Table of Contents

UNIT 4 Light and Applications of Optics

Name _____ Date _____

Safety in Your Science Classroom

Use with textbook pages xii–xv.

Following these safety rules and procedures will help keep you and others safe.

Before you begin...

- Be aware of your environment. Listen carefully to instructions, know where fire extinguishers, first-aid kits, and other safety apparatus is located, and tell your teacher if you have any allergies or other conditions that may affect your work.
- Read the activity. Be sure you understand the instructions, or ask for help.
- Protect yourself. Wear lab aprons, safety goggles, and other protective clothing, as recommended. Tie back long hair and remove scarves and long necklaces.
- Set yourself up for success. Make sure your work area is clear. Gather materials safely and place them where they will not cause a hazard.

While you work...

- Do not taste anything, or draw anything into a tube with your mouth. Never smell a substance directly. Instead, waft the fumes toward you with your hand.
- Carry materials carefully. Make room for other students who may be carrying equipment.
- Handle sharp objects with care. Always cut away from yourself, dispose of broken objects with care, and let your teacher know if anything breaks or has a sharp or jagged edge.
- Respect electricity. Make sure your hands are dry when using electrical equipment, pull on the plug—not the cord—to unplug electrical equipment, place cords where people will not trip over them, and report any damaged equipment or frayed cords to your teacher.
- Protect against fire and burns. When heating an item, use heatproof containers and wear safety goggles. Point the open end of a container being heated away from you and others. If you do receive a burn, tell your teacher and apply cold water to the burn immediately.
- Read safety symbols on all materials.


Flammable and Combustible Material


Compressed Gas


Oxidizing Material


Corrosive Material


Poisonous and Infectious Material Causing Immediate and Serious Toxic Effects


Poisonous and Infectious Material Causing Other Toxic Effects


Biohazardous Infectious Material


Dangerously Reactive Material

- If part of your body comes into contact with a substance, wash it immediately and thoroughly with water. If you get anything in your eyes, wash them with water for 15 minutes and tell your teacher.
- Treat living creatures humanely and return them to their natural environment.
- Do not use power tools unless you have specialized training in using them safely.

When your work is complete...

- Clean up. Clean equipment before you put it away, and wash your hands thoroughly. Clean up spills, and dispose of materials according to your teacher's directions.

Name _____ Date _____

Safety in Your Science Classroom

Applying Knowledge

1. These 10 symbols appear in your Science Links textbook to alert you to possible dangers. Beside each symbol, write the letter of its descriptor, then write one example of what you might do when you see that symbol. One example is completed for you.


[C] Follow the teacher's instructions to dispose of leftover materials.


[ ] _____


[ ] _____


[ ] _____


[ ] _____


[ ] _____


[ ] _____


[ ] _____


[ ] _____


[ ] _____


[ ] _____

A. **Clothing Protection Safety** A lab apron should be worn.
B. **Chemical Safety** Chemicals used can cause burns or are poisonous if absorbed through the skin.
C. **Disposal Alert** Care must be taken to dispose of materials properly.
D. **Electrical Safety** Take care when using electrical equipment.
E. **Eye Safety** A danger to the eyes exists. Wear safety goggles.
F. **Fire Safety** Take care around open flames.
G. **Fume Safety** Chemicals or chemical reactions could cause dangerous fumes.
H. **Sharp Object Safety** A danger of cuts or punctures caused by sharp objects exists.
I. **Skin Protection Safety** The use of caustic chemicals might irritate the skin, or contact with micro-organisms might transmit infection.
J. **Thermal Safety** Use caution when handling hot objects.

Name _____ Date _____

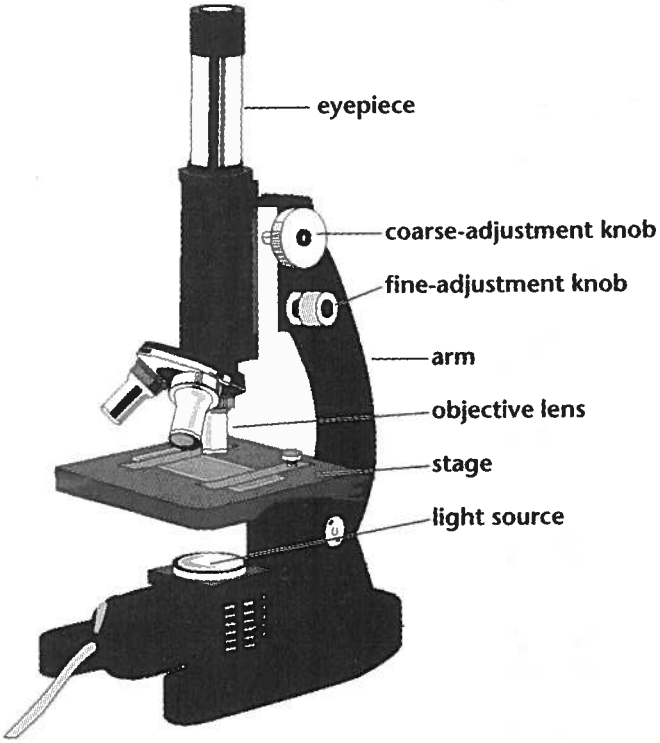
Unit 1

Using Your Appendices

Science Skills Toolkit 4: Using a Microscope

Use with textbook pages 380 to 381.

Most cells are too small to be seen with just your eyes. You need a microscope to see them. At school you use a compound light microscope.



Parts of a microscope

The eyepiece often has a magnification power of 10×. This means that an object seems ten times larger when you look at it through the lens. There are three objective lenses. Each objective lens has a different power of magnification. The low-power lens magnifies 4×. The medium-power lens magnifies 10×. The high-power lens magnifies 40×. These lenses are shown on the diagram at the right.

When you use the microscope, you are looking through two lenses at the same time — the eyepiece lens and one of the objective lenses. The magnification you see is the power of the eyepiece lens multiplied by the power of the objective lens. For example, the total magnification when using the low-power lens would be $4 \times 10 = 40\times$.

Use the coarse adjustment knob to focus an object at low power. Make sure the object is in the centre of the area you can see — the field of view. Use the fine-adjustment knob to focus on an object at medium-power and high-power to bring the object into sharper focus. If you use the coarse-adjustment knob at medium or high power you may have trouble seeing the object, and could damage the lens or the slide.

The light source shines light through the object you view. If your microscope has a mirror instead of a light, adjust the mirror to reflect light through the lenses. The diaphragm controls the amount of light reaching the object being viewed.

Troubleshooting when using a microscope

Sometimes the object you are trying to view is blurred, out of focus, or just not visible. Page 381 of your textbook lists some common problems that can occur and some strategies that may help you solve them.

Name _____ Date _____

Unit 1

Questions:

1. Complete the following table to describe your microscope.

Power of objective lens	Power of eyepiece lens	Total magnification (power of objective lens multiplied by power of eyepiece lens)
Low power: _____		4 × 10 = 40×
Medium power: 10×		
High power: _____		

2. Why should the coarse-adjustment knob be used only with the low-power objective lens?

_____

_____

_____

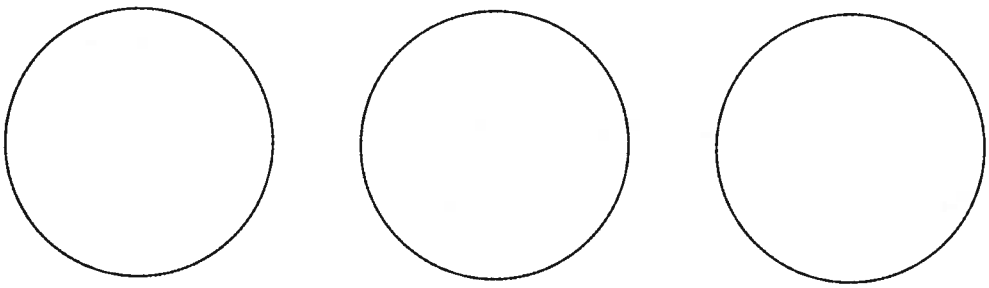
3. As you switch from low to medium power, the object being viewed sometimes appears to have disappeared. What should you do?

_____

_____

_____

4. Draw an organism that would take up half of the field of view under a compound light microscope at low power. Then draw what this organism would look like under medium and high power.



Low power Medium power High power

Name _____ Date _____

Topic **1.1** Summary

Why are cells important?

Textbook pages 8 to19

Before You Read

What is an organelle? How do organelles help cells survive?

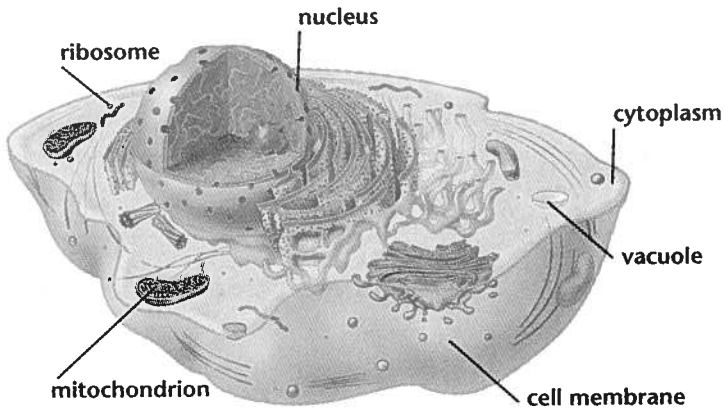
_____

_____

Studying cells helps us understand how organisms function.

By learning about cells, we can understand how to protect cells to prevent infection, observe cells to diagnose disease, and treat cells to heal illnesses.

Organelles work together to carry out life functions.



All cells contain structures called **organelles** that carry out specific roles within the cell. Some organelles of a typical animal cell are shown in the diagram. The number and type of organelles in each cell will vary depending on the role of the cell in an organism. For example, muscle cells need a lot of energy, so they have many mitochondria. As you can see in the table below, mitochondria produce energy for the cell.

Each of the organelles has a specific role in the cell.

Organelle	Function
Nucleus	Controls all the cell's activities
Mitochondria	Produce energy to power the cell's activities
Ribosomes	Help to produce proteins
Vacuoles	Store materials
Cytoplasm	fluid that supports and protects organelles that float in it
Cell membrane	surrounds, protects, and gives shape to the cell

Name _____ Date _____

Topic 1.1 Summary

Diffusion and osmosis help organisms meet their basic needs.

Cellular processes are activities that organelles perform to carry out a cell's life functions. For example, two cellular processes are involved with helping cells bring in substances that they need and removing wastes. These cellular processes are diffusion and osmosis. Both depend on the fact that the cell membrane is semi-permeable. This means that the cell membrane lets some substances move across it but not others.

Diffusion: Diffusion is one of the ways that substances are transported across the cell membrane between the external and internal environment of the cell. Diffusion is the natural movement of particles from an area of high **concentration** to an area of low concentration. For example, many cells need oxygen. Oxygen moves back and forth across the cell membrane by diffusion. When there is a higher concentration of oxygen outside the cell than inside the cell, oxygen moves from the outside to the inside across the cell membrane until there is an even distribution of oxygen outside and inside the cell.

Osmosis: The watery environment outside a cell has many substances dissolved in it. The watery environment inside a cell also has many substances dissolved in it. The concentration of dissolved substances outside the cell and inside the cell is often different. However, many of these dissolved substances cannot diffuse across the cell membrane to even out the concentrations. But water can. When the concentration of substances dissolved in water outside the cell is higher than the concentration of substances dissolved in water inside the cell, water can diffuse across the membrane until the concentrations of the watery solutions are evened out. This diffusion of water across a membrane because of concentration differences is called osmosis.

Reading Check

1. Why does a cell need different organelles?

_____

_____

_____

2. If the concentration of oxygen inside a cell is higher than it is outside a cell, which direction will oxygen move?

_____

_____

Name _____ Date _____

Cloze Activity
Topic 1.1

Use with textbook pages 8 to 19.

Why cells are important

Vocabulary		
cell membrane cells diffusion	mitochondria nucleus organelles	osmosis vacuoles cytoplasm

Use the terms in the vocabulary box to fill in the blanks. Use each term only once.

1. All living things, including plants, animals, bacteria, and fungi, are formed from one or more _____.
2. Each cell is made up of smaller components called _____.
3. In an animal cell, a _____ separates the inside of the cell from the external environment.
4. The _____ controls all cell activities.
5. Muscle cells contain _____ to release energy from glucose to fuel cell activities.
6. _____ contain water and other materials used to store or transport molecules.
7. The _____ is a fluid in which organelles float. It also protects and supports the organelles.
8. _____ is the movement of particles from an area of higher concentration to an area of lower concentration.
9. _____ is the diffusion of water through a membrane.

Name _____ Date _____

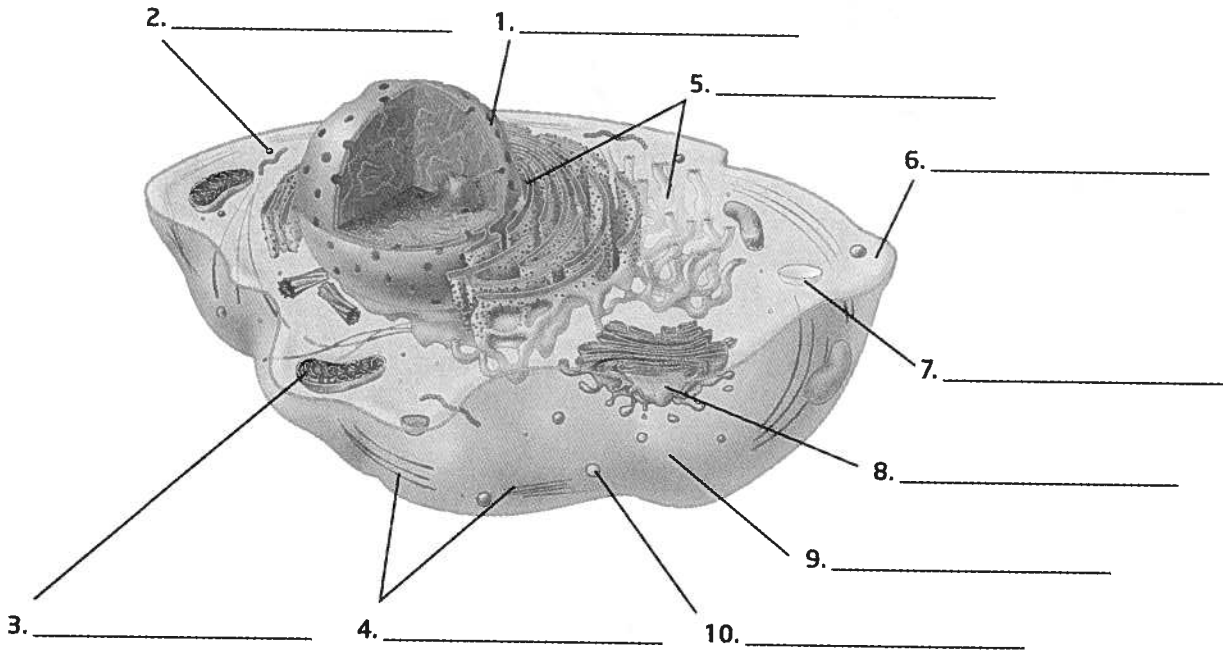
Applying Knowledge
Topic 1.1

Use with textbook pages 14 to 15.

Parts of animal cells

Vocabulary		
cell membrane chloroplast cytoskeleton endoplasmic reticulum	Golgi body mitochondria nucleus	ribosome vacuoles vesicles

Use the terms in the box to label the parts of an animal cell. Terms may be used more than once.

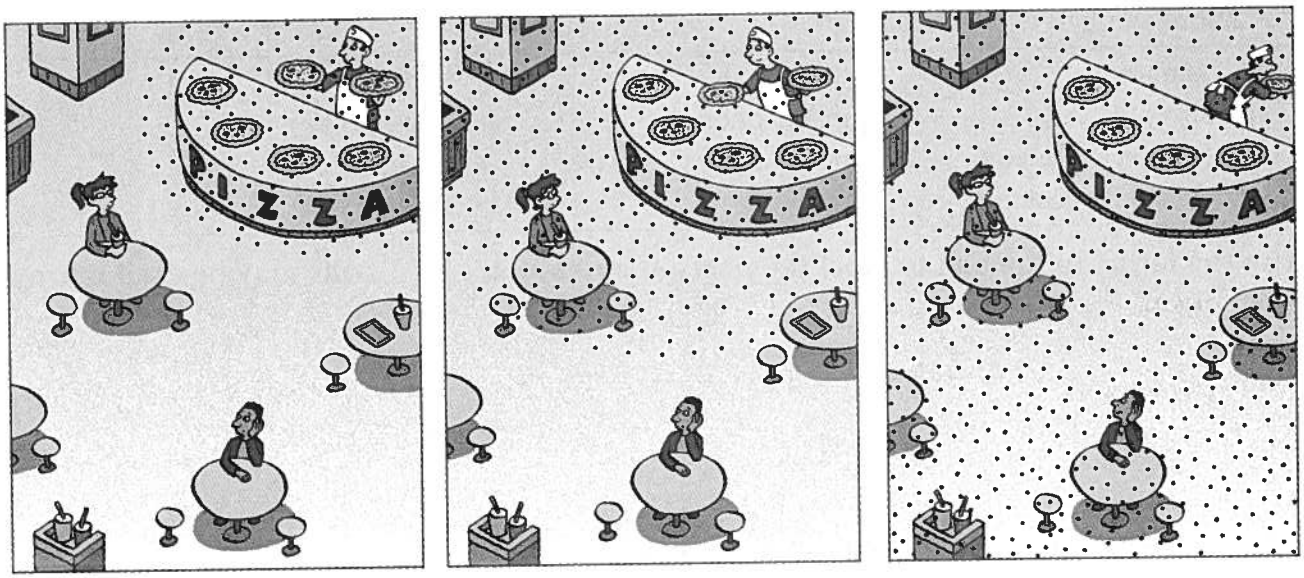


Name _____ Date _____

Analyze the Information
Topic 1.1

Use with textbook pages 16 to 17.

Diffusion



The process of diffusion occurs often in the world around you. For example, imagine that you are sitting near a restaurant or in a food fair at a local mall. Your friend is 10 m away from you. Suddenly, you catch the odour of your favourite food being prepared. Your friend does not smell anything. A short time later, your friend finally smells the food. The cartoon strip illustrates this process.

In the space below the strip, describe what is happening to the odour particles in the air, and why this is an example of diffusion.

Name _____ Date _____

Assessment
Topic 1.1

Why are cells important?

Use with textbook pages 8 to 19.

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ cell membrane	**A.** the number of molecules of a substance in a given volume.
2. _____ concentration	**B.** controls all the activities of the cell.
3. _____ diffusion	**C.** separates the inside of the cell from the external environment.
4. _____ nucleus	**D.** a structure within a cell that carries out specific functions to support the life of the cell.
5. _____ organelle	**E.** the movement of water molecules across a membrane in response to concentration differences.
6. _____ osmosis	**F.** the movement of a substance from an area of high concentration to an area of low concentration until the substance is evenly distributed.

7. What is the basic unit of life for all living things?

_____

8. Give three different general functions of organelles.

_____

_____

_____

9. Compare the functions of the following organelles:

a) nucleus and mitochondria

_____

_____

b) vacuoles and cell membrane

_____

_____

10. Explain why diffusion and osmosis are important for a cell.

_____

_____

Name _____ Date _____

Topic **1.2** Summary

Why do animal cells divide and what happens when they do?

Textbook pages 20 to 37

Before You Read

How do cells replace themselves?

_____

_____

Cells must divide for an organism to survive.

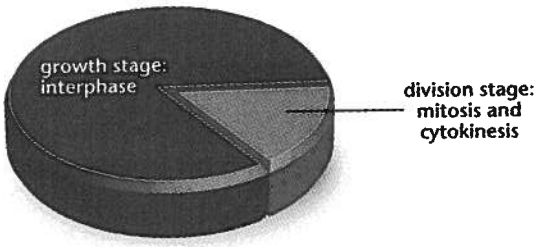
Cells divide because there is a limit to how large they can grow. To survive, a cell must take in a constant supply of nutrients, oxygen, and water. It also must get rid of waste products. Materials inside the cell must travel within the cytoplasm to reach the cell membrane and other organelles. A cell cannot carry out these processes if it grows too large.

Hereditary material is passed on during cell division.

When a cell divides, the new cells are identical to the original. Each new cell inherits the same set of instructions from the original cell. These instructions are stored in the molecule called DNA. DNA molecules are shaped like long strands of a twisted ladder. These molecules are tightly packed in the nucleus of the cell. When a cell divides, the DNA packs together even more tightly to form chromosomes.

Animal cells have a life cycle.

The **cell cycle** describes a cell's birth, growth, and reproduction. The cell cycle is made up of two main stages: a growth stage and a division stage. ✔



The growth stage: The growth stage is **interphase**. Most of the life of the cell is spent in this stage. The cell grows and carries out its life functions. The nucleus makes a copy of its organelles and DNA to prepare for division.

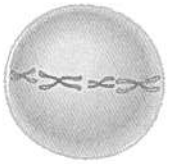
Name _____ Date _____

Topic **1.2** Summary

The division stage: This has two phases: mitosis and cytokinesis.

During **mitosis,** the contents of the nucleus separate into two identical parts. Mitosis has four phases — prophase, metaphase, anaphase, and telophase.

Prophase
The nucleus and the nuclear membrane disappear. Chromosomes form.



Metaphase
Chromosomes line up at the centre of the cell.

Anaphase
The chromosomes move to opposite ends of the cell.

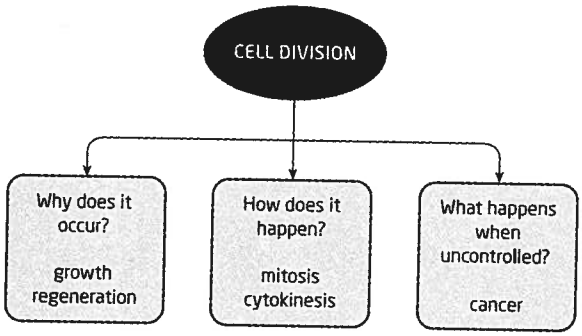
Telophase
The nuclear membrane reappears. Two new nuclei are created.

Cytokinesis occurs when the cytoplasm and organelles divide into two identical, separate cells. ✔

Uncontrolled division of animal cells can be cancer.

Uncontrolled cell growth can occur when a cell does not obey the chemical signals that start and stop cell division. Tumours are newly divided cells that have formed because a cell keeps dividing over and over. Mutations cause cells to keep dividing.

A mutation — a permanent change in a cell's DNA — can be passed on to other cells during mitosis. These changes can cause the cell to have unchecked cell growth. The causes of mutations can range from genetic inheritance to environmental or chemical factors.



✔ *Reading Check*

1. What is the name of the stage that a cell spends most of its life in?

_____

2. What is cytokinesis?

_____

_____

_____

Name _____ Date _____

Comprehension
Topic 1.2

Use with textbook pages 20 to 37.

What happens when cells divide?

1. Explain why a cell cannot become too large.

_____

_____

2. When a cell divides, how do the new cells get instructions from the original cell?

_____

_____

3. What are the two stages of cell division?

_____

_____

4. Describe what happens during each of the following stages:

a) Interphase

_____

b) Mitosis

_____

c) Cytokinesis

_____

5. How is cell division related to the cell cycle?

_____

6. Name three reasons that mutations can occur.

_____

Name _____ Date _____

Illustrating Concepts
Topic 1.2

Use with textbook pages 28 to 29

Mitosis

Summarize what is happening in the cell for each phase of mitosis. Then draw a labelled diagram of each phase.

Phase	What is happening in the cell?	Labelled diagram
Prophase		
Metaphase		
Anaphase		
Telophase		

Name _____ Date _____

Cloze Activity
Topic 1.2

Use with textbook pages 26 to 31.

Getting to know the cell cycle

Vocabulary		
anaphase	DNA	nucleus
cancer	interphase	telophase
cell cycle	membrane	tumour
cell division	metaphase	two
cytokinesis	mitosis	three
cytoplasm		

Use the terms in the vocabulary box to fill in the blanks. Use each term only once. You will not need to use every term.

1. The continuous series of events in the life of a cell is called the _____.
2. During _____, the cell makes a copy of its organelles and the DNA in its _____ to prepare for division.
3. _____ is a process in which one cell produces two new cells that are exact copies of the original cell.
4. The two main phases of cell division are _____ and _____.
5. During _____, the chromosomes align in the centre of the cell.
6. In _____, the _____ surrounding the nucleus re-forms, creating two new nuclei.
7. In cytokinesis, the _____ and organelles divide into _____ identical separate cells.
8. If a cell ignores a signal to stop dividing, the newly divided cells form a mass called a _____.
9. _____ can damage and destroy surrounding cells by invading them.

Name _____ Date _____

Assessment
Topic 1.2

Use with textbook pages 20 to 37.

Why do animal cells divide and what happens when they do?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ anaphase	A. the second phase of mitosis when the chromosomes align in the centre of the cell.
2. _____ cell cycle	B. the continuous series of events in the life of a cell in which it is born, grows, reproduces, and dies.
3. _____ cytokinesis	C. the first phase of mitosis when the nucleus and nuclear membrane disappear and chromosomes form.
4. _____ interphase	D. the stage in the cell cycle when a cell grows and carries out its usual functions, as well as making a copy of its DNA and organelles to prepare for cell division.
5. _____ metaphase	E. the ability to grow new cells to replace damaged or lost body components.
6. _____ mitosis	F. the fourth phase of mitosis when the membrane surrounding the nucleus re-forms, creating two new nuclei.
7. _____ prophase	G. the stage in the cell cycle when the contents of the nucleus separate into two identical parts.
8. _____ regeneration	H. the stage in the cell cycle when the cytoplasm and organelles divide into two identical separate cells.
9. _____ telophase	I. the third phase of mitosis when the chromosomes separate and move to opposite ends of the cell.

10. List two reasons why cell division is important.

_____

_____

11. What are the two main stages of the cell cycle?

_____

_____

12. What are the four phases of mitosis?

_____

_____

13. What is a mutation?

_____

_____

Name _____ Date _____

Topic **1.3** Summary

How do cells work together in the human body?

Textbook pages 38 to 55

Before You Read

There are eleven different systems in your body that perform all the functions that keep you alive. How many organ systems can you name?

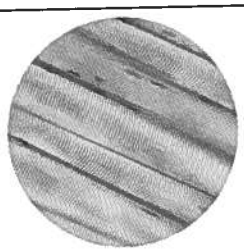
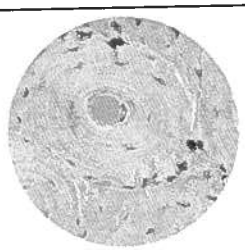
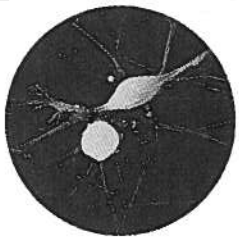
_____

_____

All cells begin alike and differentiate into specialized cells.

All cells start their lives as identical cells called stem cells. Each stem cell has the potential to become a specialized cell like a blood cell or skin cell. Each of these different types of cells has different structures and abilities to perform its job. As each cell matures it changes to suit the many different functions that it has to do. This process is known as **cell differentiation**.

Examples of specialized cells in the body

			
Muscle cells are long and thin, which allows them to change size easily.	Red blood cells have a depression to increase surface area to carry oxygen.	Bone cells contain lots of minerals to provide a strong, supporting framework for bone tissue.	Nerve cells have long extensions that carry messages a long distance. ✔

Groups of cells work together as tissues.

Cells that have the same structure and that play the same role in the body are grouped together as **tissue**. For example, muscle cells are grouped to form muscle tissue.

Groups of tissues work together as organs.

Tissues of different kinds work together in an **organ**. For instance, the heart is an organ. It is made up of several types of tissues. These include muscle tissue that lets the heart contract and relax; and nervous tissue that transfers signals to the heart from the brain and other parts of the body.

Name _____ Date _____

Topic **1.3** Summary

Groups of organs work together in organ systems.

Organs working together form **organ systems**. The digestive system has several different organs, including the stomach, the small intestine, and the large intestine. The organs of the digestive system work together to help you take in food, break it down, absorb nutrients, and rid the body of solid waste. ✔

Systems in the Human Body		
Circulatory • transports blood, nutrients, gases and wastes	Digestive • takes in and breaks down food, absorbs nutrients, rids body of solid waste	Respiratory • controls breathing and delivers oxygen to the blood and removes carbon dioxide from blood
Reproductive • produces eggs or sperm, produces sex hormones, and in females allows for growth and delivery of offspring	Integumentary • includes skin, hair, and nails • provides protective barrier, receives sensory information	Skeletal • provides a framework for muscle to attach to, protects soft organs, makes blood cells, and stores minerals
Nervous • gathers and interprets sensory information and coordinates all the functions of the organ systems	Immune • defends the body against infections	Endocrine • produces and releases hormones, helps coordinate organ systems, responds to stress
Excretory • eliminates liquid waste from body	Muscular • moves body parts and organs	

Cell → Tissue → Organ → Organ system

✔ *Reading Check*

1. Name four different types of cells that can be found in the human body.

_____

_____

_____

2. What is the difference between a tissue and an organ system?

_____

_____

_____

Name _____ Date _____

Comprehension
Topic 1.3

Use with textbook pages 38 to 55.

Cells working together

Answer the questions below.

1. What is cell differentiation?

_____

2. List three different types of cells.

_____

3. How does the structure of muscle cells help them perform their function?

_____

_____

4. What are the functions of nervous tissue?

_____

5. The heart is made up of more than one kind of tissue. Why?

_____

_____

6. Organs work together in organ systems. What organs work together in the digestive system?

_____

_____

7. Write a sentence or draw a diagram to relate these words: cell, tissue, and organ.

_____

Name _____ Date _____

Assessment
Topic 1.3

Use with textbook pages 38 to 55.

How do cells work together in the human body?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. ____ cell differentiation	**A.** a cell that has the potential to become a specialized cell.
2. ____ cell specialization	**B.** different tissues working together to perform a specific task.
3. ____ connective tissue	**C.** specialized cells working together to perform a function.
4. ____ epithelial tissue	**D.** the series of events through which stem cells develop into specialized cells.
5. ____ organ	**E.** covers the external and internal body surfaces.
6. ____ organ system	**F.** different types of cells have different structures and abilities that enable them to perform their functions efficiently.
7. ____ stem cell	**G.** strengthens, supports, or connects cells and tissues.
8. ____ tissue	**H.** a group of organs that interact with each other to perform a common task.

9. Sometimes stem cells are used to treat disease. What makes them suitable for this?

_____

_____

_____

10. Describe how the structure of nerve cells influences their function.

_____

_____

_____

11. Compare the functions of the digestive system with the functions of the respiratory system.

_____

_____

_____

_____

Name _____ Date _____

Topic **1.4** Summary

How do systems work together in the human body?

Textbook pages 56 to 75

Before You Read

Many structures and organs work together to provide the body with energy to perform its required tasks. What parts of your body do you think play a role?

_____

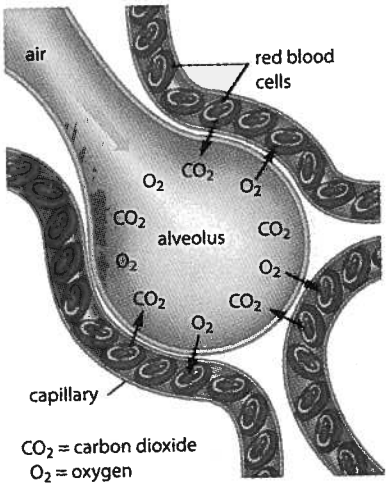
_____

The respiratory system carries oxygen to the blood and removes carbon dioxide from the blood.

The cells in your body need a lot of energy to perform their activities. In order to get this energy, cells need a constant supply of oxygen. Each time your breathe in, oxygen enters your body. A process called cellular respiration will combine this oxygen with glucose to produce usable energy, carbon dioxide, and water. Your body gets rid of the carbon dioxide every time you breathe out.

The respiratory system is made up of two lungs and a series of passages to bring the oxygen into the body and the carbon dioxide out of it. These passages lead through the nose and down the throat, and branch into smaller and smaller tubes in the lungs.

At the end of these small tubes are tiny air sacs called **alveoli**. The alveoli are surrounded by blood vessels called **capillaries**. During **gas exchange**, oxygen and carbon dioxide diffuse and exchange places between the alveoli and capillaries.



The circulatory system carries dissolved gases and nutrients.

The circulatory system moves blood throughout the body. The blood carries oxygen and nutrients to cells. It also carries carbon dioxide and other wastes away from the cells. Blood is pumped by the heart and travels to and from cells in blood vessels. **Red blood cells** are responsible for carrying oxygen and carbon dioxide in the blood.

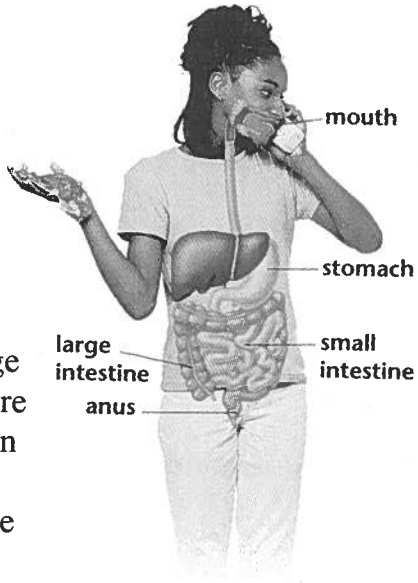
The main blood vessels are the arteries and veins. Thick-walled **arteries** carry oxygen-rich blood from the heart to capillaries. Capillaries have thin walls. Oxygen, carbon dioxide, and nutrients diffuse through them easily. From the capillaries, carbon dioxide-rich blood moves into **veins** and back to the heart.

Name _____ Date _____

Topic **1.4** Summary

The digestive system breaks down food, absorbs nutrients, and eliminates solid waste.

The process of digestion involves four major jobs in your body. Ingestion takes place as food is taken into the body at the mouth. Digestion takes place as food is physically and chemically broken down into nutrients in your mouth and stomach. **Absorption** occurs at the small intestine when nutrients are passed into the blood. At the large intestine, water and some nutrients are reabsorbed into the body. Elimination occurs when solid wastes from the digestive system are passed out of the body through the anus. ✔



✔ *Reading Check*

1. Where does gas exchange take place?

_____

2. What are the four main tasks of the digestive system?

_____

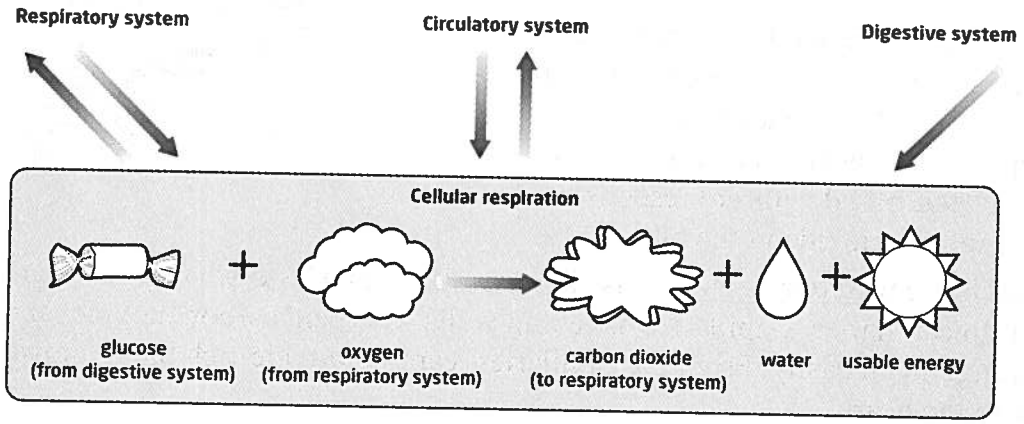
_____

_____

_____

Organ systems work together to carry out important tasks.

Your body cells need oxygen and glucose to carry out their tasks. Your respiratory system supplies oxygen to your body. Your digestive system breaks food down into nutrients, such as glucose. Your circulatory system transports the oxygen and glucose to your body cells. Your circulatory system also transports carbon dioxide and other wastes away from your body cells. Your respiratory system then removes the carbon dioxide from your body. In order for your body to perform efficiently, all these organ systems must work together.



Name _____ Date _____

Cloze Activity
Topic 1.4

Use with textbook pages 56 to 75.

Body systems working together

Vocabulary		
absorption	digestion	ingestion
alveoli	elimination	oxygen
arteries	fluid	usable energy
capillaries	glucose	veins
carbon dioxide	hairs	water
cellular respiration	heart	

Use the terms in the vocabulary box to fill in the blanks. Use each term only once.

1. Each time you breathe in, your respiratory system takes in oxygen that your cells require to carry out _____.
2. When air is inhaled, dirt and other particles are trapped by tiny _____ and sticky _____ in the nose.
3. Once air reaches the lungs, the actual exchange of gases occurs between the blood and the _____.
4. Alveoli are surrounded by a network of tiny blood vessels called _____.
5. The _____ is the muscular organ that drives the circulatory system.
6. The main blood vessels found in the circulatory system are _____ and _____.
7. _____, _____, _____, and _____ are the four tasks completed by the digestive system in the body.
8. For cellular respiration to begin, _____ and _____ are required.
9. During respiration, _____, _____, and _____ are produced.

Name _____ Date _____

Interpreting Illustrations
Topic 1.4

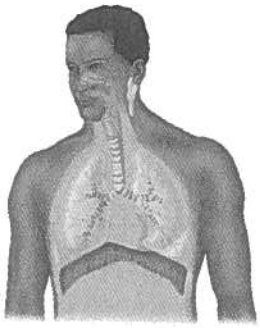
Use with textbook pages 58 to 61.

The respiratory and circulatory systems

Examine the pictures below. Answer the questions.

Respiratory system

1. Parts of respiratory system



a) What gas is taken in when you breathe?

_____

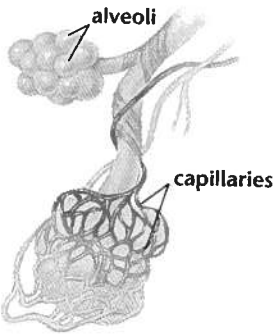
b) Describe the pathway air follows as it passes through your respiratory system.

_____

_____

_____

2. Gas exchange



a) Where does gas exchange occur?

_____

b) How does the structure of alveoli help gas exchange?

