Topic 2.2
How can we understand, describe, and name chemical compounds?

Specific Expectations

- **C1.1** analyze, on the basis of research, the function of chemical reactions in the production of selected products and/or in processes commonly encountered at home or in the workplace, and communicate their findings
- **C2.2** construct molecular models of simple chemical reactions and produce diagrams of these models
- **C3.1** describe the relationships between chemical formulae, composition, and names of simple compounds
- **C3.2** name and write the formulae for simple ionic and molecular compounds

Skills

- select, organize, and record relevant information on research topics

Materials

Please see the teaching notes for each activity for a list of the materials required. Please see pages TR-42 to TR-46 for a summary of the materials required in this topic.

Overview

In this topic, students will learn why compounds form and how to describe them using formulas and chemical names. They will also learn how to differentiate between molecular and ionic compounds and how to use the periodic table to predict the compound that will form when two elements are combined.

Common Misconceptions

- **Students often confuse molecular compounds with covalent compounds.** *Covalent* refers to the type of bond that forms between non-metal atoms in which electrons are shared between the atoms. *Ionic compounds* are formed when ionic "bonds" connect atoms. These are not truly bonds as the ions dissociate when in water; they are more an attractive force of the positive ion to the negative ion. Be careful not to mention the term *covalent* to students at this point in their learning.
- **Students may be curious about polyvalent metals, such as iron or copper.** Avoid enriching this topic with discussion of the endings *–ic* and *–ous*. This is beyond what is expected in the curriculum. If you have an especially keen student, enrichment material can be covered with them individually by referring to grade 11 chemistry textbooks.
- **Many students will struggle with creating chemical formulas from the chemicals' names.** Use molecular model kits to demonstrate how valence shells are filled and why the crossing over method works. Allow students to have the flow charts next to them while they practise naming compounds and writing formulas. This strategy is very important for English language learners.

Background Knowledge

The design of the periodic table reflects the structure of the atom. Each element in a subsequent row or period on the table has an additional electron shell relative to the elements in the previous row. Each element in a column or group from left to right has one more electron in the outer shell relative to the elements in the previous column. Non-metals are found on the right side of the table and metals are found on the left. Some groups have family names due to their shared characteristics. The elements found in the same group will have similar properties. The middle of the periodic table contains the transition metals. These metals have very large atoms that share the properties of metals. Many of these metals are used in making coins.

Group 1 contains the alkali metals. All the elements in this group (except hydrogen) are solid, reactive, and contain one electron in their outer shell. They tend to lose that electron to non-metals and become +1 ions. Elements in Group 1 can make one connection with another atom.

Group 2 contains the alkaline earth metals. All the elements in this group are solid and slightly less reactive than group 1. They contain two electrons in their outer shell and tend to lose these electrons to non-metals and become +2 ions. Alkaline earth metals can make two connections with other atoms.

Group 17 contains the halogens. Halogens are non-metals and can be gaseous or liquid. They contain outer electron shells that are missing one electron and tend to "steal" electrons from metals to fill their outer shells and become –1 ions. Many halogens are used for disinfectants. The most reactive halogen is fluorine.

Group 18 contains the noble gases. Their outer shell is full and for this reason they are very unreactive.

Ionic compounds form when metals lose electrons to non-metals. Each becomes an ion that is attracted to one another due to opposite charges. Molecular compounds form when non-metals share electrons in covalent bonds. They are typically difficult to separate in comparison to ionic compounds that dissociate in water.

When naming compounds, first identify what type of compound is being named. Emphasize this to students and it will simplify the process. When writing formulas for compounds, determine the number of bonds or connections an atom can make by looking at which column it is in on the periodic table.

Group in Periodic Table	1	2	13	14	15	16	17	18
Number of Bonds	1	2	3	4	3	2	1	0

English language learners would benefit from this type of overview prior to participating in the activities. Use the table on page 120 of the student textbook. Use drawings to clarify the language used in the table.

Literacy Strategies

Before Reading

- While looking at a periodic table, ask students to name an element that is a halogen, an element that has seven electrons, and then an element that has eight protons, and so on, as a diagnostic assessment.
- Ask students how many carbon atoms and how many oxygen atoms are in the chemical carbon dioxide. Write the chemical formula on the board. Then, ask students to guess the chemical formula for dihydrogen monooxide and what this substance is. Note: it's H_2O. or water.

During Reading

- Stop to discuss pictures and diagrams with students using think-aloud. Be sure to make connections between the pictures and diagrams in the text.
- Have students add new words to their visual glossaries. Use **BLM 2-8 Visual Glossary**, if necessary.

