

BC Science 9 Workbook Answers

UNIT 1 Atoms, Elements, and Compounds

Chapter 1 Atomic theory explains the composition and behaviour of matter.

Section 1.1 Safety in the Science Classroom

Reading Checks

Page 3

1. Listen to your teacher. Be alert. Be careful. Clean up.
2. Workplace Hazardous Materials Information System

Interpreting Illustrations

What is wrong with this picture?

Page 4

Accept any seven of the following answers:

UNSAFE SITUATION	POSSIBLE INJURY
heating a test tube without wearing safety goggles	eye damage caused by broken glass if test tube shatters or acid or base burns if liquid boils suddenly
not tying back long hair while using a Bunsen burner	burns caused by hair catching on fire
eating and drinking in the lab while dissecting a specimen	ingestion of harmful substances caused by contamination of food
drinking unknown chemicals from a beaker	ingestion of harmful substances
washing an electrical equipment with water	electrocution the next time the electrical equipment is plugged into the wall
horseplay or fooling around in the lab	head or other injuries
spills on the floor	head or other injuries from slipping and falling
working in a crowded work area; starting a lab without clearing off the work area	spillage, causing acid burns or falls
chemical spill on the table	acid burn if spill is corrosive
working with broken glassware	getting a cut
pouring acid into a test tube without using a test tube rack	acid burn

Comprehension

Safety do's and don'ts

Page 5

1. Unsafe practice: improper way of smelling sample
Correct thing to do: hold the beaker at arm's length and waft the fumes toward the nose
2. Unsafe practice: not taking immediate action
Correct thing to do: tell partner to stop, drop, and roll; inform the teacher; use the fire blanket
3. Unsafe practice: pouring chemical back into the original container
Correct thing to do: dispose of the chemical as instructed by your teacher
4. Unsafe practice: spill on the floor; someone could slip and fall
Correct thing to do: clean up the spill immediately
5. Unsafe practice: not listening to instructions
Correct thing to do: listen to the teacher's instructions; ask the teacher if you are unclear as to what you should be doing
6. Unsafe practice: using a chemical that is not clearly labelled; do not know for sure what chemical you are using
Correct thing to do: only use chemicals in clearly marked containers

Applying Knowledge

What is WHMIS?

Page 6

1. Corrosive material: will corrode substances with which it comes in contact, including human flesh
2. Dangerously reactive material: may readily react with other substances to produce harmful effects (bleach is an example)
3. Flammable and combustible material: will readily burst into flames
4. Poisonous and infectious material causing immediate and serious toxic effects: likely to cause illness or death if ingested or spilled on skin

Assessment

Safety in the Science Classroom

Page 7

1. B 2. C 3. F 4. D 5. A 6. E 7. H 8. B 9. D 10. C 11. A

Section 1.2 Investigating Matter

Reading Checks

Pages 8–9

- Students' answers may vary, but may include density, state, conductivity, boiling point, and/or melting point.
- Kinetic energy is the energy of movement.

Comprehension

What is the matter?

Page 10

1.

STATE OF MATTER	SOLID	LIQUID	GAS
shape	fixed shape	not fixed; takes the shape of the container	not fixed; fills the container
volume	fixed volume	fixed volume	not fixed; fills the space in the container
spaces between particles	particles are packed tightly together and are right up next to each other	particles are farther apart (can flow past one another)	particles are far apart (lots of space between particles)
movement of particles	particles can only vibrate	particles can slip and slide past one another	can move freely and quickly in all direction in the container

2. A

Cloze Activity

Matter all around us

Page 11

- matter, particles
- mass, volume, density
- states, heat
- melting point, boiling point
- conductivity
- kinetic
- solid, liquid, gas
- change of state
- elements

Analyzing Information

Changes of state in gold

Page 12

- changes of state

- heat energy
- condensation
- solidification or freezing
- heat energy
- temperature increases
- Kinetic energy increases and the particles spread out more so that they can slide past one another.
- The particles spread out more and move freely to spread out farther and faster.

Assessment

Investigating matter

Page 13

1. D 2. A 3. F 4. E 5. C 6. C 7. D 8. B 9. D 10. B 11. A

Section 1.3 Atomic Theory

Reading Checks

Pages 14–15

- protons, electrons, neutrons
- atomic nucleus

Vocabulary

Atomic structure

Page 16

- (a) electron
(b) shell
(c) proton
(d) neutron
(e) nucleus

2.

	PROTON	NEUTRON	ELECTRON
electric charge	positive	no charge	negative
location in the atom	nucleus	nucleus	shell (or energy level) around the nucleus

Cloze Activity

The atom

Page 17

- Dalton
- Thomson
- Rutherford, protons, neutrons
- Bohr, shells
- energy
- subatomic particles
- positive, negative, neutrons
- protons, neutrons

Comprehension

Contributions to atomic theory

Page 18

1. Dalton
2. Bohr
3. Rutherford
4. Rutherford
5. Dalton
6. Dalton
7. Thomson
8. Rutherford
9. Dalton
10. Rutherford

Assessment

Atomic theory

Page 19

1. C 2. B 3. D 4. D 5. A 6. B 7. A 8. C 9. A 10. B 11. B

Chapter 2 Elements are the building blocks of matter.

Section 2.1 Elements

Reading Checks

Page 20

1. Accept any two of the following. Metals are hard solids at room temperature; shiny; malleable; ductile; good conductors of heat and electricity.
2. First letter is capitalized. If there is a second letter, it is lower case.

Extension Activity

Element names

Page 22

1. (a) copper
(b) iron
(c) mercury
(d) nickel
(e) lead
2. (a) lead
(b) iron
(c) silver
(d) carbon
(e) sodium
(f) potassium
(g) fluorine
(h) mercury
3. (a) phosphorus

- (b) lithium
- (c) iodine
- (d) chromium
- (e) beryllium
- (f) barium
- (g) helium
- (h) bromine

Comprehension

Learning chemical symbols

Page 23

1. (a) phosphorus
(b) sulphur
(c) oxygen
(d) iodine
(e) fluorine
(f) nitrogen
2. (a) helium
(b) lithium
(c) beryllium
(d) neon
3. (a) chlorine
(b) magnesium
(c) zinc
(d) manganese
4. (a) lead
(b) gold
(c) silver
(d) tin
(e) copper
(f) iron
(g) sodium
(h) rubidium
5. Answers may vary. Check that students used the correct symbols.