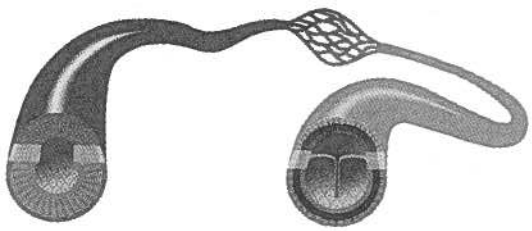
_____

c) What transports gases in the bloodstream?

_____

Circulatory system

3. Blood vessels



a) Label the following on the above diagram: artery, capillary, valve, vein.

b) Draw arrows to show the direction that blood travels along as it passes through these blood vessels.

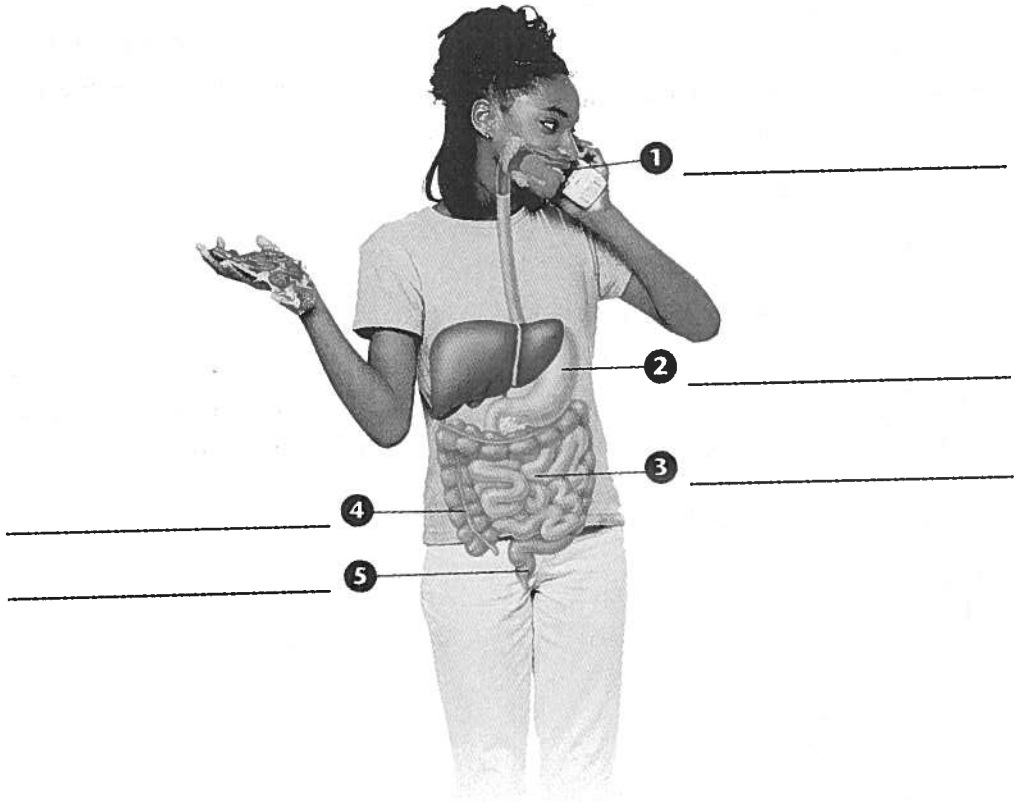
Name _____ Date _____

Applying Knowledge
Topic 1.4

Use with textbook pages 62 to 63.

The digestive system

Label the diagram. Then, fill in the table.



Part of digestive system	Describe what is happening at this stage of digestion.
1.	
2.	
3.	
4.	
5.	

Name _____ Date _____

Assessment
Topic 1.4

Use with textbook pages 55 to 75.

How do systems work together in the human body?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ absorption	**A.** air sacs in the lungs where gas exchange occurs.
2. _____ alveoli	**B.** the smallest blood vessels.
3. _____ arteries	**C.** blood cells that carry oxygen and carbon dioxide in the blood.
4. _____ capillaries	**D.** vessels that carry carbon dioxide-rich blood back to the heart.
5. _____ cellular respiration	**E.** vessels that carry oxygen-rich blood from the heart to the capillaries.
6. _____ digestion	**F.** chemical reaction that occurs in cells and requires oxygen and glucose.
7. _____ red blood cells	**G.** the process by which nutrients pass from the digestive system to the blood.
8. _____ veins	**H.** the process by which food is physically and chemically broken down into nutrients.

9. What is gas exchange?

_____

_____

10. Describe one job the circulatory and respiratory systems work together to do.

_____

_____

_____

_____

11. Describe one job the circulatory and digestive systems work together to do.

_____

_____

_____

_____

Name _____ Date _____

Topic 1.5 Summary

How do technology, substances, and environmental factors affect human health?

Textbook pages 76 to 93

Before You Read

Today with medical imaging technologies, doctors can observe, diagnose, and treat patients without opening the body. What types of imaging technologies are you aware of?

_____

_____

Medical imaging technologies are used to explore and treat the human body.

Medical imaging technologies allow doctors to observe, diagnose, and treat patients without opening the body.

- X rays and CT scans both use electromagnetic radiation to diagnose bone injuries and malformations.
- Ultrasound uses sound waves to monitor fetal development and organ function, and to detect cancer.
- An MRI scan passes radio waves through a magnetic field to produce images of soft tissue on a computer.
- A PET scan uses small amount of radioactive materials that are traced revealing details of tissues and organs.
- The internal parts of a body can be viewed by a camera attached to a tube called an endoscope. The scope can also take tissue samples and perform surgeries.
- When a doctor needs to look at a cell up close, they can use a variety of microscopes ranging from light microscopes to electron microscopes. All of these technologies have allowed us to see cells, tissues, and organs in more detail than was possible in the past.

Exposure to some technologies, substances, and environmental factors can affect our health.

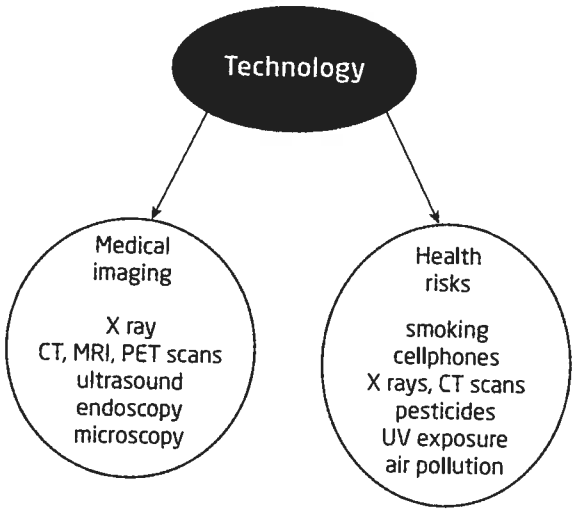
Some technologies, substances, and environmental factors are potentially harmful. The degree of exposure and the length of exposure are contributing factors to how much harm can be done. Research is being done to investigate the harmful effects of certain technologies.

- Extensive cellphone use may be linked to brain damage and cancer.
- The radiation from X rays and CT scans are generally within the safe range. However, some individuals such as pregnant woman are warned to avoid them.
- Harmful substances in pesticides can damage or kill cells.
- Smoking and second-hand smoke have been found to increase the risk of lung, heart, throat, and mouth disease.

Name _____ Date _____

Topic 1.5 Summary

- Damage to the skin and eyes, as well as increasing a person's chances of developing skin cancer, can occur from exposure to ultraviolet radiation from the Sun's rays.
- Air pollution can irritate the eyes, throat, and lungs and can cause asthma attacks in some people. ✔



✔ ***Reading Check***

1. List three technologies, substances, or environmental factors that can lead to cancer.

_____

_____

_____

Name _____ Date _____

Applying Knowledge
Topic 1.5

Use with textbook pages 78 to 79.

Medical imaging technologies

1. Match each medical imaging technology on the left with its description on the right.

Medical imaging technology	Description
a) ____ CT scan	**A.** a scope made up of a tiny camera and a light attached to a flexible tube inserted into the body.
b) ____ endoscopy	**B.** involves passing radio waves through a magnetic field around the body creating images on a computer.
c) ____ microscopy	**C.** used to view hard tissue such as bone.
d) ____ MRI scan (magnetic resonance imaging)	**D.** conducted using a variety of light and electron microscopes.
e) ____ PET (positron emission tomography)	**E.** involves scanning small amount of radioactive materials, which have been taken into the body.
f) ____ ultrasound	**F.** an X-ray source and sensor that rotate around the body while slowly moving along the body.
g) ____ X ray	**G.** involves directing sound waves at a body part and measuring reflected sound waves to make an image.

2. Which of the above medical imaging technologies would you use to do each of the following?

a) take tissue samples and perform surgeries

_____

b) monitor fetal development

_____

c) track cancer treatments

_____

d) view small objects such as cells to diagnose various diseases

_____

Name _____ Date _____

Assessment
Topic 1.5

Use with textbook pages 76 to 93.

How do technology, substances, and environmental factors affect human health?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ atherosclerosis	A. involves directing sound waves at a body part and measuring reflected sound waves to make an image.
2. _____ cancer	B. chemicals that are used to control and kill weeds and insects.
3. _____ medical imaging technologies	C. production of new cells, tissues, and organs to replace damaged body parts.
4. _____ pesticides	D. blocking of arteries caused by a build-up of fatty deposits.
5. _____ regenerative medicine	E. technologies that are used to make images of cells, tissues, and organs.
6. _____ ultrasound	F. involves sending electromagnetic radiation through the body to make an image of hard tissues.
7. _____ X ray	G. a cell that divides and reproduces abnormally with uncontrolled growth.

8. What can an MRI be used for?

_____

_____

9. What are some of the risks of too much exposure to sunlight?

_____

_____

10. Identify one example of a harmful technology, one example of a harmful substance, and one example of a harmful environmental factor. Explain why each is harmful.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name _____ Date _____

Unit 1

Literacy Test Preparation

Read the selection below and answer the questions that follow it.

Cancer causes: Popular myths about the causes of cancer

There are scary claims circulating on the Internet stating that deodorants, food additives, and plastics are the secret causes of cancer. These misconceptions about cancer causes can lead to unnecessary worry about your own health and the health of your family.

Researchers have found that the risk of breast cancer does not appear to increase with the use of deodorants or antiperspirants. Some reports have suggested that these products contain harmful substances such as aluminum compounds or parabens. The Mayo Clinic recommends that if you are concerned about these chemicals, you should choose products that don't contain them.

Food additives are chemicals that help preserve, colour, and flavour our food. In Canada, all food additives are continuously monitored and reviewed for adverse reactions and hazards. If at any time a food additive is shown to be harmful, it is removed from the market. There have been many discussions on the link between artificial sweeteners and cancer. Aspartame, also known as Nutrasweet, does not cause cancer. In 1977, a study was published that indicated an increased rate of bladder cancer in laboratory rats that were fed large doses of saccharin, another sweetener. To date, there have been no proven links between saccharin and cancer in humans. The advice from the Canadian Cancer Society is to use these artificial sweeteners in moderation.

We use many different kinds of plastics in our everyday lives. Plastic containers are designed for uses ranging from holding household products to storing food and liquids. It has been found that using plastic containers or even plastic wrap for anything other than their original use can cause health problems. There is some scientific evidence that suggests that substances used to manufacture plastic products may leach out of the container and into the food it holds. Some of these substances may be cancer-causing (carcinogenic). Before using a plastic container or plastic wrap in the microwave, be sure that it is labelled as being microwave-safe.

Plastic water bottles are generally made of a plastic known as PETE or PET. Recent articles have stated that these water bottles contain cancer-causing substances known as dioxins. There is no evidence that plastic water bottles contain dioxins. One concern about re-using water bottles is how clean they are. When re-using disposable plastic water bottles, they need to be cleaned and dried properly so bacteria cannot be allowed to grow in them. The bacteria can lead to several digestive illnesses.

Not everything written about cancer is true. It is important to find out information from credible medical sources to learn more about the latest research and up-to-date information.

Name _____ Date _____

Unit 1

Multiple Choice (Select the best or most correct answer)

1. Researchers studying risks related to breast cancer found that
   - **A.** antiperspirants are safer to use than deodorants
   - **B.** deodorants do not appear to increase the risk for breast cancer
   - **C.** breast cancer rates increase with the use of deodorants
   - **D.** deodorants and antiperspirants decrease breast cancer rates in females

2. When using products that contain artificial sweeteners, it is recommended that consumers use
   - **A.** only products containing aspartame
   - **B.** only products containing saccharin
   - **C.** artificial sweeteners in moderation
   - **D.** unlimited use of any artificial sweetener, since they are safe

3. Scientific evidence has shown that the safe way to heat a plastic container in the microwave is to
   - **A.** rinse thoroughly with cold water before heating
   - **B.** read the product label
   - **C.** cover with plastic wrap
   - **D.** never heat more than two minutes

4. The main health concern related to re-using plastic bottles is
   - **A.** toxic effects causing stomach cancer
   - **B.** increased cancer rates in athletes
   - **C.** release of dioxins leading to cancer
   - **D.** illnesses caused by bacterial growth

Short Answer question

5. Summarize this selection. Include the main idea and one point that clearly supports it.

Name _____ Date _____

Unit 2

Using Your Appendices

Literacy Skills Toolkit 5: Organizing Your Learning: Using Graphic Organizers

Use with textbook pages 412 to 417.

Graphic organizers present information visually. They allow you to see patterns and relationships that you might not see when the information is presented in a paragraph.

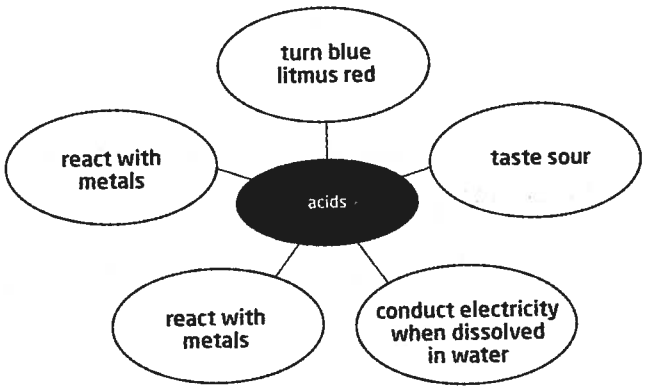
T-chart

You can use this simple two-column chart to compare or show a relationship between two things.

Ionic Compound	Molecular Compound
• formed from metals and non-metal ions • attraction between positive and negative ion • solid at room temperature • very high melting point • conduct electricity when melted or dissolved in water	• formed from non-metal ions • attraction between negative ions • solid, liquid, or gas at room temperature • lower melting point than ionic compound • do not conduct electricity when melted or dissolved in water, except in certain acids

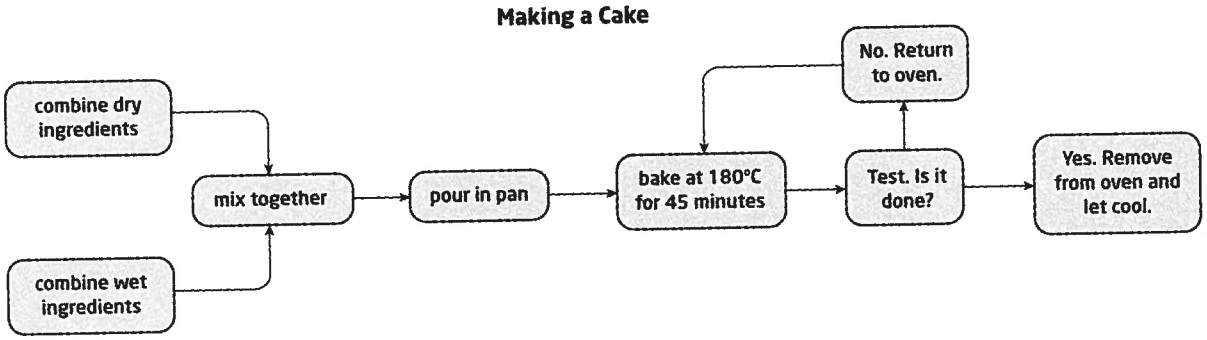
Main Idea Web

Place the main idea of a topic in the center of this organizer and then write supporting details around the outside of the main idea. You can use a main idea web to organize your ideas when you need to write a summary.



Flowchart

Use a flowchart shows a sequence of events or the steps in a process. All the events or steps are shown in the order in which they occur. Some flowcharts include questions. This happens when there are two possible paths to follow and a decision must be made.



Name _____ Date _____

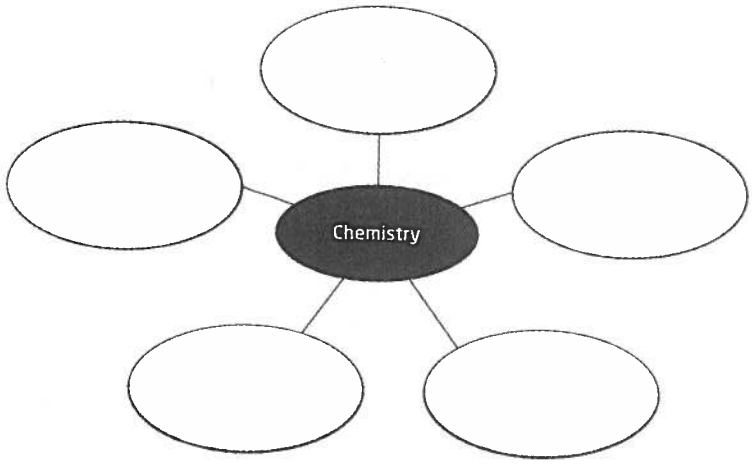
Unit 2

Questions:

1. Complete this T-chart to compare an element and a compound.

Ionic Compound	Molecular Compound
•	•
•	•
•	•
•	•
•	•

2. Place the main idea "Chemistry" in the middle of an idea web. Write supporting ideas about chemistry around the outside of the main idea.



3. Create a flow chart that explains how you get ready for school in the morning. Place a box around each step you include.

Name _____ Date _____

Topic **2.1** Summary

How do chemical reactions affect your daily life?

Textbook pages 110 to 117

Before You Read

List two chemical reactions that you have used in your life today.

_____

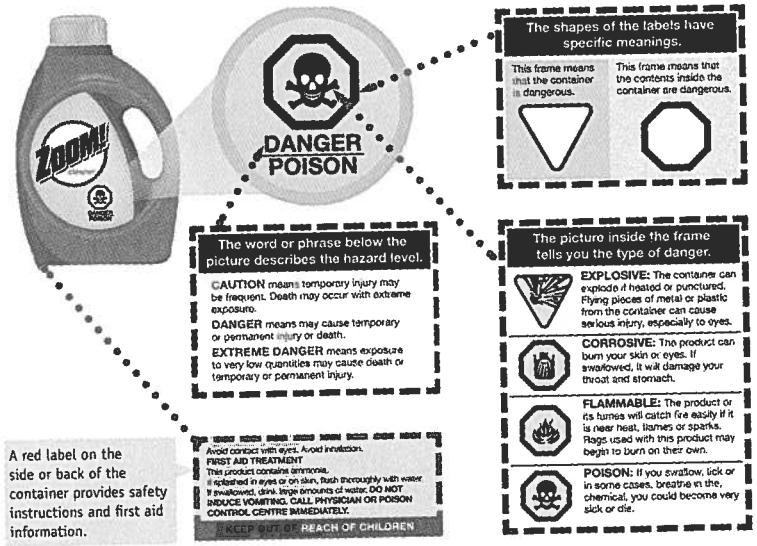
Chemical reactions support our lives and assist us at home and at work.

A **chemical reaction** is a change in matter that produces new substances with new properties. The substances that react together in a chemical reaction are called **reactants** while the new substances produced are called **products**. You can write a chemical reaction as: reactants → products

Chemical reactions also involve the release of energy or the storage of energy. **Photosynthesis** is a series of chemical reactions that happen in green plants to turn carbon dioxide and water into sugar (stored energy) and oxygen. **Cellular respiration** is a series of chemical reactions that takes a mixture of sugar and oxygen and breaks it into carbon dioxide and water, releasing the stored energy.

Chemical compounds require safe handling to minimize their hazards.

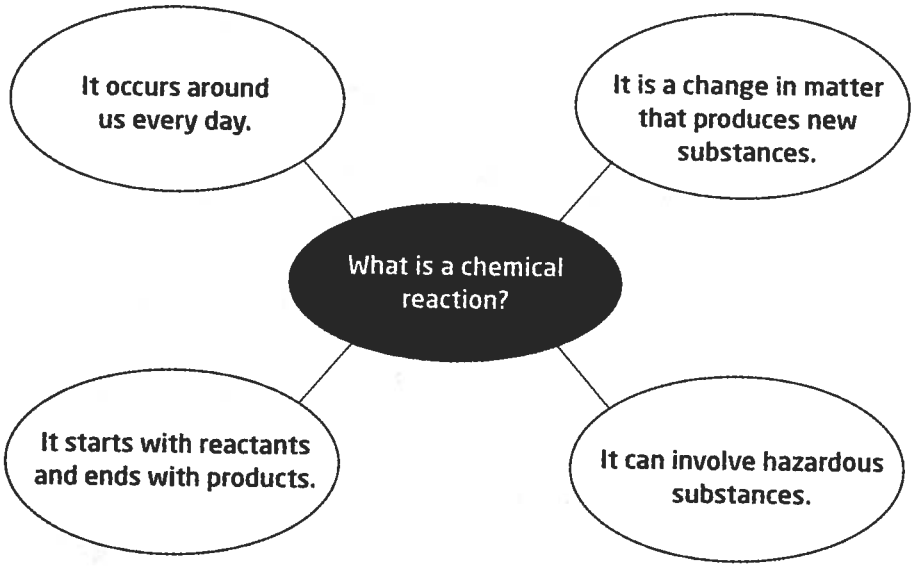
Household products can produce beneficial but also harmful chemical reactions. In order to be aware of chemical reactions that can occur with these compounds, Household Hazardous Product Symbols (HHPS) were established by Health Canada.



Name _____ Date _____

Topic 2.1 Summary

To keep workers safe on the job, the Workplace Hazardous Materials Information System (WHMIS) was designed. WHMIS provides detailed information about how to store, handle, and dispose of chemicals used in the workplace. It also provides first aid information. For the most complete information about any chemical including its properties, reactivity, storage requirements, and disposal information, you must read the Material Safety Data Sheet (MSDS) for that chemical. ✔



✔ *Reading Check*

1. Write the chemical reaction for each process.

   a) photosynthesis

   _____

   b) cellular respiration

   _____

2. Sketch the HHPS for flammable.

3. What does WHMIS stand for?

   _____

   _____

   _____

   _____

Name _____ Date _____

Cloze Activity
Topic 2.1

Use with textbook pages 112 to 116.

Chemicals and safety

Vocabulary		
cellular respiration chemical reaction dilute	HHPS MSDS photosynthesis	product reactants WHMIS

Use the terms in the vocabulary box to fill in the blanks. Use each term only once.

1. A bottle of bleach will have a _____ to warn of dangers.
2. Two of the most common chemical reactions that occur on this Earth are _____ _____ and _____.
3. _____ stands for Workplace Hazardous Materials Information System.
4. The starting materials in a chemical reaction are the _____.
5. The _____ is a detailed information page which gives steps for handling and storing substances safely.
6. A _____ involves a change in matter that produces new substances with new properties.
7. The final substance in a chemical reaction is called a _____.
8. Acetic acid that has been mixed with water is said to be _____.

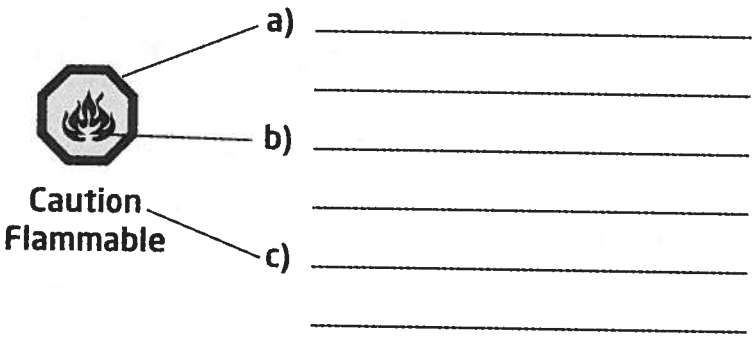
Name _____ Date _____

Interpreting Illustrations
Topic 2.1

Use with textbook pages 114 to 115.

Safe handling of chemical compounds

1. Label and explain each part of this HHPS.



2. A corrosive substance is extremely dangerous. Draw the HHPS you will see on a container of this substance.

3. What might happen if you swallow, taste, or breathe in a poisonous chemical?

_____

4. What does EXTREME DANGER mean on the HHPS? Circle the letter of the correct answer.

A. Temporary injury may be frequent. Death may occur with extreme exposure.
B. May cause temporary or permanent injury or death.
C. Exposure to very low quantities may cause death or temporary or permanent injury.

Name _____ Date _____

Applying Knowledge
Topic 2.1

Use with textbook pages 114 to 116.

WHMIS labels

Below is a supplier WHMIS label and a blank workplace WHMIS label.

Supplier WHMIS label

HYDROGEN PEROXIDE SOLUTION 3%

SEE MATERIAL SAFETY DATA SHEET FOR THIS PRODUCT

WARNING! MAY BE HARMFUL IF SWALLOWED. CAUSES EYE IRRITATION.

PRECAUTIONS: Avoid breathing vapours or mist.
Avoid prolonged or repeated contact with skin.

Wear splash-proof safety goggles and rubber gloves.
Use with adequate ventilation especially in closed areas.

FIRST AID: In case of contact with eyes, immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Seek medical attention immediately. In case of contact with skin, wash exposed area with soap and water. Seek medical attention if skin irritation develops. In case of ingestion, drink several glasses of water to dilute. If large amounts are swallowed, seek medical advice immediately.

ATTENTION! STORE IN A COOL, WELL-VENTILATED DARK AREA. PROTECT FROM FREEZING. ISOLATE FROM INCOMPATIBLE SUBSTANCES. PROTECT CONTAINER FROM PHYSICAL DAMAGE. CONTAINERS MAY BE HAZARDOUS WHEN EMPTY DUE TO RESIDUE

LIFE Chemicals
123 Reactant Drive
Product City, ON
ABC1234

Workplace WHMIS label

HYDROGEN PEROXIDE SOLUTION 3%

1. Use the supplier label to find the information needed for the workplace label.
2. Draw the workplace WHMIS label for this substance.

Name _____ Date _____

Assessment
Topic 2.1

Use with textbook pages 110 to 117.

How do chemical reactions affect your daily life?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ chemical reaction	**A.** a substance that has been reduced in concentration because water has been added to it.
2. _____ product	**B.** in a chemical reaction, the substances found at the end.
3. _____ reactant	**C.** a change in matter that produces new substances with new properties.
4. _____ dilute	**D.** a detailed listing of the properties, storage requirements, and disposal of chemicals.
5. _____ WHMIS	**E.** the starting materials for a chemical reaction.

6. Draw the symbol that represents eye safety.

7. What happens to the reactants when a chemical reaction occurs? Explain.

_____

_____

8. Draw the HHPS for an explosive, dangerous substance.

9. What piece of safety information will provide you with the most information about a chemical?

_____

Name _____ Date _____

Topic **2.2** Summary

How can we understand, describe, and name chemical compounds?

Textbook pages 118 to 139

Before You Read

List the names or chemical formulas of compounds you know already.

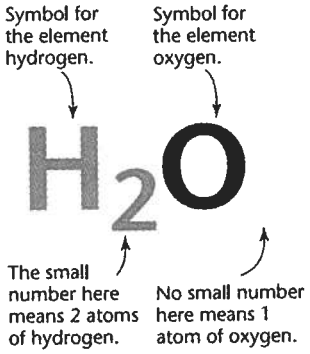
_____

_____

_____

Chemical compounds are represented using chemical names and chemical formulas.

To tell different compounds apart, each one is given a unique chemical name. Each chemical name can be translated into a chemical formula. A **chemical formula** is a group of letters and subscript numbers that represent the make-up of a chemical compound. The letters in the compound are the chemical symbols of the elements in the compound. The subscript numbers tell you how many atoms of these elements are in the compound. ✔



The chemical formula for the compound water, H_2O, tells you that there are two atoms of hydrogen (H) for every one atom of oxygen (O).

Reactive elements can become more stable when they form compounds.

When elements form compounds, they become more stable because when the elements combine to form compounds, each element makes a full outer electron shell.

- Metal elements lose electrons to form positive ions to become more stable.
- Non-metal elements can gain electrons to form negative ions OR non-metals can share electrons to become more stable.

Ions are atoms that have either a positive electrical charge or a negative electrical charge. ✔

Name _____ Date _____

Topic 2.2 Summary

Chemical compounds are described as either ionic or molecular.	
Ionic compound	**Molecular compound**
An **ionic compound** forms when a positively charged metal ion attracts a negatively charged non-metal ion. Ionic compounds are solids at room temperature, have very high melting points, and conduct electricity when they are melted or dissolved in water.	A **molecular compound** forms when non-metal atoms share electrons. Molecular compounds may be solids, liquids, or gases at room temperature; have lower melting points than ionic compounds; and do not conduct electricity when melted or dissolved in water, except in the case of certain acids.

Ionic compounds are named with the metal ion first, followed by the non-metal ion ending in"ide."

Formula-to-name steps

STEP 1	Look at the chemical formula: $CaCl_2$. Use the periodic table to name the metal ion.	Ca = calcium
STEP 2	Use the periodic table to name the non-metal ion.	Cl = chlorine
STEP 3	Change the ending of the non-metal ion to "ide."	chlorine → chloride
STEP 4	Write the first part of the name from step 1 with the second part of the name from step 3.	calcium chloride

Name-to-formula steps

STEP 1	Look at the name of the compound: aluminum oxide. Use the periodic table to find the symbols for the ions.	aluminum = Al oxide = oxygen = O
STEP 2	Write the ion charges above the symbols for the ions.	Al^{3+} O^{2-}
STEP 3	Drop the + and − signs, and criss-cross the ion charges to get the subscripts: Al_2 and O_3. If the charges are the same, they cancel. Use no subscripts.	Al_2^{3+} O_3^{2-}
STEP 4	Write the chemical formula.	Al_2O_3

Reading Check

1. What do the letters in a chemical formula represent?

2. What is an ion?

3. What types of elements combine to form ionic compounds and molecular compounds?

4. Write the name or formula for each ionic compound.
   a) LiCl
   b) sodium oxide

Name _____ Date _____

Topic 2.2 Summary

Molecular compounds are named using numerical prefixes.

Numerical prefix	Number it represents
mono-	1
di-	2
tri-	3
tetra-	4
penta-	5
hexa-	6
hepta-	7
octa-	8

Formula-to-name steps

STEP 1	Look at the formula of the molecular compound: CO_2. Use the periodic table to name the first element.	**C = carbon**
STEP 2	Choose the correct prefix for the number of atoms of the element.	**carbon** There is only one atom of carbon, so the correct prefix is "mono." But "mono" is not included for the first element.
STEP 3	Use the periodic table to name the second element.	**O = oxygen**
STEP 4	Change the ending of the second element to "ide."	**oxygen → oxide**
STEP 5	Choose the correct prefix for the number of atoms of the element.	**2 = di → dioxide** There are two atoms of oxygen, so the correct prefix is "di."
STEP 6	Combine the two parts of the name.	**carbon dioxide**

Name-to-formula steps

STEP 1	Look at the name of the molecular compound: dinitrogen tetroxide. Use the periodic table to find the symbols for the elements.	**nitrogen = N** **oxide = oxygen = O**
STEP 2	Compare the prefixes in the name to those in **Table 2.6** on page 131 to determine the number of atoms of each element.	**di = 2** **two nitrogen = 2N** **tetra = 4** **four oxygen = 4O**
STEP 3	Write in the subscripts, and write the chemical formula.	N_2O_4

Reading Check

5. Write the name or formula for each compound.

a) CO

_____

b) nitrogen trifluoride

_____

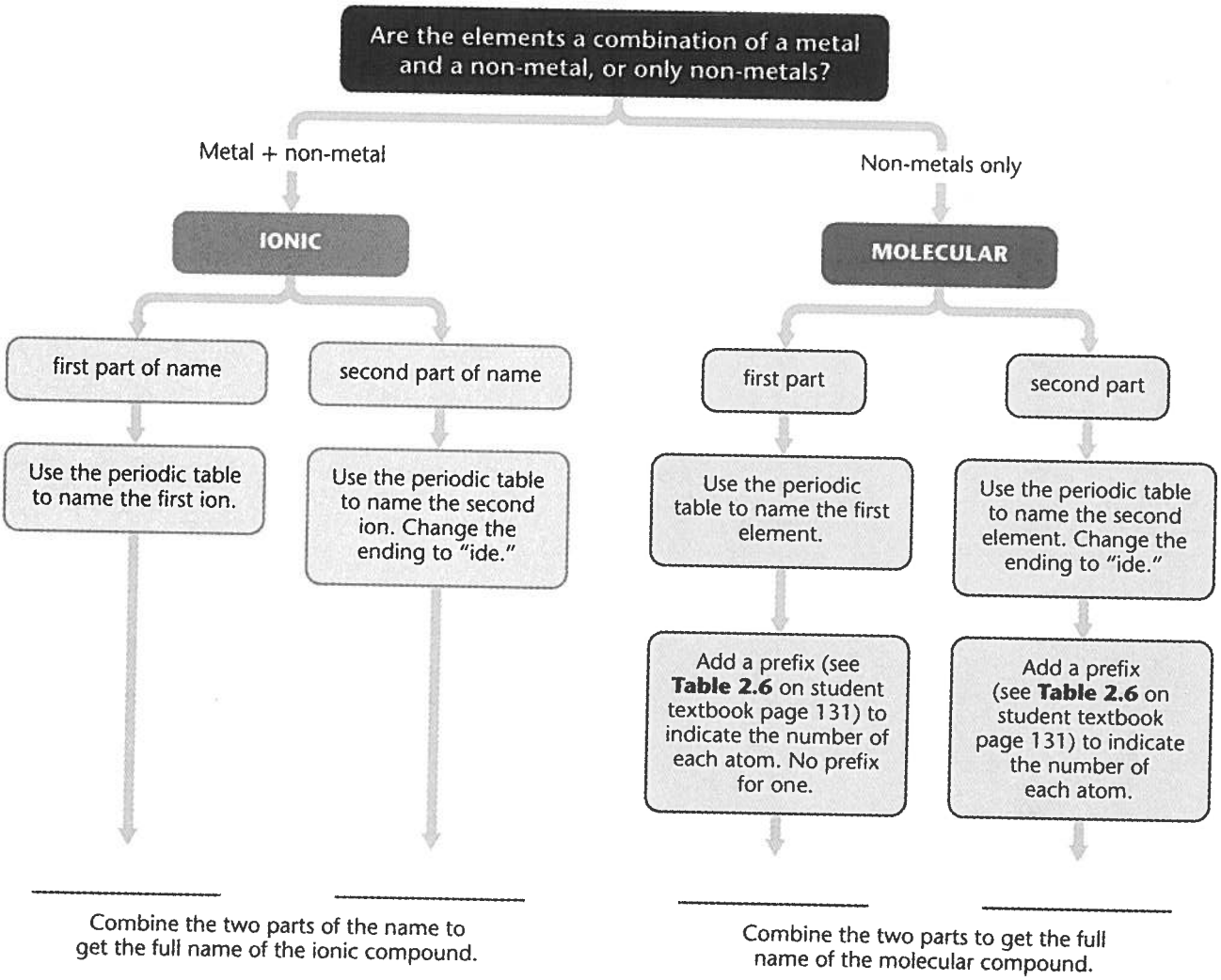
dinitrogen tetroxide

N_2O_4

Name _____ Date _____

Topic **2.2** Summary

How to name a chemical compound



Name _____ Date _____

Topic **2.2** Summary

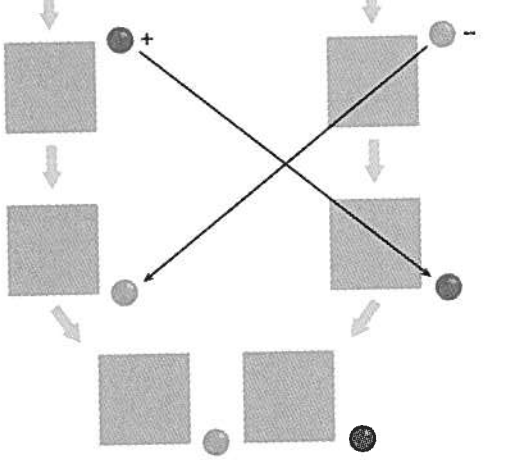
How to write a chemical formula

Are the elements a combination of a metal and a non-metal, or only non-metals?

Metal + non-metal

IONIC

- **first part**
  - Use the periodic table to find the symbol for the metal ion.
  - Include the charge of the ion.
- **second part**
  - Use the periodic table to find the symbol for the non-metal ion (or hydroxide).
  - Include the charge of the ion.



Combine the two parts to get the formula of the ionic compound.

Non-metals only

MOLECULAR

- **first part**
  - Use the periodic table to find the symbol for the first element.
  - Use the prefix to determine the number of each atom. Place the prefix as the subscript. If there is no prefix, the number is one. Do not add a subscript.
- **second part**
  - Use the periodic table to find the symbol for the second element.
  - Use the prefix to determine the number of each atom. Place the prefix as the subscript. If the prefix is "mono-" do not add a subscript.

Combine the two parts to get the formula for the molecular compound.

Name _____ Date _____

Analyze the Information
Topic 2.2

Use with textbook pages 128 to 135.

Writing names and formulas of ionic compounds

Use the periodic table on page 148 to help you answer these questions.

1. Use the chart on page 128 of your textbook to help you write the names of these ionic compounds.
Check page 129 of your textbook for the spelling of each "ide" name.

	Chemical formula	Chemical name
a)	Ag_2O	
b)	KI	
c)	LiCl	
d)	BaO	
e)	ZnF_2	
f)	Mg_3P_2	
g)	$CaBr_2$	
h)	Na_2S	
i)	$AlCl_3$	
j)	Be_3N_2	

2. Use the chart on page 129 of your textbook to help you write the chemical formulas for these ionic compounds.

	Chemical name	Chemical formula
a)	beryllium sulfide	
b)	lithium nitride	
c)	zinc chloride	
d)	sodium bromide	
e)	calcium chloride	
f)	magnesium oxide	
g)	silver iodide	
h)	aluminum sulfide	
i)	potassium fluoride	
j)	calcium phosphide	

3. Complete the table. First, identify each ion and its charge. Then, give the formula and name for each ionic compound formed. The table has been partially completed to help you.