After Reading

- Have students complete the Learning Check questions.
- Students could create concept maps or flowcharts to summarize the information. Ask students to suggest which method of summarizing the information they have just learned might be most effective. Provide students with time to begin their summaries. Offer students the option of using **BLM G-40 Concept Map** or **BLM G-43 Flowchart**.

Assessment FOR Learning		
Tool	**Evidence of Learning**	**Supporting Learners**
Learning Check, page 125	Students explain that an atom is more stable and less reactive when its outer shell of electrons is full.	• Have students act out or use manipulatives to show what electrons can do during compound formation (transfer or share).
Learning Check, page 134 Learning Check, page 135 Investigation 2A, page 138	Students identify compounds as molecular or ionic and name or create formulas for the compounds.	• Review the flowcharts on page 134 and 135 with students and explain how to use them.

Topic 2.2 (Student textbook pages 118–139)

Using the Topic Opener

- Before starting this topic, ask students to name as many common chemical reactions as they can. Ask them to think of chemical reactions they encounter daily. Invite English language learners to use lists made in Topic 2.1.
- Write the common name of the chemicals compounds listed along with their chemical name. Ask students to identify the elements they think make up the compounds.
- Use the Starting Point Activity as a diagnostic tool. Students should remember what a chemical formula is and how it is used to describe molecules.

Starting Point Activity (Student textbook pages 119)

Pedagogical Purpose

This activity introduces the idea that the names of compounds are based on their structure. By using common items rather than atoms, this activity should make naming compounds less intimidating.

Planning	
Time	15 min in class

Activity Notes and Troubleshooting

- Students should work in pairs or groups of three.
- Encourage students to make a formula before trying to name the items. This will remind them to include the parts in the name rather than jumping to a name like "ice-cream sandwich" for diagram C.
- You could provide paper cut-outs of the pieces represented in the pictures. Students could manipulate them while discussing the names they invent.

Additional Support

- DI For spatial learners, provide Lego® or small cut-outs of the components of each picture.
- DI For logical-mathematical learners, provide alternative items to name using molecular model kits.
- DI After creating naming rules, join two groups together to have them compare their answers. This exercise will benefit interpersonal learners.
- DI ELL Help English language learners by naming the components in the pictures or asking them to think of foods that they are familiar with. Draw the foods and then apply naming rules to those foods.

Starting Point Activity Answers

Answers may vary. For example:

2. Diagram A: diyellow trired legide
Diagram B: mushroom tomato pepper onionide
Diagram C: ice-cream dichocide

3. Rule 1: Name should end with "ide".
Rule 2: Name should provide some information about the parts that make up the compound.

Instructional Strategies for Topic 2.2

Student textbook pages 120–121

- DI ELL Have students use **BLM 2-15 Periodic Table Colouring** to highlight the important features of the periodic table. This tool will help spatial and English language learners.
- DI Set up stations around the room with information on each of the groups of the periodic table, such as whether they are metals or non-metals, and have students rotate from station to station, making notes. Or, they could visit two groups, make notes, and then present to someone who has visited two different groups. This exercise will help bodily-kinesthetic learners.
- DI Play one of the games below with students. Logical-mathematical and bodily-kinesthetic learners will find these games interesting.
  - Make cards with clues to the groups on the periodic table, such as "the most reactive metal is found here" or "none of these elements react with others" and have students identify which group is described.
  - As a class, make up signals or body actions to match each group (alkaline metals, alkali earth metals, halogens, and noble gases).
  - Have students brainstorm the uses that each of the groups has in common. For example, batteries contain lithium, bones are made of calcium, chlorine is used to disinfect drinking water, and helium is used to inflate balloons. Do elements in the same group serve similar purposes?
  - Use **BLM 2-16 Bohr Diagrams** to highlight the importance of electrons in compound formation.
- ELL Provide **BLM 2-17 Electrons and Protons of Elements** for English language learners to complete. This tool will help students become familiar with reading information from the periodic table.

Student textbook pages 122–123

- Before reading, review prior learning from grade 9. Write a formula on the chalkboard, such as NaCl or CO_2. Ask students what information is given by the formula. Some will say the name of the chemical, others will know that the symbols represent elements, and others that the numbers in the formula tells how many atoms of each element are present. Then ask students to draw a picture of each molecule.
- ELL Prior to reading, discuss Figure 2.9 on page 122. Print it on the chalkboard and point to each component as you use the vocabulary to name it, for example, subscript, hydrogen, atom. Have students make notes on how to read a chemical formula. Pair English language learners with students who have strong English language skills if necessary.