Analyzing Information

Elements in Earth's crust

Page 24

1.

	MOST COMMON ELEMENT	SECOND MOST COMMON ELEMENT	THIRD MOST COMMON ELEMENT
in the whole Earth	iron	oxygen	silicon
in Earth's crust	oxygen	silicon	aluminum

2. (a) 52.5%
(b) 24.8%

**Assessment
Elements
Page 25**

1. B 2. A 3. D 4. E 5. G 6. J 7. F 8. D 9. B 10. A 11. C
12. C 13. D

**Section 2.2 The Periodic Table and
Chemical Properties**

Reading Checks

Pages 26–27

1. name, chemical symbol, atomic number, atomic mass, ion charge
2. a group of elements with common properties

Comprehension

What is in the box?

Page 28

1. (a) atomic number
(b) chemical symbol
(c) name
(d) atomic mass
(e) common ion(s)
2. (a) 12
(b) 24.3
(c) 2+
(d) 12
3. (a) potassium
(b) +
(c) 19
(d) 39.1
4. (a) 8
(b) 16.0
(c) 2-
(d) O
5. (a) phosphorus
(b) 31.0
(c) 3-
(d) 15

**Applying Knowledge
Families of elements**

Page 29

1. F 2. A 3. E 4. B 5. E 6. F 7. A 8. B 9. E 10. A
11. B 12. F

**Analyzing Information
Using the periodic table
Page 30**

1. periodic table, properties
2. periods, families
3. metals, good
4. non-metals, poor
5. metalloids, metals, non-metals
6. atomic number
7. atomic mass
8. ion charge
9. ions, multiple ion charge

Assessment

The periodic table and chemical properties

Page 31

1. B 2. D 3. A 4. E 5. C 6. A 7. C 8. A 9. D 10. A

**Section 2.3 The Periodic Table and
Atomic Theory**

Reading Checks

Page 32

1. the number of electrons in each of the energy levels (shells)
2. electrons in the valence shell (outermost shell)

Applying Knowledge

The number game with atoms and ions

Page 34

1. (a) number
(b) atom
(c) lost
(d) gained
2.

ELEMENT NAME	ATOMIC NUMBER	ION CHARGE	ATOM OR ION?	NUMBER OF PROTONS	NUMBER OF ELECTRONS
beryllium	4	2+	ion	4	2
sodium	11	0	atom	11	11
argon	18	0	atom	18	18
chlorine	17	0	atom	17	17
nitrogen	7	3-	ion	7	10
calcium	20	0	atom	20	20
sulphur	16	2-	ion	16	18
lithium	3	+	ion	3	2
aluminum	13	3+	ion	13	10

Illustrating Concepts
Drawing Bohr model diagrams
Page 35

1.

ATOM/ION	ATOMIC NUMBER	NUMBER OF PROTONS	NUMBER OF ELECTRONS	NUMBER OF ELECTRON SHELLS
neon atom	10	10	10	2
fluorine atom	9	9	9	2
fluorine ion	9	9	10	2
sodium atom	11	11	11	3
sodium ion	11	11	10	2
argon atom	18	18	18	3
chlorine atom	17	17	17	3
chlorine ion	17	17	18	3
potassium atom	19	19	19	4
potassium ion	19	19	18	3

2.

ARGON ATOM	CHLORINE ATOM	CHLORINE ION	POTASSIUM ATOM	POTASSIUM ION
Ar symbol in the centre; first shell: 2 paired electrons; second shell, 8 paired electrons; third shell, 8 paired electrons	Cl symbol in the centre; first shell: 2 paired electrons; second shell, 8 paired electrons; third shell, 7 electrons (3 are paired, one is single)	Cl symbol in the centre; same electron arrangement as argon	K symbol in the centre; first shell: 2 paired electrons; second shell, 8 paired electrons; third shell, 8 paired electrons; fourth shell, 1 electron	K symbol in the centre; same electron arrangement as argon

3. A neon atom, fluorine ion and sodium ion all have the same electron arrangement. A fluorine ion has gained an electron and a sodium ion has lost one electron to achieve noble gas stability.

4. An argon atom, chlorine ion and potassium ion all have the same electron arrangement. A chlorine ion has gained an electron and a potassium ion has lost one electron to achieve noble gas stability.

Interpreting Illustrations
Analyzing Bohr model diagrams
Page 36

1. (a) 7

(b) 2

(c) 7

(d) 5

(e) nitrogen atom

2. (a) 6

(b) 2

(c) 6

(d) 4

(e) carbon atom

3. (a) 8

(b) 2

(c) 8

(d) 6

(e) oxygen atom

4. (a) 10

(b) 2

(c) 10

(d) 8

(e) neon atom

5. They all have the same number of electron shells.

Assessment

The periodic table and atomic theory

Page 37

1. E 2. F 3. F 4. B 5. B 6. D 7. B 8. C 9. C 10. C

11. C 12. C

Chapter 3 Elements combine to form compounds.

Section 3.1 Compounds

Reading Checks

Pages 38–39

- when atoms gain or lose electrons
- when non-metal atoms bond by sharing their electrons

Cloze Activity

Words to know about compounds

Page 40

- element
- compound
- chemical bonds

4. electrons, electrons
5. positively, negatively
6. ionic compounds
7. gain
8. ionic lattice
9. covalent compounds
10. molecule
11. polyatomic ion

Comprehension

True or false?

Page 41

1. False. A **compound** is a pure substance made of more than one element. *or* An element is a pure substance made of **only** one type of atom.
2. True
3. False. In covalent compounds, atoms **share** electrons to form molecules.
4. True
5. True
6. False. Ions are formed when atoms lose or gain **electrons**.
7. True
8. False. A polyatomic ion can be **positively charged** or **negatively charged**.
9. True

Applying Knowledge

Comparing ionic and covalent compounds

Page 42

IONIC COMPOUND	BOTH	COVALENT COMPOUND
A, C, F, G, I, J, K	B, E	D, H, L

Assessment

Compounds

Page 43

1. E 2. C 3. F 4. B 5. D 6. D 7. C 8. D 9. D 10. C 11. D

Section 3.2 Names and Formulas of Ionic Compounds

Reading Checks

Page 44

1. symbols that identify each ion in a compound
2. metal that can form two or more different positive ions with different charges

Applying Knowledge

Writing names and formulas of ionic compounds

Page 46

1.