		Chlorine becomes chloride. Cl^{-1}	Fluorine becomes _____. _____	Oxygen becomes _____. _____
a)	sodium Na^{+1}			
b)	magnesium _____			
c)	calcium _____			

Name _____ Date _____

Applying Knowledge
Topic 2.2

Use with textbook pages 128 to 135.

Writing names and formulas of molecular compounds

1. Use the chart on page 131 of your textbook to help you write the names of these molecular compounds.

	Chemical formula	Chemical name
a)	P_2O_5	
b)	CS_2	
c)	N_2O_4	
d)	SF_2	
e)	CBr_4	
f)	BCl_3	
g)	P_2O_3	
h)	NF_3	
i)	OF_2	
j)	SO_3	

2. Use the chart on page 132 of your textbook to help you write the chemical formulas for these molecular compounds.

	Chemical name	Chemical formula
a)	carbon tetrachloride	
b)	dinitrogen trioxide	
c)	sulfur dichloride	
d)	carbon dioxide	
e)	dinitrogen monoxide	
f)	phosphorus trichloride	
g)	nitrogen triiodide	
h)	silicon tetrafluoride	
i)	hydrogen monobromide	
j)	carbon monoxide	

Name _____ Date _____

Applying Knowledge
Topic 2.2

Use with textbook pages 128 to 135.

Ionic or molecular?

1. Identify the types of atoms in each compound as either metal or non-metal. Then decide if the compound is ionic or molecular. Use the periodic table on page 148 to help you.

	Chemical formula	Metal or non-metal elements?	Ionic or molecular compound?
a)	$SrCl_2$		
b)	P_2O_3		
c)	SCl_2		
d)	CBr_4		
e)	Rb_2S		

2. Identify the following compounds as ionic or molecular. Then write the names of the compounds.

	Chemical formula	Ionic or molecular?	Compound name
a)	CO		
b)	$BaCl_2$		
c)	SF_6		
d)	BrCl		
e)	NaF		
f)	MgO		
g)	PF_5		
h)	N_2O_3		
i)	AgCl		
j)	Li_2Se		

3. Identify the following compounds as ionic or molecular. Then write their chemical formulas.

	Compound	Ionic or molecular?	Compound formula
a)	carbon dioxide		
b)	zinc oxide		
c)	potassium bromide		
d)	dinitrogen pentoxide		
e)	aluminum sulfide		
f)	phosphorus trichloride		
g)	disulfur dinitride		
h)	magnesium phosphide		
i)	lithium iodide		
j)	diphosphorus hexoxide		

Name _____ Date _____

Assessment
Topic 2.2

Use with textbook pages 118 to 139.

How can we understand, describe, and name chemical compounds?

Match each Term on the left with the best Descriptor on the right. Each term is used only once.

Term	Descriptor
1. _____ ionic	A. the type of compound formed when a metal and a non-metal combine.
2. _____ molecular	B. represents the number of atoms of each element in the compound.
3. _____ subscript	C. the type of compound formed when two non-metals combine.
4. _____ symbol	D. short form for a chemical name of a compound.
5. _____ chemical formula	E. the letters in the chemical formula.

6. Write the name and symbol for a non-metal element.

_____

7. Check (✓) which compounds are ionic or molecular.

	Chemical compound	Ionic	Molecular
a)	NaCl		
b)	nitrogen triiodide		
c)	potassium oxide		
d)	CO_2		

8. Write the chemical name for each compound.

	Chemical compound	Chemical name
a)	$MgBr_2$	
b)	Al_2O_3	
c)	SI_3	
d)	P_2O_3	
e)	SiF_4	

9. Write the chemical formula for each compound.

	Chemical compound	Chemical formula
a)	sodium fluoride	
b)	calcium nitride	
c)	diphosphorus trioxide	
d)	boron triiodide	
e)	beryllium chloride	

10. Explain the steps in determining the chemical formula of a compound from its name. Use sodium sulfide to help you explain.

Step 1. _____

_____

Step 2. _____

_____

Step 3. _____

_____

Step 4. _____

_____

Name _____ Date _____

Topic **2.3** Summary

Textbook pages 140–157

What happens during a chemical reaction, and how can it be described?

Before You Read

Describe a chemical reaction that you have seen today. How did you know this was a chemical reaction?

_____

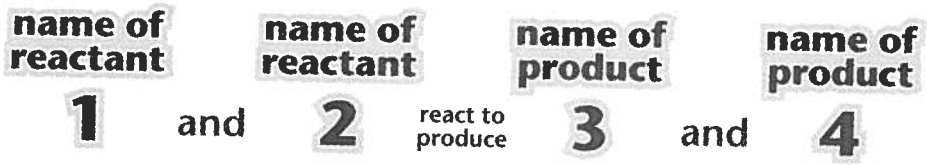
_____

During a chemical reaction, chemical compounds are changed into different compounds with different properties.

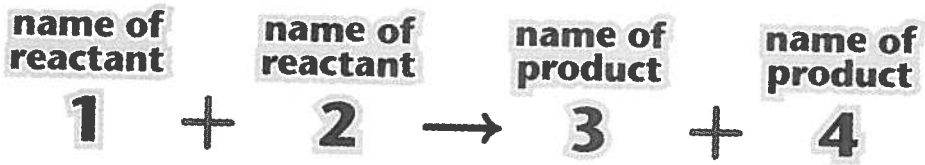
The products of a chemical reaction are always new substances with new properties compared to the reactants. There are several clues that a chemical reaction has taken place.

- There is a change in energy.
- There is a change in colour.
- A gas is formed.
- A solid substance (a precipitate) is formed.

The four types of chemical reactions can be described using word equations.



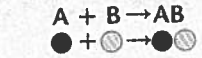
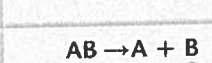
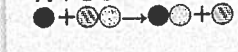
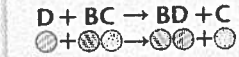
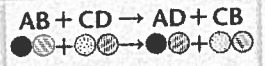
means



Name _____ Date _____

Topic 2.3 Summary

There are four main types of chemical reactions.

Type of reaction	Representation of the reaction	Example
Synthesis reaction • Two or more reactants combine to produce a new product.	A + B → AB 	zinc + sulfur → zinc sulfide.
Decomposition reaction • One compound breaks down into two or more simpler compounds or elements.	AB → A + B 	calcium chlorate → calcium + chlorate
Single displacement reaction • One element takes the place of another element in a compound.	A + BC → AC + B  D + BC → BD + C 	aluminum + hydrogen chloride → aluminum chloride + hydrogen chloride + sodium iodlde → sodium chloride + iodlne
Double displacement reaction • The metal ions of two different compounds exchange places.	AB + CD → AD + CB 	barium nitride + magnesium sulfide → barium sulfide + magnesium nitride

Reading Check

1. List three clues that will tell you a chemical reaction has occurred.

_____

_____

_____

2. What type of reaction is hydrogen + oxygen → water?

_____

Name _____ Date _____

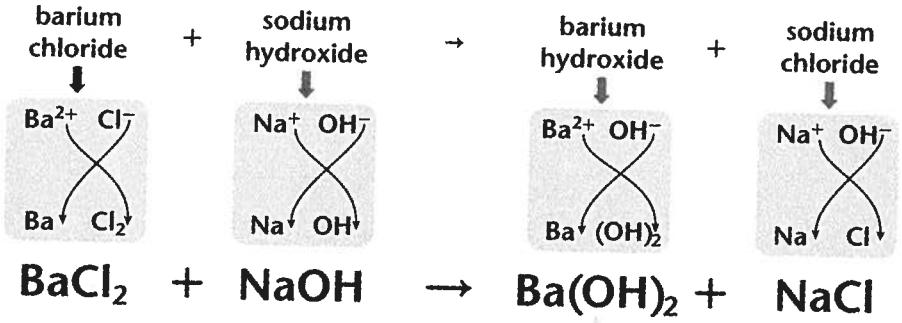
Topic 2.3 Summary

Elements That Contain More Than One Atom of the Element

Non-metal element	Found in nature as
hydrogen, H	H_2
nitrogen, N	N_2
oxygen, O	O_2
fluorine, F	F_2
phosphorus, P	P_4
sulfur, S	S_8
chlorine, Cl	Cl_2
selenium, S	Se_8
bromine, Br	Br_2
iodine, I	I_2

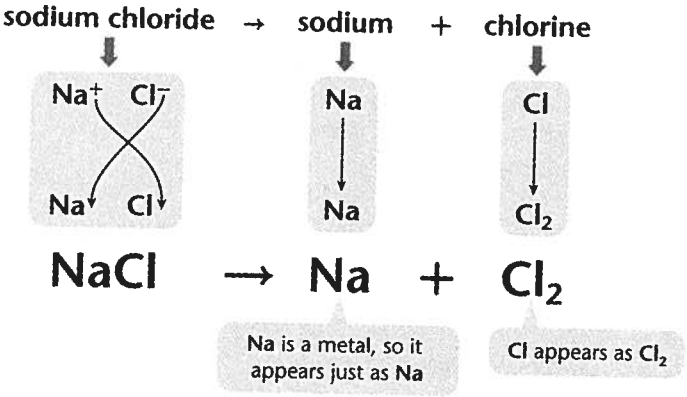
Chemical reactions can be described using chemical equations.

To write a **chemical equation**, you start with a word equation. Then use the rules that you have learned to translate each chemical name into the correct chemical formula.



Note that compounds containing more than one OH ion (hydroxide ion) have brakets around the OH.

If there is an element name in the word equation, the chemical symbol for most of the elements can be found on the periodic table. There are a few non-metal elements that contain more than one atom of the element in their chemical symbol. The list in the margin shows you the symbols for these elements.



Na is a metal, so it appears just as Na

Cl appears as Cl_2

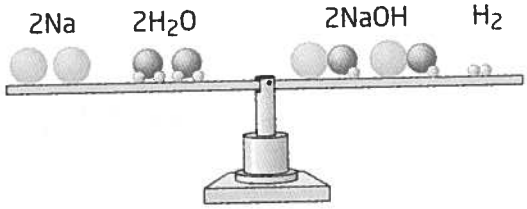
Name _____ Date _____

Topic **2.3** Summary

Atoms and mass are conserved during a chemical reaction.

During a chemical reaction, atoms are not created and they are not destroyed. The atoms of the reactants are rearranged to make new products. This is the **law of conservation of mass** and why **chemical reactions must be balanced**. The number of atoms of each element on the reactant side of the equation must be the same as the number of atoms of each element on the product side.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$



Balance an Equation

1. Make a table of reactants and products. Count how many of each type of atom are on each side of the equation.
2. Find an unbalanced atom. Multiply the compound on the other side of the equation, which has that atom, by a number to balance this atom in the reaction. Change the numbers in your table to show the change.
3. Repeat step 2 for any other unbalanced atoms, until all the atoms are balanced.
4. Count the atoms on each side of the equation to make sure that they are all balanced.

Reading Check

3. Balance the following equation.

__ Na + __ $CuCl_2$ →
__ Cu + __ NaCl

Name _____ Date _____

Cloze Activity
Topic 2.3

Use with textbook pages 142 to 145.

Chemical reactions and chemical compounds

Vocabulary		
a gas forms a precipitate forms and balanced chemical formulas colour change	decomposition double displacement heat produced light produced products react to produce	reactants single displacement synthesis word equation

Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term. Some questions have more than one correct answer.

1. A reaction in which a metal element displaces the metal atom of a compound is a _____ reaction.

2. In a reaction, the "→" means _____ while the "+" means _____.

3. A _____ uses words to describe what happens to reactants and products during a chemical reaction.

4. In order to make sure the number of atoms in the reactants is equal to the number of atoms in the products, chemical reactions must be _____.

5. Two clues that a chemical reaction has occurred are _____ and _____.

6. The beginning substances in a chemical reaction are the _____ while the ending substances are the _____.

7. The chemical reaction $Ag + O_2 \rightarrow Ag_2O$ is a _____ reaction.

8. A reaction in which one reactant breaks into two smaller products is a _____ reaction.

9. In order to understand chemical equations around the world, _____ are used instead of word equations because they mean the same thing in every country.

Name _____ Date _____

Comprehension
Topic 2.3

Use with textbook pages 144 to 145.

Classifying chemical equations

Classify each of the following reactions as a synthesis (S), decomposition (D), single displacement (SD), or double displacement (DD).

_____ **1.** copper chloride + zinc → zinc chloride + copper

_____ **2.** magnesium + oxygen → magnesium oxide

_____ **3.** aluminum fluoride + bromine → aluminum bromide + fluorine

_____ **4.** lead nitrate + potassium iodide → lead iodide + potassium nitrate

_____ **5.** nickel sulfide → nickel + sulfur

_____ **6.** lead + bromine → lead bromide

_____ **7.** sodium sulfide + barium hydroxide → sodium hydroxide + barium sulfide

_____ **8.** tin iodide → tin + iodine

_____ **9.** $Ni\ I_2 + F_2 \rightarrow NiF_2 + I_2$

_____ **10.** $K + HOH \rightarrow KOH + H_2$

_____ **11.** $Cu + AgNO_3 \rightarrow Cu(NO_3)_2 + Ag$

_____ **12.** $HgO \rightarrow Hg + O_2$

_____ **13.** $Ba + Cl_2 \rightarrow BaCl_2$

_____ **14.** $H_2S + LiOH \rightarrow Li_2S + HOH$

_____ **15.** $CoBr_2 + Pb(NO_3)_2 \rightarrow bBr_2 + Co(NO_3)_2$

_____ **16.** $Ba + P_4 \rightarrow Ba_3P_2$

Name _____ Date _____

Comprehension
Topic 2.3

Use with textbook pages 145 to 147.

Word equations into chemical equations

Classify each chemical reaction as a synthesis (S), decomposition (D), single displacement (SD), or double displacement (DD). Then express the word equation as a chemical equation.

_____ **1.** magnesium + sulfur → magnesium sulfide

_____

_____ **2.** sodium hydroxide → sodium oxide + water

_____

_____ **3.** calcium sulfide + hydrogen chloride → calcium chloride + hydrogen sulfide

_____

_____ **4.** chlorine + strontium iodide → strontium chloride + iodine

_____

_____ **5.** silver oxide → silver + oxygen

_____

_____ **6.** calcium hydroxide + hydrogen nitride → hydrogen hydroxide + calcium nitride

_____

_____ **7.** lithium + silver fluoride → lithium fluoride + silver

_____

_____ **8.** aluminum chloride + sodium bromide → sodium chloride + aluminum bromide

_____

_____ **9.** zinc + magnesium phosphide → magnesium + zinc phosphide

_____

_____ **10.** sodium + oxygen → sodium oxide

_____

Name _____ Date _____

Analyze the Information
Topic 2.3

Use with textbook pages 148 to 151.

Balancing chemical equations

Refer to page 149 for detailed instructions on how to balance chemical equations.

Balance each chemical equation by inserting the correct coefficients, or numbers.

1. ___ NI_3 → ___ N_2 + ___ I_2
2. ___ Fe_2O_3 + ___ HCl → ___ $FeCl_3$ + ___ H_2O
3. ___ Zn + ___ Cu_3N_2 → ___ Cu + ___ Zn_3N_2
4. ___ $PbCl_2$ + ___ NaI → ___ PbI_2 + ___ NaCl
5. ___ H_2S + ___ Al → ___ H_2 + ___ Al_2S_3
6. ___ As + ___ O_2 → ___ As_2O_5
7. ___ Al + ___ I_2 → ___ AlI_3
8. ___ HgO → ___ Hg + ___ O_2
9. ___ Ba + ___ HOH → ___ H_2 + ___ $Ba(OH)_2$
10. ___ K + ___ Br_2 → ___ KBr
11. ___ SiO_2 + ___ HF → ___ SiF_4 + ___ H_2O
12. ___ S + ___ O_2 → ___ SO_3
13. ___ Cl_2 + ___ $FeBr_3$ → ___ $FeCl_3$ + ___ Br_2
14. ___ H_2 + ___ F_2 → ___ HF
15. ___ Li + ___ H_2O → ___ LiOH + ___ H_2
16. ___ CuI_2 + ___ Fe → ___ FeI_2 + ___ Cu
17. ___ BN + ___ F_2 → ___ BF_3 + ___ N_2
18. ___ $FeCl_3$ + ___ $Ca(OH)_2$ → ___ $Fe(OH)_3$ + ___ $CaCl_2$

Name _____ Date _____

Applying Knowledge
Topic 2.3

Use with textbook pages 146–152.

Chemical reactions and chemical equations

Rewrite the each sentence as a **chemical word equation**. Then write the chemical equation for the reaction by first writing the **chemical formula** for each reactant and product, and then **balance the chemical equation**.

1. When aluminum metal is exposed to oxygen, aluminum oxide is formed.

   word equation: _____

   chemical equation: _____

2. Water reacts with sodium oxide powder to produce a sodium hydroxide solution.

   word equation: _____

   chemical equation: _____

3. Hydrogen gas reacts with nitrogen trifluoride gas to form nitrogen gas and hydrogen fluoride.

   word equation: _____

   chemical equation: _____

4. When heated vigorously, mercury oxide breaks down into liquid mercury and oxygen gas.

   word equation: _____

   chemical equation: _____

5. When solid phosphorus is burned in oxygen, phosphorus trioxide is formed.

   word equation: _____

   chemical equation: _____

6. Copper sulfide decomposes into copper and sulfur when heated in a very hot flame.

   word equation: _____

   chemical equation: _____

Name _____ Date _____

Applying Knowledge
Topic 2.3

7. Chlorine and sodium iodide react to form sodium chloride and iodine.

word equation: _____

chemical equation: _____

8. When silver chloride is mixed with sodium sulfide, sodium chloride and silver sulfide are formed.

word equation: _____

chemical equation: _____

9. When grey zinc powder and yellow sulfur powder are mixed and then heated, a white solid called zinc sulfide is formed.

word equation: _____

chemical equation: _____

10. Hydrogen chloride mixes with sodium hydroxide forming sodium chloride and water (hydrogen hydroxide).

word equation: _____

chemical equation: _____

Name _____ Date _____

Assessment
Topic 2.3

Use with textbook pages 140 to 157.

What happens during a chemical reaction, and how can it be described?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ law of conservation of mass	**A.** a representation of a chemical reaction using words.
2. _____ double displacement reaction	**B.** a reaction in which the metal atoms of two compounds "switch."
3. _____ synthesis reaction	**C.** a chemical reaction in which the total mass and number of atoms of the reactants equal the total mass and number of atoms of the products.
4. _____ chemical equation	**D.** a reaction in which two elements combine to form a compound.
5. _____ word equation	**E.** a representation of a chemical reaction using formulas.

6. Write the chemical equation for the given word equation.

carbon + oxygen → carbon dioxide

_____

7. Balance the chemical equations.

a) _____ GaF_2 + _____ Cs → _____ CsF + _____ Ga

b) _____ Na + _____ O_2 → _____ Na_2O_2

8. Label each reaction as synthesis (S), decomposition (D), single displacement (SD), or double displacement (DD).

_____ **a)** sodium nitride → sodium + nitrogen

_____ **b)** $Cl_2 + KI \rightarrow KCl + I_2$

9. What types of reactions are shown? Write the balanced chemical equations.

_____ **a)** phosphorus + chlorine → phosphorus trichloride

_____

_____ **b)** zinc hydroxide + hydrogen chloride → zinc chloride + hydrogen hydroxide

_____

Name _____ Date _____

Topic **2.4** Summary

Textbook pages 158 to 175

What are acids and bases, and how do they react?

Before You Read

You may have heard the word *acid* used in your everyday life. List some things that this word was describing when you heard it.

_____

Acids and bases are compounds with specific properties.

Acids	Bases
• taste sour	• taste bitter
• corrode metals	• have a slippery texture
• corrode animal tissues	• corrode animal tissues
• turn litmus red	• turn litmus blue
• neutralize bases	• neutralize acids
Found in:	**Found in:**
• sour foods	• bitter foods
• batteries	• batteries
• medicines	• medicines
• cleaning products	• cleaning products

NEVER taste any unknown acid or base. Many are dangerous and can cause severe burns and sometimes death. ✔

To identify an acid from a base, you can use an acid-base indicator, such as litmus paper. When placed in an acid, litmus paper turns red. When placed in a base, litmus paper turns blue.

You can also use a pH scale to identify an acid from a base. The scale ranges from 0 (most acidic) to 14 (most basic). A pH of 7 is neutral, meaning the substance is neither acidic nor basic. ✔

Name _____ Date _____

Topic **2.4** Summary

An acid and a base react in a neutralization reaction to produce a salt and water.

A neutralization reaction is a double displacement reaction between an acid and a base that produces water and a salt. A "salt" is a general term that means an ionic compound that is usually neutral.

$$HA + B\text{-}OH \rightarrow AB + H_2O\ (HOH)$$

- HA: Acids have a hydrogen (H)
- B-OH: Bases have hydroxide (OH)
- AB: The other parts of the acid and base combine to make a salt
- H_2O (HOH): The hydrogen (H) and the hydroxide (OH) often combine to make water (H_2O or HOH)

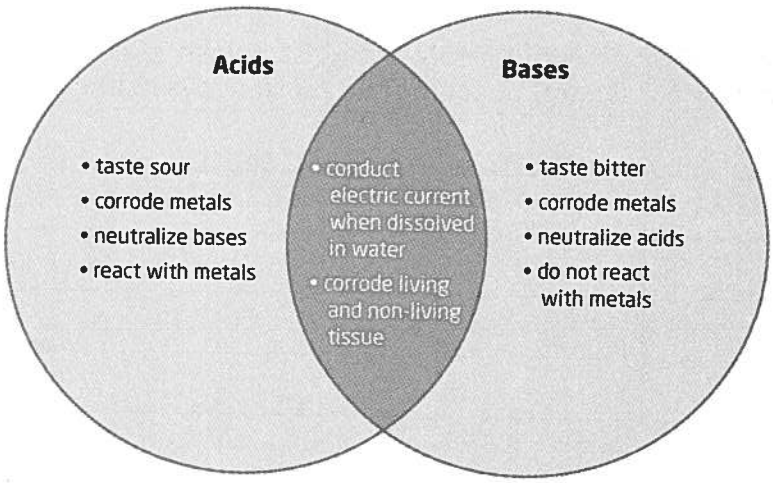
$$HBr + LiOH \rightarrow LiBr + H_2O\ (HOH)$$

- HBr: pH < 7 turns blue litmus red
- LiOH: pH > 7 turns red litmus blue
- LiBr: pH = 7 (neutral) no change to litmus paper

Some examples of useful everyday neutralization reactions include using **antacids** to neutralize stomach acid and using a base called calcium hydroxide or "lime" to neutralize acid spills that may happen when acids are transported from where they are manufactured to where they are used.

Acid and base reactions require safe handling to minimize hazards.

Many chemicals can be dangerous at home and in the workplace. Hair stylists wear gloves to protect their hands, auto body technicians wear full-face air-purifying respirators when painting cars, custodians need to be careful what chemicals they use and mix together, and welders need to wear eye protection.



Reading Check

1. Describe one difference between acids and bases.

_____

_____

_____

_____

2. Is a substance with a pH of 4.5 an acid or a base?

_____

3. What is the pH of table salt?

_____

_____

Name _____ Date _____

Applying Knowledge
Topic 2.4

Use with textbook pages 160 to 163.

pH of acids and bases

1. a) What is an acid-base indicator? Give an example.

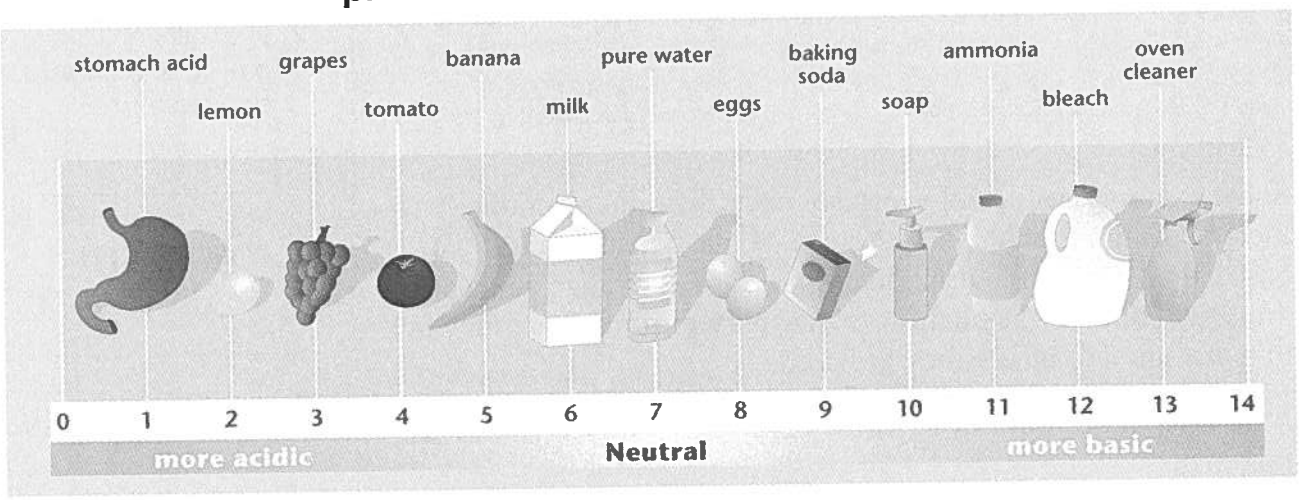
_____

b) What is a pH scale?

_____

2. Complete the table using the information shown in the scale. Identify if the substance is an acid or a base. Then, sort the items from most acidic to most basic.

pH values of common substances



Substance	pH value	Acid or base?	Most acidic (1) to most basic (9)
lemon			
ammonia			
milk			
tomato			
oven cleaner			
egg			
soap			
grapes			
pure water			

Name _____ Date _____

Comprehension
Topic 2.4

Use with textbook pages 160 to 165.

Acids, bases, and neutralization

1. Compare and contrast acids and bases by completing the following table.

	Acids	Bases
Definition		
pH range		
Taste		
Touch		
Electrical conductivity		
Reaction with metals		
Reaction with litmus paper		
Examples		

2. Why must you NEVER taste an unknown acid or base?

_____

3. a) Circle the correct general description of a neutralization reaction.

A. ionic compound + base gives ionic acid + oxide

B. acid + base gives salt + water

C. acid + base gives ionic compound + oxide

b) Circle the correct general equation for a neutralization reaction.

A. $HA + B\text{-}OH \rightarrow AB + H_2O$

B. $HA_2 + B\text{-}OH \rightarrow HB + HA_2O$

C. $2HA + B\text{-}OH \rightarrow HB + 2HAO$

4. Balance the following neutralization reactions.

i) _____ HBr + _____ $KOH \rightarrow$ _____ KBr + _____ HOH

ii) _____ HF + _____ $Fe(OH)_3 \rightarrow$ _____ FeF_3 + _____ HOH

iii) _____ HCl + _____ $Ca(OH)_2 \rightarrow$ _____ $CaCl_2$ + _____ HOH

5. a) What is a salt?

_____

b) Name each of the salts produced in the equations in question 4.

i) _____

ii) _____

iii) _____

Name _____ Date _____

Cloze Activity
Topic 2.4

Use with textbook pages 160 to 165.

Acids and bases

Vocabulary		
acid acid-base indicator antacid base	blue neutral neutralization reaction	pH scale red salt

Use the terms in the vocabulary box to fill in the blanks. Use each term only once.

1. A compound that tastes sour, corrodes metals and tissue, and turns blue litmus paper _____ is a(n) _____.

2. A compound that tastes bitter, has a slippery texture, corrodes tissue, and turns red litmus paper _____ is a(n) _____.

3. A substance that changes colour when it is added to an acid or a base, or when an acid or a base is added to it, is called a(n) _____.

4. A _____ is a scale from 0 to 14 that describes how acidic or basic a substance is. A pH value of 7 is _____.

5. An acid and a base react in a _____ to produce a _____ and water.

6. An _____,which is used to neutralize stomach acid, is an example of a neutralization reaction.

Name _____ Date _____

Assessment
Topic 2.4

Use with textbook pages 158 to 175.

What are acids and bases, and how do they react?

Match each Term in the top box on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ acid	**A.** a series of numbers from 0 to 14, which describes how acidic or basic a substance is.
2. _____ base	**B.** a double displacement reaction which involves mixing an acid and a base.
3. _____ neutralization	**C.** reacts with metals, tastes sour, and turns litmus paper red.
4. _____ pH scale	**D.** a substance which is one colour when added to a base and a different colour when added to an acid.
5. _____ acid-base indicator	**E.** turns litmus blue, feels slippery, and tastes bitter.

6. You bite into an apple. It tastes very sour. Use your knowledge of acids and bases to explain what type of substance must be in the apple. Explain how you could test to confirm what you think.

_____

_____

_____

_____

7. Explain which properties make bases good for oven and drain cleaning products.

_____

_____

8. Classify each substance as acidic, basic, or neutral.

	Substance	pH	Acidic, basic, or neutral?
a)	blood	7.6	
b)	tap water	7.3	
c)	bleach	12.0	
d)	grapefruit	2.3	

9. a) Circle the neutralization reaction.

i) $NaCl + Ag_2S \rightarrow Na_2S + AgCl$

ii) $HCl + KOH \rightarrow KCl + HOH$

b) Explain how you know your choice is correct.

_____

_____

c) What are the names of the products in the neutralization reaction?

_____

_____

Name _____ Date _____

Unit 2

Literacy Test Preparation

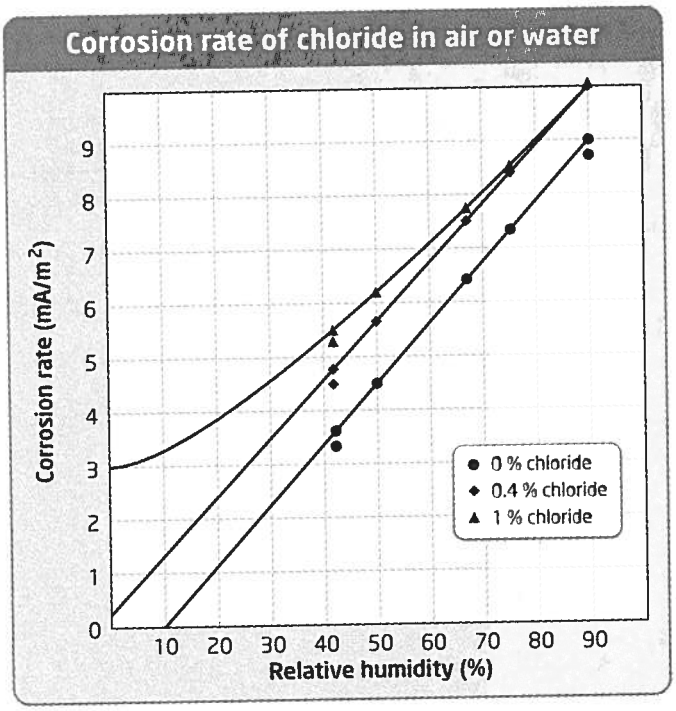
Read the selection below and answer the questions that follow it.

The chemistry of crumbling bridges

Many roadways in Ontario travel over rivers and rough terrain. Bridges allow vehicles access to many parts of the province. The material used to build the bridges for our roadways is concrete. But these concrete bridges require additional material to support cars and trucks on the roadway. The bridges are supported by bars placed inside the concrete. These bars are mainly made of iron. Over time, the concrete breaks down and the iron bars become exposed to air. Iron is an element that will break down when it is exposed to oxygen and water (which are both found in the air). This reaction is called a *corrosion reaction* and the iron will break down according to this equation:

$$2Fe + O_2 + 2H_2O \rightarrow 2Fe(OH)_2$$

There are a number of factors that increase the rate of corrosion—one is exposure to chloride. During winter, roads are sprinkled with road salt to make them safe for travel. The graph shows the rate of corrosion for different amounts of chloride in the air or water.



Name _____ Date _____

Unit 2

Multiple Choice

Select the best or most correct answer.

1. Which chemicals are necessary for corrosion?
   - **A.** iron
   - **B.** iron and oxygen
   - **C.** iron, oxygen, and water
   - **D.** iron, oxygen, water, and chloride

2. Which reactant in the equation does relative humidity refer to?
   - **A.** iron
   - **B.** oxygen
   - **C.** water
   - **D.** chloride

3. What happens to the rate of corrosion as the relative humidity increases?
   - **A.** As the relative humidity increases, the rate of corrosion decreases.
   - **B.** As the relative humidity increases, the rate of corrosion stays the same.
   - **C.** As the relative humidity increases, the rate of corrosion remains constant.
   - **D.** As the relative humidity increases, the rate of corrosion increases.

4. How does the concentration of chloride affect the rate of corrosion?
   - **A.** The lower the concentration of chloride, the faster the rate of corrosion.
   - **B.** The greater the concentration of chloride, the faster the rate of corrosion.
   - **C.** The greater the concentration of chloride, the slower the rate of corrosion.
   - **D.** The concentration of chloride does not affect the rate of corrosion.

5. Where does the chloride come from?
   - **A.** road salt
   - **B.** air
   - **C.** concrete
   - **D.** table salt

Short Answer

6. Write a paragraph expressing your opinion about whether or not road salt should be used on bridges in the winter. Use evidence from the selection and from the material you learned in this unit to support your opinion.

Name _____ Date _____

Unit 3

Using Your Appendices

Science Skills Toolkit 1: Analyzing Issues—Science, Technology, Society, and the Environment

Use with textbook pages 367 to 370.

Studying the past and present effects of climate change, and predicting the future climate, can be challenging for scientists. Before they can make decisions, scientists need to carefully consider the facts about this issue. This is called *analyzing the issue*. How can you analyze an issue about the effects of climate change?

Steps to Analyzing Issues

1. *Identify the issue.*
   What is the question that you need to form an opinion about?
2. *Research information on the issue.*
   You can find information about an issue from many different sources. These include:
   - the Internet
   - books
   - newspapers and magazines
   - TV
   - radio
   - talking to experts

   When you research information, make sure the information is presented in a fair and non-judgmental way. Keep notes as you gather information. Record your sources. You can use flowcharts, concept maps, and cause-and-effect maps to organize your work.
3. *Consider alternatives.*
   As you research, you may come across conflicting ideas and new questions. As a result, you may have to do more research.
4. *Weigh the pros and cons.*
   When you have finished your research, consider the pros and cons of each option. You can use a rating system or a chart to help keep track of your opinions.
5. *Make a decision.*
   Look through your notes and research. Make sure you understand the issue and solutions well before you make a decision and present your thoughts to others.
6. *Evaluate your decision.*
   Based on the pros and cons, is your choice the best option? If you are not satisfied with your decision, consider other options. You may wish to do additional research.
7. *Take action or communicate your decision.*
   You may choose to take action, as either an individual or as part of a group, or to communicate your decision for others to think about.

Name _____ Date _____

Unit 3

Questions:

1. Identify three sources of information that you could use to research an issue about climate change.

_____

_____

2. Why is it important to only use information that is presented in a fair way?

_____

_____

3. Greenhouse gases such as methane are one of the causes of global warming. Cattle that are raised for their meat and milk are one of the main sources of methane. Some people believe that the solution to this problem is for all Canadians to become vegetarians. Use a graphic organizer to show the pros and cons of this solution. Indicate whether you have any bias in this issue.

4. Imagine that a car manufacturer claims that there is no link between climate change and cars.

   a) What possible bias might be present in this claim?

   _____

   _____

   b) What steps could you take to determine if this claim is accurate or not?

   _____

   _____

   _____

Name _____ Date _____

Topic **3.1** Summary

What is climate, and how has it changed during Earth's history?

Textbook pages 192 to 201

Before You Read

What do you know about climate change? Write what you know and what you have heard on the lines below.

_____

_____

_____

_____

Climate and weather are different, but linked.

Weather describes what is happening in the atmosphere right now. It is the current conditions of the atmosphere at a specific time and place. The **atmosphere** is the layer of gases that surrounds Earth.

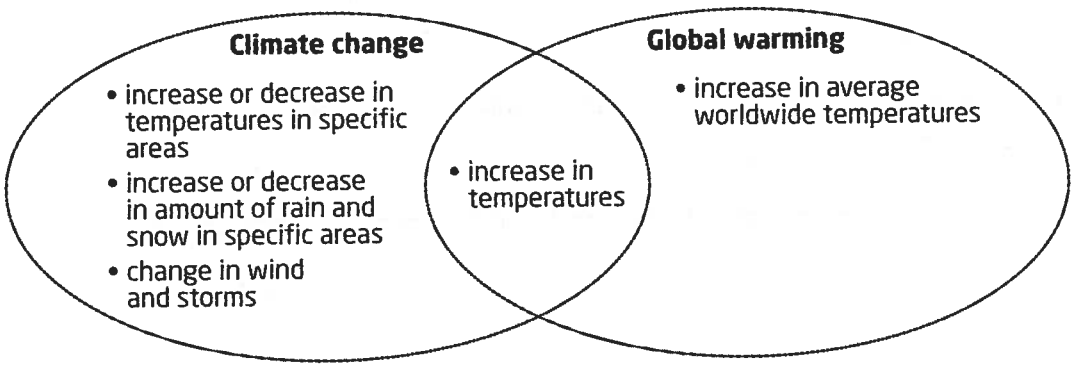
Climate refers to weather patterns for a large area over a long time—years, decades, centuries, or even longer.

Climate Change and Global Warming Are Not the Same Thing

Global warming is an increase in average global (worldwide) air temperature. Climate change involves changes in air temperature, as well as changes in other parts of the weather such as rain and snow, wind, and storms. These changes are usually very slow and gradual.

Climate has changed frequently throughout Earth's past.

Discoveries of fossils have shown that some areas that are now cold were once tropical, and some areas experienced ice ages and were covered with glaciers. Some of these changes happened over millions of years, and some happened over hundreds of thousands of years. Scientists are concerned about climate change today because it is happening more quickly than it ever has before. This is because of the effects that humans are having on Earth.



Name _____ Date _____

Comprehension
Topic 3.1

Use with textbook pages 194 to 199.

Weather and climate

1. Scientists discovered a dinosaur fossil in Greenland. What does this mean about Greenland's climate in the past?

_____

2. We know that Earth's climate has changed before. Why are scientists worried about climate change today?

_____

3. What are three examples of how changes in climate are affecting some parts of the world?

_____

_____

_____

4. Explain how global warming is different from climate change.

_____

_____

5. Your friend is talking about how cold it is today. Is she talking about weather or climate? Explain.

_____

_____

6. Your grandfather said when he was your age, it used to snow so much that he would have to climb out his bedroom window to leave his home. Is he discussing the weather or climate? Explain.