Student textbook pages 124–125

- Before reading, review the families of elements (alkali metals, metalloids, halogens, noble gases, and so on) and the traits more reactive elements have (close to full outer shells and metals with more shells versus non-metals with fewer shells).
- List the three ways that elements combine to form compounds. Demonstrate how this occurs by having students represent elements (use post-it notes to represent electrons) and have the elements combine to form compounds.
- After completing Activity 2.5, have students answer the Learning Check questions. Students should summarize how they know what will happen when two elements combine.

Student textbook pages 126–127

- Before reading, review the concept of compound versus element. Draw pictures of molecules and ask students if they are compounds or elements. Review the types of elements (metal and non-metal) and where they are found on the periodic table. The review could be done as a game or a presentation of questions.

- Make notes on the characteristics of ionic versus molecular compounds. Demonstrate the properties of salt versus sugar. Write the formulas for salt and sugar, and ask students to identify the compound that contains a metal and is therefore ionic. Have students examine Table 2.2 and Table 2.3. Emphasise the colour coding in the formulas as you read them. Discuss how the tables support the information in the text. In Table 2.2 the metal part of the formulas is written in blue and the non-metal in yellow. In Table 2.3 the formulas are written entirely in yellow.
- As a follow up, give each student a card with the name of a different element. Ask students to find a partner and decide if their elements would form a compound or not. Compounds would be formed between a metal and a non-metal or between two non-metals. Students should indicate what type of compound their elements would form, if possible. If a pair does not agree, they should ask you or another pair for assistance. Each student should then find a new partner. After a few minutes, stop the activity and ask random pairs of students what elements they have and what type of compound they can form.

Student textbook pages 128-129

- First read the subtitle, then write the formula of a simple ionic compound on the board. For example, use NaCl and ask students what it is called. Repeat with $MgCl_2$.
- Model how to name an ionic compound by explaining the flowchart in Figure 2.10. Then model how to determine the formula by explaining the flowchart in Figure 2.11.
- Show how the periodic table can help students remember the charge on the ion. For example, Group 1 has a charge of 1, group 2 has a charge of 2, group 17 has a charge of 1, and group 16 has a charge of 2.
- Compare crossing over to find a formula to the cross multiplication of fractions.
- DI Give students **BLM 2-18 Ionic Compounds**. Have students use a highlighter and pattern recognition to show how the charge becomes the subscript. Logical-mathematical learners will find this an interesting activity.
- Create metallic element cards and non-metallic compound cards. (Photocopy and enlarge the periodic table and cut out the element cells.) Give half of the class the metallic element cards and the other half the non-metallic compound cards. Use Table 2.4 to help you. Students have to find a partner. Together they determine the chemical name and formula of the compound they form. Students should record their answers on the chalkboard in a table with the headings "Elements", "Chemical Name", and "Formula".
- Explain to students that the periodic table shows the ion that can form for each element.

Student textbook pages 130-133

- Before starting this section, check students' understanding of how to differentiate between molecular and ionic compounds. Ask them to prepare their own Venn diagram, and them have the students share with a partner to expand or revise as necessary. Use think-pair-share and **BLM G-49 Venn Diagram**, if necessary.
- Write examples of common molecular compounds on the chalkboard, such as carbon dioxide and nitrogen dioxide. Ask students to predict the formulas and then compare their formulas with a partner. Next, write an unfamiliar formula on the chalkboard, such as sulfur dioxide, and ask students to predict the formula.
- DI Discuss the meanings of several prefixes in Table 2.6. Then write a compound such as NH_3 on the chalkboard and ask students for the name followed by the name of a compound like carbon tetrahydride. Ask them to predict the formula. Students should be familiar with the prefixes from their work in geometry. Provide **BLM 2-19 Prefixes** so students can relate the number of sides in geometric shapes to the prefixes. This will make the connection to the prefixes used in naming compounds more apparent. Logical-mathematical learners will enjoy reviewing the prefixes.

- Students should summarize the steps in Figure 2.12 and Figure 2.13 about how to name compounds.
- Give each student an element card with a non-metal written on it. Have students form small groups and create a molecular compound. Ask them to write their formula and name on the chalkboard.