	CHLORINE Cl ⁻	FLUORINE F ⁻	OXYGEN O ²⁻
sodium Na ⁺	NaCl sodium chloride	NaF sodium fluoride	Na ₂ O sodium oxide
magnesium Mg ²⁺	MgCl ₂ magnesium chloride	MgF ₂ magnesium fluoride	MgO magnesium oxide
calcium Ca ²⁺	CaCl ₂ calcium chloride	CaF ₂ calcium fluoride	CaO calcium oxide

2. (a) potassium chloride
(b) lithium bromide
(c) barium fluoride
(d) silver phosphide
(e) zinc sulphide
(f) strontium oxide
(g) aluminum chloride
(h) magnesium carbide
3. (a) BeS
(b) Ag₂O
(c) NaBr
(d) ZnCl₂
(e) CaS
(f) Li₃N
(g) RbCl
(h) GeBr₄

Comprehension

Compounds with a multivalent metal

Page 47

1.

	IONS	FORMULA	COMPOUND NAME
A.	Mn ³⁺ , O ²⁻	Mn ₂ O ₃	manganese(III) oxide
B.	Pb ³⁺ , Br ⁻	PbBr ₃	lead(III) bromide
C.	Pt ²⁺ , Cl ⁻	PtCl ₂	platinum(II) chloride
D.	Au ³⁺ , S ²⁻	Au ₂ S ₃	gold(III) sulphide
E.	Pb ⁴⁺ , O ²⁻	PbO ₂	lead(IV) oxide
F.	Sb ³⁺ , S ²⁻	Sb ₂ S ₃	antimony(III) sulphide
G.	Fe ²⁺ , S ²⁻	FeS	iron(II) sulphide
H.	Co ³⁺ , O ²⁻	Co ₂ O ₃	cobalt(III) oxide

2. (a) iron(III) fluoride
 (b) copper(II) chloride
 (c) tin(IV) oxide
 (d) platinum(IV) sulphide
 (e) cobalt(II) bromide
 (f) gold(I) oxide
 (g) chromium(III) phosphide
 (h) lead(II) iodide
3. (a) PbCl_3
 (b) Cu_2O
 (c) SnS_2
 (d) BiCl_5
 (e) Au_2O
 (f) CrF_2
 (g) MnI_2
 (h) Fe_2Se_3

Comprehension

Compounds with polyatomic ions

Page 48

1. (a) silver nitrate
 (b) barium sulphate
 (c) ammonium chloride
 (d) calcium phosphate
 (e) nickel(II) hydroxide
 (f) copper(II) carbonate
 (g) strontium(II) nitrate
 (h) chromium(III) sulphate
2. (a) Ca(OH)_2
 (b) NH_4Cl
 (c) NaNO_2
 (d) LiHCO_3
 (e) $\text{K}_2\text{Cr}_2\text{O}_7$
 (f) Sn(OH)_2
 (g) $(\text{NH}_4)_3\text{PO}_4$
 (h) $\text{Fe(NO}_3)_3$

3.

	POSITIVE ION	NEGATIVE ION	FORMULA	COMPOUND NAME
A.	Ca^{2+}	CO_3^{2-}	CaCO_3	calcium carbonate
B.	K^+	SO_3^{2-}	K_2SO_3	potassium sulphite
C.	Na^+	ClO_3^-	NaClO_3	sodium chlorate
D.	Mg^{2+}	ClO_4^-	$\text{Mg(ClO}_4)_2$	magnesium perchlorate

	POSITIVE ION	NEGATIVE ION	FORMULA	COMPOUND NAME
E.	Cs^+	OH^-	CsOH	cesium hydroxide
F.	NH_4^+	PO_4^{3-}	$(\text{NH}_4)_3\text{PO}_4$	ammonium phosphate
G.	Ca^{2+}	CN^-	Ca(CN)_2	calcium cyanide
H.	Fe^{3+}	HSO_4^-	$\text{Fe(HSO}_4)_3$	iron(III) hydrogen sulphate

Assessment

Names and formulas of ionic compounds

Page 49

1. A 2. D 3. G 4. B 5. B 6. B 7. A 8. C 9. B

Section 3.3 Physical and Chemical Changes

Reading Checks

Pages 50–51

- one or more new substances
- endothermic

Cloze Activity

Evidence of chemical change

Page 52

- chemical
- physical
- changes of state
- physical, chemical
- reactant, product
- gas bubbles, solid
- exothermic; (in any order) sound, light, heat
- endothermic

Illustrating Concepts

Chemical change and physical change

Page 53

- (a) causes one or more new substances to be formed; new chemical bonds are formed while other chemical bonds are broken
 (b) change in appearance but not in chemical composition; no new substances are formed
- (a) physical change
 (b) chemical change
- (c) physical change
 (d) chemical change
 (e) physical change
 (f) chemical change

3. Students' drawings will vary. Drawings could show the following: (a) cutting bread in half (b) toasting the bread (c) chopping the wood (d) burning the wood.

Comprehension

Endothermic or exothermic?

Page 54

- (a) process that releases energy
(b) process that absorbs energy
- (a) exothermic
(b) endothermic
- (a) endothermic
(b) endothermic
(c) exothermic
(d) exothermic
(e) exothermic
(f) exothermic
(g) endothermic
(h) exothermic
(i) exothermic

Assessment

Physical and chemical changes

Page 55

1. E 2. D 3. A 4. B 5. A 6. D 7. B 8. C 9. D

UNIT 2 Reproduction

Chapter 4 The nucleus controls the functions of life.

Section 4.1 The Function of the Nucleus within the Cell

Reading Checks

Pages 56–57

- stores instructions for how to make cells, for chemicals and structures that cells must make, and for everything else the cell does
- cells need proteins in order to work properly

Cloze Activity

Inside the nucleus

Page 58

- nucleus
- DNA, molecule
- DNA, genetic
- chromosomes
- number

- 46, 23
- genes, chromosomes
- molecule
- ribosomes, nucleolus

Interpreting Illustrations

The control centre of the cell

Page 59

- Students' answers may vary, but should include some or all of the following: long, two-stranded molecule with a shape like a ladder that has been twisted into a spiral
- nucleus
- DNA
- chromosomes
- gene
- (a) chromosome
(b) DNA
(c) chromosome
(d) nucleus

Comprehension

True or false?