_____

_____

7. An ice shelf in Antarctica collapsed into the ocean. This would be a result of what process? Explain.

_____

_____

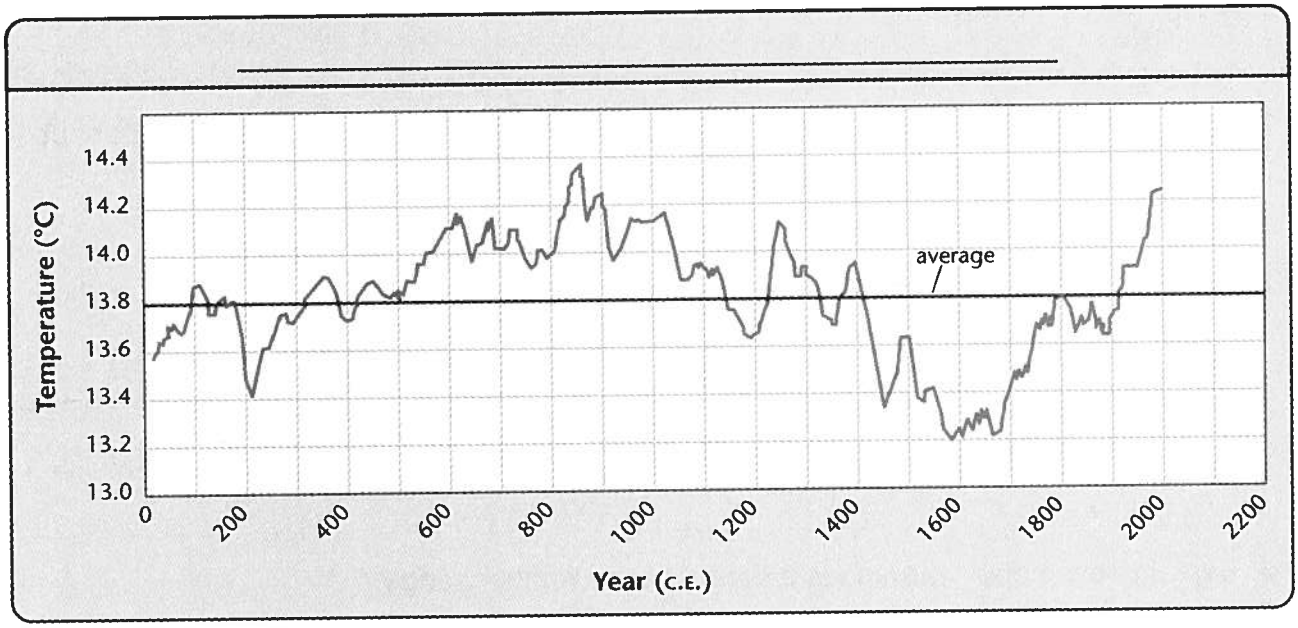
Name _____ Date _____

Analyze the Information
Topic 3.1

Use with textbook pages 194 to 199.

Earth's temperatures

Use the information on the graph to answer the following questions.



1. Add a title to the graph.

_____

2. In the year 2000, were temperatures warmer than average or cooler than average?

_____

3. The Little Ice Age occurred during what time period?

_____

4. On the graph, draw your prediction of how the average global temperatures will change over your lifetime.

5. For question 4, explain why you think the average global temperatures will change this way.

_____

_____

Name _____ Date _____

Assessment
Topic 3.1

Use with textbook pages 192 to 201.

What is climate, and how has it changed during Earth's history?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ atmosphere	**A.** an increase in Earth's average worldwide temperature.
2. _____ weather	**B.** the pattern of weather conditions within a region over a long time period.
3. _____ climate	**C.** changes in weather conditions experienced by a region over a long period of time.
4. _____ global warming	**D.** the layer of gases that surrounds Earth.
5. _____ climate change	**E.** the conditions of the atmosphere for a specific place at a specific time.

6. Describe three ways that climate is changing now around the world.

_____

_____

_____

7. What new factor is influencing Earth's climate?

_____

_____

_____

8. If we are in a time of global warming, does that mean that every place on Earth is getting warmer every year? Why or why not?

_____

_____

_____

Name _____ Date _____

Topic 3.2 Summary

Where are the effects of climate change felt, and what is their impact?

Textbook pages 202 to 211

Before You Read

What effects might climate change have on terrestrial ecosystems? What effects might there be on aquatic ecosystems?

_____

_____

Reading Check

1. What are three ways that climate change is affecting ecosystems in the oceans?

_____

_____

_____

Climate change affects aquatic ecosystems.

Sea ice in the Arctic and Antarctic is melting. This is threatening the people and wildlife that depend on the ice for survival. As the sea ice disappears, krill, the organisms at the bottom of the food chain, die. The animals that eat krill move outside their normal feeding areas and create new food chains. Some species may disappear as a result of this new competition.

Warmer ocean waters are killing coral reefs, the nurseries of the oceans. Warmer oceans also affect ocean currents. As ocean water gets warmer, currents are slowing down. This can change the climates of nearby lands.

Warmer temperatures are melting glaciers and mountain snow packs, creating more run-off and adding to an increase in sea level. A rising sea level puts coastal areas in danger of flooding. Tropical storms and hurricanes form over warm ocean water. As ocean waters increase in temperature, storms and hurricanes will become more severe.

Climate change affects terrestrial ecosystems.

As habitats change, many organisms that are unable to adapt will die out. As many as a million species are at risk. Many Canadian migrating birds are changing their migration habits and staying longer through the winter months. Unfortunately, since Canadian winters are still harsh, many of these birds, such as the summer tanager, will not survive until spring.

Glacial land ice is melting and may all disappear by 2050. In addition, permafrost, the permanently frozen layer of soil in Canada's far north, is starting to melt. Many trees and buildings depend on permafrost for stability. When the permafrost melts, the soil shifts, causing trees to lean over and buildings to collapse.

Topic 3.2 Summary

Increased temperatures and decreased rainfall lead to desertification—the spreading of deserts. Crops may fail and water reservoirs may dry out, leading to food and water shortages.

Severe weather, such as heat waves, drought, storms, and floods, can cause injuries to humans and destruction of property, leaving people homeless and vulnerable to disease. In addition, certain diseases and virus-carrying insects are thriving in areas where the climate is becoming warmer and wetter. For example, West Nile virus, carried by mosquitoes, is harmful to some organisms, including humans. It first appeared in North America in 1999. It is now found in Ontario and other parts of Canada. ✔

Both positive and negative impacts of climate change are occurring worldwide.

While climate change has many negative effects, it also has some positive effects. Some of each are shown in this table.

Positive and Negative Effects of Climate Change

Climate change	Positive Effects	Negative Effects
Melting sea ice	• new shipping lanes can open • new oil and gas reserves become available	• flooding • organisms die and food chains are broken • people can no longer hunt and fish on sea ice
Warmer ocean water		• organisms die or move and food chains are broken
Rising sea level		• flooding • habitats are destroyed • loss of human life
Melting land ice		• adds to already rising sea levels • loss of permafrost means trees and buildings in arctic become unstable
Warmer air temperatures	• longer growing seasons in cool areas, such as Canada	• desertification • drought causes crops to die • migrating birds change their patterns, and may die out • some diseases are spreading to new areas

✔ *Reading Check*

2. What are three ways that climate change is affecting ecosystems on land?

Name _____ Date _____

Applying Knowledge
Topic 3.2

Use with textbook pages 204 to 205.

How climate change affects aquatic ecosystems

Complete the table to describe how climate change affects aquatic (water) ecosystems.

Climate Change		
Effects of climate change	**Organisms that are affected**	**Additional information**
Melting sea ice		
New food chains		
Warmer oceans		
Rising sea levels		
More violent storms		

Name _____ Date _____

Cloze Activity
Topic 3.2

Use with textbook pages 206 to 209.

Climate change affects ecosystems.

Vocabulary	
climate change desertification disease global migration	mosquitoes sea permafrost tropical storms

Use the terms in the vocabulary box to fill in the blanks. Use each term only once.

1. The spread of deserts is called _____.
2. Flooding and heavy rainfall can affect human health by creating conditions that are favourable for _____.
3. _____ is the term used to describe when birds or other species travel south for the cold winter months.
4. "Drunken forests" are forest with trees that lean, instead of growing vertically. They are caused by the melting of the _____ layer in the soil of Canada's North.
5. _____ is a complex process that can cause both drought and flooding.
6. Melting glaciers add their meltwater to already rising _____ levels.
7. As ocean water becomes warmer, _____ become more severe.
8. The West Nile virus, which is carried by _____ is now present in Ontario and other regions of Canada.
9. Climate change is a _____ concern.

Name _____ Date _____

Comprehension
Topic 3.2

Use with textbook pages 204 to 209.

Climate change

Answer the questions.

1. List three effects of climate change that could be positive and explain why.

_____

_____

_____

2. Why is coral bleaching a problem for aquatic ecosystems?

_____

_____

_____

3. In what way does the melting of sea ice affect the traditional Inuit way of life?

_____

_____

4. Why is the melting of permafrost in Canada's North a concern?

_____

_____

5. How are floods connected to illness and disease for humans?

_____

_____

6. Why might some areas of the world be more affected by climate change than others?

_____

_____

_____

Name _____ Date _____

Assessment
Topic 3.2

Use with textbook pages 202 to 211.

Where are the effects of climate change felt, and what is their impact?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ bleaching	A. land based.
2. _____ West Nile virus	B. water based.
3. _____ desertification	C. the effect of warm ocean waters on corals.
4. _____ aquatic	D. a mosquito-borne illness that flourishes in warm, wet conditions and is harmful to humans.
5. _____ terrestrial	E. the spread of deserts.

6. How can food chains change in ocean ecosystems due to climate change?

_____

_____

_____

7. Explain how climate change makes permafrost less permanent.

_____

_____

8. Explain why climate change can create drought in one area and flooding in another.

_____

_____

_____

_____

Name _____ Date _____

Topic **3.3** Summary

What natural factors affect climate, and how do they affect it?

Textbook pages 212 to 229

Before You Read

Not all the effects on Earth's climate are a result of human actions. What are some natural factors that have an effect on Earth's climate?

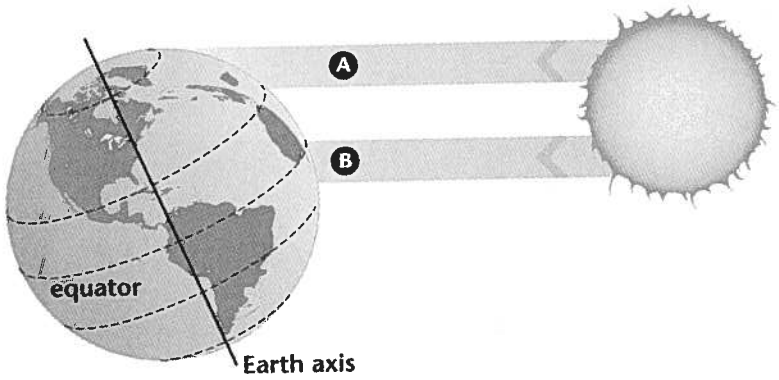
_____

_____

Interactions of the Sun and Earth affect climate.

The Sun is the most important factor affecting Earth's climate. The Sun gives off *solar energy*, which is light, heat, and other forms of energy. The amount of solar energy varies from decade to decade. In more active years, the Sun gives off more solar energy. In general, this causes temperatures on Earth to increase. During less active years, in general, temperatures on Earth decrease. Changes in temperature also cause changes in precipitation patterns.

Since Earth is a sphere, the Sun's solar energy strikes Earth's surface at different angles.



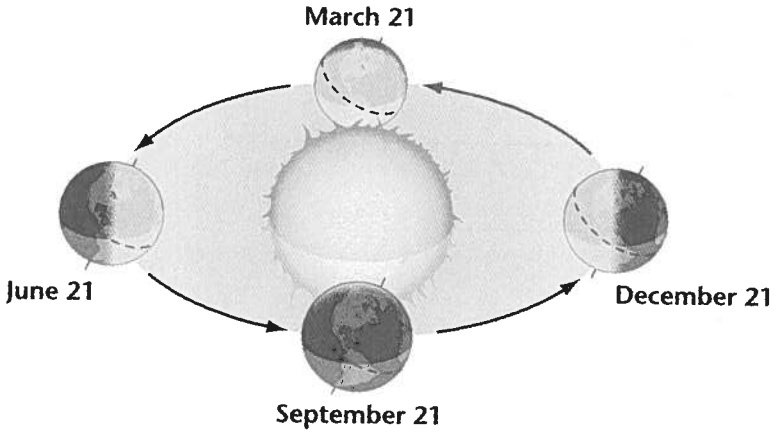
A. Near the north and south poles, the Sun's energy is spread out over a large area, so it does not warm the Earth very much.

B. Near the equator, the Sun's energy is spread over a smaller area, so it warms the Earth a lot. ✔

Earth's tilt is responsible for the patterns of the seasons. As Earth moves through its yearly orbit of the Sun, the northern hemisphere sometimes points toward the Sun and sometimes points away. When the northern hemisphere (including Canada) points toward the Sun, it experiences warmer temperatures (summer) and the southern hemisphere has cooler temperatures (winter). When the northern hemisphere points away from the Sun, the reverse is true.

Name _____ Date _____

Topic
3.3
Summary



The atmosphere affects climate around the world.

Earth's atmosphere affects climate in two main ways. It evens out temperatures and it transfers heat around the world.

Earth's atmosphere heats up close to the equator. Areas farther from the equator, such as Canada, are generally cooler. This uneven heating causes air to move. We call this movement of air wind. Hot air rises, cools, and then sinks in a huge circular pattern, carrying warmer air to cooler areas.

The natural greenhouse effect moderates Earth's temperature.

If Earth did not have an atmosphere, temperatures would be extreme. Certain gases in Earth's atmosphere absorb heat. This is a natural part of Earth's climate that helps to keep Earth's temperature moderate.

This process is called the "greenhouse" effect because it is similar to how greenhouses absorb and radiate solar energy to keep the air inside it warm. Solar energy penetrates the glass and warms the plants and other objects inside the greenhouse. When these plants and other objects radiate some of the heat, it can't pass through the glass panels. Instead, the heat is absorbed by air molecules and then radiated inside the greenhouse, keeping it warm.

Like the glass panels in a greenhouse, the greenhouse gases in Earth's atmosphere absorb the solar energy. They also absorb energy radiated from Earth's surface. Heat is trapped inside the atmosphere, and the gases radiate the heat, warming Earth.

Reading Check

1. Does more solar energy strike Earth at the equator or at Earth's poles?

_____

_____

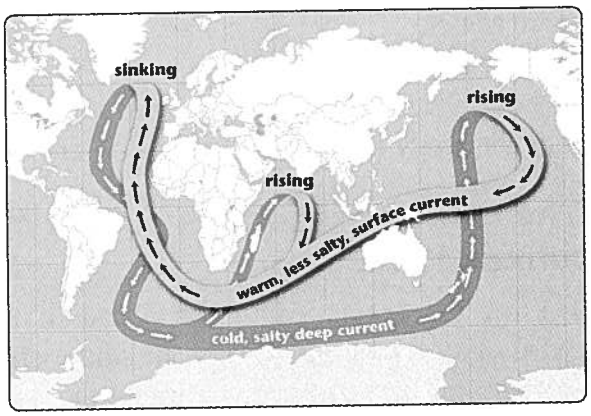
Name _____ Date _____

Topic **3.3** Summary

Greenhouse Gases	
Gas	**Natural Sources**
Water vapour	ocean evaporation plants and animals
Carbon dioxide	plants and animals volcanoes forest fires decaying organisms
Methane	bacteria in wetlands bacteria in the digestive system of some animals vents in Earth's crust
Nitrous oxide	bacteria in oceans and tropical soils

The hydrosphere affects global climate.

The hydrosphere includes all the water in all its forms on Earth. Oceans, lakes, rivers, ice, snow, and water vapour in the atmosphere are all part of Earth's hydrosphere. Like Earth's atmosphere, the hydrosphere helps to moderate temperatures and transfer heat.



It takes more heat to warm water than to warm an equal volume of air. The top 2 m of ocean water holds as much heat as Earth's entire atmosphere. Oceans also help moderate temperature by absorbing and storing the greenhouse gas carbon dioxide. This is called a *carbon sink*. Removing carbon dioxide from Earth's atmosphere helps keep Earth from getting too warm. When there is less carbon dioxide in the air, the oceans release it into the atmosphere again, keeping Earth from getting too cool.

The hydrosphere transfers heats around the planet in a huge deep-water current system called the great ocean conveyor belt.

Moving continents have a variety of effects on climate.

About 200 million years ago, the continents were grouped together at Earth's equator. In this location, the continents were very warm and they radiated their heat into Earth's atmosphere, making Earth a hot, steamy planet. Today, the continents are farther apart and there are land masses at Earth's poles. This has a cooling effect on the atmosphere and the whole planet. Cooler temperatures also affect precipitation. Changes in the locations of continents also affect wind patterns and ocean currents, which affect climate.

Name _____ Date _____

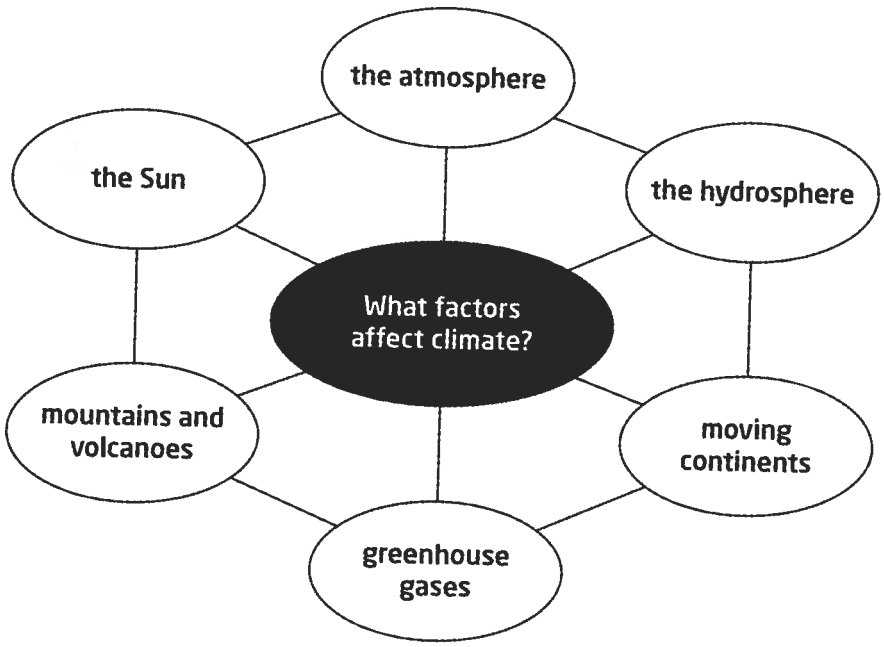
Topic **3.3** Summary

Moving continents affect climate in another way. When one piece of Earth's crust meets another, they push together to form mountains. Mountains force air higher up into the atmosphere. The air cools, then travels down the other side of the mountain, carrying the cooler air along the land. The mountains also affect rain and snowfalls by affecting the path of moisture-carrying winds. ✔

Sometimes there is volcanic activity where two pieces of crust meet. Volcanic eruptions can spew millions of tonnes of gas and dust into the atmosphere. These materials reflect solar energy and can have a severe cooling effect, which can continue for decades or longer. Volcanic eruptions affect precipitation patterns and can release greenhouse gases into the atmosphere, which can add to global warming.

The interaction of all natural factors affects climate in ways that are hard to predict.

Each of the factors in this topic affect climate and one another.



✔ *Reading Check*

2. List four greenhouse gases.

_____

_____

_____

_____

3. Does it take more heat to warm air or water?

_____

_____

4. How do mountains affect climate?

_____

_____

_____

_____

Name _____ Date _____

Applying Knowledge
Topic 3.3

Use with textbook pages 219.

Greenhouse gases

Complete the table.

Type of greenhouse gas	Natural sources	Other details
Water vapour		
Carbon dioxide		
Methane		
Nitrous oxide		

Name _____ Date _____

Comprehension
Topic 3.3

Use with textbook pages 214 to 223.

Earth's climate

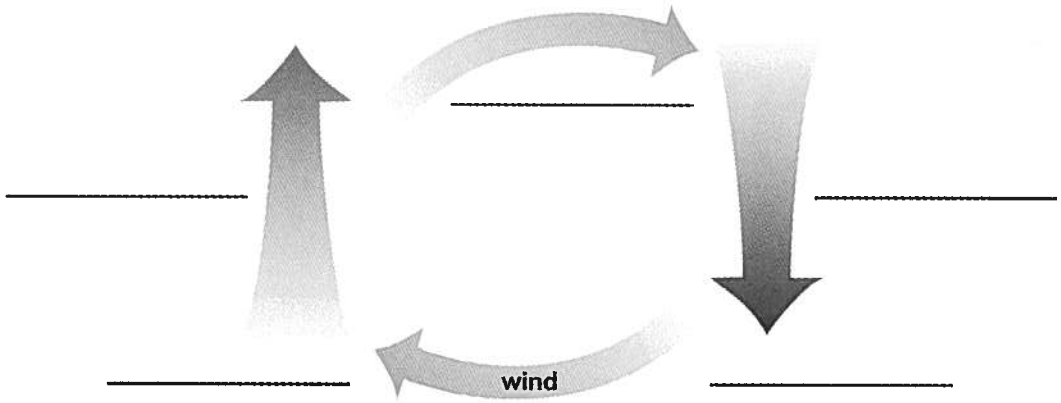
1. Earth's curved surface affects climate. Explain why.

_____

_____

_____

2. The atmosphere heats up unevenly, causing air in the atmosphere to move. Label the diagram to show this air movement. Use the following labels: *warm air*, *cold air*, *rises*, *sinks*, *wind*.



3. What is the greenhouse effect?

_____

_____

_____

4. Why is the greenhouse effect important?

_____

_____

5. Give an example to explain why it is challenging to predict changes in Earth's climate system.

_____

_____

_____

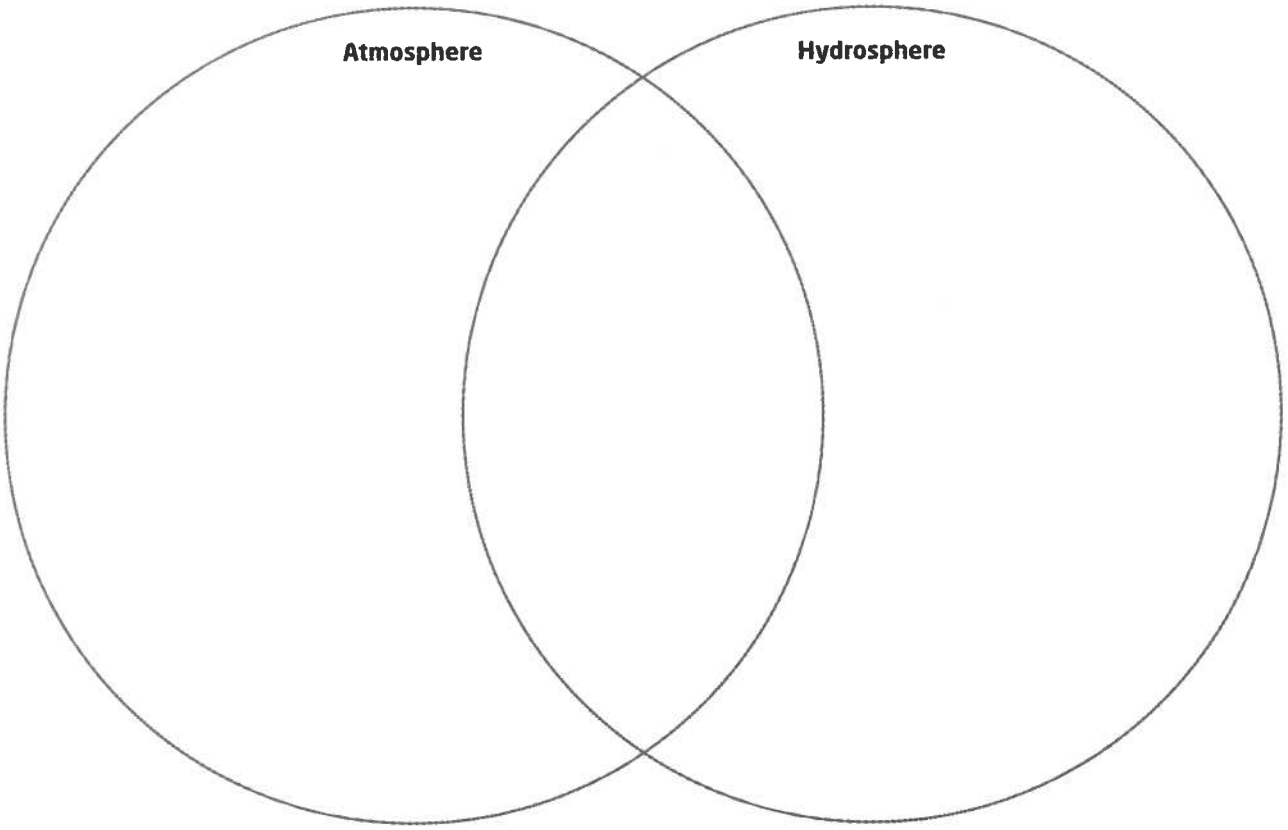
Name _____ Date _____

Applying Knowledge
Topic 3.3

Use with textbook pages 216 to 221.

Earth's atmosphere and hydrosphere

Use the Venn diagram to compare the atmosphere and the hydrosphere and how they affect Earth's climate.



Name _____ Date _____

Assessment
Topic 3.3

Use with textbook pages 212 to 229.

What natural factors affect climate, and how do they affect it?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. ____ heat sink	**A.** something that absorbs and holds carbon dioxide, for example: the oceans.
2. ____ greenhouse effect	**B.** light and other forms of energy from the Sun.
3. ____ hydrosphere	**C.** a process in which certain gases in Earth's atmosphere absorb heat from the Sun and heat radiated from Earth's surface.
4. ____ carbon sink	**D.** something that absorbs and keeps in heat, for example the atmosphere.
5. ____ great ocean conveyor belt	**E.** a huge deep-water current system in which the hydrosphere transfer heats around the planet.
6. ____ solar energy	**F.** all the water in all its forms on Earth, including oceans, lakes, rivers, ice, snow, and water vapour in the atmosphere.

7. Explain how Earth's tilt affects the intensity of solar energy that strikes Earth's surface.

_____

_____

_____

_____

8. How is Earth's orbit around the Sun responsible for the seasons?

_____

_____

_____

_____

9. Compare the greenhouse effect in Earth's atmosphere with the same effect in a greenhouse.

_____

_____

_____

_____

_____

Name _____ Date _____

Topic **3.4** Summary

How do human activities affect the natural greenhouse effect?

Textbook pages 230 to 241

Before You Read

What human activities can you think of that contribute to the greenhouse effect?

_____

_____

Human activities produce more greenhouse gases, which enhance the natural greenhouse effect.

Earth's average temperature is increasing very quickly. Most scientists agree that this is because human activities are enhancing the natural greenhouse effect. This phenomenon is called the *anthropogenic greenhouse effect*. (*Anthropogenic* means "human-caused.") It is connected with the start of the industrial revolution about 300 years ago. At that time, people started to move to cities to work in coal-fueled factories. More factories were built. These required more coal, and more people moved into the growing cities to find work.

Since then, people have been adding more and more greenhouse gases into the atmosphere. Human activities produce carbon dioxide, methane, and nitrous oxide—the same greenhouse gases that are produced naturally. Halocarbons are greenhouse gases that are only produced by humans.

Anthropogenic Greenhouse Gases	
Carbon dioxide	• produced from burning fossil fuels, such as coal, oil, and natural gas • produced from deforestation, or the clearing of land. Trees remove carbon dioxide through photosynthesis, so fewer trees means less carbon dioxide is removed.
Methane	• absorbs 25 times more heat than carbon dioxide • produced from farming—cows, sheep, and goats have bacteria in their guts that produce methane • produced from growing rice in flooded fields • produced from decomposing garbage in landfills
Nitrous oxide	• 300 times more of a heat sink than carbon dioxide • produced from the farming of crops and livestock, the use of fertilizers, and vehicle exhaust
Halocarbons (industrial chemical compounds such as chlorofluorocarbons (CFCs))	• are thousands of times more potent than carbon dioxide • are now banned in Canada • take thousands of years to break down in the atmosphere

Name _____ Date _____

Topic 3.4 Summary

Canadians add to the increase of greenhouse gases in the atmosphere.

Although Canada has less than 1 percent of the world's population, Canadians contribute nearly 2 percent of the world's greenhouse gases. The cause and effect map shows some of the activities that are responsible for greenhouse gas emissions.

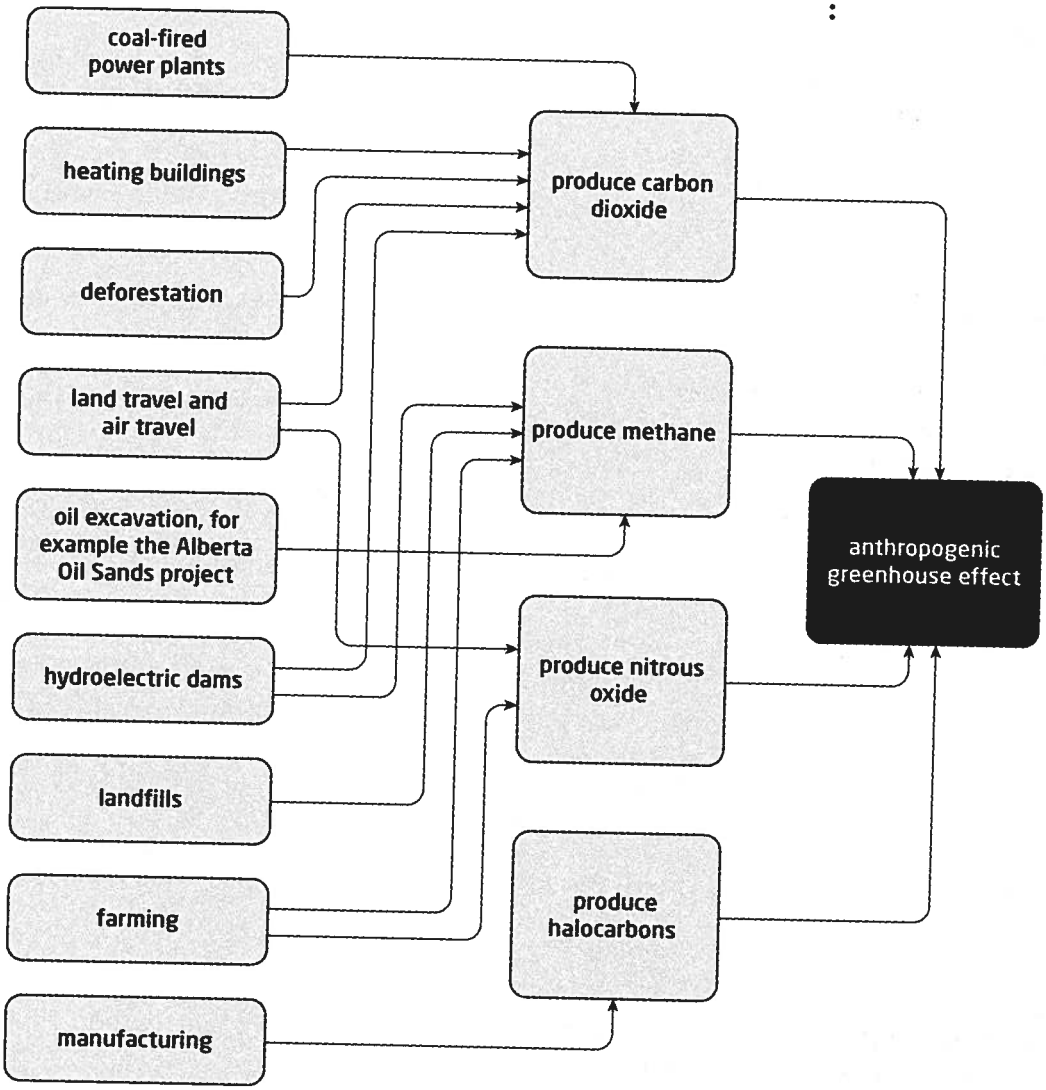
Reading Check

1. What does *anthropogenic* mean?

_____

_____

_____



Name _____ Date _____

Cloze Activity
Topic 3.4

Use with textbook pages 232 to 235.

Causes of greenhouse gases

Vocabulary	
coal fossil fuels halocarbons humans industrial revolution	landfills methane nitrous oxide oil sands urbanization

Use the terms in the vocabulary box to fill in the blanks. Use each term only once.

1. The anthropogenic greenhouse effect is different from the natural greenhouse effect because it is caused by _____
2. Greenhouse gases created entirely by humans and by industry are called _____.
3. _____ release greenhouse gases from both burning them and from extracting them.
4. Cows, sheep, and goats create _____ gas through the bacteria in their guts.
5. _____ are also responsible for releasing methane as the garbage decomposes.
6. _____ absorbs 300 times more heat than carbon dioxide.
7. Alberta's _____ are responsible for three times the greenhouse gas emissions than conventional oil.
8. The _____ marked the start of large amounts of human-produced greenhouse gases.
9. _____ involves clearing land, building roads, and increased transportation, all of which produce greenhouse gases.
10. Most of the electrical energy produced in the Maritimes, Alberta, and Saskatchewan comes from burning _____.

Name _____ Date _____

Applying Knowledge
Topic 3.4

Use with textbook pages 232 to 235.

Human activities that produce greenhouse gases

1. Canada is one of the coldest countries in the world. Explain why Canada's climate has an affect on the amount of greenhouse gases it produces.

_____

_____

_____

2. Rice growing, hydroelectric dams, and landfills all have something in common: methane emissions. Explain why.

_____

_____

_____

3. Explain how cutting down a tree affects greenhouse gases.

_____

_____

_____

4. Which greenhouse gas is more potent: carbon dioxide or methane? Explain your answer.

_____

_____

_____

5. Although you might not have thought so, farming is a contributor to greenhouse gas emissions in several ways. List two ways farming contributes to greenhouse gases.

_____

_____

_____

6. What are two ways in which the industrial revolution is connected to greenhouse gas emissions?

_____

_____

_____

Name _____ Date _____

Analyze the Information
Topic 3.4

Use with textbook pages 232 to 237.

Greenhouse gases produced by generating electricity

Much of Canada's electrical power comes from hydroelectric and coal-fired plants. Using a graphic organizer of your choice, compare these two electrical generation options in terms of the greenhouse gases they produce.

Name _____ Date _____

Assessment
Topic 3.4

Use with textbook pages 230 to 241.

How do human activities affect the natural greenhouse effect?

Match each Term on the left with the best Descriptor on the right. Use each Descriptor only once.

Term	Descriptor
1. _____ anthropogenic	A. the spread of cities into rural areas.
2. _____ halocarbons	B. human-caused.
3. _____ industrial revolution	C. a period of time 300 years ago where people began to move to cities to work in factories.
4. _____ deforestation	D. the clearing of large areas of forest.
5. _____ urbanization	E. human-produced greenhouse gases that are industrial chemical compounds.

6. What is the anthropogenic greenhouse effect?

_____

_____

7. How is the industrial revolution connected with urbanization?

_____

_____

_____

_____

8. What are the anthropogenic sources of nitrous oxide?

_____

_____

_____

9. How is Canada's geographic location related to greenhouse gas emissions?

_____

_____

_____

_____

Name _____ Date _____

Topic **3.5** Summary

How can we assess present climate change and reduce our impact?

Textbook pages 242 to 259

Before You Read

What ways can you think of to reduce your contributions to climate change?

_____

_____

Studying past climates helps us understand how climate changes over time.

By looking at how Earth's climate changed in the past, scientists can learn how today's climate responds to change. Three of the best sources of information are tree rings, ice cores, and fossils. Tree rings help scientists learn about climate events such as droughts, floods, and forest fires. As a tree grows, it adds two new layers of wood under its bark each year—tree rings. Skilled observers can "read" the features of tree rings, such as size, shape, and colour. These features can determine what was happening in the environment of the tree as it was growing. Since trees can be hundreds of years old, they can provide information about the recent past.

Ice fields in the Arctic and Antarctica have been there for hundreds of thousands of years. The oldest ice is about one million years old. Each year, a new layer of ice is added. Each layer holds clues of what the atmosphere was like when the ice formed. This record can be retrieved with special drills that take ice core samples. Dust and ash trapped in the ice indicate volcanic eruptions or forest fires. Plant pollen tells the species of plants that were alive at the time. Temperature and humidity can be determined by the size and shape of ice crystals. Air bubbles trapped in the ice show how much oxygen, carbon dioxide, and other gases were in the atmosphere when the ice formed.

To learn about Earth before the oldest ice, scientists turn to fossils. Fossils are the remains of ancient organisms that have been turned to rock. The types of fossils found in certain places tell scientists what the climate must have been like during that time. ✔

Name _____ Date _____

Topic **3.5** Summary

We use various tools to assess present climate change.

Weather balloons carry mini weather stations to measure the temperature, air pressure, and humidity at different heights up to 30 000 m. A radio transmitter relays the information back to the ground.

Weather radar detects precipitation forming inside clouds. These data help to detect storms that are forming. Radar uses pulses of microwaves. Then the pulses strike water droplets or ice crystals in the atmosphere, and they bounce back to a receiver that collects the data.

In 1997, Canada, Japan, and the United States launched the first of a series of climate-related satellites. This joint program is part of the Earth Observing System (EOS). Today, EOS satellites monitor conditions on land, in the atmosphere, and in the oceans.

We use models and projections to estimate future climate change.

Scientists use all the climate data they collect, and—with sophisticated computer programs—create global climate models. A *global climate model* uses mathematical equations to help scientists understand and predict changes in Earth's climate.

The many uncertainties in how Earth's systems will change make climate predictions tricky. It is impossible to account for every possible climate variable. In addition, people are unpredictable. Scientists have to guess how people might behave in the future. They create "if … then" scenarios. *If* people act in a certain way, *then* we can expect a certain kind of effect.

Reading Check

1. What are three sources of information about Earth's past climate?

_____

_____

_____

_____

2. What tools do scientists use to collect data on climate change today?

_____

_____

_____

3. What is a global climate model?

_____

_____

_____

_____

Name _____ Date _____

Topic
3.5
Summary

We can use our ingenuity to reduce our impact on climate change.