Student textbook pages 134-135

- Give students **BLM 2-20 Naming Chemical Compounds Flowchart** and **BLM 2-21 Writing Formulas Flowchart** and model how to use the flowcharts.
- Give practice questions and ask students to talk you through using each flowchart. For example: What is the name of the compound formed when aluminum and sulfur react? What is the formula? What is the name of the compound that contains 2 carbon atoms and 4 hydrogen atoms? What is the formula?
- Have students work in pairs to complete the Learning Check questions and take up the answers in class.

Activity 2.3 Electrons and Protons of Elements

(Student textbook page 121)

Pedagogical Purpose

This activity is a review of grade 9 concepts that students need in order to understand how compounds form. This review step is critical for English language learners because it supports them as they revisit concepts and vocabulary.

Planning	
Materials	**BLM 2-17 Electrons and Protons of Elements** (optional)
Time	30 min in class

Skills Focus

- communicate using different methods
- apply ideas to new situations

Activity Notes and Troubleshooting

- Students should work in pairs or in groups of four.
- Students may struggle with the terminology used on the periodic table. Provide them with the terms for labels A to D (atomic number, atomic mass, symbol, element name) or provide them with **BLM 2-17 Electrons and Protons of Elements,** which guides them through the activity.

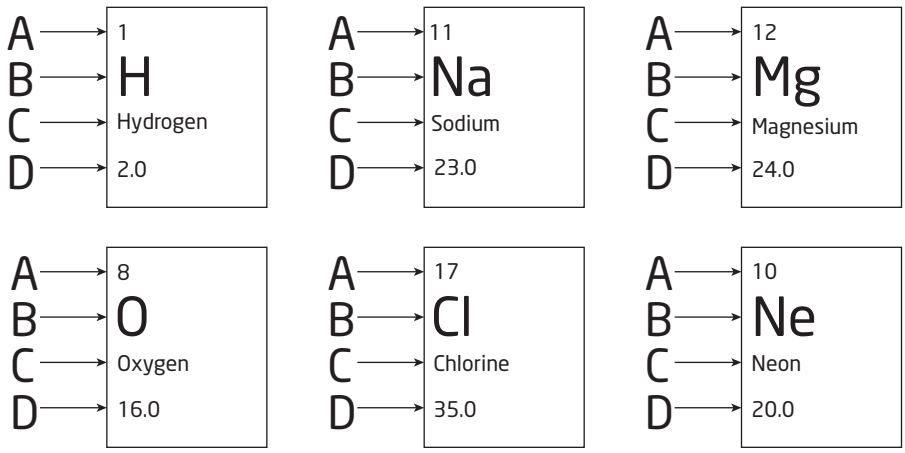
Additional Support

- ELL Provide **BLM 2-17 Electrons and Protons of Elements** to English language learners. This tool will help them decode the periodic table cell information. Review the task and language of the blackline master, and work through an example before starting the activity. Partner English language learners with classmates with strong English skills, and encourage them to talk about the concepts and use the vocabulary as they proceed.
- DI Encourage spatial learners to use Figure 2.7 while completing the activity.
- DI For bodily-kinesthetic learners, provide cut-outs of the information for one of the elements and have them move the cut-outs to the appropriate position in the cell.
- DI Enrichment—To decrease the amount of time needed to complete activity, assign each element in questions 2 and 3 to a group of students. Have each group present their answers and explanations to the class. All the elements could be assigned to logical-mathematical learners for a challenge.

Activity 2.3 Answers

1. A atomic number, B chemical symbol, C element name, D atomic mass

2.



3. Hydrogen has 1 proton, sodium has 11 protons, magnesium has 12 protons, oxygen has 8 protons, chlorine has 17 protons, and neon has 10 protons.

Learning Check Answers (Student textbook page 121)

1. Diagram should resemble Figure 2.6, on page 120.

2. Noble gases. They have a full outer shell of electrons.

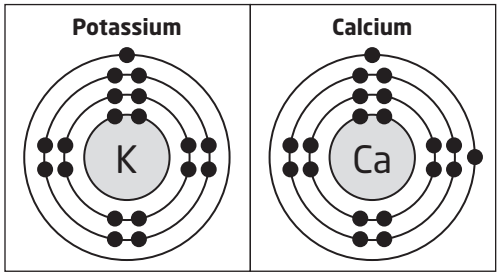
3. **a)** K. It is lower in the group and metals are more reactive the farther down you go.

b) F. It is higher in the group and non-metals are more reactive the higher up you go.

c) Na. There are fewer electrons in the outer shell, so it is closer to being full.

d) Cl. The outer shell is fuller.