Page 60

- False. The **nucleus** directs and controls all of the cell's activities.
- True
- True
- False. Humans have **23** pairs of chromosomes. *or* Humans have **46 chromosomes in each body cell.**
- False. One pair of **chromosomes** helps determine if a person will be born as a male or female.
- True
- True
- False. Genes are part of chromosomes.

Assessment

The function of the nucleus within the cell

Page 61

1. G 2. C 3. A 4. F 5. B 6. D 7. A 8. D 9. A 10. A
11. D 12. D

Section 4.2 Mutations

Reading Checks

Pages 62–63

- a change in the genetic material of a gene
- negative, positive, neutral

Applying Knowledge
Mutations concept map
Page 64

radiation, cigarette smoke, pesticides

mutations

negative, positive, neutral

curved red blood cells, gene that protects plants from disease (or protein that prevents HIV from infecting a person)

Comprehension

Gene mutation

Page 65

1. A gene mutation is a change in the genetic material of a gene.
2. negative, positive, neutral
3. positive
4. curved red blood cell (Other answers may be acceptable.)
5. neutral
6. Mutagens are factors in the environment that cause mutations.
7. Answers will vary, but could include cigarette smoke, radiation from X rays, radiation from UV rays, pollutants, pesticides, and household chemicals.
8. Researchers are replacing a mutated gene with a healthy copy of the gene.

Cloze Activity

The effects of mutations

Page 66

1. gene mutation
2. proteins
3. mutagens
4. mutagens
5. negative mutations
6. positive mutations
7. neutral mutations
8. gene therapy, mutated gene, healthy gene

Assessment

Mutation

Page 67

1. D 2. A 3. G 4. C 5. B 6. E 7. C 8. C 9. A 10. B
11. A 12. D

Chapter 5 Mitosis is the basis of asexual reproduction.

Section 5.1 The Cell Cycle and Mitosis

Reading Checks

Pages 68–69

1. interphase, mitosis, cytokinesis
2. uncontrolled cell division

Comprehension

Getting to know the cell cycle

Page 70

1. three
2. interphase, DNA
3. mitosis
4. cytokinesis, two
5. four
6. prophase, nucleolus
7. metaphase, duplicated chromosomes
8. anaphase, duplicated chromosomes
9. telophase, nucleolus

Interpreting Illustrations

Identifying stages of the cell cycle

Page 71

1. growth and cell activity
2. DNA is copied
3. continued growth and preparation for mitosis
4. mitosis
5. cytokinesis
6. interphase

Description

1. Cells grow and carry out their life functions.
2. The nucleus makes a copy of its DNA.
3. There is continued growth and preparation for mitosis.
4. The nucleus of the cell divides into two equal and identical parts.
5. The two equal, identical parts of the cell separate.
6. Cells grow and carry out their life functions.

Illustrating Concepts
Mitosis
Page 72

PHASE	WHAT IS HAPPENING TO THE CELL?	LABELLED DIAGRAM
prophase	<ul style="list-style-type: none"> – The duplicated chromosomes form an X and the nucleolus disappears. – Spindle fibres, which are tiny tube-like structures made of protein, begin to form in plant and animal cells. 	
metaphase	<ul style="list-style-type: none"> – The duplicated chromosomes line up across the middle of the cell. 	
anaphase	<ul style="list-style-type: none"> – The duplicated chromosomes move apart to opposite ends of the cell. 	
telophase	<ul style="list-style-type: none"> – A nucleolus forms around the chromosomes at the opposite ends of the dividing cell. 	

Assessment

The cell cycle and mitosis

Page 73

1. E 2. F 3. A 4. D 5. B 6. A 7. A 8. B 9. C 10. A 11. D

Section 5.2 Asexual Reproduction

Reading Checks

Page 75

- Any of: can out-compete other organisms, reproduce quickly, and can survive if predators increase.
- cells that usually divide to form one of many different types of cells

Cloze Activity

Types of asexual reproduction

Page 76

- clone

- asexual reproduction
- binary fission
- budding
- fragmentation
- vegetative reproduction
- spore formation
- DNA
- stem cells

Illustrating Concepts

What are the five different types of asexual reproduction?

Page 77

Answers can be in any order.

- binary fission: bacteria or amoeba; splitting of a single parent cell into two equal parts that have the same copies of genetic material
- budding; hydra, sponge, or yeast; a group of rapidly dividing cells develops on an organism and breaks away to become a new organism independent of its parent
- fragmentation: plants such as moss or animals such as sea star or coral; a small piece of an organism breaks away from it and develops into a new individual
- spores: fungi or algae; reproductive cells develop into a new individual by repeated mitosis
- vegetative reproduction: plant; special cells, usually in the stems and roots of plants, divide repeatedly to form structures that develop into a plant that is identical to the parent

Comprehension

True or false?

Page 78

- False. Asexual reproduction is the formation of a new individual that has **the same** genetic information as its parent.
- False. Asexual reproduction occurs in **one-celled** organisms such as bacteria and in **multicellular** organisms such as plants.
- True
- True
- False. Growing new plants from the cut ends of **stems and roots** is one way that humans make clones of plants.
- False. Making clones of animals involves taking the nucleus from one type of cell and putting it in the **egg cell that has had its nucleus removed**.

Assessment

Asexual reproduction

Page 79

- 1. G 2. D 3. B 4. E 5. C 6. A 7. H 8. A 9. C 10. C
- 11. B 12. B 13. D

Chapter 6 Meiosis is the basis of sexual reproduction.

Section 6.1 Meiosis

Reading Checks

Pages 80–81

- 1. 46 (arranged in 23 pairs)
- 2. four

Applying Knowledge

The role of gametes

Page 82

- 1.

ORGANISM	DIPLOID NUMBER (2n)	HAPLOID NUMBER (n)
human	46	23
fruit fly	8	4
black bear	76	38
peanut	20	10
chimpanzee	48	24

- 2. (Male-female and sperm-egg can be reversed.)
 Top row of boxes: diploid, male parent, female parent, diploid
 Second row: haploid, sperm cell, egg cell, haploid
 Third row: fertilization
 Bottom box: diploid

Cloze Activity

What happens in meiosis?