People are using ingenuity to try and solve climate change mainly by reducing greenhouse gases. The table lists some examples.

Invention	What it does	Problem being solved
Protein produced from a type of bacteria	captures carbon dioxide from smokestacks and transforms it into calcium carbonate	removes carbon dioxide from smokestacks that would otherwise end up in Earth's atmosphere
Artificial trees	removes carbon dioxide from the atmosphere faster and in larger amounts than real trees	keeps carbon dioxide out of Earth's atmosphere
Riverdale NetZero house	produces energy and is a completely self-sufficient house	produces all the energy it needs—and even more—through solar power
Deep Lake Water Cooling Project	uses cold water from Lake Ontario to cool buildings in summer	reduces these buildings' energy use in summer by 90 percent
Clothesline	uses solar energy and wind to dry clothes	reduces use of electrical or gas-powered clothes dryers
White roofs and reflective pavement	reflects solar energy to keep Earth cooler	could drop Earth's temperature several degrees if used in the 100 largest cities

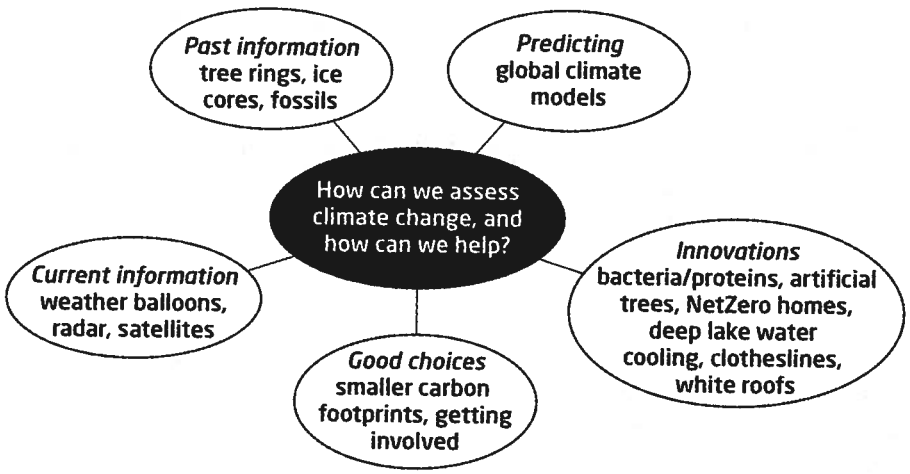
Name _____ Date _____

Topic
3.5
Summary

We can make personal choices that reduce our impact on climate change.

A carbon footprint is the total amount of greenhouse gas emissions caused by an individual, a company, or an organization. We can make choices that decrease the size of our footprints and our impact on Earth. We can lower the heat in our homes and put on a sweater, and, when we make purchases, we can choose to buy products that are made and packaged responsibly.

We are all global citizens. The choices we make can influence companies, but we can do more. Because the climate change problem has no borders, the solution must also be international and involve cooperation among countries. Many such agreements are already in place and being enacted in Canada at the local, provincial, national, and international level. You can help at any or all of these levels. You have the power to make a difference.



Reading Check

4. What is a carbon footprint?

_____

_____

_____

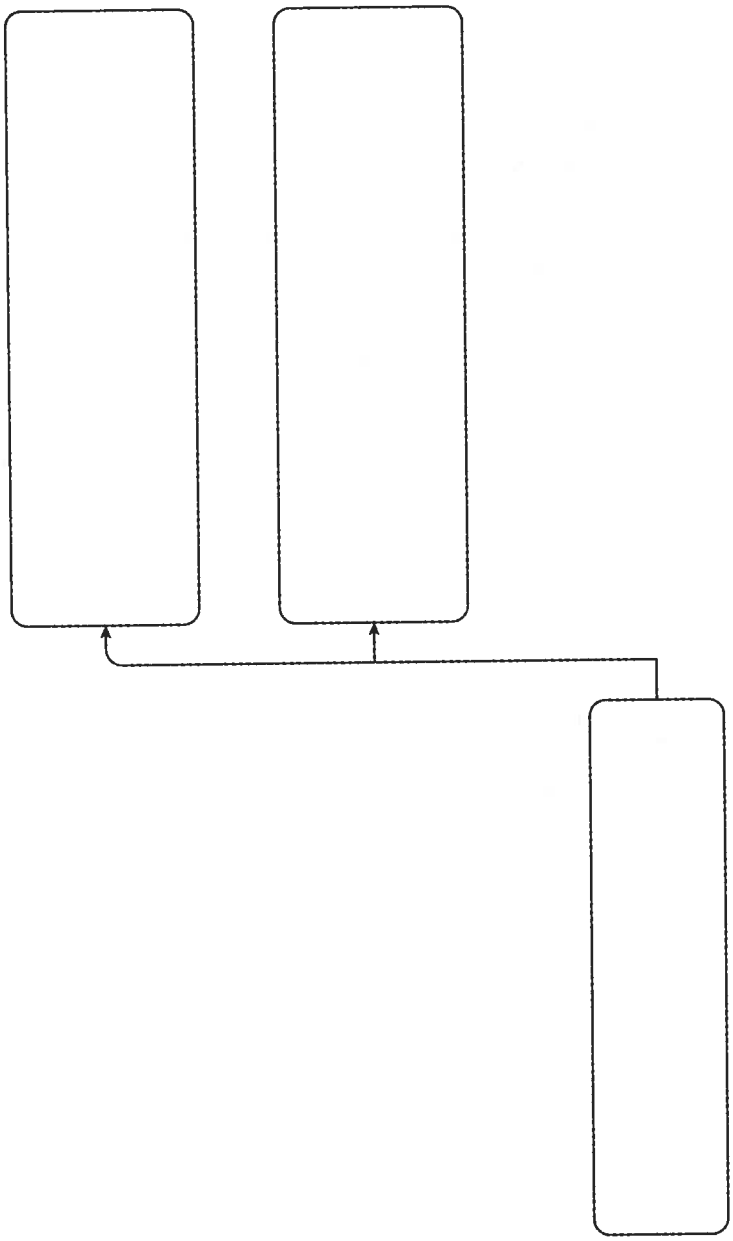
Name _____ Date _____

Applying Knowledge
Topic 3.5

Use with textbook pages 252 to 253.

How can you impact climate change?

Use this cause-and-effect map to show how purchasing an item (of your choice) can impact climate change. Add additional "effect bubbles" as you wish.



Name _____ Date _____

Comprehension
Topic 3.5

Use with textbook pages 244 to 247.

Collecting data about Earth's climate

Use this table to compare the different tools scientists use to collect data about Earth's climate.

Tool	Type(s) of data collected	Other information
Tree rings		
Ice cores		
Fossils		
Weather balloons		
Radar		
Satellites		

Name _____ Date _____

Cloze Activity
Topic 3.5

Use with textbook pages 244 to 251.

Studying climate change

Vocabulary		
artificial trees bioclimate profile clotheslines energy	global climate model humans ice cores radar	satellites tree rings white roofs

Use the terms in the box to fill in the blanks. Use each term only once.

1. Scientists can determine climate events in the past such as droughts, floods, and forest fires using _____.

2. _____ uses microwave pulses that bounce off of water droplets or ice crystals and back to a receiver.

3. A computer program uses mathematical equations to help scientists develop a _____.

4. Some solutions to climate change, such as _____ and _____ are simple and easy.

5. Scientists can determine what Earth's climate was like 100 000 years ago by using _____.

6. _____ can make detailed observations of the entire planet in a single day.

7. _____ capture more carbon dioxide from the atmosphere than real trees.

8. A graph of temperature and moisture conditions for a specific area for a period of time is called a _____ and is used by Environment Canada.

9. Using global climate models for predictions can be tricky because _____ are unpredictable.

10. Riverdale NetZero in Edmonton, Alberta, is called *NetZero* because it is able to produce all the _____ it needs.

Name _____ Date _____

Assessment
Topic 3.5

Use with textbook pages 242 to 259.

How can we assess present climate change and reduce our impact?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ global climate model	**A.** a house in Alberta that produces all the energy it needs.
2. _____ carbon footprint	**B.** samples of the permanent ice from the Arctic or Antarctica taken with special drills.
3. _____ ice cores	**C.** mathematical equations to help scientists understand and estimate changes in Earth's climate.
4. _____ bioclimate profile	**D.** the total amount of greenhouse gas emissions caused by an individual, a company, or an organization.
5. _____ NetZero	**E.** a graph of temperature and moisture of a specific area for a period of time.

6. What choices can you make to be a more climate-friendly consumer?

_____

_____

7. What can scientists learn from fossils about Earth's climate in the distant past?

_____

_____

_____

8. What do weather balloons measure?

_____

_____

9. When studying tree rings, an observer noticed a very wide light-coloured ring. What might this mean?

_____

_____

10. Is Canada able to solve the climate-change problem on its own? Why or why not?

_____

_____

_____

Name _____ Date _____

Unit 3

Literacy Test Preparation

Read the selection below and answer the questions that follow it.

Polar bears—A symbol of global warming

Polar bears have become an international symbol of climate change and global warming. The image of this majestic animal stranded on an ice floe in the Arctic sea is a familiar reminder of the threat of climate change on Earth.

The primary threat to polar bears today is the destruction of their sea ice habitat from increasing temperatures. Their homes are literally melting away. In 2008, polar bears were classified as a threatened species under the *Endangered Species Act*, due to global warming. In the 1960s and 1970s, polar bears were nearly extinct due to overhunting. Sport hunters would often pursue the bears over the ice in helicopters or on icebreaking ships. Polar bears were so threatened that an international agreement was reached in 1973 between Canada, Alaska (United States), Russia, Greenland (Denmark), and Norway to outlaw sport hunting, protect polar bears' shelters and migration habitats, and share research findings.

Today, there are an estimated 20 000 to 25 000 polar bears, with about 60 percent living in Canada. Polar bears depend on sea ice for hunting, breeding, and sometimes shelter. Polar bears prey on seals from sea ice, and without the platforms of sea ice, polar bears are unable to reach their prey. In 2004, four polar bears drowned while trying to swim to the sea ice they needed for hunting. Virtually unheard of in previous years, drowning polar bears are now becoming commonplace.

Polar bears are the largest land predator in the world. Adult males weigh between 350 and 680 kg. Female bears weigh between 150 and 250 kg. Polar bears are at the top of the food chain in the Arctic region. A decline in polar bear numbers will affect the entire Arctic ecosystem.

Polar bears are well adapted to life in the frozen Arctic where temperatures in January and February are a chilly –34°C on average. A thick layer of fat insulates their bodies against the cold and two layers of fur provide additional protection. Even in very cold temperatures, polar bears will quickly overheat. Polar bear paws are an average 31 cm across with thick black footpads and claws that are more than 5 cm long. Their large paws keep them from slipping on ice and distribute their weight to prevent them from cracking thin ice. The size of their paws also helps in swimming.

The only long-term solution to saving polar bears is to reduce the effects of climate change and prevent the melting of the sea ice. Current estimates are that the Arctic sea will be completely ice free by 2040. Do your part to reduce climate change and help save this symbolic species.

Name _____ Date _____

Unit 3

Multiple Choice

Select the best answer.

1. What do polar bears eat?
   - **A.** plants
   - **B.** people
   - **C.** penguins
   - **D.** seals

2. Why are polar bears drowning?
   - **A.** their thick fur makes them too heavy in the water
   - **B.** they fall through thin ice
   - **C.** they have to swim too far to reach sea ice to hunt seals
   - **D.** hunters chase them into the water

3. Why are polar bears a threatened species under the *Endangered Species Act*?
   - **A.** global warming is melting their habitat
   - **B.** hunters are killing them
   - **C.** there are no more seals for them to eat
   - **D.** oil and gas drilling has ruined their habitat

4. How can we save polar bears?
   - **A.** ban polar bear hunting
   - **B.** drive cars that do not produce greenhouse gases
   - **C.** work to reduce climate change
   - **D.** put them in zoos

Short Answer

5. Summarize this section. Include a main idea and one point that clearly supports it.

Name _____ Date _____

Unit 4

Using Your Appendices

Science Skills Toolkit 5: Scientific Drawing

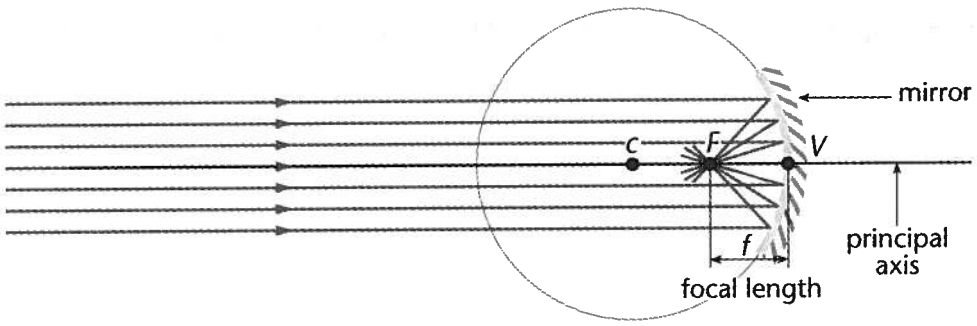
Use with textbook pages 382–383.

If you want to explain a detailed idea, a clear diagram can be the best way to do it.

Steps to Making a Clear Scientific Drawing

1. Get a sharp pencil, a ruler, a sheet of unlined paper—and a good eraser! Scientific drawings need to be clear, neat, and accurate. If your drawing gets too messy, then start over again with a new sheet of paper.
2. Use plenty of space and allow room for labels. Place all your labels on the right of the diagram if you can. If there is no room for them on the right, put them elsewhere.
3. Study what you are going to draw. Think about what you should include. Draw only what you can see from a particular angle. If you need to, draw the object from another angle as well.
4. Use dots to show darker areas and double lines to show thicker areas. Try to avoid using colour. If you do have to use colour, choose colours that are close to those in the object.
5. Label your diagram. Use a ruler to draw a straight line from the part being labelled to the label. Don't allow any label lines to cross.
6. Give your diagram a title. People will want to know what they looking at.

This drawing has all the elements a good drawing needs.



Parallel light rays reflecting in a concave mirror

Name _____ Date _____

Unit 4

Questions:

1. Why do scientific drawings need to be clear, neat, and accurate? Give an example.

_____

_____

_____

_____

2. What is the wrong with this diagram of penny-farthing bicycle?

_____

_____

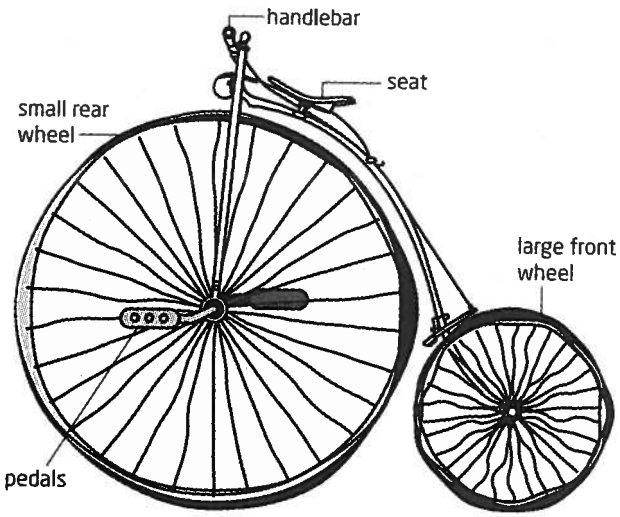
_____

_____

_____

_____

_____



3. Make a scientific drawing of some object in your school or home, such as a light bulb or a cell phone.

Name _____ Date _____

Topic **4.1** Summary

What is light and how is it produced?

Textbook pages 276 to 285

Before You Read

How do you think light is produced? Record your thoughts below.

_____

_____

Mark the Text

Check for Understanding

As you read, stop and reread any parts you do not understand. Highlight the sentences that help you to understand better.

Many technologies produce light by converting other forms of energy.

The light that hot objects emit is called **incandescence**. The light that unheated objects emit is called **luminescence**.

Light-producing technology	What energy is transformed	Examples
Incandescence		
Burning fuel, such as wood, produces light.	Chemical energy	Wood fires, the Sun, candles
Passing **electrical energy** through a light bulb filament causes the filament to glow hot.	Electrical energy	Incandescent light bulbs
Luminescence		
Chemiluminescence occurs when light is released during a chemical reaction.	Chemical energy	Glow sticks, fireflies
Electric discharge occurs when electrons move from one end of a sealed glass tube to the other. They collide with gas particles and transfer energy to them. The gas particles release the energy as visible light.	Electrical energy	Street lights, sodium vapour lights
Fluorescence is like electric discharge, but the inside of the glass tube is coated with phosphor and the gas particles emit (invisible) ultraviolet light, which the phosphor converts to visible light.	Electrical energy	Fluorescent light bulbs

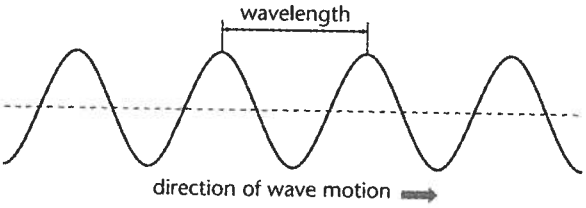
Name _____ Date _____

Topic **4.1** Summary

Light is energy and travels like a wave.

Light is a form of energy. It is related to other forms of energy, including microwaves, X-rays, and ultraviolet. Together, these forms of related energy are part of the **electromagnetic spectrum**. The energy of the electromagnetic spectrum travels in the form of waves. The electromagnetic spectrum is arranged in order of wavelength.

The diagram below is a model of a wave. An important characteristic of a wave is its **wavelength**. This is the distance from the peak of one part of the wave to the next peak. ✔



Electromagnetic waves have different wavelengths. For example, radio waves have very long wavelengths, and gamma rays have extremely short wavelengths. The only waves of the electromagnetic spectrum that human eyes can see are waves of visible light. These are the "colours of the rainbow." From longest waves to shortest, they are red, orange, yellow, green, blue, and violet.

✔ *Reading Check*

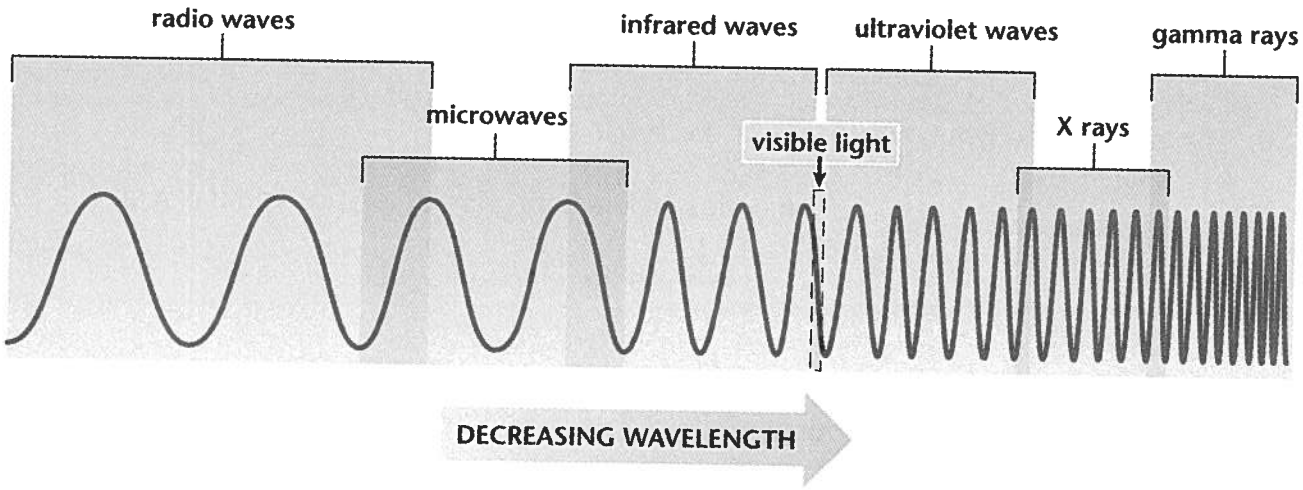
1. How is incandescence different from luminescence?

_____

_____

2. What is the distance between two peaks of a wave called?

_____



Name _____ Date _____

Cloze Activity
Topic 4.1

Use with textbook pages 276 to 285.

Light

Vocabulary	
chemiluminescence incandescent luminescence electromagnetic waves energy fluorescence	frequency electric discharge electromagnetic spectrum visible light wave wavelength

Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term.

1. Light is a form of _____.
2. The light emitted by a hot object is called _____.
3. The light emitted by an unheated object is called _____.
4. Other forms of _____ can be converted into light.
5. Light released during chemical reactions is called _____.
6. The Sun is an example of _____ light. It converts chemical energy into light energy.
7. Light travels like a _____.
8. The distance between two peaks of a wave is called the _____.
9. _____ includes visible light, ultraviolet, and radio waves.
10. An _____ shows the electromagnetic waves in order of wavelength.
11. Radio waves have a longer _____ than visible light does.
12. The waves of _____ are the only waves of the electromagnetic spectrum that you can see.

Name _____ Date _____

Comprehension
Topic 4.1

Use with textbook pages 278 to 279.

Incandescence and luminescence

1. How are the technologies that produce incandescence and luminescence different?

_____

_____

2. How are the technologies that produce incandescence and luminescence alike?

_____

_____

3. Circle what kind of light each object emits.

(a) fire	incandescence / luminescence
(b) a fluorescent light bulb	incandescence / luminescence
(c) a red burner on an electric stove	incandescence / luminescence
(d) a flashlight	incandescence / luminescence
(e) a sodium vapour light	incandescence / luminescence
(f) a glow stick	incandescence / luminescence
(g) a candle	incandescence / luminescence
(h) a firefly	incandescence / luminescence
(i) a neon sign	incandescence / luminescence
(j) a torch	incandescence / luminescence
(k) a kerosene lamp	incandescence / luminescence
(l) the Sun	incandescence / luminescence
(m) a glow-in-the-dark watch dial	incandescence / luminescence
(n) molten lava	incandescence / luminescence
(o) star light	incandescence / luminescence
(p) a television screen	incandescence / luminescence
(q) a computer monitor	incandescence / luminescence

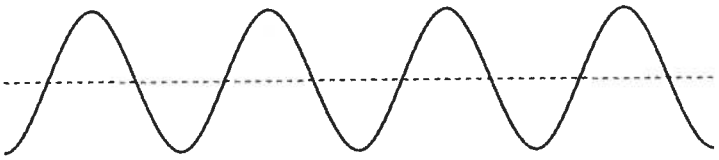
Name _____ Date _____

Interpreting Illustrations
Topic 4.1

Use with textbook pages 280 to 283.

Electromagnetic Waves

1. Label the wavelength of this wave.



2. Order the waves from shortest (1) to longest (4) wavelength.

a)

_____

b)

_____

c)

_____

d)

_____

Use the electromagnetic spectrum below to answer questions 3 and 4.

3. Order the waves from shortest (1) to longest (5) wavelength:

___ radio waves

___ X rays

___ visible

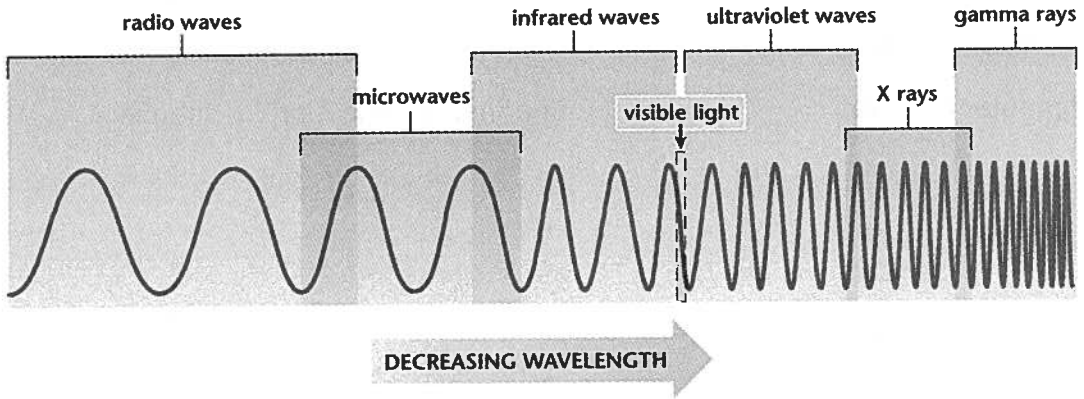
___ infrared

___ ultraviolet

4. Describe two ways that visible light is different from other waves of the electromagnetic spectrum.

_____

_____



Name _____ Date _____

Assessment
Topic 4.1

Use with textbook pages 276 to 285.

What is light and how is it produced?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.	
Term	**Descriptor**
1. _____ light	**A.** light emitted by unheated objects.
2. _____ electromagnetic spectrum	**B.** light emitted by hot objects.
3. _____ incandescence	**C.** the distance between two wave peaks.
4. _____ luminescence	**D.** electromagnetic waves, arranged by wavelength.
5. _____ wavelength	**E.** a form of energy related to radio waves and infrared.

6. Give two examples of each type of light.

a) incandescence:

_____

_____

b) luminescence:

_____

_____

7. Draw a wave and label its parts.

8. What does a wavelength represent?

_____

_____

9. Circle which colour of light has the longer wavelength.

red light / blue light

Name _____ Date _____

Topic **4.2** Summary

How does light interact with objects to give them colour?

Textbook pages 286 to 293

Before You Read

In this topic, you will explore light and colour. How does light give objects their colour? Record your ideas below.

_____

_____

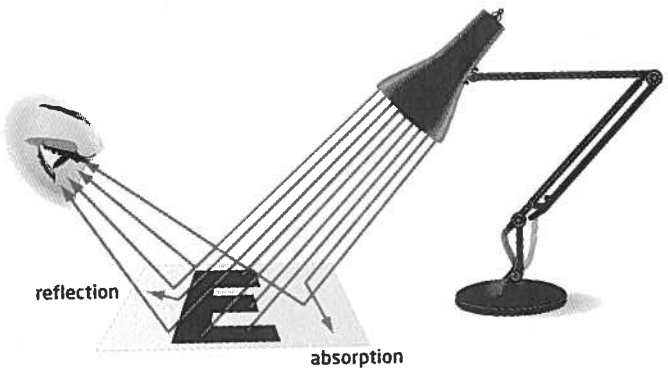
Mark the Text

Identify Definitions

Highlight the definition of each word in bold type.

Objects absorb, reflect, or transmit light.

Light travels in a straight line. You use an arrow called a **ray** to show the direction it travels. Ray diagrams show how light behaves when it hits an object. When light hits an object, it may be reflected, absorbed, or transmitted.

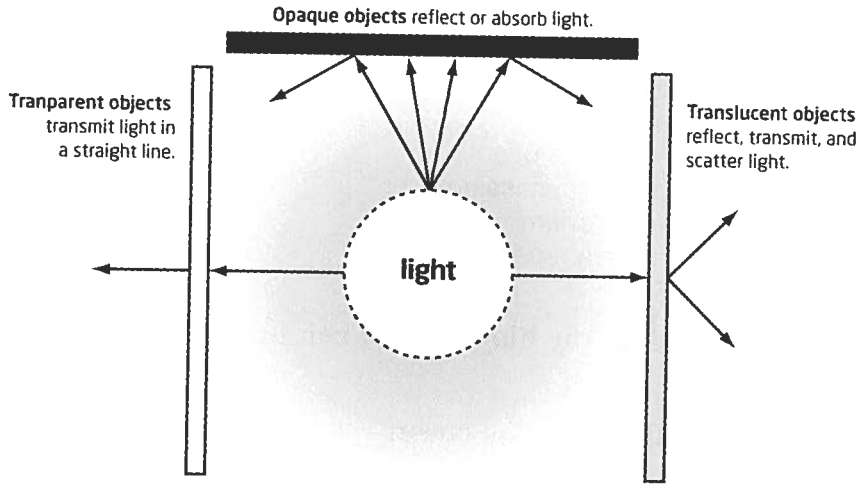


- **Reflection** occurs when light bounces off an object. You can see an object, such as this white paper, because some of the light that reflects off the object travels to your eyes.
- **Absorption** occurs when something, such as black print, absorbs light. You can see the print because your brain interprets this lack of light as the colour black.
- **Transmission** occurs when light goes through an object.
  - A **transparent** object, like a window, transmits all or most light with no change in direction.
  - A **translucent** object, like frosted glass, transmits some light and scatters it in different directions.
  - An **opaque** object, like a book, does not transmit light; it reflects or absorbs light.

Name _____ Date _____

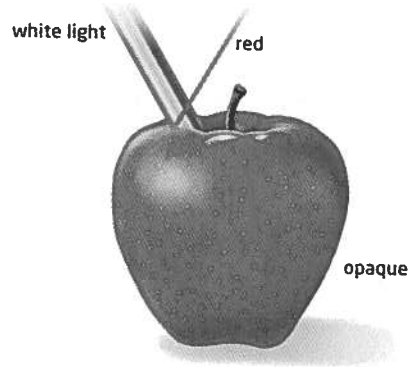
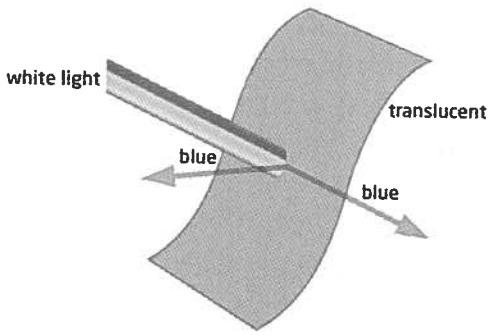
Topic **4.2** Summary

Objects reflect, absorb, and transmit light.



Objects can absorb some colours and reflect or transmit others.

An object's colour is determined by the colours that it absorbs, reflects, or transmits. White light combines all of the colours (wavelengths) of visible light.

When white light hits an opaque object, such as a red apple, the apple reflects its own particular colour and absorbs all other colours.	
When white light hits a coloured transparent or translucent object, such as blue cellophane, the object absorbs every colour except for its own particular colour. That colour will be transmitted and reflected.	

Reading Check

1. Name the three ways light can behave when it hits an object.

_____

_____

_____

2. What are the differences among a transparent, a translucent, and an opaque object?

_____

_____

_____

3. What determines the colour of an object that we see?

_____

_____

_____

Name _____ Date _____

Cloze Activity
Topic 4.2

Use with textbook pages 286 to 293.

Reflect, absorb, and transmit

Vocabulary	
absorb absorption opaque ray reflection	reflect translucent transmission transmit transparent

Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term.

1. The process in which light bounces off an object is called _____.
2. The process in which light travels through an object is called _____.
3. The process in which light energy remains in the object that it hits is called _____.
4. A _____ is an arrow that shows the direction light is travelling.
5. Light will travel through a(n) _____ object as if there was no object in its path.
6. _____ objects do not allow light to go through them.
7. Light scatters in different directions after travelling through _____ objects.
8. Opaque objects will only _____ or _____ light.
9. _____ and _____ objects will transmit light.
10. Clear glass is an example of a(n) _____ object.
11. Wax is an example of a(n) _____ object.
12. A book is an example of a(n) _____ object.

Name _____ Date _____

Comprehension
Topic 4.2

Use with textbook pages 288 to 289.

Light rays

Answer the questions below.

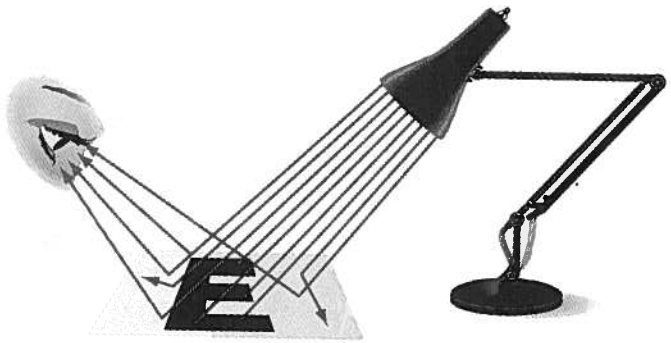
1. Refer to the light rays in the diagram to explain why you can see each item.

(a) the white paper

_____

(b) the black print

_____



2. What will happen when white light strikes each object? Circle all the choices that apply.

a) metal spokes on a bicycle wheel absorption reflection transmission	**b)** black asphalt on a basketball court absorption reflection transmission
c) swimming pool water absorption reflection transmission	**d)** fog absorption reflection transmission

3. Is each material opaque, transparent, or translucent?

a) wood : _____

b) cardboard : _____

c) aluminum foil : _____

d) wax paper : _____

e) plastic wrap : _____

f) clean air : _____

g) clear glass : _____

h) frosted window : _____

Name _____ Date _____

Illustrating Concepts
Topic 4.2

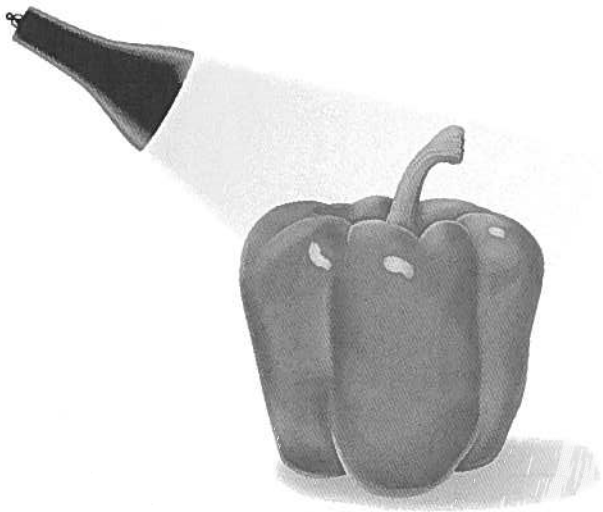
Use with textbook pages 288 to 291.

The colour of objects

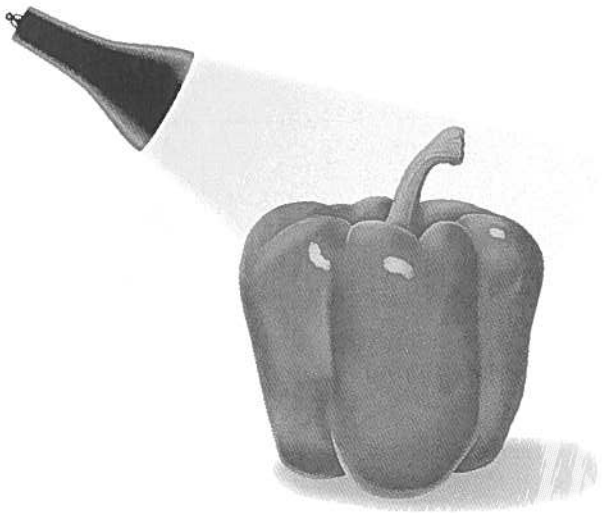
1. a) Is the pepper opaque, transparent, or translucent?

_____

b) Draw rays to explain why the pepper appears green under white light.



2. Suppose you shine a red light on this green pepper. What colour will the pepper be? Draw light rays to explain your answer.

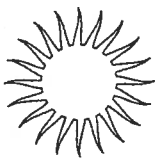


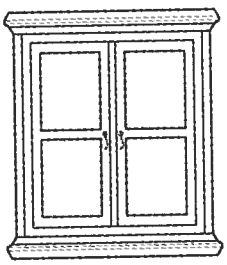
3. The window in this drawing is transparent and tinted yellow.

a) Draw light rays to show how sunlight behaves when it hits the window.

b) What colour will the tinted glass be?

_____



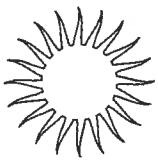


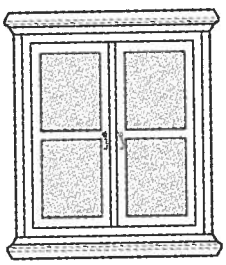
4. The window in this drawing is translucent and tinted yellow.

a) Draw light rays to show how sunlight behaves when it hits the window.

b) What colour will the tinted glass be?

_____





Name _____ Date _____

Assessment
Topic 4.2

Use with textbook pages 286 to 293.

How does light interact with objects to give them colour?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ absorption	A. an arrow that shows which direction light travels.
2. _____ opaque	B. an object through which light travels without changing direction.
3. _____ ray	C. what happens when light bounces off an object.
4. _____ reflection	D. what happens when light energy hits an object and remains in it as heat.
5. _____ translucent	E. what happens when light travels through an object.
6. _____ transmission	F. an object thorough which light travels and changes direction.
7. _____ transparent	G. an object that does not transmit light.

8. a) Explain why you can see black print on a white paper.

_____

_____

_____

_____

b) Draw a ray diagram to show how the light travels.

9. Complete each statement with the words reflect(s), absorb(s), or transmit(s).

a) An opaque object's colour is determined by the colours that it _____ and _____ .

b) When a transparent object has a certain colour, it _____ and _____ that colour and _____ all other colours.

Name _____ Date _____

Topic **4.3** Summary

How can you mix colours to make different colours?

Textbook pages 294 to 303

Before You Read

How are different colours created? Record your ideas below.

_____

_____

Reading Check

1. What are the three additive primary colours?

_____

_____

_____

2. What are the three secondary colours?

_____

_____

_____

3. What are the three pairs of complementary colours?

_____

_____

Colours of light can be added together to form a variety of colours.

Your eyes contain only three types of cells, and with them you can see millions of colours. When you look at a coloured object, different combinations of these cells are stimulated, and your brain interprets them as the colours that you see. The **primary colours** can be mixed to produce any other colour.

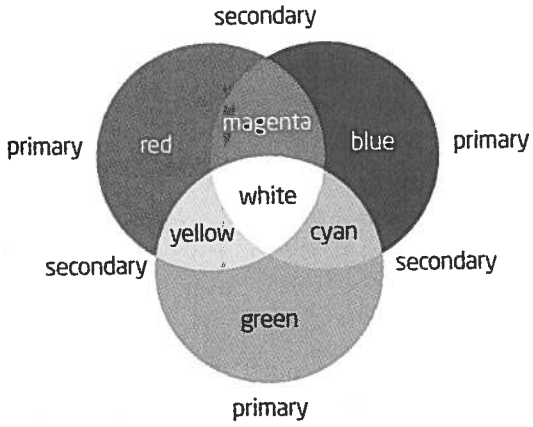
There are three additive primary colours.

There are three **additive primary colours:** red, green, and blue. When two primary colours combine, they produce a **secondary colour.** The three secondary colours are yellow, magenta, and cyan.

red + green = yellow,
red + blue = magenta
green + blue = cyan

All three primary colours combine to produce white.

red + green + blue = white



A primary colour and the secondary colour created when the other two primary colours are combined are **complementary colours**. Red and cyan are complementary colours. Green and magenta are complementary colours Blue and yellow are complementary colours.