4.



Activity 2.4 Interpreting Chemical Formulas (Student textbook page 123)

Pedagogical Purpose

This activity provides practice in decoding chemical formulas.

Planning	
Materials	molecular model kits (optional) **BLM 2-22 Interpreting Chemical Formulas** (optional)
Time	15 min in class

Skills Focus

- communicate using formulas
- decode formulas

Activity Notes and Troubleshooting

- Have students work in pairs and then compare answers with another pair.
- Model how to decode Na_3PO_4 before having students work on their own formulas.
- Provide molecular model kits and have students build or draw the molecules.
- Provide **BLM 2-22 Interpreting Chemical Formulas** for students to record their answers.

Additional Support

- ELL Quickly review the examples given in the charts with English language learners before they begin.
- Provide a copy of the periodic table to help students identify the elements in their formulas.
- DI For bodily-kinesthetic learners, provide molecular model kits and have students build the molecules.
- DI Have spatial learners draw each molecule before answering the questions.

Activity 2.4 Answers

2.

Chemical Formula	Number of Atoms of Each Element
Na_3PO_4	3 atoms sodium (Na) 1 atom phosphorus (P) 4 atoms oxygen (O)
$MgCl_2$	1 atom magnesium (Mg) 2 atoms chlorine (Cl)
$NaC_5H_8NO_4$	1 atom sodium (Na) 5 atoms carbon (C) 8 atoms hydrogen (H) 1 atom nitrogen (N) 4 atoms oxygen (O)
H_2O_2	2 atoms hydrogen (H) 2 atoms oxygen (O)
$C_6H_{12}O_6$	6 atoms carbon (C) 12 atoms hydrogen (H) 6 atoms oxygen (O)
CO_2	1 atom carbon (C) 2 atoms oxygen (O)
CCl_2F_2	1 atom carbon (C) 2 atoms chlorine (Cl) 2 atoms fluorine (F)
CH_2F_2	1 atom carbon (C) 2 atoms hydrogen (H) 2 atoms fluorine (F)

Learning Check Answers (Student textbook page 123)

1. a) The subscript tells how many atoms of the element before the subscript is in the compound.

b) No subscript means that there is only one atom of an element.

2. one nitrogen atom and three hydrogen atoms

3. CH_4

4. N_2O_4

Activity 2.5 Building Ions (Student textbook page 124)

Pedagogical Purpose

This activity allows students to see or model what happens when an ion forms.

Planning	
Materials	Per student: small round objects, such as buttons, pennies, or poker chips **BLM 2-23 Electron Shell Template** (optional) **BLM 2-24 Building Ions** (optional)
Time	15 min in class 15 min preparation

Skills Focus

- make models
- interpret the periodic table

Activity Notes and Troubleshooting

- Provide students with **BLM 2-23 Electron Shell Template.**
- Students may need help determining the number of each subatomic particle. Focus on the number of electrons only and remind them that it is the same as the atomic number for a neutral atom.
- Have students create their models in small groups and then do a gallery walk to see all of the ions and the original atoms.
- Do not use food to represent electrons. Students will have difficulty focussing on the activity.

Additional Support

- ELL Provide **BLM 2-24 Building Ions** to help English language learners complete this activity.
- ELL Some English language learners have difficulty understanding antecedents. Draw their attention to the dashes in the text on page 124, and explain their function in the sentence.
- Enrichment—Tell students that elements in period 4 can hold 18 electrons. Challenge them to build one of the larger atoms and its ion.

Activity 2.5 Answers

What to Do

2-5. Models and sketches will vary.

What Did You Find Out?

1. **a)** All of the ion models have full outer shells.
   b) Some models will have a different number of shells depending on which period the element is in.
2. The model of the atom contains the same number of electrons as the atomic number. The ion has either lost or gained electrons to get a full outer shell.

Learning Check Answers (Student textbook page 125)

1. Helium has two electrons in its outer shell. The other noble gases have eight. There is a difference because the first shell can only hold two electrons. They all have full shells.
2. Metals lose electrons and become positive ions to get a full outer shell of electrons.
3. Non-metals gain electrons to fill their outer shells and become negative ions or they share electrons with other non-metals.

Activity 2.6 Ionic or Molecular? (Student textbook page 127)

Pedagogical Purpose

In this activity, students apply their knowledge of metallic and non-metallic elements and the characteristics of compounds to practise identifying compounds as ionic or molecular.