Page 83

- 1. gametes, gametes, gametes
- 2. fertilization, zygote
- 3. mitosis, embryo
- 4. 23
- 5. 23, haploid
- 6. chromosome
- 7. meiosis I
- 8. meiosis II
- 9. diploid, 4

Interpreting Illustrations

Comparing meiosis and mitosis

Page 84

Answers may vary slightly. Sample answers:

- 1. In both, chromosomes line up along the equator.
- 2. In meiosis I, each pair of chromosomes includes one chromosome from each parent.
- 3. In both, chromosomes are pulled to opposite poles.
- 4. In meiosis II, there are half as many chromosomes as in mitosis.

Assessment

Meiosis

Page 85

- 1. C 2. E 3. B 4. J 5. H 6. I 7. A 8. D 9. F 10. C 11. C
- 12. C 13. A 14. A

Section 6.2 Sexual Reproduction

Reading Checks

Pages 86–87

- 1. during the first eight weeks after fertilization
- 2. organs and parts of the body continue to develop

Cloze Activity

Embryonic and fetal development

Page 88

- 1. mating
- 2. external, fish
- 3. internal, birds
- 4. embryo
- 5. blastula, embryonic stem cells
- 6. ectoderm, mesoderm, endoderm
- 7. differentiation
- 8. fetus

Illustrating Concepts

Types of sexual reproduction

Page 89

Students' definitions and examples may vary.

	EXTERNAL FERTILIZATION	INTERNAL FERTILIZATION
Definition	A sperm cell and egg cell unite outside the bodies of the parents.	Sperm cells are deposited inside the female's body where they meet an egg cell.
Examples of organisms	Animals that live in water Sea urchins Fish (salmon) Mosses Ferns	Water-dwelling orcas Most land dwelling animals Mountain goats Humans Most plants

Interpreting Illustrations

From human embryo to human baby

Page 90

- (a) ectoderm
(b) mesoderm
(c) endoderm
- skin and nervous system
- kidneys, skeleton, muscles, blood vessels and reproductive organs
- lungs, liver, and lining of digestive system
-

TRIMESTER	WHAT IS HAPPENING AT THIS STAGE OF FETAL DEVELOPMENT?
(a) First	Brain and spinal cord are forming. Fingers and toes have appeared. Ears, kidneys, lungs, liver, and muscles are developing. Sexual differentiation almost complete.
(b) Second	Fetal movements are felt. Eyelids open. Fetus can survive outside of mother with specialized care.
(c) Third	Rapid weight gain occurs due to the growth and accumulation of fat.

Assessment

Sexual reproduction

Page 91

1. E 2. A 3. F 4. D 5. C 6. A 7. B 8. D 9. A 10. C

Section 6.3 Assisted Reproductive Technologies

Reading Checks

Pages 92–93

- unable to have a child
- IVF, ICSI

Cloze Activity

Types of assisted reproductive technologies

Pages 94

- infertility
- assisted reproductive technologies
- uterus
- sperm
- intracytoplasmic sperm injection, uterus
- gamete intrafallopian transfer, fallopian tubes
- gametes, surrogate mother
- in vitro fertilization
- stem cells

Applying Knowledge

Describing assisted reproductive technologies

Page 95

ASSISTED REPRODUCTIVE TECHNOLOGY	DESCRIPTION
1. artificial insemination (AI)	Sperm are collected from the male and then injected into the female.
2. in vitro fertilization (IVF)	A woman's egg cell is placed in a petri dish, and then sperm are injected into the dish so that one sperm cell may fertilize the egg.
3. gamete intrafallopian transfer (GIFT)	A woman's egg cell is mixed with sperm, and then the mixture is injected into the woman's fallopian tubes. This way, an egg may be fertilized inside the woman's body.
4. intracytoplasmic sperm injection (ICSI)	A single sperm cell is injected into an egg cell. The fertilized egg is then inserted into the woman's uterus.

Extension Activity

The impact of reproductive technologies on society

Page 96

Students' answers will vary. Accept all reasonable answers—there are no right or wrong responses. Students should use point form to summarize the points of view of both partners.

Assessment

Assisted reproductive technologies

Page 97

1. E 2. D 3. F 4. G 5. B 6. A 7. C 8. D 9. C 10. A 11. D

UNIT 3 Characteristics of Electricity

Chapter 7 Static charge is produced by electron transfer.

Section 7.1 Static Charge

Reading Checks

Pages 98–99

- proton, electron
- electrons

Cloze Activity

Charge it

Page 100

- static charge
- atoms

3. nucleus, protons, neutrons
4. electrons
5. neutral
6. positive
7. negative
8. insulators, conductors
9. coulomb
10. Van de Graaff generator
11. grounding

Applying Knowledge

Static charge detective

Page 101

1. Charge on socks: positive
Charge on skirt: negative
2. Charge on comb: negative
Charge on hair: positive
3. Charge on window: positive
Charge on paper towel: negative
4. Charge on balloon: negative
Charge on cat's fur: positive

Comprehension

Conductors and insulators

Page 102

1. (a) material that allows electrons to move freely
(b) material that does not allow electrons to move freely
2. (a) insulator; does not allow electrons to move freely
(b) insulator; does not allow electrons to move freely
(c) conductor; allows electrons to move freely
(d) conductor; allows electrons to move freely
(e) conductor; allows electrons to move freely
(f) insulator; does not allow electrons to move freely

Assessment

Static charge

Page 103

1. C 2. B 3. A 4. B 5. C 6. A 7. A 8. B, C 9. B 10. A
11. C 12. D 13. C 14. C

Section 7.2 Electric Force

Reading Checks

Pages 104–105

1. they will be attracted
2. neutral objects are temporarily charged by induction

Interpreting Illustrations

Neutral, positive, or negative charges?

Page 106

1. Answers A, B, and C can be in any order.
(a) Opposite charges attract.
(b) Like charges repel.
(c) Neutral objects are attracted to charged objects.
2. (a) attract
(b) attract
(c) attract
(d) repel
(e) repel
(f) attract

Comprehension

Charging by conduction or induction

Page 107

1. (a) induction
(b) conduction
(c) induction
2. (a) induction
(b) induction
(c) conduction

Cloze Activity

Positive, negative, and neutral objects

Page 108

1. electric force
2. laws of static charge, attract, repel
3. Either order is acceptable: type of charge, distance between objects
4. increase, decrease
5. electroscope
6. repel
7. neutral
8. conduction, electroscope
9. induction, electroscope
10. induction

Assessment

Electric force

Page 109

1. A 2. B 3. B 4. A 5. D 6. C 7. B 8. A 9. D

Chapter 8 Ohm's law describes the relationship of current, voltage, and resistance.