Name _____ Date _____

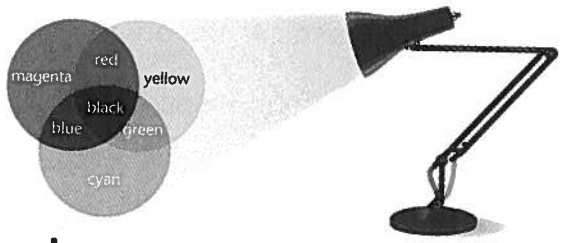
Topic **4.3** Summary

There are three subtractive primary colours.

There are three **subtractive primary colours:** cyan, magenta, and yellow. These colours produce other colours when mixed and placed under white light. This is because some colours are absorbed and some are reflected. When all three subtractive primary colours are subtracted from white light, the result is black.

Secondary colours are produced when subtractive primary colours are subtracted from white light. When complementary colours are subtracted from white light, the result is black.

white – (cyan + magenta) = blue
white – (cyan + yellow) = green
white – (magenta + yellow) = red ✔



✔ *Reading Check*

4. What are the three subtractive primary colours?

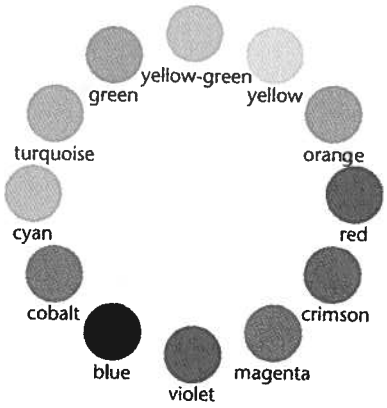
_____,
_____,
_____

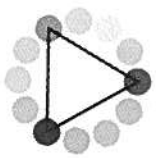
A colour wheel shows types of colours.

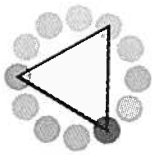
A colour wheel shows the additive and subtractive primary colours, secondary colours, complementary colours, and **tertiary colours**. Tertiary colours are produced when secondary colours are mixed.

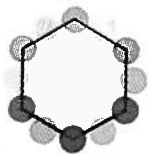
5. What are the three subtractive secondary colours?

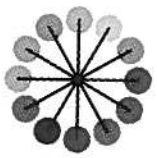
_____,
_____,
_____




primary additive colours
secondary subtractive colours


primary subtractive colours
secondary additive colours


tertiary colours


complementary colours

The additive primary colours are the subtractive secondary colours. The subtractive primary colours are the additive secondary colours.

Combining additive primary colours

red + green + blue = white
red + green = yellow red + blue = magenta green + blue = cyan

Complementary colours

red—cyan, green—magenta, blue—yellow

Combining subtractive primary colours

white – (cyan + magenta + yellow) = black
white – (cyan + magenta) = blue
white – (cyan + yellow) = green
white – (magenta + yellow) = red

6. Where are pairs of complementary colours located on the colour wheel?

_____
_____

Name _____ Date _____

Comprehension
Topic 4.3

Use with textbook pages 296 to 299.

Additive and subtractive colours

Answer the questions below.

1. Complete each statement.

a) The additive primary colours are _____, _____, and _____.

These colours are the same as the subtractive _____ colours.

b) The subtractive primary colours are _____, _____, and _____. These colours are the same as the additive _____ colours.

2. Complete the following colour equations.

a) red + blue = _____

b) green + blue = _____

c) red + green + blue = _____

d) cyan + red = _____

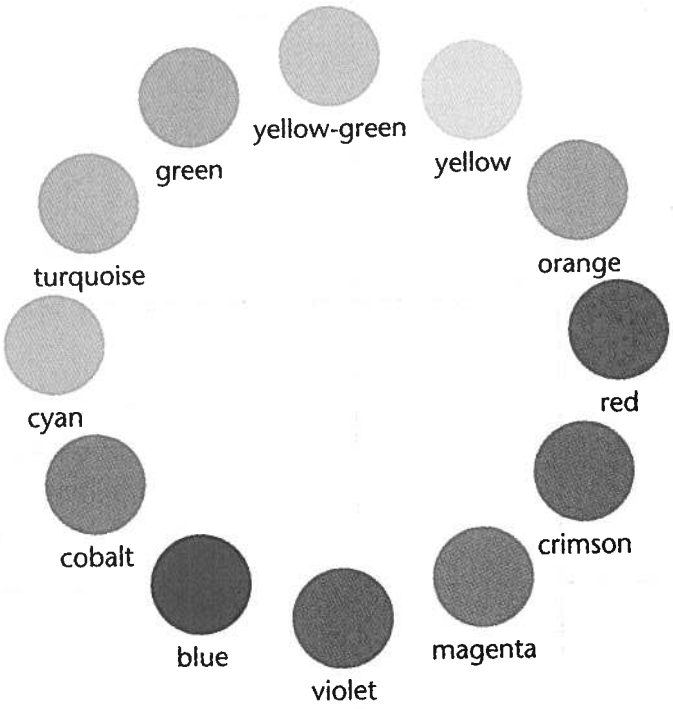
e) white – (cyan + yellow) = _____

f) white – (magenta + yellow) = _____

g) white – (cyan + magenta + yellow) = _____

h) white – (green + magenta) = _____

3. Connect each pair of complementary colours.



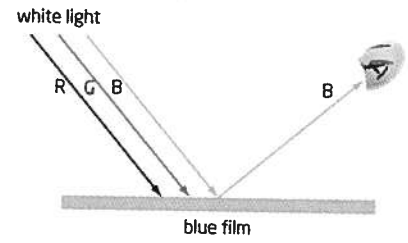
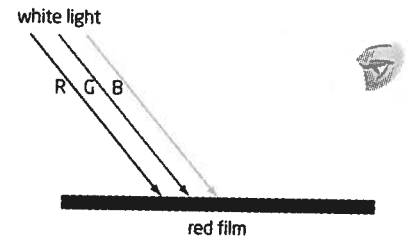
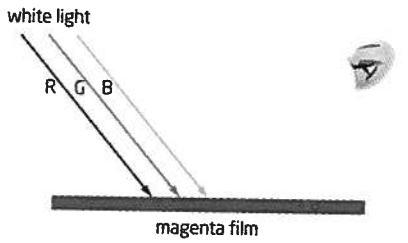
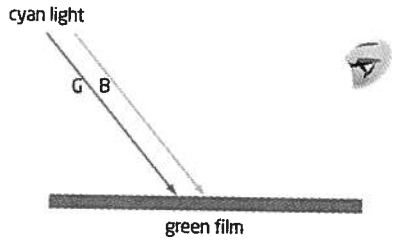
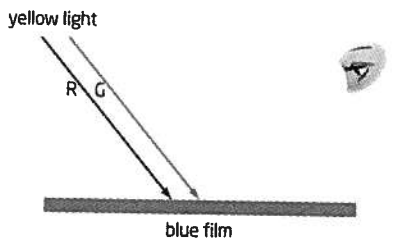
Name _____ Date _____

Illustrating Concepts
Topic 4.3

Use with textbook pages 296 to 299.

Absorption and subtractive colours

1. Complete the table, including drawing and naming the reflected light. Part a) is done for you as an example.

	Colour(s) absorbed	Colour(s) reflected	Colour equation
a) 	red, green	blue	W – (R + G) = B
b) 			
c) 			
d) 			
e) 			

Name _____ Date _____

Applying Concepts
Topic 4.3

Use with textbook pages 294 to 302.

Colourful spotlights

The stage crew for a rock band is setting up some coloured spotlights to light up the stage during a concert. There are red, blue, and yellow spotlights. A large white banner with the band's name in cyan will be hung on the back wall. The band has hired you to be the lighting consultant.

1. The band wants to begin with the stage lit in magenta. What combination of colours should be used?

_____

_____

_____

2. What sequence of lights is needed to make the band's name on the banner appear first blue, then green, and finally black?

_____

_____

_____

3. The band wants to make their grand entrance with a white spotlight aimed at the centre of the stage floor where they will rise from below. What combination of colours will produce white?

_____

_____

_____

4. The band plans to end the show with the lights changing from orange to yellow to orange. Which colour combinations are needed to achieve this?

_____

_____

_____

Name _____ Date _____

Assessment
Topic 4.3

Use with textbook pages 294 to 303.

How can you mix colours to make different colours?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. ____ additive primary colours	**A.** red, green, and blue.
2. ____ complementary colours	**B.** red, green, and yellow.
3. ____ secondary colours	**C.** cyan, magenta, and yellow.
4. ____ subtractive primary colours	**D.** generated by combining two primary colours.
5. ____ tertiary colours	**E.** generated by combining two secondary colours.
	F. a primary colour and the secondary colour created when the other two primary colours are combined.

6. Complete each equation.

a) red + blue = _____

b) green + blue = _____

c) magenta + green = _____

d) white – (cyan + yellow)

= _____

e) white – (magenta + yellow)

= _____

f) white – (green + magenta)

= _____

g) magenta – blue

= _____

7. Write two relationships between additive and subtractive colours.

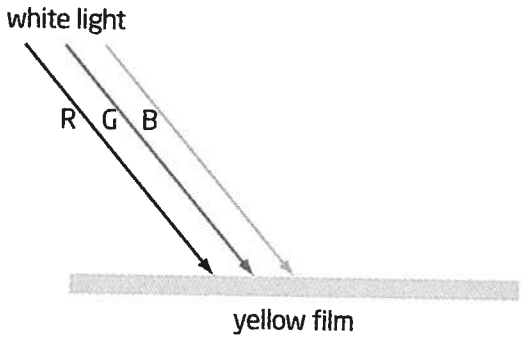
_____

_____

_____

_____

8. a) Draw, and label, which colour(s) of light will be reflected.



b) Write the colour equation.

_____

Name _____ Date _____

Topic **4.4** Summary

What is the law of reflection and how do mirrors form images?

Textbook pages 304 to 331

Before You Read

How do mirrors form images? Write your ideas on the lines below.

_____

_____

Reading Check

1. According to the law of reflection, how does the angle of incidence compare with the angle of reflection?

_____

_____

_____

2. What four characteristics describe a mirror image?

_____

_____

_____

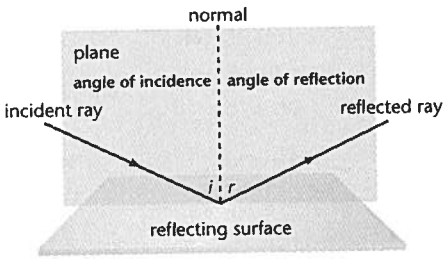
_____

The angle of reflection is equal to the angle of incidence.

Suppose you shine a light at a mirror. The **incident ray** is the light ray that travels toward the mirror. The reflected ray is the light ray that travels away from the mirror. The normal is an imaginary line drawn perpendicular (at right angles to) a surface.

The **Law of Reflection** states the following:

- The angle of reflection is equal to the angle of incidence.
- The reflected ray and the incident ray are on opposite sides of the normal.
- The incident ray, the normal, and the reflected ray lie on the same plane (flat surface). ✔



An image has four characteristics.

The item in front of a mirror is called the **object** and its reflection is called the **image**. You can describe an image by four characteristics:

- **Location:** The distance between the image and the mirror may be shorter than, equal to, or longer than the distance between the object and the mirror. Also, the image may be behind the mirror or in front of it.
- **Orientation:**
  - An **upright** image has the same orientation as the object.
  - An **inverted** image has an orientation that is opposite or upside down compared with the object.
- **Size:** The image may be the same size as the object, or larger, or smaller.
- **Type:**
  - An image is **real** when the reflected rays meet in front of the mirror, so they do not need to be extended behind the mirror.

Name _____ Date _____

Topic **4.4** Summary

- An image is **virtual** when the reflected rays never reach the position of the image; they just appear to come from this position behind the mirror. ✔

There are three types of mirrors.

There are plane, concave, and convex mirrors.

- A **plane mirror** has a smooth, flat surface.
- A **concave mirror** caves inward at the centre.
- A **convex mirror** bulges outward at the centre.

These terms apply to concave and convex mirrors.

- The **principal axis** is a line drawn perpendicular to the centre.
- The **focal point** (F) is the point at which reflected rays meet when incident rays are parallel to, and near, the principal axis.
- The **centre of curvature** (C) is the centre of the sphere that the mirror fits on. The focal point is halfway between the centre of curvature and the mirror.
- The **focal length** (f) is the distance from the mirror to the focal point.

✔ *Reading Check*

3. How are a plane mirror, a concave mirror, and a convex mirror different?

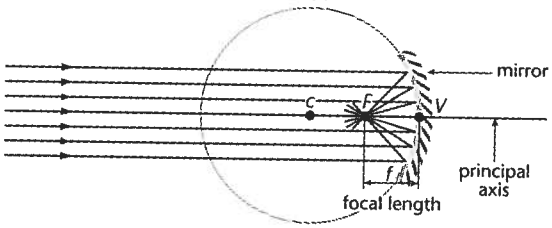
_____

_____

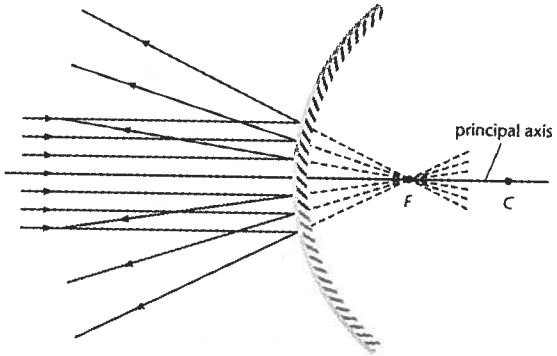
_____

_____

This mirror is concave.



This mirror is convex.



✔

Type of mirror	Image location	Image orientation	Image size	Image type
Plane	Image distance equal to object distance	Upright	Same size as object	Virtual
Concave (object between focal point and mirror)	Image distance is longer than object distance	Upright	Larger than object	Virtual
Concave (object between centre of curvature and focal point)	Image distance is longer than object distance	Inverted	Larger than object	Real
Convex	Image distance is shorter than object distance	Upright	Smaller than object	Virtual

Name _____ Date _____

Cloze Activity
Topic 4.4

Use with textbook pages 304 to 331.

Plane, concave, and convex mirrors

Vocabulary	
centre of curvature concave convex focal point focal length incidence incident ray	normal plane principal axis real reflected ray reflection virtual

Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term.

1. According to the law of reflection, the angle of _____ and the angle of _____ are equal.
2. The _____ is the light ray that travels toward a reflective surface.
3. The _____ is the line that is perpendicular to the surface.
4. The reflected ray and the incident ray are on opposite sides of the _____.
5. The image formed in a plane mirror is a _____ image.
6. A _____ mirror caves inward at the centre.
7. A _____mirror bulges out at the centre.
8. A _____ mirror forms images that are identical to the objects.
9. A line that is normal to the centre of a spherical mirror and passes through the centre of curvature is called the _____ .
10. The _____ is the distance between the focal point and the mirror.
11. The focal point is located halfway between the _____ and the mirror.
12. A concave mirror forms a _____image when the object is between the focal point and the mirror.
13. A concave mirror forms a _____ image when the object is between the centre of curvature and the focal point.

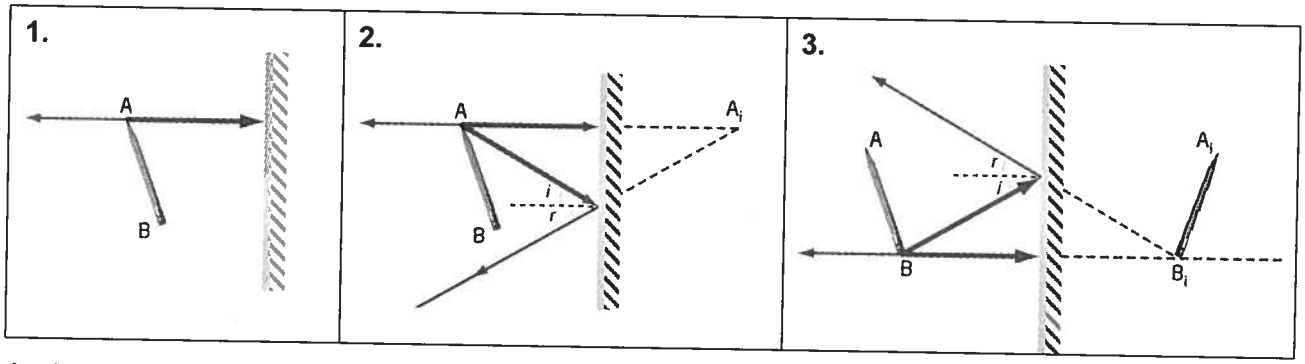
Name _____ Date _____

Illustrating Concepts
Topic 4.4

Use with textbook pages 308 to 311.

Ray diagrams for plane mirrors

These diagrams show how to locate the image of an object in a plane mirror. Refer to page 310 of your textbook for an explanation of these drawings.



1. Draw a plane mirror and an object 2 cm in front of it. Locate the image and list its characteristics.

	Characteristics of image
	Location: _____
	Orientation: _____
	Size: _____
	Type: _____

2. Draw a plane mirror. Draw the same object as in question 1, but this time draw it 4 cm in front of the mirror. Locate the image and list its characteristics.

	Characteristics of image
	Location: _____
	Orientation: _____
	Size: _____
	Type: _____

3. Compare the images you drew. How did the change in the object's location affect the image's characteristics? _____

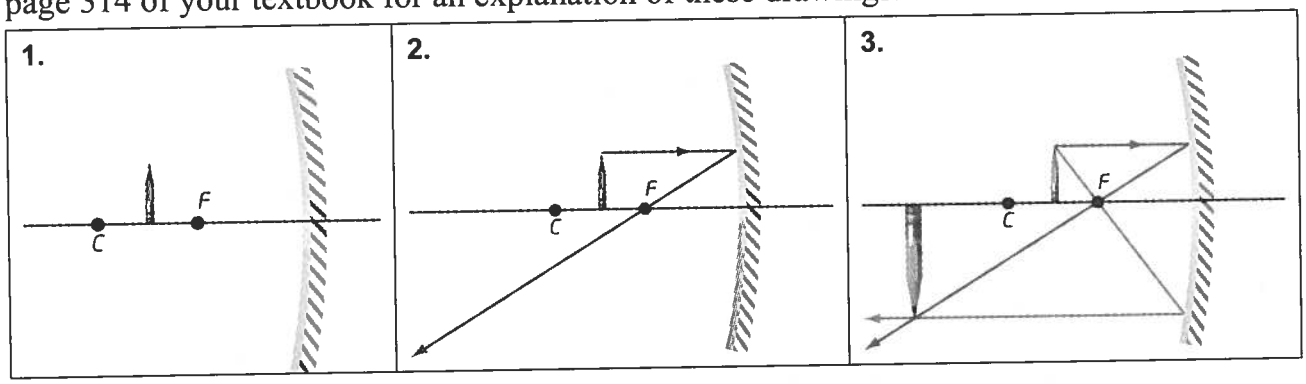
Name _____ Date _____

Illustrating Concepts
Topic 4.4

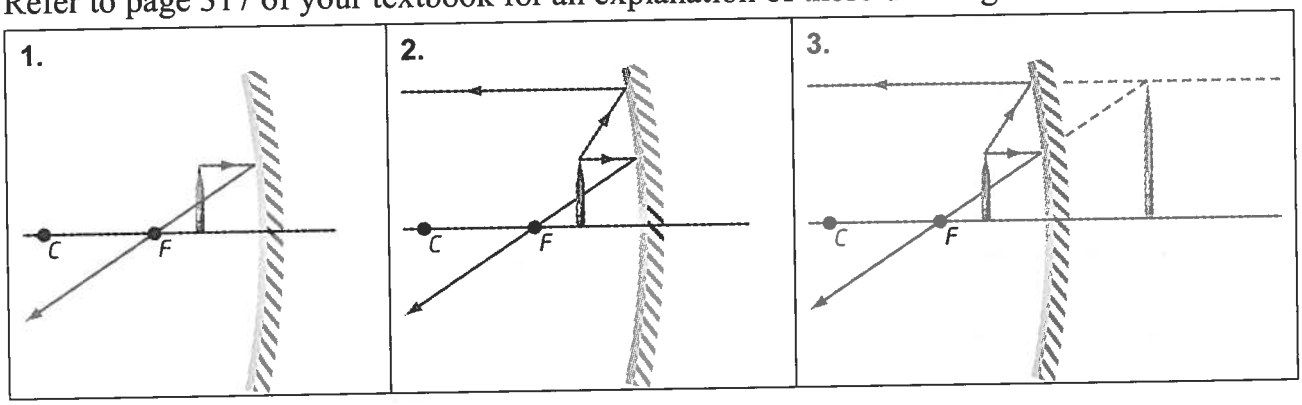
Use with textbook pages 312 to 317.

Ray diagrams for concave mirrors

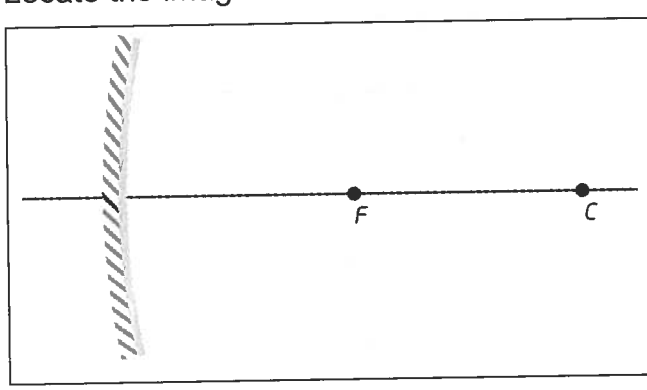
These diagrams show how to locate the real image of an object in a concave mirror. Refer to page 314 of your textbook for an explanation of these drawings.



These diagrams show how to locate the virtual image of an object in a concave mirror. Refer to page 317 of your textbook for an explanation of these drawings.



1. Draw an object 2 cm tall and 4 cm from this mirror. Locate the image and list its characteristics.



Characteristics of image

Location: _____

Orientation: _____

Size: _____

Type: _____

2. The image in question 1 is real because the object is between the _____ and the _____. If it had been between the _____ and the _____, it would have been a virtual image.

Name _____ Date _____

Illustrating Concepts
Topic 4.4

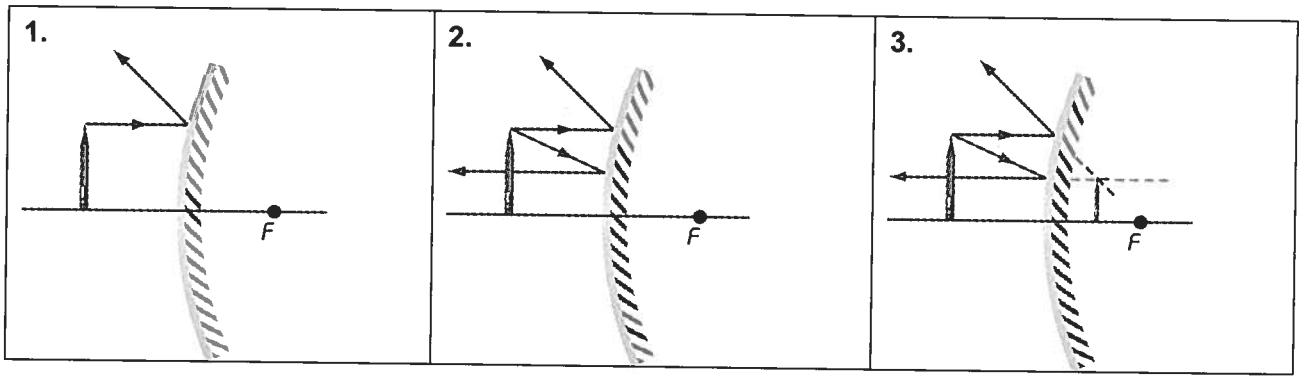
Use with textbook pages 318 to 321.

Ray diagrams for convex mirrors

The light rays that hit a convex mirror behave as follows:

- A ray parallel to the principal axis will reflect as though it were coming from the focal point.
- A ray that travels as though it were going toward the focal point will reflect back parallel to the principal axis.

These diagrams show how to locate the image of an object in a convex mirror. Refer to page 314 of your textbook for an explanation of these drawings.



1. Draw a convex mirror, its principal axis, and a focal point 4 cm behind the mirror. Draw an object 6 cm tall and 5 cm from the mirror.
Locate the image and list its characteristics.

Characteristics of image

Location: _____

Orientation: _____

Size: _____

Type: _____

F

Name _____ Date _____

Applying Knowledge
Topic 4.4

Use with textbook pages 308 to 321.

Types of mirrors

1. Identify the type of mirror (plane, concave, or convex) that would give an image with each set of characteristics. If need be, say where the object is in relation to the focal point.

a) **location:** image distance is equal to object distance
size: same size as object
orientation: upright
type: virtual

_____
_____
_____

b) **location:** image distance is shorter than object distance
size: smaller than object
orientation: upright
type: virtual

_____
_____
_____

c) **location:** image distance is longer than object distance
size: larger than object
orientation: inverted
type: real

_____
_____
_____

d) **location:** image distance is longer than object distance
size: larger than object
orientation: upright
type: virtual

_____
_____
_____

2. Identify the type of mirror (plane, convex, or concave) that is best suited for each use. Briefly justify your answer.

a) dentist's mirror

_____
_____
_____

b) dressing room mirror

_____
_____
_____

c) safety/security mirror

_____
_____
_____

d) microscope

_____
_____
_____

e) car headlights

_____
_____
_____

f) side view mirror

_____
_____
_____

Name _____ Date _____

Assessment
Topic 4.4

Use with textbook pages 304 to 331.

What is the law of reflection and how do mirrors form images?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ angle of incidence	A. a smooth, flat reflecting surface.
2. _____ angle of reflection	B. the point where reflected rays meet when incident rays are parallel to and near the principal axis.
3. _____ centre of curvature	C. the point that is the same distance from all points on the surface of a curved mirror.
4. _____ concave mirror	D. the angle between the incident ray and the normal.
5. _____ convex mirror	E. the angle between the reflected ray and the normal.
6. _____ focal point	F. an image that is formed when light rays meet and do not have to be extended backward.
7. _____ focal length	G. the distance from the mirror to the focal point.
8. _____ incident ray	H. a line drawn normal to the centre of a spherical mirror.
9. _____ normal	I. a line that is perpendicular to a surface.
10. _____ plane mirror	J. a light ray that "bounces" off a surface.
11. _____ principal axis	K. a light ray that is travels toward a mirror.
12. _____ reflected ray	L. a mirror that "caves-in".
	M. a mirror that bulges outward.

13. Draw and label a diagram that shows the law of reflection.

14. List the four characteristics used to describe mirror images.

_____

_____

_____

_____

Name _____ Date _____

Topic **4.5** Summary

What is refraction and how can it be used?

Textbook pages 332 to 343

Before You Read

How can light refraction be used? Record your thoughts below.

_____

_____

Mark the Text

Identify Definitions

Highlight the definition of each word in bold type.

Reading Check

1. What causes refraction?

_____

_____

2. When does a refracted ray bend away from the normal?

_____

_____

3. Name a technology that uses refraction.

_____

_____

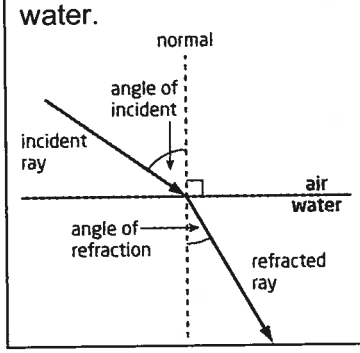
_____

Refraction is light changing direction.

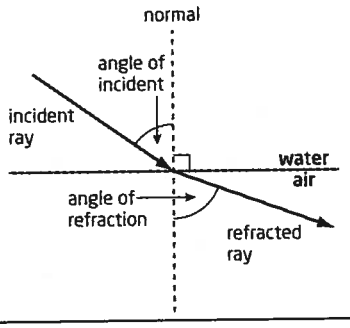
A material through which light travels is called a **medium**. When light passes from one medium to another, it changes direction. This change in direction, called **refraction**, occurs because light travels at different speeds in different media.

The **angle of incidence** is the angle between the **incident ray** and the normal. The **angle of refraction** is the angle between the **reflected ray** and the normal. These two angles are not equal.

Light bends toward the normal as it passes from a medium in which it travels quickly into a medium in which it travels slowly—for example from air to water.



Light bends away from the normal as it passes from a medium in which it travels slowly into a medium in which it travels quickly—for example, from water to air.



Refraction is used in communications technologies.

Refraction is used in fibre optics communications (telephone, cable television, high-speed Internet). Optical fibres can carry information for long distances at nearly the speed of light. They are more practical than copper wires because they are not affected by electrical storms. Also, fibre optic cables are smaller, are lighter, and can carry more signals over a longer distance.

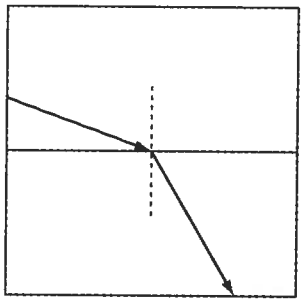
Name _____ Date _____

Illustrating Concepts
Topic 4.5

Use with textbook pages 334 to 339.

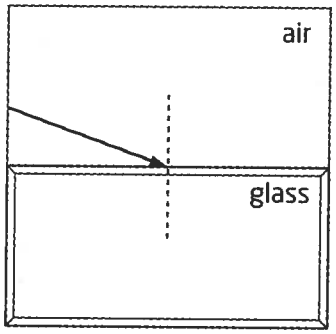
Bending Light

1. Label the incident ray, refracted ray, angle of incidence, and angle of refraction in this diagram.

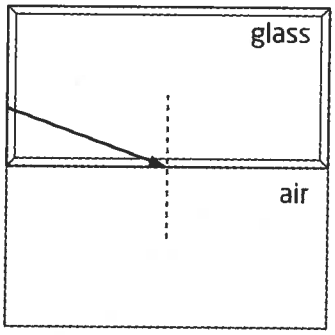


2. Draw the refracted ray in each diagram. Keep in mind light travels least quickly in glass, more quickly in water, and most quickly in air.

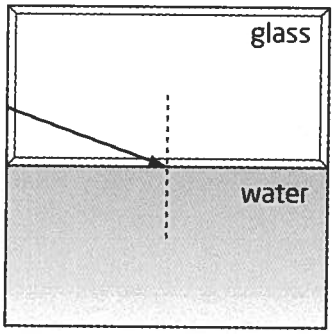
a)



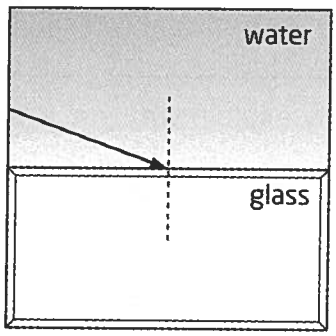
b)



c)

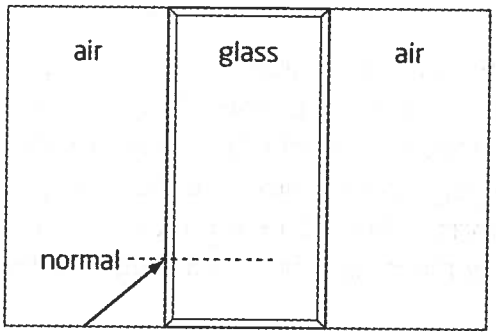


d)

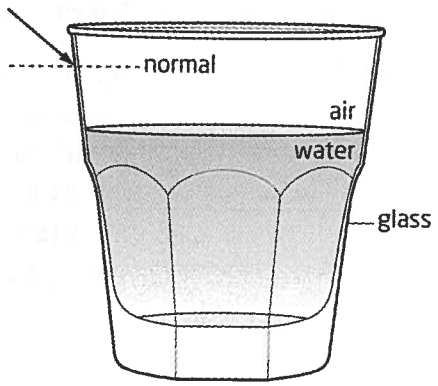


3. Complete the ray diagram to show the path that a light ray takes.

a)



b)



Name _____ Date _____

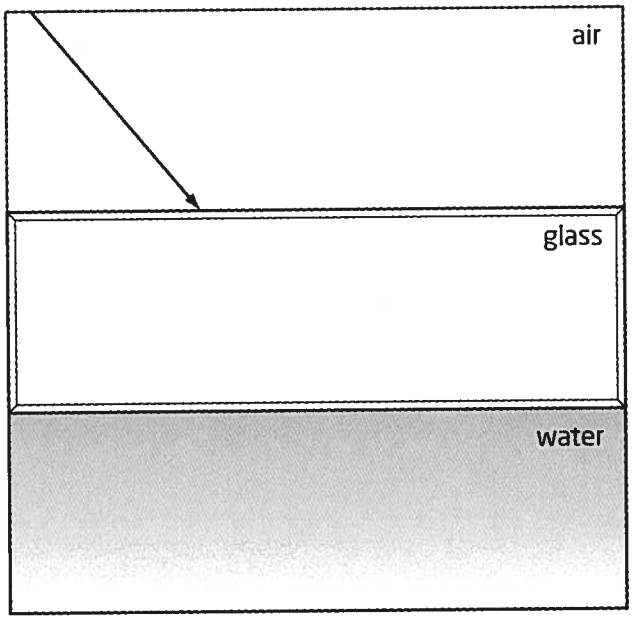
Applying Knowledge
Topic 4.5

Use with textbook pages 336 to 338.

Applications of refraction

1. The diagram shows a layer of air, glass, and water. A light ray from the air is about to enter the glass.
The speed of light in air is 3.0×10^8 m/s.
The speed of light in glass is 2.0×10^8 m/s.
The speed of light in water is 2.25×10^8 m/s.

a) Draw the light ray as it passes from the air, through the glass, and through the water.



b) Briefly explain why you drew the light's path as you did.

_____

_____

_____

2. You are given two sealed containers of liquid that look alike. Your classmate says the two liquids are actually different. You cannot unseal the containers. Describe an experiment you could try to determine whether the liquids might be different.

_____

_____

_____

_____

_____

Name _____ Date _____

Assessment
Topic 4.5

Use with textbook pages 332 to 343.

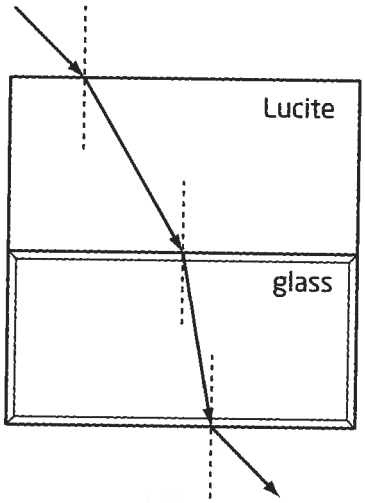
What is refraction and how can it be used?

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ angle of refraction	**A.** the change in direction light takes when it crosses a boundary between two media.
2. _____ medium	**B.** the angle of incidence for which the angle of refraction is 90°.
3. _____ refracted ray	**C.** the ray that has crossed a boundary between two media.
4. _____ refraction	**D.** the angle between the refracted ray and the boundary between the two media.
	E. the angle between the refracted ray and the normal at the point at which the ray crossed the boundary.
	F. the substance through which light travels.

5. Light travels more quickly in ice than in water. Draw a ray diagram of a light ray travelling through ice into water. Label the two different media, the boundary between them, an incident ray, a refracted ray, the normal, the angle of incidence, and the angle of refraction.

6. In this diagram a ray of light travels through air, Lucite, glass, and air again. Does light travel more quickly in Lucite or glass? Explain your reasoning.



Name _____ Date _____

Topic **4.6** Summary

What are lenses and what are some of their applications?

Textbook pages 344 to 355

Before You Read

What are lenses and how can we use them? Record your thoughts below.

_____

_____

Mark the Text

Check for Understanding
As you read this section, stop and reread any parts you do not understand. Highlight the sentences that help you to understand better.

Reading Check

1. What is a lens?

_____

_____

_____

_____

2. What is the difference between a converging lens and a diverging lens?

_____

_____

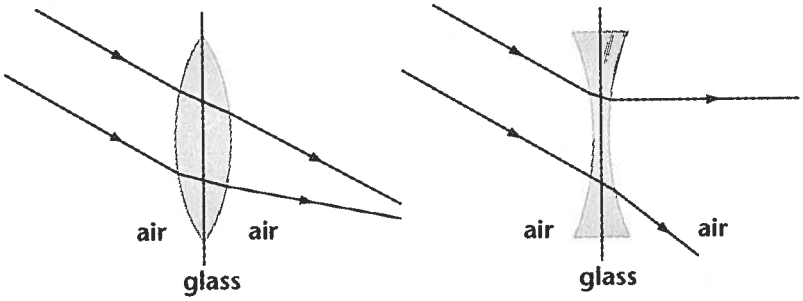
_____

_____

There are three types of lenses.

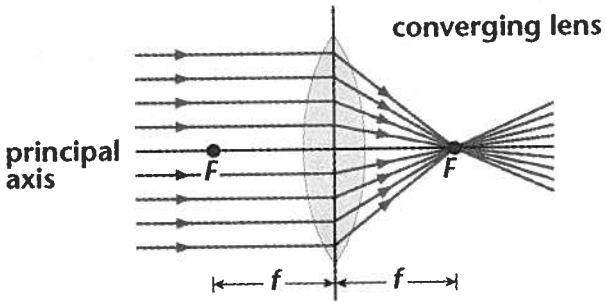
A **lens** is a thin, transparent piece of glass or plastic that has at least one curved side. The sides may be concave, convex, or plane. A **converging lens** (convex) makes light rays come together. A **diverging lens** (concave) make light rays move apart.

This is a converging lens. This is a diverging lens.



Converging lenses produce different types of images.

When parallel rays pass through a converging lens, they meet at one point, called the **focal point**. Each converging lens has two focal points, one on each side. The focal length is the distance between the focal point and the lens.



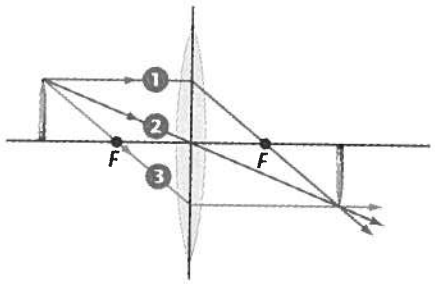
Name _____ Date _____

Topic 4.6 Summary

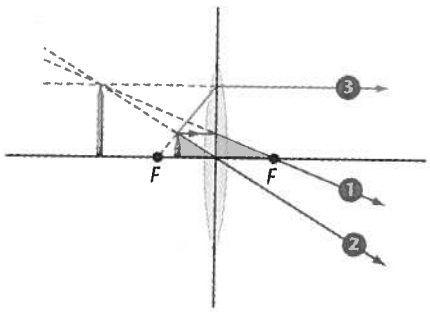
Here is how to draw a ray diagram for a converging lens.