Planning	
Materials	**BLM 2-25 Ionic or Molecular?** (optional)
Time	15 min in class

Skills Focus

- read formulas
- make decisions

Activity Notes and Troubleshooting

- Students should have the periodic table available while completing this activity.
- Provide **BLM 2-25 Ionic or Molecular?** for students to record their work.

Additional Support

- DI Encourage spatial learners to highlight metals in blue and non-metals in yellow.
- DI Challenge musical learners to make a jingle to help them remember the difference between ionic and molecular compounds. (Perhaps to the tune of *Mary Had a Little Lamb*.)
- DI Interpersonal learners should work in pairs and discuss their answers with a partner.
- ELL Provide verbal instructions and model the answer for the first compound for English language learners. Then ask students to explain how to answer the questions for the second compound.
- DI Have students create a Venn diagram comparing ionic and molecular compounds. Spatial learners will benefit from this exercise.

Activity 2.6 Answers

Chemical Formula	Types (metal or non-metal)	Ionic or Molecular
$MgBr_2$	metal, non-metal	ionic
PH_3	non-metal, non-metal	molecular
P_4O_{16}	non-metal, non-metal	molecular
NaI	metal, non-metal	ionic
SiF_4	non-metal, non-metal	molecular
Ag_3P	metal, non-metal	ionic
O_2F_2	non-metal, non-metal	molecular

Learning Check Answers (Student textbook page 127)

1. Metals and non-metals combine to form ionic compounds.

2. Non-metallic elements combine to form molecular compounds.

Learning Check Answers (Student textbook page 129)

1. Ionic compounds are named by stating the name of the metal and then the name of the non-metal with the ending "ide".
2. **a)** sodium bromide
   b) lithium fluoride
   c) magnesium bromide
   d) aluminum iodide
   e) potassium sulfide
3. The charge on each ion tells you how many of the other element is in the ionic compound.
4. **a)** CsF **b)** $SrCl_2$ **c)** BaO **d)** K_3P **e)** AlN

Learning Check Answers (Student textbook page 131)

1. Molecular compounds are named in two parts. The first part is the name of the non-metal with the lower group number on the periodic table. The second part is the name of second non-metal, ending in "ide."
2. **a)** sulfur dioxide
   b) sulfur trioxide
   c) carbon tetrachloride
   d) potassium pentachloride
   e) carbon monoxide

Learning Check Answers (Student textbook page 132)

1. The prefix tells you the number of atoms of each element in a molecular compound.
2. **a)** SF_2 **b)** NO **c)** S_2O_3 **d)** S_2F_2 **e)** $SiCl_4$
   f) P_2O_5 **g)** CS_2 **h)** CI_4 **i)** N_2S_4

Activity 2.7 Building Models of Molecular Compounds

(Student textbook page 133)

Pedagogical Purpose

This activity provides students with hands-on practice in creating, naming, and writing the formulas of molecular compounds.

Planning	
Materials	molecular model kits or modelling clay and toothpicks
Time	30 min in class 10 min preparation

Skills Focus

- build models
- gather data

Activity Notes and Troubleshooting

- You can use other materials for the models such as foam balls and toothpicks, paper circles, and so on.
- Have students work in pairs or in small groups. Students should each have a turn at building models.

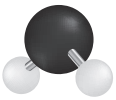
Additional Support

- DI Have bodily-kinesthetic learners act out the creation of the molecules by assigning students the roles of the atoms. For example, to model CS_2, have one student labelled C join with two students labelled S.
- DI Musical learners might like to write a jingle about one of the compounds that includes the formula, the structure, and compound's name.
- DI Ask visual learners to create a cartoon showing the formation of one of the molecular compounds.
- DI Encourage logical-mathematical students to use the flow charts for each step until they are familiar with the process.
- ELL Read the directions to the activity with English language learners. Take this time to explain the instructional vocabulary and syntax of question 3 and others.

Activity 2.7 Answers

What to Do

2-4.