Section 8.1 Electric Potential Energy and Voltage

Reading Checks

Pages 110–111

1. stored energy that has the potential to make something move or change
2. potential difference

Vocabulary Puzzle

Electricity crossword puzzle

Page 112

Across

2. potential energy
3. electrolyte
7. electrodes
9. coulomb
10. dry cell
13. voltage
14. electrochemical cell

Down

1. kinetic energy
2. potential difference
4. terminals
5. voltmeter
6. wet cell
8. volt
11. battery
12. energy

Cloze Activity

Electric potential energy

Page 113

1. energy
2. Answers can be in either order: electrochemical cell, battery
3. potential energy
4. chemical, electrical
5. separated
6. chemical
7. electrodes, electrolyte
8. negatively, positively
9. potential difference

Interpreting Illustrations

Electrochemical cells

Page 114

1. (a) positive terminal
(b) plastic insulator
(c) electrolyte
(d) carbon rod
(e) negative terminal
2. (a) negative terminal
(b) positive terminal
(c) lead plate
(d) electrolyte

Assessment

Electric potential energy and voltage

Page 115

1. C 2. F 3. D 4. A 5. B 6. B 7. A 8. A 9. B 10. A

Section 8.2 Electric Current

Reading Checks

Page 116

1. a complete pathway through which electrons can flow
2. ammeter

Applying Knowledge

Identifying circuit symbols

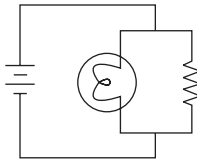
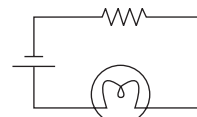
Page 118

1. C, IV
2. B, V
3. D, II
4. E, I
5. A, III
6. In any order: conducting wire, battery, switch, bulb

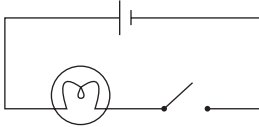
Illustrating Concepts

Drawing circuit diagrams

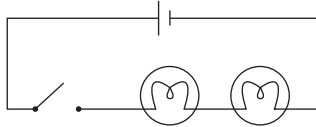
Page 119

1. 
2. 

3.



4.



Comprehension

True or false?

Page 120

1. True
2. False. An electric load transforms **electrical energy into other forms of energy.**
3. True
4. True
5. False. A switch is a **device that can turn the circuit on and off by closing or opening the circuit.** or A **battery** is the source of electric potential energy in a circuit.
6. True
7. False. Current electricity is the **continuous flow of charge in a complete circuit.** or **Static electricity** is charge that remains stationary on an insulator.
8. True
9. False. Electric current is measured in **amperes.** or Potential difference (voltage) is measured in volts.
10. True

Assessment

Electric current

Page 121

1. A 2. D 3. B 4. F 5. C 6. D 7. A 8. D 9. A

Section 8.3 Resistance and Ohm's Law

Reading Checks

Page 123

1. Resistance equals voltage divided by current.
2. a component in an electric circuit that has a specific resistance

Comprehension

Voltage, current, and resistance

Page 124

1. (a) amount of charge passing a point in a conductor every second
(b) amount of electric potential energy per one coulomb of charge

(c) opposition to the flow of current through a circuit

(d) mathematical equation that shows how voltage, current, and resistance are related (resistance equals voltage divided by current)

(e) a component in a circuit that has a specific resistance, used to control current or voltage

	CURRENT	VOLTAGE	RESISTANCE
Symbol	I	V	R
Unit	amperes (A)	volts (V)	ohms (Ω)
Meter used for measurement	ammeter	voltmeter	ohmmeter
Symbol for Meter			
Formula	$I = V \div R$	$V = I \times R$	$R = V \div I$

Applying Knowledge

Calculations with Ohm's law

Page 125

2. $R = V \div I = 120 \text{ V} \div 10 \text{ A} = 12 \Omega$
3. $V = I \times R = (0.2 \text{ A})(30 \Omega) = 6 \text{ V}$
4. $I = V \div R = 3 \text{ V} \div 24 \Omega = 0.125 \text{ A}$
5. $V = I \times R = (6 \text{ A})(20 \Omega) = 120 \text{ V}$

Analyzing Information

Relationship between current, voltage, and resistance

Page 126

1. (a) As current increases, voltage increases.
(b) This suggests that there is a positive correlation between voltage and current. It also suggests that there is a direct relationship between voltage and current.
2. The voltage doubles when the current is doubled.

Assessment

Resistance and Ohm's law

Page 127

1. E 2. F 3. D 4. A 5. C 6. B 7. D 8. A 9. B 10. B
11. B 12. A

Chapter 9 Circuits are designed to control the transfer of electrical energy.

Section 9.1 Series and Parallel Circuits

Reading Checks

Page 128

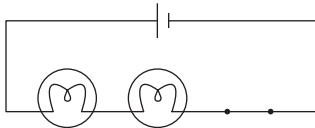
1. an electric circuit with one path for current to take
2. an electric circuit with two or more pathways for electric current to take

Comprehension
Series or parallel?
Page 130

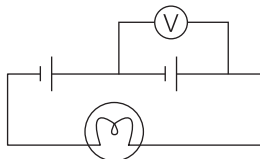
1. series
2. parallel
3. parallel
4. series
5. series
6. series
8. parallel
9. parallel
10. series
11. parallel

Interpreting Illustrations
Is it in series or in parallel?
Page 131

1. B
2. D
3. E
4. A
- 5.



- 6.