1. Draw a ray parallel to the principal axis, which passes through the lens and refracts to pass through the focal point on the other side.
2. Draw a ray through the centre of the lens that continues on in the same direction.
3. Draw a ray that enters the lens from the focal point and exits the lens parallel to the principal axis.

When the object is beyond the focal point, as shown on the right, the image is real and inverted. The top of the image will be at the point at which the three rays meet. The bottom of the image will be on the principal axis.



When an object is between the focal point and the lens, as shown on the right, the image is virtual, upright, and larger than the object. The three rays spread apart and do not meet. They need to be extended until they meet, as the dotted lines show. The top of the image will be at the point at which the extended rays meet. The bottom of the image will be on the principal axis.



Reading Check

3. What factor determines the location and size of the image produced by a converging lens?

_____

_____

_____

4. When would you use extended rays to find the image produced by a converging lens?

_____

_____

_____

_____

Images Produced by a Converging Lens			
Object location	**Image orientation**	**Image size**	**Image type**
Beyond focal point	Inverted	Varies	Real
Between lens and focal point	Upright	Larger than object	Virtual

Name _____ Date _____

Comprehension
Topic 4.6

Use with textbook pages 346 to 351.

How a converging lens works

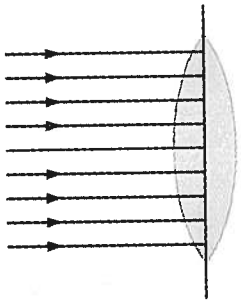
1. Explain why a lens has two focal points instead of one.

_____

_____

2. **(a)** Label the principal axis, axis of symmetry, focal point (*F*), and focal length (*f*) in this diagram.

   (b) Show how a beam of parallel rays would travel through the lens to the other side.



Converging lens

3. Complete the rules for drawing ray diagrams. Match the start of each sentence in column A with the correct ending in column B.

A	B
a) Any ray that enters the lens parallel to the principal axis will …	**i.** keep travelling in the same direction.
b) Any ray that travels through the centre of the lens will …	**ii.** leave the lens parallel to the principal axis.
c) Any ray that enters the lens from the focal point will …	**iii.** pass through the focal point on the other side of the lens.

4. Complete the table.

Images Produced by a Converging Lens			
Object location	**Image orientation**	**Image size**	**Image type**
Between lens and focal point			
Beyond focal point			

Name _____ Date _____

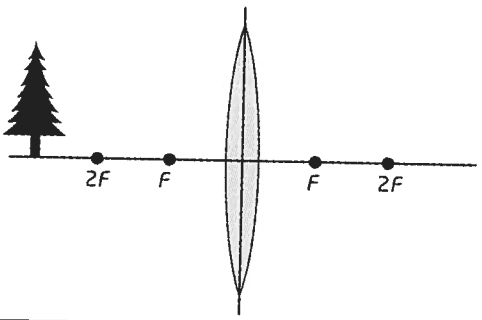
Illustrating Concepts
Topic 4.6

Use with textbook pages 350 to 353.

Images produced by a converging lens

1. Locate the image in each ray diagram. Then, list its characteristics.

a) The object is beyond 2F (twice the distance of the focal point).



Characteristics of image

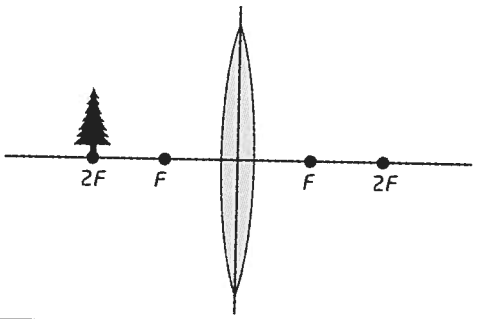
Location: _____

Orientation: _____

Size: _____

Type: _____

b) The object is at 2F.



Characteristics of image

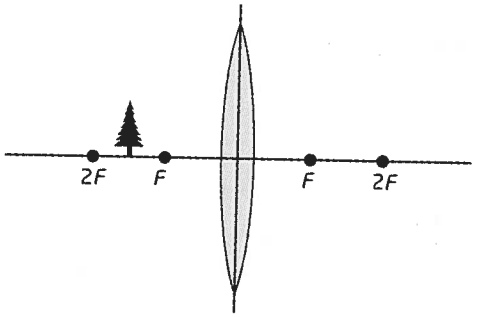
Location: _____

Orientation: _____

Size: _____

Type: _____

c) The object is between 2F and F.



Characteristics of image

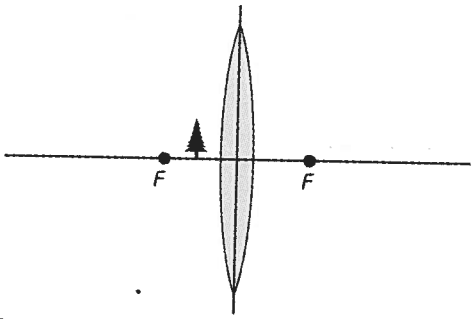
Location: _____

Orientation: _____

Size: _____

Type: _____

d) The object is between F and the lens.



Characteristics of image

Location: _____

Orientation: _____

Size: _____

Type: _____

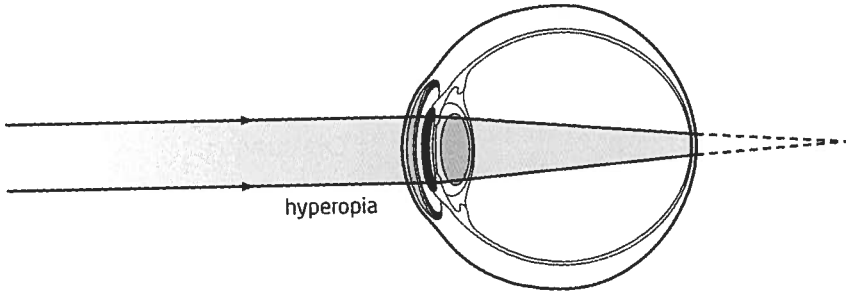
Name _____ Date _____

Applying Knowledge
Topic 4.6

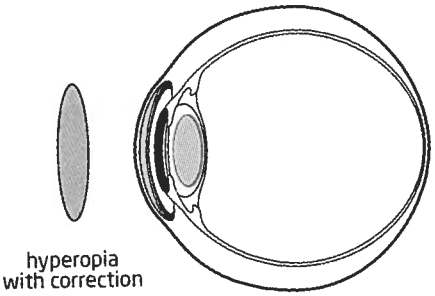
Use with textbook pages 346 to 353.

Devices that use a converging lens

1. The human eye normally focuses the image of an object on the retina. However, people who are farsighted find the image of a close object blurry because the image is focussed behind the retina.



Farsightedness can be corrected with a converging lens. Draw how this can be done in the diagram. The added converging lens helps to focus the image on the retina, instead of behind it.



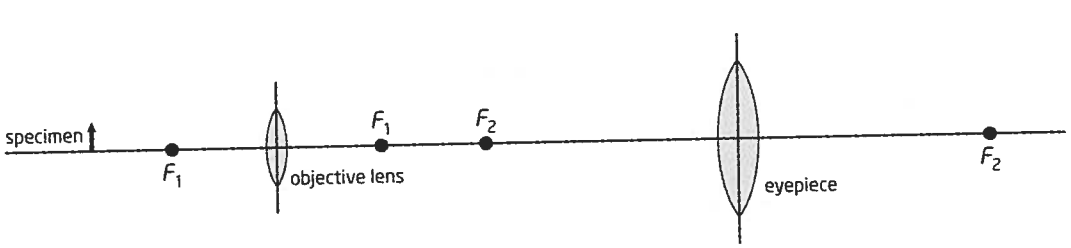
2. A compound microscope magnifies an object using two converging lenses: the objective lens and the eyepiece lens.

(a) On the ray diagram below, locate the image of the object formed by the objective lens. Describe the size and orientation of the image.

size of image: _____ orientation of image: _____

(b) Use the image you drew in part (a) as the object the eyepiece lens magnifies. Complete the diagram to locate the second image. Describe the size and orientation of the image.

size of image: _____ orientation of image: _____



Name _____ Date _____

Assessment
Topic 4.6

Use with textbook pages 344 to 355.

What are lenses and what are some of their applications?

Match each Descriptor on the left with the Lens on the right. Each Lens may be used more than once.

Descriptor	Lens
1. _____ the reading stone was this type of lens	**A.** converging lens
2. _____ The sides of this lens are concave.	**B.** diverging lens
3. _____ The sides of this lens are convex.	
4. _____ This lens makes light rays come together.	
5. _____ This lens makes light rays move apart.	

6. Suppose a light ray enters a converging lens parallel to the principal axis. How will it travel after it leaves the lens?

_____

_____

_____

_____

_____

7. a) Draw a principal axis and a vertical line through it to represent the centre of a converging lens. Draw a focal point on each side of the lens, 2 cm from the lens. Draw a 1 cm high object 3 cm from the centre of the lens. Locate the image.

b) Describe the image.

Size: _____

Location: _____

Orientation: _____

Type: _____

8. What happens to an image's size and orientation as the object moves closer to a converging lens?

Size: _____

Orientation: _____

9. How far must an object be from a converging lens for the lens to act as a magnifying glass that produces an image that is larger and upright?

_____

_____

_____

Name _____ Date _____

Unit 4

Literacy Test Preparation

Read the selection below and answer the questions that follow it.

The Lights and Colours of Fireworks

With a resounding "BOOM!" bright lights explode in the night sky and a display of star patterns and colours awe the spectators below. From the time the firework is lit to the time it explodes in the sky, there is a well-timed sequence of events to produce the desired effect of lights and colours.

Fireworks have become a traditional part of holiday celebrations since they were invented almost a thousand years ago. When most people think of fireworks, they think of bright lights and colours exploding in the sky. These kinds of fireworks are called aerial shells, as opposed to fireworks that are used on the ground, such as sparklers.

Most aerial shells are launched and exploded using gunpowder. Gunpowder is a mixture of 75 percent potassium nitrate, 15 percent charcoal or sugar, and 10 percent sulfur. These substances react with one another when enough heat is supplied. When an aerial shell is lit, the burning gunpowder produces nitrogen and carbon dioxide. These gases propel the firework into the sky. A second package of gunpowder, oxide, and colourants explodes with a bang. The shape of the firework depends on how the components are packed into the firework shell. The colours of the firework depend on what metal salts are used.

Colour production in fireworks involves incandescence and luminescence. Incandescence is the light emitted by a heated object. As the object gets hotter, the light it emits changes colour, from infrared, to red, to orange, to yellow, and lastly to white light. Because of this colour change, it is possible to get a desired colour in a firework by controlling its temperature. For example, the incandescence of iron with carbon or charcoal produces a gold colour.

Luminescence is the light emitted by an unheated object. When the metal salts are heated, the electrons in the salts' atoms absorb the energy, and as a result they become excited and unstable. As these electrons return to their ground state, they release the energy in the form of photons (light). The energy of the photons determines the wavelength (colour) of the metal salts. The amount of energy released varies from element to element, so each metal salt produces its own colour. For example, calcium salts produce orange and barium compounds produce green.

At one time, we used fireworks that were harmful to the environment. For example, some fireworks used toxic metals to create colours, or burned carbon, which produced black smoke. Today we tend to use environmentally friendly fireworks. These fireworks use nitrogen-rich compounds and non-toxic metals to create colours. For example, lithium salts produce red, sodium compounds produce orange, and potassium produces violet.

Name _____ Date _____

Unit 4

Multiple Choice

(Select the best or most correct answer.)

1. What determines a firework's colour?
   - **A.** the metal salts in the firework
   - **B.** the packing of the components in the firework shell
   - **C.** the type of firework used (sparkler or aerial shell)
   - **D.** the temperature of the night air

2. Which process(es) is (are) involved in the colour production of fireworks?
   - **A.** incandescence only
   - **B.** luminescence only
   - **C.** incandescence and luminescence
   - **D.** additive and subtractive colours

3. What happens to the excited electrons of metal salt atoms when they return to their ground state?
   - **A.** They release the energy in the form of photons (light).
   - **B.** They release the energy in the form of heat.
   - **C.** They react with other metal salt atoms to produce a gas.
   - **D.** They absorb more energy from the burning gunpowder.

4. Which colour-producing metals are in environmentally friendly fireworks?
   - **A.** barium compounds
   - **B.** calcium salts
   - **C.** sodium compounds
   - **D.** nitrogen-rich compounds

Short Answer

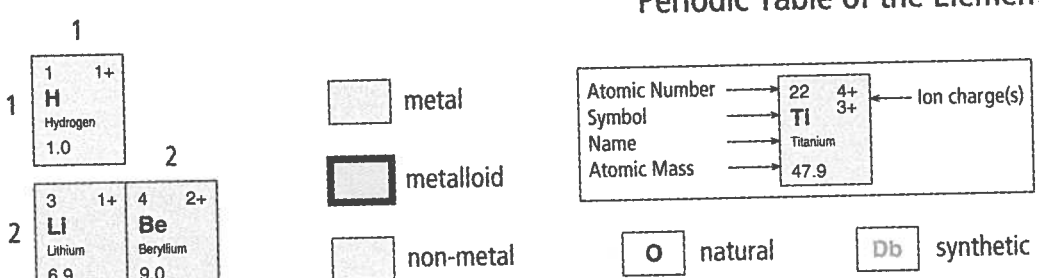
5. Summarize this selection. Include the processes used to produce colours in fireworks.

Name

Date

Appendix

Periodic Table of the Elements



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 1+ **H** Hydrogen 1.0																	2 0 **He** Helium 4.0
3 1+ **Li** Lithium 6.9	4 2+ **Be** Beryllium 9.0											5 **B** Boron 10.8	6 **C** Carbon 12.0	7 3− **N** Nitrogen 14.0	8 2− **O** Oxygen 16.0	9 1− **F** Fluorine 19.0	10 0 **Ne** Neon 20.2
11 1+ **Na** Sodium 23.0	12 2+ **Mg** Magnesium 24.3											13 3+ **Al** Aluminum 27.0	14 **Si** Silicon 28.1	15 3− **P** Phosphorus 31.0	16 2− **S** Sulfur 32.1	17 1− **Cl** Chlorine 35.5	18 0 **Ar** Argon 39.9
19 1+ **K** Potassium 39.1	20 2+ **Ca** Calcium 40.1	21 3+ **Sc** Scandium 45.0	22 4+ 3+ **Ti** Titanium 47.9	23 5+ 4+ **V** Vanadium 50.9	24 3+ 2+ **Cr** Chromium 52.0	25 2+ 3+ 4+ **Mn** Manganese 54.9	26 3+ 2+ **Fe** Iron 55.8	27 2+ 3+ **Co** Cobalt 58.9	28 2+ 3+ **Ni** Nickel 58.7	29 2+ 1+ **Cu** Copper 63.5	30 2+ **Zn** Zinc 65.4	31 3+ **Ga** Gallium 69.7	32 4+ **Ge** Germanium 72.6	33 3− **As** Arsenic 74.9	34 2− **Se** Selenium 79.0	35 1− **Br** Bromine 79.9	36 0 **Kr** Krypton 83.8
37 1+ **Rb** Rubidium 85.5	38 2+ **Sr** Strontium 87.6	39 3+ **Y** Yttrium 88.9	40 4+ **Zr** Zirconium 91.2	41 3+ 5+ **Nb** Niobium 92.9	42 2+ 3+ **Mo** Molybdenum 95.9	43 7+ **Tc** Technetium (98)	44 3+ 4+ **Ru** Ruthenium 101.1	45 3+ 4+ **Rh** Rhodium 102.9	46 2+ 4+ **Pd** Palladium 106.4	47 1+ **Ag** Silver 107.9	48 2+ **Cd** Cadmium 112.4	49 3+ **In** Indium 114.8	50 4+ 2+ **Sn** Tin 118.7	51 3+ 5+ **Sb** Antimony 121.8	52 2− **Te** Tellurium 127.6	53 1− **I** Iodine 126.9	54 0 **Xe** Xenon 131.3
55 1+ **Cs** Cesium 132.9	56 2+ **Ba** Barium 137.3	57 3+ **La** Lanthanum 138.9	72 4+ **Hf** Hafnium 178.5	73 5+ **Ta** Tantalum 180.9	74 6+ **W** Tungsten 183.8	75 4+ 7+ **Re** Rhenium 186.2	76 3+ 4+ **Os** Osmium 190.2	77 3+ 4+ **Ir** Iridium 192.2	78 4+ 2+ **Pt** Platinum 195.1	79 3+ 1+ **Au** Gold 197.0	80 2+ 1+ **Hg** Mercury 200.6	81 1+ 3+ **Tl** Thallium 204.4	82 2+ 4+ **Pb** Lead 207.2	83 3+ 5+ **Bi** Bismuth 209.0	84 2+ 4+ **Po** Polonium (209)	85 1− **At** Astatine (210)	86 0 **Rn** Radon (222)
87 1+ **Fr** Francium (223)	88 2+ **Ra** Radium (226)	89 3+ **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 **Ds** Darmstadium (281)	111 **Rg** Roentgenium (272)	112 **Uub*** Ununbium (285)	113 **Uut*** Ununtrium (284)	114 **Uuq*** Ununquadium (289)	115 **Uup*** Ununpentium (288)	116 **Uuh*** Ununhexium (292)		118 **Uuo*** Ununoctium (294)

* Temporary names

58 3+ 4+ **Ce** Cerium 140.1	59 3+ 4+ **Pr** Praseodymium 140.9	60 3+ **Nd** Neodymium 144.2	61 3+ **Pm** Promethium (145)	62 3+ 4+ **Sm** Samarium 150.4	63 3+ 2+ **Eu** Europium 152.0	64 3+ **Gd** Gadolinium 157.3	65 3+ 4+ **Tb** Terbium 158.9	66 3+ **Dy** Dysprosium 162.5	67 3+ **Ho** Holmium 164.9	68 3+ **Er** Erbium 167.3	69 3+ 2+ **Tm** Thulium 168.9	70 3+ 2+ **Yb** Ytterbium 173.0	71 3+ **Lu** Lutetium 175.0
90 4+ **Th** Thorium 232.0	91 5+ 4+ **Pa** Protactinium 231.0	92 6+ 4+ 5+ **U** Uranium 238.0	93 5+ 3+ 4+ 6+ **Np** Neptunium (237)	94 4+ 6+ 3+ 5+ **Pu** Plutonium (244)	95 3+ 4+ 5+ 6+ **Am** Americium (243)	96 3+ **Cm** Curium (247)	97 3+ 4+ **Bk** Berkelium (247)	98 3+ **Cf** Californium (251)	99 3+ **Es** Einsteinium (252)	100 3+ **Fm** Fermium (257)	101 2+ 3+ **Md** Mendelevium (258)	102 2+ 3+ **No** Nobelium (259)	103 3+ **Lr** Lawrencium (262)

Based on mass of C-12 at 12.00.

Any value in parentheses is the mass of the most stable or best known isotope for elements that do not occur naturally.

Name _____ Date _____

Balancing Chemical Equations

To balance a chemical equation, follow the steps below.

Step 1 Make a table with the reactants and products. Count and record how many of each type of atom are on each side of the equation.

$Na + CuCl_2 \rightarrow Cu + NaCl$

Reactants	Products
1 Na	1 Na
1 Cu	1 Cu
2 Cl	1 Cl

Step 2 Identify an unbalanced atom. *Multiply* the compound on the other side of the equation, which contains that atom, by a coefficient to balance this atom in the reaction. Change the numbers in your table to indicate the change.

$Na + CuCl_2 \rightarrow Cu + 2\ NaCl$

Reactants	Products
1 Na	**2** Na
1 Cu	1 Cu
2 Cl	**2** Cl

Chlorine is unbalanced. Since there is only 1 Cl atom on the product side, place the coefficient 2 in front of NaCl. (This means that you multiply NaCl by 2.) The coefficient must go in front of the whole compound, because it applies to the Na atoms and the Cl atoms in the whole compound.

Step 3 Repeat what you did in step 2 for any other unbalanced atoms, until all the atoms balance.

$2\ Na + CuCl_2 \rightarrow Cu + 2\ NaCl$

Reactants	Products
2 Na	**2** Na
1 Cu	1 Cu
2 Cl	**2** Cl

Now sodium is unbalanced. Since there are now 2 Na on the product side and there is only 1 Na on the reactant side, place the coefficient 2 in front of Na on the reactant side. (Multiply Na by 2.)

Step 4 Count the atoms on each side of the chemical equation to make sure that they are all balanced.

Name _____ Date _____

Glossary

How to Use This Glossary

This Glossary provides the definitions of the key terms that are shown in boldface type in the workbook. Definitions for other important terms are included as well. The Glossary entries also show the numbers of the topics where you can find the words.

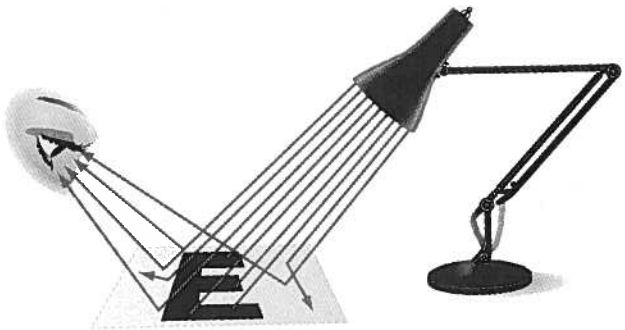
A pronunciation guide, using the key below, appears in square brackets after selected words.

a = mask, back
ae = same, day
ah = car, farther
aw = dawn, hot
e = met, less
ee = leaf, clean
i = simple, this
ih = idea, life
oh = home, loan
oo = food, boot
u = wonder, Sun
uh = taken, travel
uhr = insert, turn
s = sit
z = zoo
zh = equation

Emphasis is placed on the syllable(s) in CAPITAL letters.

A

absorption *In Biology:* the process by which nutrients diffuse or are moved from the digestive system to the blood; *In Optics:* the process in which light energy remains in the object that it hits, and the light energy is converted into heat; as shown here, black text on a white page appears black because all light is absorbed (1.4, 4.2) ▼

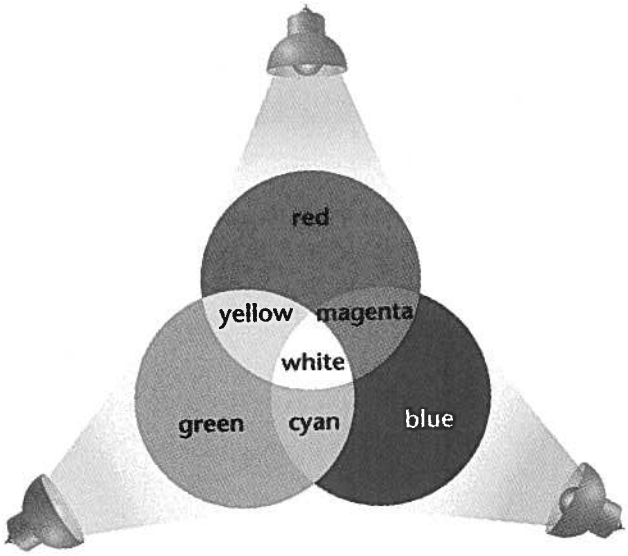


acid deposition more commonly known as acid rain; precipitation that has a pH less than 5.6 (2.4)

acid a compound that tastes sour, corrodes metals and tissue, and turns blue litmus paper red (2.4)

acid-base indicator a substance that changes colour when added to an acid or a base (2.4)

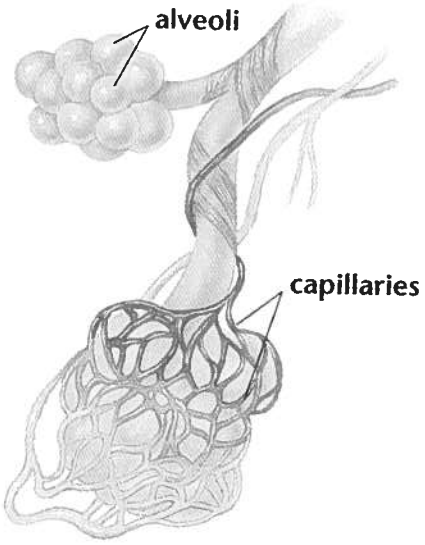
additive primary colours red, green, and blue; when these colours of light are combined, they produce the additive secondary colours; if all three additive primary colours are overlapped, they "add up" to form white, as shown (4.3) ▼



additive secondary colours cyan, magenta, and yellow; produced by combining the additive primary colours, as shown above (4.3) ▲

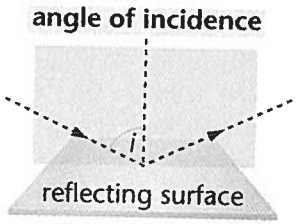
Name _____ Date _____

alveoli [AL-vee-OH-lih] air sacs in the lungs where gas exchange occurs (singular is alveolus) (1.4) ▼

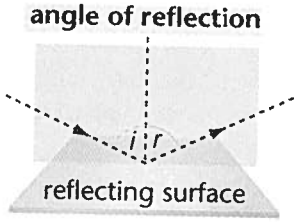


anaphase [AN-uh-faez] the third phase of mitosis, when the chromosomes separate and move to opposite ends of the cell (1.2) ▼

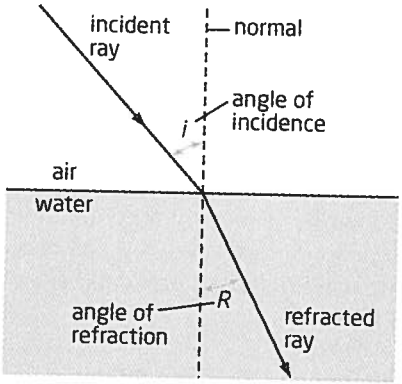
angle of incidence (*i*) the angle between the incident ray and the normal (4.4) ▼



angle of reflection (*r*) the angle between the reflected ray and the normal (4.4) ▼



angle of refraction (*R*) the angle between the refracted ray and the normal (4.5) ▼



antacid non-toxic base that is used to neutralize stomach acid; relieves the pain of excess stomach acid (acid reflux or heartburn) (2.4)

anthropogenic [AN-thruh-puh-JEN-ik] caused by humans (3.4)

anthropogenic greenhouse effect a process in which human-produced greenhouse gases in Earth's atmosphere absorb heat energy from the Sun and Earth's surface (3.4)

anus [AE-nus] part of the digestive system through which feces are eliminated (1.4)

arteries thick-walled, elastic blood vessels that carry blood away from the heart (1.4)

atmosphere the layer of gases above Earth's surface; helps to moderate (even out) temperatures so they are not too extreme; transfers heat around the globe (3.1, 3.3)

average global temperature an average calculated from air temperatures measured in numerous places worldwide (3.1)

Name _____ Date _____

B

balanced chemical equation represents a chemical reaction using coefficients (numbers in front of the reactants and products) that tell you how much of the reactants are used and how much of the products are made (2.3) ▼

$$2\,Na + 2\,H_2O \rightarrow 2\,NaOH + H_2$$

The 2 in front of Na means two atoms of Na or Na Na

The 2 in front of H_2O means 2 sets of H_2O
$2 \times H_2 = H\,H\,H\,H$
$2 \times O = O\,O$

The 2 in front of NaOH means 2 sets of NaOH
$2 \times Na = Na\,Na$
$2 \times O = O\,O$
$2 \times H = H\,H$

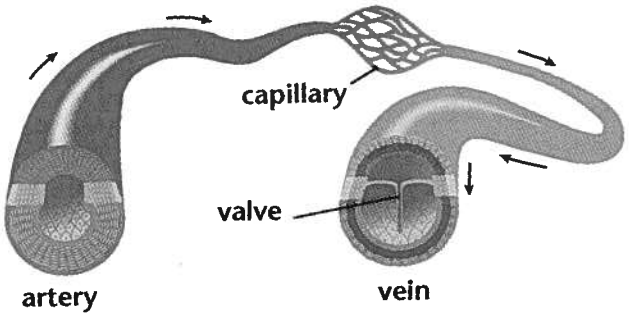
If there is no coefficient, it means a 1, so 1 set of $H_2 = H\,H$

base a compound that tastes bitter, has a slippery texture, corrodes tissue, and turns red litmus paper blue (2.4)

bioclimate profile a method for communicating climate-projection information; a graph of temperature and moisture conditions of a particular site over a period of time (3.5)

bioluminescence [BIH-oh-LOOM-in-E-sens] light that is released through biochemical processes in living organisms (4.1)

blood vessels elements of the circulatory system that transport blood; include arteries, veins, and capillaries (1.4) ▼

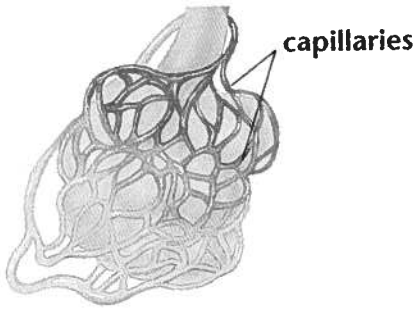


C

calcium carbonate commonly known as lime; a chemical that is added to lakes affected by acid rain to neutralize the water (2.4)

cancer cells with abnormal genetic material that are dividing uncontrollably and can spread to other parts of the body (1.2)

capillary [kuh-PIL-uh-ree] tiny blood vessels that play an important role in gas exchange (1.4) ▼



carbon dioxide second-most-abundant greenhouse gas; produced in and by the cells of most living organisms through cellular respiration (3.3)

carbon footprint the total amount of greenhouse gas emissions caused by an individual, company, or organization (3.5)

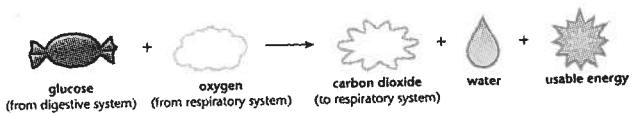
carbon sink a process that absorbs and stores carbon dioxide from the atmosphere (3.3)

cell cycle the continuous series of events in the life of a cell in which it is born, grows, reproduces, and dies (1.2)

cell differentiation the series of events through which stem cells develop into specialized cells (1.3)

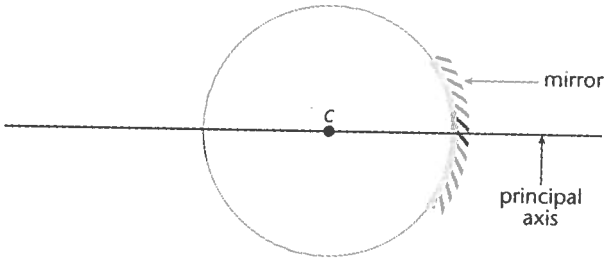
cell membrane semi-permeable membrane that separates the inside of the cell from the external environment; controls the flow of materials into and out of the cell (1.1)

cellular respiration a process in the cells of most living things that converts the energy stored in chemical compounds into usable energy; the word equation for the process is shown here (1.4) ▼



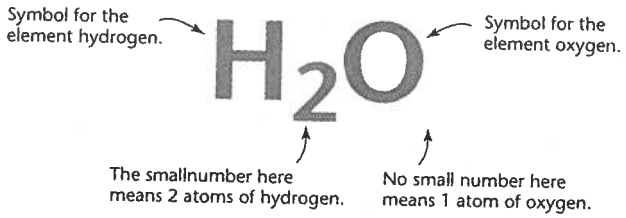
Name _____ Date _____

centre of curvature (*C*) the centre of the imaginary sphere that a curved mirror fits on (4.4) ▼



chemical equation an equation that uses chemical symbols to represent reactants and products in a chemical reaction (2.3)

chemical formula a group of letters and subscript numbers that represent the make-up of a chemical compound (2.2) ▼



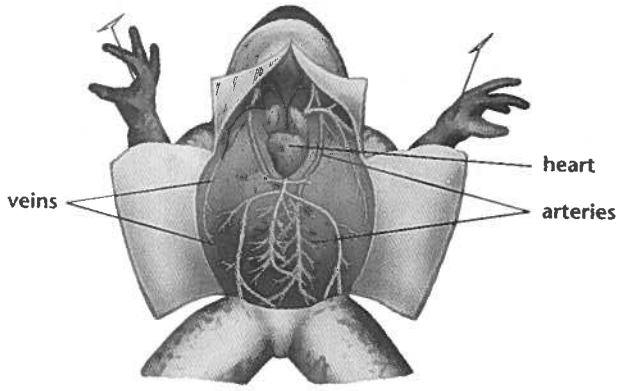
chemical reaction a change in matter that produces new substances with new properties (2.1)

chemiluminescence [KEM-ee-loo-min-ES-uhns] light that is released during chemical reactions; the process that allows glow sticks to give off light (4.1)

chlorofluorocarbons (CFCs) [KLOR-oh-FLUHR-oh-kar-buns] damaging greenhouse gases; used in the past as solvents and as coolants in refrigerators, but banned due to the damage they cause to the atmosphere's ozone layer (3.4)

chromosomes a super-condensed form of chromatin formed during cell division; because they are compact, they are a convenient way to pass on hereditary information when a cell divides. (1.2)

circulatory system transports blood, nutrients, gases, and wastes within the body; helps to control temperature, fluid balance, and acidity (1.3) ▼



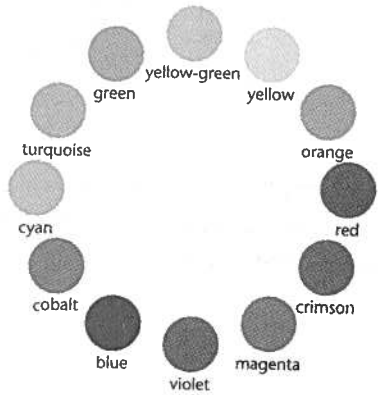
climate change a change in the weather conditions that a region experiences over a long period of time; refers not only to changes in temperature patterns, but also to changes to long-term patterns in other parts of weather such as precipitation (rain and snow), wind, and storms (3.1)

climate projection a prediction of how climate may change in the future, usually based on a global climate model (3.5)

climate the pattern of weather conditions within a region over a long period of time (3.1)

coefficient [KOH-ee-FI-shunt] the number in front of a product or reactant in a balanced chemical equation; tells you how much of the reactant or product is used (2.3)

colour wheel a graphic organizer that summarizes the additive and subtractive primary colours, the secondary colours, the complementary colours, and the tertiary colours (4.3) ▼



Name Date

complementary colours red/cyan, green/magenta, and blue/yellow; pairs of colours that can be combined to form white, or subtracted to form black; a primary colour and the secondary colour created by mixing the other two primary colours; colours that are directly across from each other on a colour wheel (4.3)

concave mirror a reflecting surface that curves inward or "caves in" in the centre (4.4) ▼

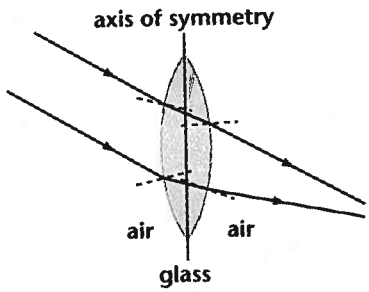
concentration the number of molecules of a substance in a given volume (1.1)

conductivity ability to conduct (transfer) electricity; can also refer to ability to transfer heat (2.2)

connective tissue strengthens, supports, or connects cells and tissues (1.3)

converge come together (4.6)

converging lens lens that makes light rays come together; curved outward on at least one side; also known as a convex lens (4.6) ▼

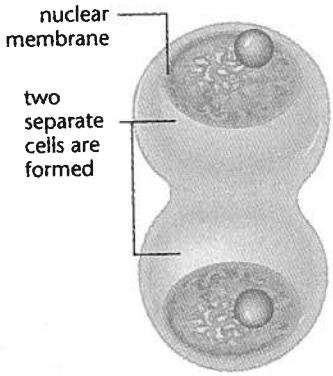


convex mirror a mirror that bulges out in the centre; shaped like the outside of a piece of a sphere (4.4) ▼

coral animal that lives in the ocean, in a close association with algae (3.2)

CT (computerized axial tomography) scan imaging technique that produces a 3-D image that looks like slices of the body; used to view hard tissue, such as bone, and to diagnose bone injuries and malformations (1.5)

cytokinesis [SIH-toh-kuh-NEE-sus] the stage in the cell cycle when the cytoplasm and organelles divide into two identical, separate cells (1.2) ▼



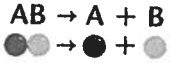
cytoplasm [SIH-toh-PLAZ-um] includes the organelles, and other life-supporting materials, such as sugar and water, all contained by the cell membrane (1.1)

cytoskeleton [SIH-toh-SKEL-uh-tuhn] filaments and tubules that provide a framework for the cell, helping it maintain its structure and providing "tracks" along which vesicles and organelles can move (1.1)

Name Date

D

decomposition reaction a type of reaction in which one compound breaks down into two or more simpler compounds or elements (2.3) ▼



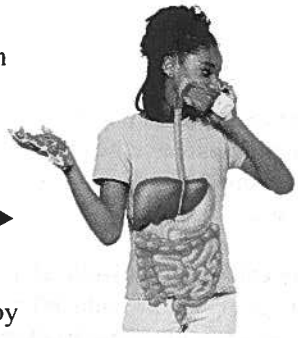
deforestation a practice in which large areas of forest are cleared of their trees; results in less carbon dioxide being removed from the atmosphere through photosynthesis (3.4)

desertification [duh-zuhr-tuh-fuh-KAE-shun] the spread of deserts; affects all organisms living in an area, including humans, due to lack of water for crops and drinking water (3.2)

diffusion the movement of molecules or other particles from an area of high concentration to an area of low concentration until they are evenly distributed (1.1) ▼

digestion process in which food is broken down into nutrients physically (through dissolving and breaking it into smaller bits) and chemically (through chemical reactions) (1.4)