Element 1 and Number	Element 2 and Number	Chemical Formula	Chemical Name	Sketch of Model
1 C	2 S	CS_2	carbon disulphide	
1 C	1 O	CO	carbon monoxide	
1 N	2 O	NO_2	nitrogen dioxide	
1 B	3 Cl	BCl_3	boron trichloride	
2 N	1 O	N_2O	dinitrogen monoxide	
1 P	3 F	PF_3	phosphorus trifluoride	

Learning Check Answers (Student textbook page 134)

1. Determine if the formula is made of a metal and a non-metal or two non-metals.

2. a) ionic, potassium chloride
b) molecular, arsenic pentoxide
c) ionic, magnesium bromide
d) molecular, phosphorous trichloride
e) molecular, selenium hexafluoride
f) ionic, magnesium phosphide

Learning Check Answers (Student textbook page 135)

1. Determine if the name is made of a metal and a non-metal or two non-metals.

2. a) ionic, CaO
b) molecular, N_2I_3
c) ionic, Na_3P
d) molecular, ICl_3
e) molecular, PBr_4
f) ionic, AlP

Activity 2.8 Modelling Ionic Compounds (Student textbook page 136)

Pedagogical Purpose

This activity allows students to see and model how electrons are transferred during the formation of an ionic compound.

Planning	
Materials	scissors **BLM G-51 Activity 2.8 Shapes** **BLM 2-26 Modelling Ionic Compounds** (optional)
Time	30 min in class 10 min preparation
Safety	Remind students to handle scissors with care.

Skills Focus

- build models
- interpret formulas

Activity Notes and Troubleshooting

- Supply students with **BLM G-51 Activity 2.8 Shapes**.
- Alternate materials could include molecular model kits or modelling clay and toothpicks. For molecular model kits, put sticks or springs into non-metals and no sticks into metals before students begin. For the clay and toothpicks, mould balls out of clay, put toothpicks into non-metals and poke holes into metals.
- Have students work in pairs or small groups with each student taking turns building models.
- If using molecular model kits or modelling clay, warn students to work in a responsible way with the materials.
- Remind students that the sticks and holes represent electrons or space for electrons, Stress that all holes must be filled when making the models.
- Provide **BLM 2-26 Modelling Ionic Compounds** for students to record their work.
- Have students draw each model they build.

Additional Support

- DI For spatial learners, provide 3-D models, molecular model kits, or modelling clay and toothpicks.
- Model how to build a molecule such as AlI_3 (aluminum iodide) to demonstrate how to fill the holes of aluminum with three atoms of iodine.
- ELL Ensure that English language learners understand what is meant by shapes "representing" ions.

Activity 2.8 Answers

What to Do

2.

Metal Ion (Positive)	Non-metal Ion (negative)	Compound Name	Compound Formula
K	I	potassium iodide	KI
Al	P	aluminum phosphide	AlP
Mg	F	magnesium fluoride	MgF_2
Na	O	sodium oxide	Na_2O
Ba	Cl	barium chloride	$BaCl_2$
Ga	F	gallium fluoride	GaF_3
Ca	N	calcium nitride	Ca_3N_2

What Did You Find Out?

1. They are equal.

2. The charge on X is +2.

Activity 2.9 Kitchen Chemistry (Student textbook page 137)

Pedagogical Purpose

The purpose of this activity is to challenge students to apply their knowledge to find the chemical names and formulas of common ingredients and to classify the compounds as ionic or molecular.

Planning	
Materials	Internet access or research materials
Time	5 min to explain the activity

Skills Focus

- gather and interpret data
- analyze information
- evaluate sources of data

Activity Notes and Troubleshooting

- This activity could be done in the classroom but ideally should be assigned as homework.
- Suggest to students that they look at labels of soup cans or natural foods when at home.
- Provide a list of potential ingredients students might find in foods.

Additional Support

- ELL Have students with strong English skills work with English language learners to read and interpret the information on the food package. English language learners could also select a package that is labelled in their first language.

Activity 2.9 Answers

What to Do

Answers will vary. For example:

1. **a)** Macaroni and Cheese Powdered Cheese Sauce

   b) whey, milk fat, milk protein concentrate, salt, sodium tripolyphosphate, contains less than 2% of citric acid, sodium phosphate, lactic acid, milk, calcium phosphate, yellow 5, yellow 6, cheese culture, enzymes.

2.

	Ingredient 1	Ingredient 2	Ingredient 3
Name	salt	sodium phosphate	calcium phosphate
Formula	NaCl	Na_3P	Ca_2P
Elements It Contains	sodium, chloride	sodium, phosphate	sodium phosphate
Ionic or Molecular?	ionic	ionic	ionic

3. Salt is one ingredient that is added for flavouring and as a preservative.

Investigation 2A Ionic or Molecular? (Student textbook page 138)

Pedagogical Purpose

This investigation gives students practical experience in distinguishing between molecular and ionic compounds.