Applying Knowledge
Calculations with series circuits
Page 132

1. (a) 10Ω
 (b) 3 A
 (c) 18 V
 (d) 12 V
2. (a) 18 V
 (b) 2 A
 (c) 3Ω

Assessment
Series and parallel circuits
Page 133

1. B 2. A 3. A 4. B 5. A 6. B 7. B 8. A 9. C 10. D

Section 9.2 The Power of Electricity
Reading Checks
Pages 134–135

1. $P = IV$
2. $E = Pt$

Comprehension
Power calculations
Page 136

1. $P = I \times V = (20)(240) = 3\,600 \text{ W}$
2. $P = I \times V = (12)(120) = 1\,440 \text{ W}$
3. $I = P \div V = 120 \div 15 = 8 \text{ A}$
4. $I = P \div V = 210 \div 120 = 1.75 \text{ A}$
5. $V = P \div I = 2.4 \div 0.8 = 3 \text{ V}$
6. $P = I \times V = (2)(30) = 60 \text{ W}$

Comprehension
Energy calculations
Page 137

1. $E = P \times t = (1.2)(0.5) = 0.6 \text{ kW}\cdot\text{h}$
2. $E = P \times t = (0.7)(12) = 8.4 \text{ kW}\cdot\text{h}$
3. $P = E \times t = 0.6 \div 6 = 0.1 \text{ kW}$ or 100 W
4. $t = E \div P = 1.75 \div 1 = 1.75 \text{ h} \div 7 = 0.25 \text{ h}$ (15 min)
5. $P = I \times V = (3)(30) = 90 \text{ W} = (0.09)(2) = 0.18 \text{ kW}\cdot\text{h}$

Applying Knowledge
Paying for electricity
Page 138

1. (a) $E = P \times t = (15)(240)(1.5)(0.09) \div 1000 = \0.49
 (b) $E = P \times t = (0.1)(5)(0.09) = (\$0.05)(6) = \$0.27$
 (c) $E = P \times t = (2)(120)(0.25)(24)(7)(0.09) \div 1000 = \0.91
2. $E = P \times t = (2.5)(120)(4)(7)(2)(0.09) \div 1000 = \1.51
3. $\$0.54 \div \$0.09 = 6 \text{ kWh}$; $t = E \div P = 6 \div 4 = 1.5 \text{ h}$

Assessment
The power of electricity
Page 139

1. A 2. B 3. E 4. D 5. B 6. A 7. B 8. B

UNIT 4 Space Exploration

Chapter 10 Scientific evidence suggests the universe formed about 13.7 billion years ago.

Section 10.1 Explaining the Early Universe

Reading Checks

Pages 140–141

1. 13.7 billion years
2. wavelengths get longer

Cloze Activity

The early days of the universe

Page 142

1. astronomers
2. celestial bodies
3. radiation
4. galaxies
5. spectroscope
6. radio telescope
7. space probes
8. red shift
9. compressed
10. Big Bang

Comprehension

True or false?

Page 143

1. False. According to the Big Bang theory, when the universe began it was small, dense, and extremely **hot**.
2. False. The Big Bang is a theory that astronomers have proposed.
3. False. According to the Big Bang theory, the universe began **13.7** billion years ago.
4. False. The universe appears to be **expanding** because galaxies and stars are moving **away from** each other.
5. False. Background radiation is transmitted in waves that were first detected by a **radio telescope** in the 1960s.
6. False. If a star is moving **away from** you, there is a red shift, which means its wavelengths get longer.
7. False. The distance between stars and galaxies is **increasing**.

Interpreting Illustrations

Modelling an expanding universe

Page 144

1. The raisins in the uncooked bread dough all move away from each other as the bread bakes. In a similar way, galaxies in the universe are moving away from each other as the universe expands.
2. and 3. Students' answers may vary. Accept all reasonable models and explanations.

Assessment

Explaining the early universe

Page 145

1. E 2. A 3. B 4. G 5. F 6. D 7. B 8. C 9. A
10. A 11. B

Section 10.2 Galaxies

Reading Checks

Pages 146–147

1. huge group of stars, gas, and dust held together by gravity
2. group of stars found within a galaxy

Cloze Activity

Inside a galaxy

Page 148

1. First three answers may be in any order: stars, gas, dust, gravity
2. billion, billion
3. nebula
4. spiral
5. Milky Way, spiral
6. elliptical
7. irregular
8. gas, dust
9. star clusters
10. globular
11. open

Comprehension

All about galaxies

Page 149

1. A galaxy is a collection of stars, gas, and dust held together by gravity.
2. The three basic shapes of galaxies are spiral, elliptical, and irregular.
3. The Milky Way is a spiral galaxy.
4. An elliptical galaxy contains some of the oldest stars in the universe.

- Irregular galaxies have lots of gas and dust, which are the building blocks of stars.
- Over 50%
- The two types of star clusters are globular clusters and open clusters.
- Globular clusters are held together by gravity in a spherical shape while open clusters are spaced apart.

Illustrating Concepts

Galaxy shapes

Page 150

Students' answers and diagrams may vary slightly.

Spiral galaxy: Diagram should look like a spiral, or a plate with a ball in the middle

Description: looks like a pinwheel with many long "arms" spiralling out from a centre core

Elliptical galaxy: Diagram should look like a flattened circle

Description: ranges in shape from a perfect sphere to a stretched out sphere

Irregular galaxy: Diagram could be any shape.

Description: does not have any regular shape such as spiral arms or an obvious central bulge

Assessment

Galaxies

Page 151

- A 2. G 3. D 4. F 5. C 6. E 7. C 8. B 9. A 10. B
- A 12. C

Chapter 11 The components of the universe are separated by unimaginably vast distances.

Section 11.1 Stars

Reading Checks

Pages 152–153

- massive, gaseous, spherical object in space that gives off light
- when a high mass star collapses in a powerful explosion

Cloze Activity

Describing stars

Page 154

- hydrogen, helium, fusion
- yellow

- red
- whitish-blue
- Doppler
- mass
- red dwarf
- white dwarf, black dwarf
- supernova, neutron
- black hole

Interpreting Illustrations

The evolution of stars

Page 155

- A low mass star starts as a nebula, changes into a red dwarf, and then becomes a white dwarf.
- An intermediate mass star starts as a nebula, changes into a red giant, cools into a white dwarf, and then becomes a black dwarf.
- A high mass star eventually collapses into a supernova. The supernova will change either into a neutron star or a black hole

Comprehension

True or false?

