6, you will determine whether a lever requires the amount of work required to lift an object 15 cm into the air. There are several different ways to arrange your materials into a lever. The following sample procedure suggests one possible design: a class 2 lever.

Equipment and Materials: string; scissors; standard masses or washers on a string; spring scale; ruler or metric stick; rigid piece of wood; tape; paper clips

Procedure

1. Tie a piece of string around the mass or washers. Make a small loop in one end of the string.
2. Hang the mass or washers from one end of a spring scale. Make sure the mass is not resting on anything.
3. Slowly lift the spring scale and the mass 15 cm. Lift it at a constant speed. As you lift, your partner should observe the reading on the spring scale and record the number in Table 1. This is the amount of force required to lift the mass without a lever.

Force to lift mass without lever (Step 3)	Force to lift mass with lever (Step 7)	Starting height of mass and lever combined (Step 10)	Force to lift mass and lever combined (Step 11)	Force to lift mass (Step 13)	Distance to move the lever (Step 13)	Work to lift mass without lever (Step 14)	Work to lift mass with lever (Step 14)

4. Place the piece of wood that you will use as a lever flat on the floor or on another flat surface.
5. Tie a piece of string around one end of the lever. Use tape to secure the string.

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Less Work or Easier Work?—Investigating Levers: Sample Procedure (continued)

6. Slide a paper clip through the string so that one end of the paper clip sticks up from the lever. Your design should look like the design in Figure 1.

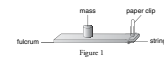


Figure 1

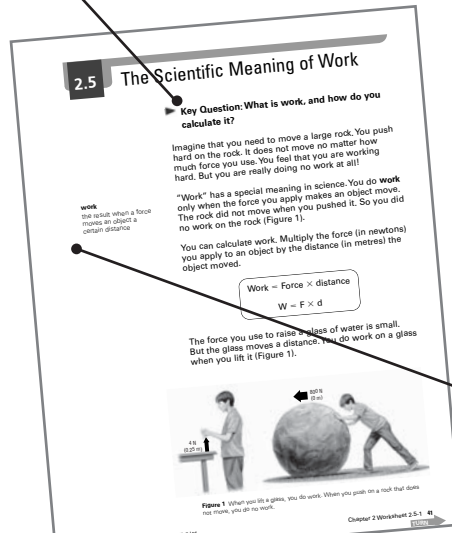
7. Attach a spring scale to the paper clip at the end of the lever. Slowly lift the end of the lever by lifting the spring scale. As you lift, your partner should observe and record the reading on the spring scale. This is the amount of force required to lift the lever.
8. Place the lever back down on the flat surface. Tape the standard mass or washers halfway between the string and the other end of the wood.
9. Measure and record the starting height of the mass and the end of the lever. Both of these numbers are equal to the thickness of the wood.
10. Repeat step 7. This is the amount of force required to lift the mass and lever combined.
11. To find the amount of force required to lift the mass, subtract the value in step 7 from the value in step 10.
12. Have your partner hold the ruler vertically next to the lever. Raise one end of the lever until the mass is 15 cm higher than it was initially. Use the ruler to measure the height of the mass.
13. As you hold the lever steady, your partner should measure the height of the end of the lever. This is the distance you have to move the lever in order to raise the mass 15 cm.
14. The amount of work required to lift the mass without the lever is equal to the force you measured in step 3 times 0.15 m. The amount of work required to lift the mass with the lever is equal to the force you measured in step 11 times the distance you measured in step 13.

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Student Success Workbook Quick Tour

Key Question

Key Questions are provided at the start of each section in the Student Success Workbook.

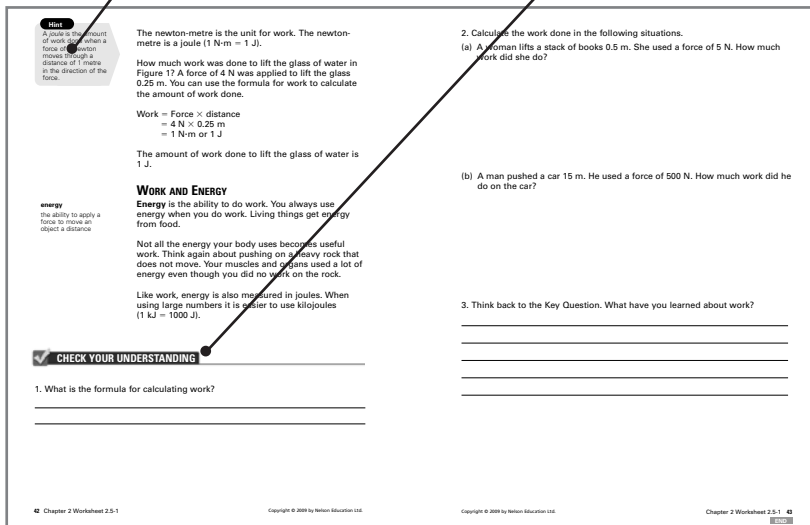


Margin Definitions

Margin Definitions from the Student Book are included in the Student Success Workbook.

Hint Boxes

Hint Boxes provide tips or reminders to help student learning.



Check Your Understanding

Check Your Understanding questions are provided at the end of each section in the Student Success Workbook.

Activity Worksheets

Activity worksheets provide extra support for understanding science concepts, and can include:

- Worked sample problems and supplemental practice problems
- Drawing and/or labeling diagrams activities
- Vocabulary definition and matching
- Crossword puzzles and other vocabulary reinforcement activities