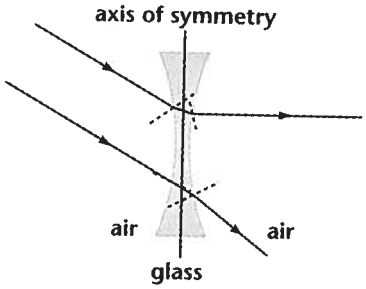
digestive system organ system responsible for taking in and breaking down food, absorbing nutrients, and ridding the body of solid waste (1.3) ▶



dilute [dih-LOOT] reduced in concentration by being mixed with a liquid, such as water (2.1)

diverge move apart (4.6)

diverging lens a lens that makes light rays move apart; curved inward on at least one side; also known as a concave lens (4.6) ▼



DNA (deoxyribonucleic acid) [dee-AWK-see-RIH-boh-noo-KLAE-ik A-sid] a unique molecule that stores the instructions that determine all of the details of an organism's life (1.2)

double displacement reaction a type of chemical reaction in which the metal ions of two different compounds exchange places (2.3) ▼

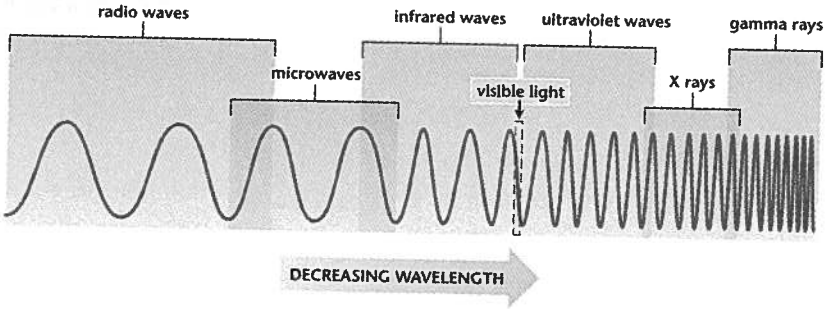
drunken forests groups of trees that have tilted or fallen over due to quickly thawing permafrost and shifting soil (3.2)

E

electric discharge a type of luminescence that occurs in a sealed glass tube; used in many street lights (4.1)

electromagnetic radiation energy that travels as waves that move outward in all directions from a source; includes infrared radiation, ultraviolet radiation, radio waves, X rays, gamma rays, and visible light (1.5)

electromagnetic spectrum a representation of the types of electromagnetic waves arranged according to wavelength (4.1) ▼



electromagnetic waves waves that carry electrical energy and magnetic energy (4.1)

elimination process in which solid waste passes from the digestive system out of the body (1.4)

endoscopy [en-DAWS-kuh-pee] an imaging process that is used to view internal body parts without cutting open the body; to diagnose diseases, take tissue samples, and perform surgeries (1.5)

epithelial tissue [e-pi-THEE-lee-uhl TI-shyoo] body tissue that covers the external and internal body surfaces (1.3)

esophagus [e-SAW-fuh-gus] tube-like organ that pushes the food into the stomach using wave-like muscular contractions (1.4)

excretory system [EX-kruh-TOH-ree or ex-KREE-tuh-ree SIS-tum] organ system that eliminates liquid waste from the body; helps to control fluid balance and acidity (1.3)

explosive used to describe a container that can explode if heated or punctured; flying pieces of metal or plastic from the container can cause serious injury, especially to eyes (2.1)

F

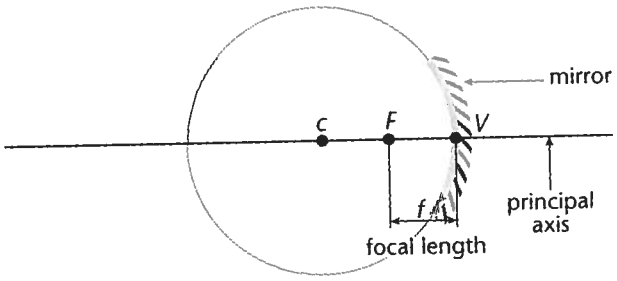
fibre optic a cable containing many optical fibres—tiny glass fibres that transmit light (4.5)

field of view the circle that you see through the eyepiece of a microscope (U1)

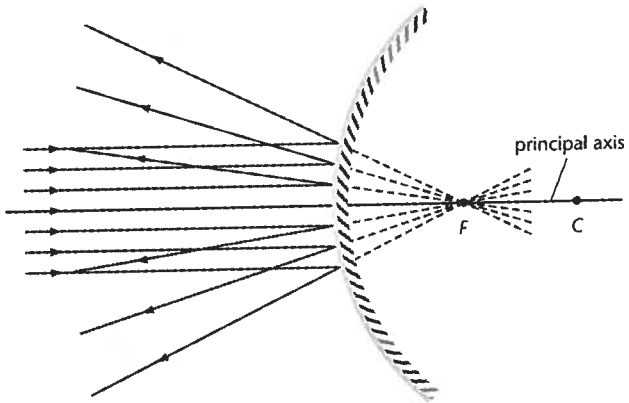
flammable used to indicate that a product or its fumes will catch fire easily if it is near heat, flames, or sparks; rags used with this product may begin to burn on their own (2.1)

fluorescence [flohr-E-sens] a form of electric discharge in which the gases emit ultraviolet light, which transfers energy to a phosphor coating on the inside of a fluorescent bulb; the phosphor releases the energy as light (4.1)

focal length (*f*) the distance from the vertex of a mirror or the centre of a lens to the focal point of the mirror or lens (4.4) ▼



focal point (*F*) the point where reflected rays meet when incident rays are parallel to and near to the principal axis; for a concave mirror, the focal point is in front of the mirror; for a convex mirror, extended rays meet at a focal point behind the mirror (4.4) ▼



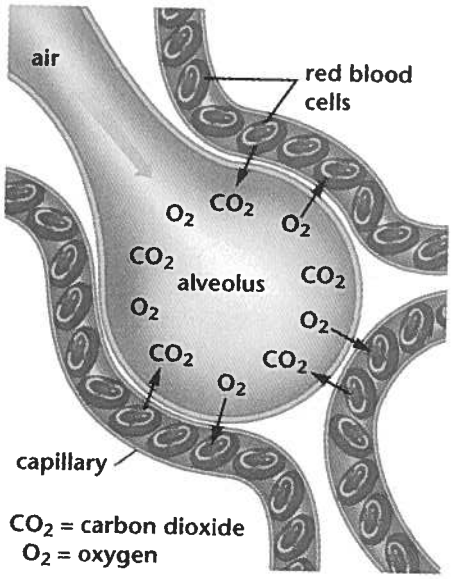
fossil fuels materials that are burned to carry out industrial processes, generate electricity, heat homes, and power vehicles; derived from once-living tissues; include coal, oil, and natural gas (3.4)

fossils remains of ancient organisms that are preserved in rock or other substances; the type of fossil in a certain place tells scientists what the climate must have been like there during that period (3.1, 3.5) ▼

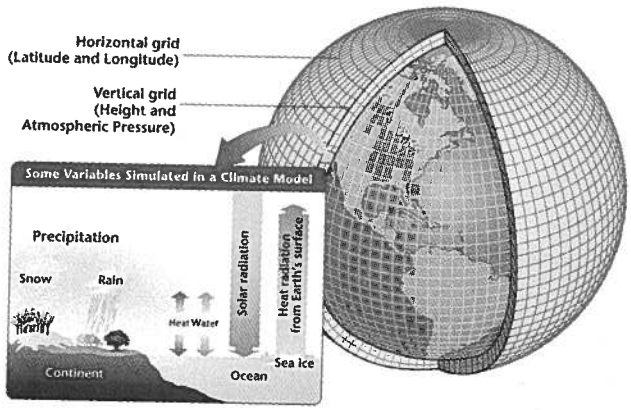
Name Date

G

gas exchange the process of taking in oxygen and releasing carbon dioxide (1.4) ▼



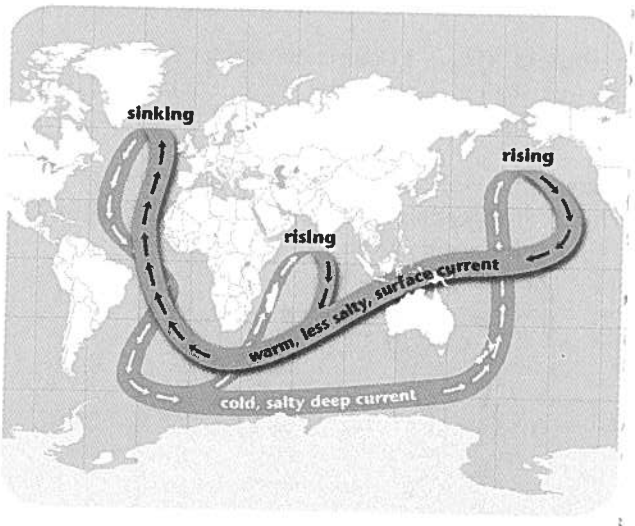
global climate model a computer program that uses mathematical equations to help scientists understand and estimate changes in Earth's climate (3.5) ▼



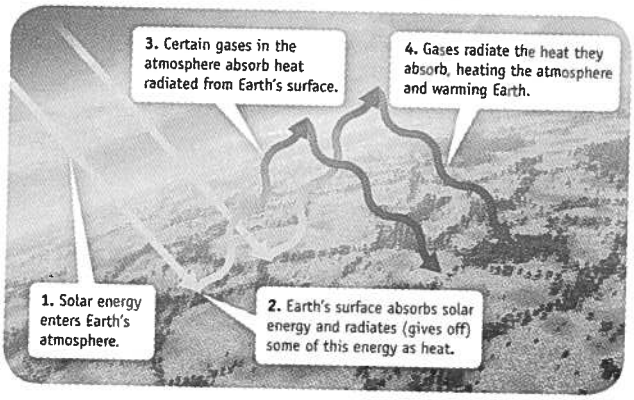
global warming an increase in average global (world-wide) temperatures; refers to an average increase in one part of weather—air temperature—as it affects the whole planet (3.1)

Golgi body [GOHL-jee BAW-dee] organelle that sorts and packages proteins and other molecules for transport out of the cell (1.1)

great ocean conveyor belt massive system of deep-water currents in the oceans that moves water and heat around the whole Earth; driven by differences in density arising from temperature and salt level (cold, salty water sinks; warm, less-salty water stays on the surface) (3.3) ▼



greenhouse effect a natural process in which certain gases in Earth's atmosphere absorb heat from the Sun as well as heat radiated from Earth's surface (3.3) ▼



greenhouse gases gases in Earth's atmosphere that act like the air in a greenhouse, absorbing energy from the Sun and trapping heat in the atmosphere; major greenhouse gases are water vapour, carbon dioxide, methane, and nitrous oxide (3.3)

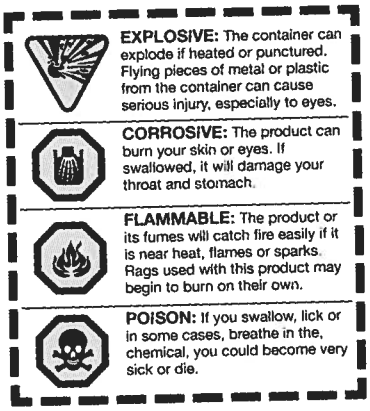
Name Date

H

halocarbons [HAE-loh-KAR-buns] the only greenhouse gases produced solely by human beings; industrial chemical compounds such as chlorofluorocarbons (CFCs) (3.4)

halogens Group 17 non-metals; their outermost electron shell is one electron short of being full; the most reactive non-metals (2.2)

Hazardous Household Product Symbols (HHPS) icons that appear on household product labels to warn of possible danger; display some basic safety information about a product (2.1) ▼



heart the major organ of the circulatory system; pumps blood through the body (1.3)

heat sink something that can absorb heat and store heat (3.3)

hydrogen an element that has only one electron; unique because it can behave like a metal or a non-metal; has only one electron in its outer shell, but needs only one electron to complete its outer shell (2.2)

hydrosphere [HIH-drus-feer] water in all its different forms on Earth (3.3)

I

ice age a time period in Earth's history when glaciers covered a large part of Earth's surface; the last ice age began 26 000 years ago (3.1)

image distance the distance from a mirror or lens to the image (4.4) ▼

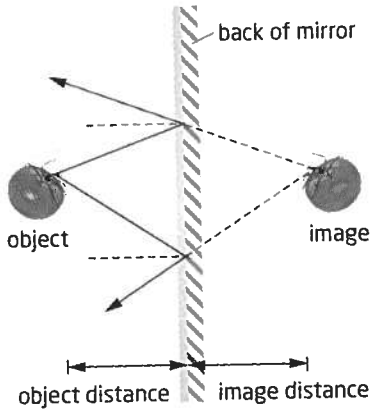
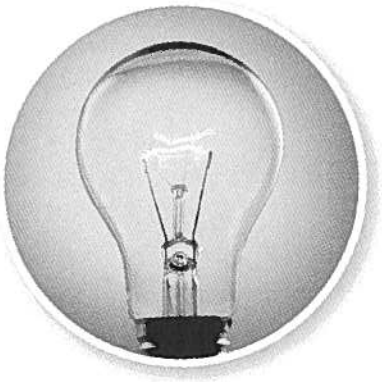


image the reflection of an object in the mirror (4.4)

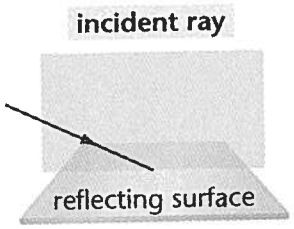
immune system an organ system that defends the body against infections (1.3)

incandescence [IN-kan-DES-uhns] light given off by an object because it is very hot (4.1) ▼



incandescent light bulb a bulb in which electrical current runs through a tiny metal filament, making the filament so hot that it glows (4.1) ▲

incident ray a light ray travelling toward a mirror or other surface (4.4) ▼



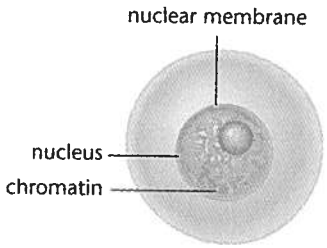
Name Date

industrial revolution a period in history that started about 300 years ago, when people who lived in the countryside began moving to cities to work in factories; factories used steam engines fueled by the burning of coal (3.4)

ingestion [in-JES-chun] the process in which food is taken into the body (1.4)

integumentary system [in-TEG-yoo-MEN-tuh-ree SIS-tum] an organ system that includes the skin, hair, and nails; provides a protective barrier around the body; receives sensory information; helps to control body temperature (1.3)

interphase the stage in the cell cycle when a cell grows and carries out its usual functions, as well as making a copy of its DNA and organelles to prepare for cell division (1.2) ▼



inverted an image that is oriented opposite to the image; (the image is upside down compared with the object) (4.4)

ion [IH-uhn] an atom or a group of atoms that has an electrical charge, either positive or negative (2.2)

ionic compound a compound composed of oppositely charged ions; forms because the positively charged metal ions attract the negatively charged non-metal ions; is solid at room temperature, has a very high melting point, and conducts electricity when melted or dissolved in water (2.2)

i-pill "intelligent pill;" can deliver medication directly to where it is needed, and then electronically release a pre-measured amount at that location; contains a microprocessor, battery, pH sensor, temperature sensor, wireless transceiver, fluid pump, and reservoir for the medication (1.5)

K

kidneys organs that produce urine by filtering wastes and excess water from the blood (1.3)

krill tiny animals at the bottom of the aquatic food chain that feed on microscopic plants called plankton; declining numbers of krill have an impact on the many organisms that feed on them (3.2)

L

large intestine a tube-like organ in the digestive system; reabsorbs water and some nutrients from undigested food (1.4)

law of conservation of mass during a chemical reaction, the total mass and number of atoms of the reactants equal the total mass and number of atoms of the products (2.3)

law of reflection the angle of reflection is equal to the angle of incidence; the reflected ray and the incident ray are on opposite sides of the normal; the incident ray, the normal, and the reflected ray lie on the same plane (4.4)

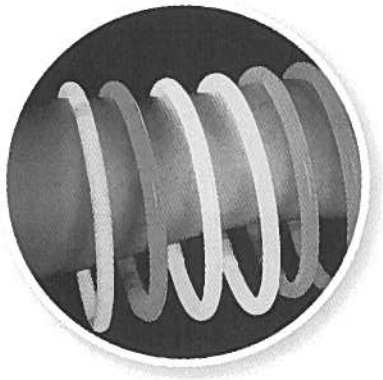
lens a thin piece of glass or plastic that has at least one curved side (4.6)

litmus paper an acid-base indicator that often comes in two colours—red and blue; acids turn blue litmus paper red, while bases turn red litmus paper blue (2.4) ▼

liver an organ that cleans the blood and stores substances such as certain vitamins and minerals (1.3)

location the position of an image relative to a mirror or lens (4.4)

luminescence [LOO-min-E-sens] light given off by an object that has not been heated; may be in the form of fluorescence, electric discharge, or chemiluminescence (shown here) (4.1) ▼



lungs respiratory organs that draw oxygen-rich air into the body and remove carbon-dioxide rich air from the body (1.3)

M

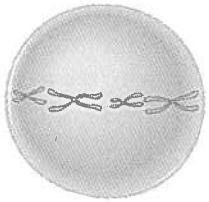
Material Safety Data Sheet (MSDS) information about the composition and properties of a chemical substance, as well as steps for handling and storing it safely (2.1)

medical imaging technologies technologies that are used to make images of cells, tissues, and organs (1.5)

medium the substance or material that light is travelling through (the plural of medium is *media*) (4.5)

metals elements left of the metalloid "staircase" on the periodic table; all metals except mercury are malleable, shiny, conduct heat and electric current, and are solids at room temperature (2.2)

metaphase the second phase of mitosis, when the chromosomes align in the centre of the cell (1.2) ▼



methane a foul-smelling gas released by bacteria in the digestive system as they break down food; also released by microorganisms that live in wetlands or melting permafrost; released by openings in Earth's crust; a major greenhouse gas (3.3)

microscopy [mih-KRAWS-kuh-pee] a group of techniques that are conducted using a variety of microscopes, including light microscopes and electron microscopes; used to view small objects, such as cells, and to diagnose various diseases (1.5)

mitochondria [MIH-toh-KAWN-dree-uh] organelles responsible for releasing energy from glucose to fuel cellular activities (singular: mitochondrion) (1.1)

mitosis the stage in the cell cycle when the contents of the nucleus separate into two identical copies (1.2)

molecular compounds compounds that form when non-metal atoms share electrons with each other; may be solids, liquids, or gases at room temperature; have lower melting points than ionic compounds; do not conduct electric current when they are melted or dissolved in water, except in the case of certain acids (2.2)

MRI (magnetic resonance imaging) scan a medical imaging technique that creates images of the body using radio waves and a magnetic field; used to contrast soft tissue (such as organs) and hard tissue (such as bones) and to diagnose disease in soft tissues and organs (1.5)

muscle tissue tissue that allows body parts to move, exert force, or change shape (1.3)

muscular system organ system that moves body parts, such as arms, and organs, such as the stomach; maintains posture (1.3)

mutation a change in the hereditary information carried in a cell's DNA (1.2)

N

natural greenhouse effect a natural process in which certain gases in Earth's atmosphere absorb heat from the Sun as well as heat radiated from Earth's surface (3.4)

nervous system an organ system that gathers and interprets sensory information from outside and inside the body; coordinates all the functions of other organ systems (1.3)

nervous tissue senses, conducts, and transmits information (1.3)

neutralization reaction [NOO-truh-lih-ZAE-shun ree-AK-shun] a chemical reaction between an acid and a base that "neutralizes" their acidic and basic properties (2.4) ▼

$$HA + B\text{-}OH \rightarrow AB + H_2O\ (HOH)$$

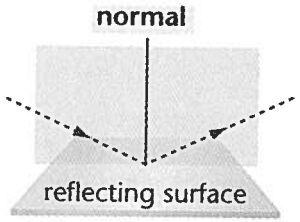
Acids have a hydrogen (H) | Bases have hydroxide (OH) | The other parts of the acid and base combine to make a salt | The hydrogen (H) and the hydroxide (OH) often combine to make water (H_2O or HOH)

nitrate a negative ion that consists of one nitrogen and three oxygen atoms, and has one negative charge; the four atoms remain attached and act as a unit in many chemical reactions; has the chemical formula NO_3^- (2.3)

nitrous oxide greenhouse gas produced when certain species of bacteria break down nitrogen-rich compounds for food; absorbs 300 times more heat than carbon dioxide does (3.3, 3.4)

non-metals the elements on the right of the periodic table; are not malleable, do not conduct heat or electric current, and can be solids, liquids, or gases at room temperature (2.2)

normal a line perpendicular to a surface, such as a mirror, or a boundary between two substances, such as air and water (4.4) ▼



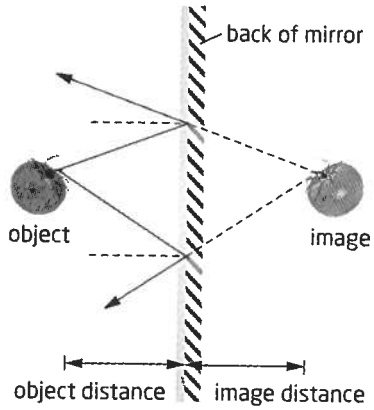
nuclear membrane a semi-permeable membrane that separates the nucleus from the rest of the cell and regulates the passage of substances into and out of the nucleus (1.2)

nucleus organelle that controls all cell activities (1.1)

numerical prefix a syllable that can be added to the beginning of a word to indicate the number of units present (2.2)

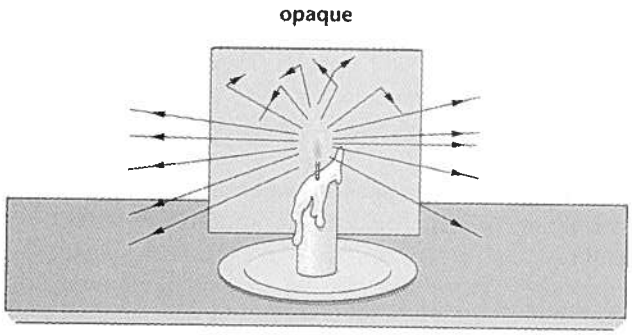
O

object distance the distance from a mirror or lens to the object (4.4) ▼



object the item in front of the mirror or lens (4.4)

opaque [oh-PAEK] a property of an object that will not allow any light to penetrate it (4.2) ▼



optical fibre made of a tiny glass fibre, called the core, which is about the size of a human hair, and a cladding (protective coating) made of a different type of glass, that covers the core; sends light in pulses, carrying information long distances at nearly the speed of light (4.5)

organ different tissues working together to perform a specific task; connective, nervous, and epithelial tissues make up the brain, shown below (1.3) ▼

organelle a structure within a cell that carries out specific functions to support the life of the cell; functions include bringing in nutrients, removing wastes, generating and releasing energy for the cell to use, making substances that the cell needs, and reproducing (1.1)

organ system a group of organs that interact with each other to perform a common task; the circulatory system (shown) includes the heart, arteries, and veins (1.3) ▼

orientation how an image is oriented vertically relative to an object; whether an image is oriented in the same direction as the object (right side up or upright) or in the opposite direction as the object (upside down or inverted) (4.4)

osmosis the movement of water molecules across a membrane in response to concentration differences (1.1)

P

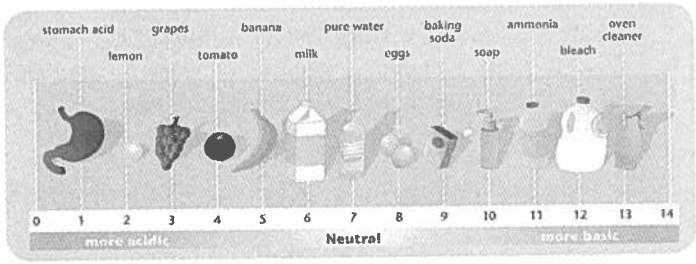
permafrost the permanently frozen layer of soil found in Canada's far north (3.2)

perpendicular at an angle of 90° (4.4)

pesticides chemicals that are used to control and kill weeds and insects (1.5)

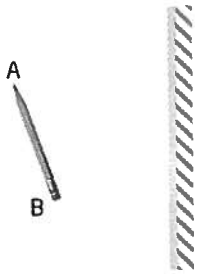
PET (positron emission tomography) scan an imaging technique that involves scanning small amounts of radioactive materials that have been taken into the body; reveals details of soft tissues and organs; used to diagnose cancer or track cancer treatments (1.5)

pH scale a scale from 0 to 14 that describes how acidic or basic a substance is (2.4) ▼



photosynthesis a process in the cells of plants, algae, and some bacteria that converts light energy from the Sun into stored chemical energy that can be used by organisms (2.1)

plane mirror any smooth, flat reflecting surface; often represented in diagrams as a straight line with hatch marks (short diagonal lines) on the non-reflecting side, as shown here (4.4) ▼



plane flat surface (4.4)

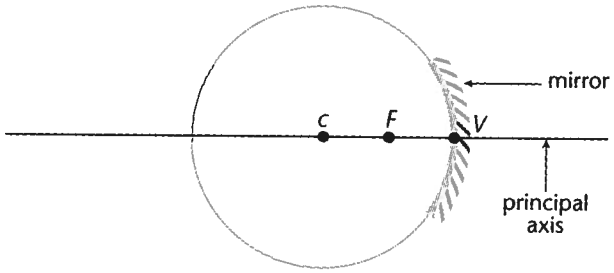
plankton microscopic plants that are a vital part of aquatic ecosystems; krill and larger organisms feed on plankton (3.2)

poison term used on product labels to indicate that you could become very sick or die if you swallow, lick, or, in some cases, breathe in the chemical (2.1)

prefix a syllable that can be added to the beginning of a word to change its meaning (2.2)

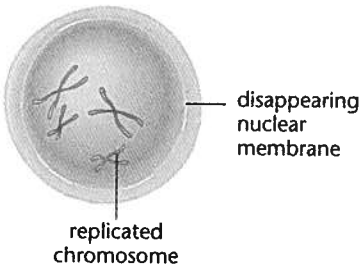
primary colours three colours which, when combined in different amounts, can generate any other colour (4.3)

principal axis a line drawn normal to the centre of a spherical mirror or a lens; always goes through the centre of curvature, *C* (4.4) ▼



products new substances produced in a chemical reaction (2.1)

prophase the first phase of mitosis, when the nucleus and nuclear membrane disappear and chromosomes form (1.2) ▼

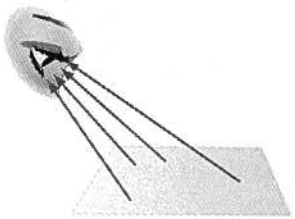


protractor device used to measure angles (4.4)

R

ray diagrams diagrams that demonstrate light rays, and allow you to make predictions about the way light behaves (4.2)

ray an arrow that shows the direction in which light is travelling (4.2) ▼



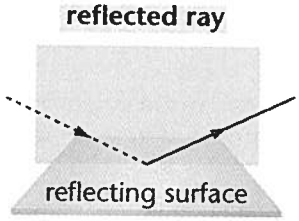
reactants substances that react together in a chemical reaction (2.1)

reactive describes the likelihood of an atom taking part in a chemical reaction and forming a compound (2.2)

real an image that is formed when light rays meet and do not have to be extended backwards; (if a screen is placed at the location of an image, the image will appear on the screen) (4.4)

red blood cells blood cells that carry oxygen and carbon dioxide in the blood (1.4)

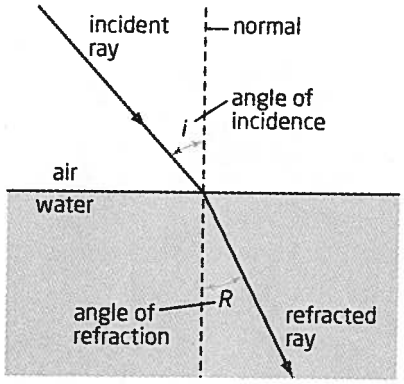
reflected ray a light ray that has "bounced" off a reflecting surface (4.4) ▼



reflection the process in which light "bounces off" the surface of an object and travels in another direction; can also refer to the image produced when this process occurs (4.2) ▼

refracted ray a light ray after it has crossed a boundary between two media (4.5)

refraction the change in the direction in which light is travelling when it crosses a boundary between two media (4.5) ▼

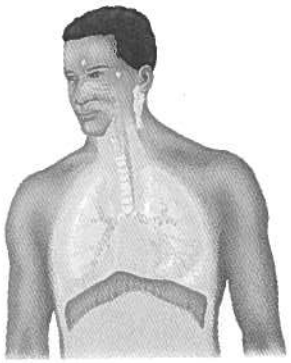


regeneration the ability to grow new cells to replace damaged or lost body components (1.2)

regenerative medicine [re-JEN-ruh-tiv MED-uh-sin] process of producing new cells, tissues, and organs to replace damaged body parts (1.5)

reproductive system organ system that produces eggs (in females) and sperm (in males); produces estrogen, testosterone, and the other sex hormones; in females, allows for the growth and delivery of offspring (1.3)

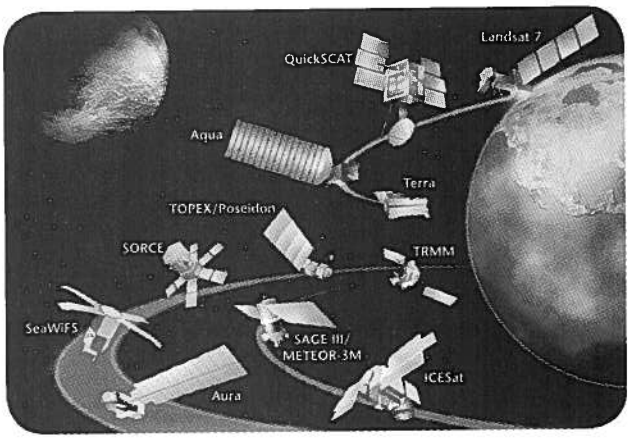
respiratory system organ system that controls breathing; delivers oxygen to the blood and removes carbon dioxide from the blood (1.3) ▼



ribosomes organelles that help to produce proteins, which make up much of a cell's structure and are required for activities necessary for the cell's survival; some ribosomes float in the cytoplasm, and others are attached to the endoplasmic reticulum (1.1)

S

satellite human-made object or vehicle that orbits Earth, the Moon, or other bodies in space; EOS (Earth Observing System) satellites can make detailed observations of the whole planet in a single day (3.5) ▼



secondary colours the colours generated by combining two primary colours; additive secondary colours are cyan, magenta, and yellow (4.3)

single displacement reaction a type of chemical reaction in which one element takes the place of another element in a compound (2.3) ▼

$$A + BC \rightarrow AC + B$$

$$D + BC \rightarrow BD + C$$

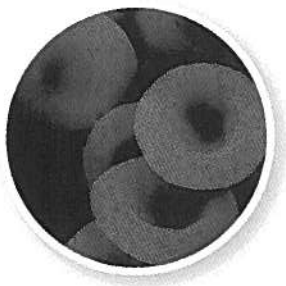
size whether an image is larger or smaller than an object; sometimes called the magnification of the image (4.4)

skeletal system organ system that provides a framework for muscles to attach to, protects the soft organs, makes blood cells, and stores minerals (1.3)

small intestine organ in the digestive system; nutrients from food are absorbed into the bloodstream here (1.4)

solar energy light and other forms of energy that the Sun gives off; can be converted into electrical energy (3.3)

specialized cells cells that have differentiated, or developed special characteristics that make them well suited to their function; red blood cells take on a flattened circular shape with a depression in the middle (1.3) ▼



stomach digestive organ that churns and digests food (1.3)

subscript numbers small numbers at the base of larger letters; tell you how many atoms of these elements are in a compound; for example, in O_2, the subscript 2 indicates there are two atoms of oxygen (2.2)

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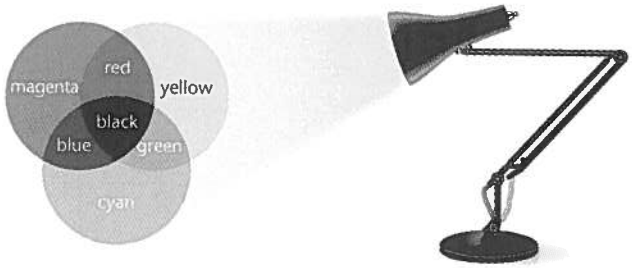
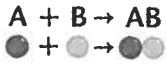
subtractive primary colours cyan, magenta, and yellow; a variety of combinations of these three colours can subtract light from white light to produce nearly any colour (4.3) ▼



subtractive secondary colours red, green, and blue; the colours produced by subtracting equal amounts of two of the three subtractive primary colours; same as the additive primary colours (4.3)

synthesis reaction a chemical reaction in which two or more reactants combine to produce a new product (2.3) ▼



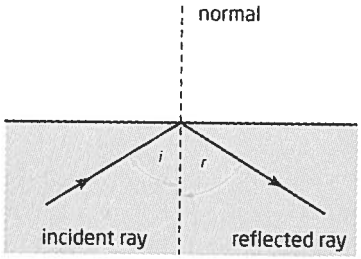
T

telophase: the fourth phase of mitosis, when the membrane surrounding the nucleus re-forms, creating two new nuclei (1.2) ▼

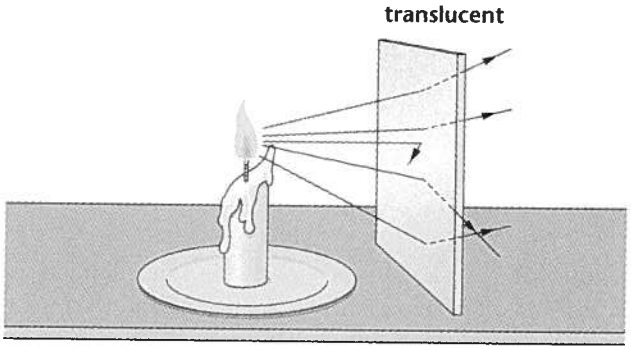
tertiary colour [TUHR-shee-ae-ree KUH-luhr] the colour that you get by mixing the secondary colours (4.3)

tissue specialized cells working together to perform a function; the four major types of human tissue are muscle tissue, connective tissue, nervous tissue, and epithelial tissue (shown here) (1.3) ▼

total internal reflection the condition in which no light can escape the medium because the angle of incidence is larger than the critical angle; all light is reflected within the medium (4.5) ▼

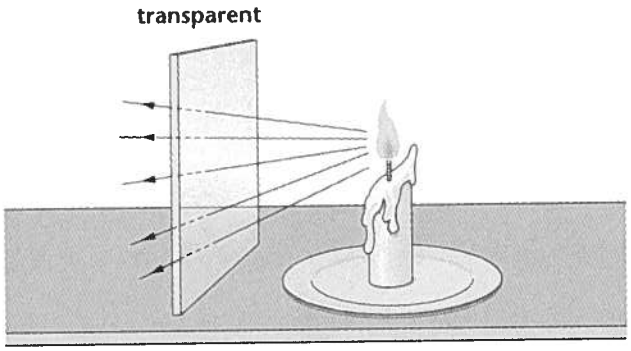


translucent [trans-LOO-sent] property of an object that allows light to pass through but scatters it in different directions (4.2) ▼



transmission the process in which light travels through an object and continues travelling; transparent and translucent objects transmit light, while opaque objects do not (4.2)

transparent property of an object that allows light to penetrate the object, making it possible to see objects from the other side (4.2) ▼



tumour an abnormal group or clump of cells (1.2)

type whether an image is real or virtual; if reflected rays do not meet, the image is virtual; if reflected rays do meet, the image is real; a real image can be viewed on a screen while a virtual image cannot (4.4)

U

ultrasound an imaging technique that involves directing sound waves at a body part and measuring reflected sound waves to make an image; used to view soft tissue, monitor fetal development, observe organ function, and detect cancer (1.5)

upright an image that has the same orientation as the object (4.4)

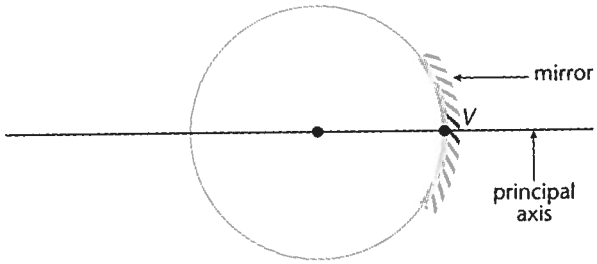
urbanization the spread of cities into rural areas; involves clearing land, building roads, and increased transportation; produces greenhouse gases (3.4)

V

vacuoles [VAK-yoo-uhls] organelles that contain water and other materials and are used to store or transport small molecules; plant cells tend to have one large vacuole; animal cells may have several smaller vacuoles (1.1)

veins thin-walled, inelastic blood vessels that have valves to keep blood from backing up as it is carried toward the heart (1.4)

vertex (*V*) the point where the principal axis meets the mirror (4.4) ▼



vesicles [VEE-zi-kuhls] membrane-covered sacs that transport and/or store materials inside the cell and sometimes help these materials cross the cell membrane to enter or exit the cell (1.1)

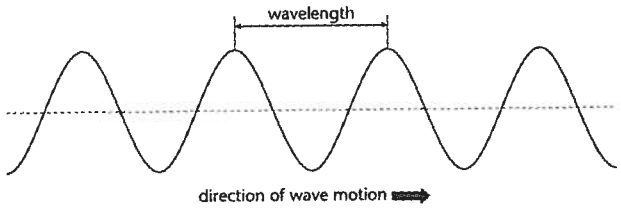
virtual image an image that is located where no light rays ever meet; occurs when reflected rays are separating and must be extended backwards to find out where they meet (4.4)

visible light a very small part of the electromagnetic spectrum; the longest wavelengths of visible light are red (7.0×10^{-7} m) and the shortest wavelengths are blue (4.0×10^{-7} m) (4.1)

W

water vapour evaporation from water; given off by cellular respiration and certain plant processes; most abundant greenhouse gas (3.3)

wavelength the distance between peaks on a wave (4.1) ▼



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weather balloon device that carries a mini weather station to measure the temperature, pressure, and humidity at different heights up to about 30 000 m; a small radio transmits the collected data back to the ground (3.5) ▼

weather the conditions of the atmosphere for a specific place at a specific time (3.1)

West Nile Virus a virus carried and transmitted by mosquitoes; causes a disease that can be fatal (3.2)

WHMIS (Workplace Hazardous Materials Information System) provides detailed information about how to store, handle, and dispose of chemical substances that are used in the workplace; also provides first aid information (2.1)

word equation uses words instead of chemical formulas to describe what happens to reactants and products during a chemical reaction (2.3) ▼

X

X ray a form of electromagnetic radiation; can be sent through the body to make an image; used to view hard tissue, such as bone; used to diagnose bone injuries and malformations (abnormal structures) (1.5, 4.1)