Page 156

- False. A star gives off light due to **nuclear** reactions that take place at its core.
- False. During most of the life of a star, atoms of **hydrogen** gas fuse and become atoms of **helium** gas.
- False. Yellow stars, such as our Sun, are **fairly hot**. or **Whitish-blue stars** are the hottest type of stars.
- True
- False. Intermediate mass stars expand into red giants and then cool to become a white dwarf and then a black dwarf.
- True
- True

Assessment

Stars

Page 157

- B 2. D 3. C 4. A 5. A 6. B 7. D 8. C 9. D 10. A 11. A

Section 11.2 The Sun and Its Planetary System

Reading Checks

Page 159

- rotation is spinning on axis; revolution is travelling around the Sun
- asteroids, comets

Cloze Activity

Getting to know the solar system

Page 160

1. hydrogen
2. nuclear reactions
3. solar prominences
4. solar flares, solar wind
5. axis, rotation
6. revolution
7. Answers may appear in any order: Mercury, Venus, Earth, and Mars
8. Answers may appear in any order: Jupiter, Saturn, Uranus, and Neptune
9. moon
10. asteroids
11. comets

Interpreting Illustrations

Features of the Sun

Page 161

1. E 2. D 3. C 4. A 5. B
6. (a) solar prominence
(b) sunspot
(c) photosphere
(d) corona
(e) solar flare

Vocabulary

Our solar system

Page 162

Across

2. photosphere
4. asteroid
5. prominence
11. rotation
12. planet
13. wind

Down

1. corona
3. system
6. revolution
7. moon
8. comet
9. axis
10. sunspot

Assessment

The Sun and its planetary system

Page 163

1. D 2. A 3. C 4. F 5. B 6. E 7. I 8. G 9. A 10. B 11. D
12. D 13. C 14. B

Section 11.3 Measuring Distances in Space

Reading Checks

Pages 164–165

1. distance that light travels in one year
2. the diameter of Earth's orbit

Cloze Activity

Describing distances in space

Page 166

1. light-year
2. 300 000 km/s
3. years (or light-years), hours, minutes
4. triangulation
5. parallax
6. parallax
7. baseline
8. months

Extension Activity

Parallax

Page 167

1. When you blink your eyes, the pencil appears to shift in position against the chart of the planets.
2. When you blink your eyes, the pencil appears to shift in position against the chart of the planets. The shifting appears to have increased.
3. When the pencil is approximately 5 cm from your face, the shifting has increased.
4. The closer the pencil is to your face, the amount of the shifting (parallax) increases.
5. As the pencil moves outwards or the distance increases, the amount of shifting (parallax) decreases.
6. The term that could be used to describe this shifting is parallax.

Extension Activity

How big is space?

Page 168

1. electron
2. single-cell organism
3. human

4. grey whale
5. Mount Robson
6. Moon
7. Earth
8. Sun
9. solar system
10. galaxy
11. distance from Earth to Proxima Centauri
12. observable universe

Assessment

Measuring distances in space

Page 169

1. D 2. A 3. B 4. B 5. D 6. B 7. C 8. D 9. B 10. D

Chapter 12 Human understanding of Earth and the universe continues to increase through observation and exploration.

Section 12.1 Earth, Moon, and Sun Interactions

Reading Checks

Pages 170–171

1. causes light to strike Earth at different angles
2. total or partial blocking of sunlight when one object in space passes in front of another

Cloze Activity

How do Earth, the Sun, and the Moon interact?

Page 172

1. axis
2. eclipse
3. solar
4. total, eclipse, partial, eclipse
5. lunar
6. total, eclipse
7. constellations
8. Ptolemy
9. Copernicus, Galileo
10. Kepler

Illustrating Concepts

Eclipses

Page 173

1. Diagrams may vary, but should show the Moon between Earth and the Sun, and the Moon's shadow falling on Earth.

2. Diagrams may vary, but should show Earth between the Sun and Moon and Earth's shadow falling on the Moon.

Interpreting Illustrations

Seasons

Page 174

1. Beginning on the left side and continuing in a clockwise manner, the labels should be summer, spring, winter, autumn
2. Answers may vary but should include the following points: Earth's axis is tilted on an angle of 23.5°. This axis tilt causes light from the Sun to strike Earth at different angles during its revolution around the Sun. As Earth orbits the Sun, Earth's axis always points in the same direction. However, the amount of sunlight that falls on Earth's surface at different points in its journey is different. This difference is what causes the seasons.

Assessment

Earth, Moon, and Sun interactions

Page 175

1. E 2. A 3. F 4. H 5. I 6. D 7. G 8. B 9. A 10. A 11. C

Section 12.2 Aboriginal Knowledge of the Solar System

Reading Checks

Pages 176–177

1. All aspects of the physical and spiritual universe
2. Length of time from one new moon or full moon to the next

Cloze Activity

Looking at the solar system

Page 178

1. holistic
2. realms
3. interconnected universe
4. Western
5. Answers could be in either order: spiritual, physical
6. Moon
7. lunar month
8. 13
9. constellations

Applying Knowledge

Comparing Aboriginal knowledge and Western science approaches

Page 179

Students' answers will vary. Accept all reasonable

answers. Sample answer:

Aboriginal approach: practical knowledge of celestial bodies, interconnected universe, holistic approach, common realms: undersea, land world, sky world, spiritual realm

Western approach: physical realm, physically observed, measured, documented, and tested

Both approaches: observed Moon, Sun, planets, and celestial bodies

Extension

An interconnected universe

Page 180

Students' diagrams and explanations may vary. Accept all reasonable answers.

Diagram may include undersea or sea world, the land world, the spirit world and the sky world. Explanation should stress the interrelationships between all the parts of the diagram drawn.

Assessment

Aboriginal knowledge of the solar system

Page 181

1. C
2. E
3. D
4. B
5. A
6. D
7. B
8. C
9. D
10. B
11. D

Section 12.3 Exploring Space: Past, Present, and Future

Reading Checks

Pages 182–183

1. rovers
2. Answers may vary.
Benefit: new inventions
Risk: equipment failure, pollution

Cloze Activity

Space exploration

Page 184

1. indirect
2. optical
3. radio
4. satellites, geosynchronous
5. probes
6. rovers
7. rockets
8. rewards
9. risks
10. ethics
11. terraforming

Extension

Exploring questions about space

Page 185

1. and 2. Accept all reasonable questions and ideas.
There are no right or wrong questions or answers.
Look for evidence that student has thought about questions.

Extension

Technology for exploring space

Page 186

1. and 2. Accept all reasonable designs and descriptions. Students should be able to explain their technologies and provide labelled diagrams of them.

Assessment

Exploring space: past, present, and future

Page 187

1. D
2. A
3. G
4. B
5. H
6. E
7. C
8. F
9. D
10. C
11. D
12. C