Planning	
Materials	Per group: 250 mL beaker scoop stirring rod conductivity tester 500 mL distilled water 15 mL Epsom salts 10 mL isopropyl alcohol (rubbing alcohol) 15 mL washing soda 15 mL sugar 10 mL vegetable oil **BLM 2-27 Investigation 2A, Ionic or Molecular?** (optional) **BLM 2-28 Ionic or Molecular? Table** (optional) **BLM G-49 Venn Diagram** (optional)
Time	45 min in class 20 min preparation
Safety	Remind students not to eat or drink anything in the science classroom. Students should wear gloves, safety goggles, and aprons.

Background

Ionic compounds will dissociate in water and dissolve. They will also become conductive due to the presence of ions in solution. Ionic compounds are always solid at room temperature. Molecular compounds may or may not dissolve in water but if they do dissolve, they do not become conductive. They can be solid, liquid, or gas at room temperature.

Skills Focus

- make observations
- record data
- make conclusions

Activity Notes and Troubleshooting

- Instruct students stir each mixture carefully so that all of the compound can dissolve.
- A conductivity tester can be made by using a circuit light bulb, three wires, and a battery. Connect a wire to the battery, the battery to the light, and a wire leading from the light. Place the ends of both loose wires into the solution. If the light goes on, the solution is conductive.
- Students should work in groups of four. Assign each student an organizational role such as safety checker, material gatherer, clean-up person, and reader. Have students rotate their roles so that each student gets to test at least one compound.
- Use only distilled water for this experiment. Tap water contains dissolved minerals that may affect the results.

Additional Support

- Provide students with **BLM 2-27 Investigation 2A, Ionic or Molecular?**
- Enrichment—Add more household items to the test list, such as baking soda, vinegar, or carbon dioxide. To get carbon dioxide, students could blow into a solution with a straw.
- DI Test logical-mathematical learners with a "mystery" substance, such as salt, and see if they classify it correctly as molecular or ionic.
- DI Have spatial learners draw pictures of the procedure and add a column to their observations that allows them to draw what they observe.
- ELL Draw a picture on the chalkboard to illustrate the method to be used for the tests. Ask English language learners to label the pictures with the materials to be used. Have their partners read the instructions with their English language learning partner for the first substance, and explain each step as the English language learner completes the task.
- Ask students to create a Venn diagram to compare the results shown in this experiment. Use **BLM G-49 Venn Diagram**.
- Ask students how they would classify a compound that dissolves in solution but does not conduct electricity.
- Ask students to design an experiment to see if carbon dioxide is ionic or molecular.
- Provide **BLM 2-28 Ionic or Molecular? Table** for students to record their work.

Investigation 2A Answers

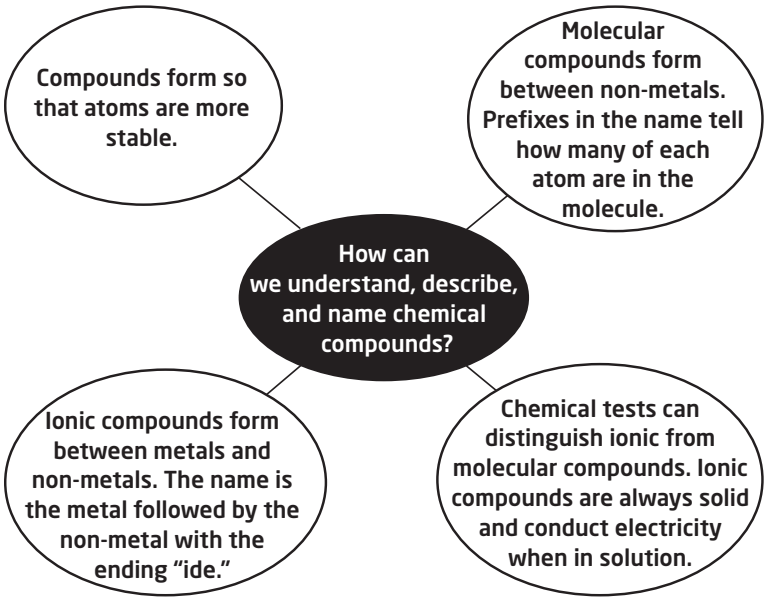
Substance	State at Room Temperature (Is it a solid, liquid, or gas?)	Solubility in Water (Does it dissolve?)	Conductivity as a Liquid or Dissolved in Water	Molecular or Ionic?
distilled water	liquid	n/a	no	molecular
Epsom salts	solid	yes	yes	ionic
rubbing alcohol	liquid	no/yes	no	molecular
washing soda	solid	yes	yes	ionic
sugar	solid	yes	no	molecular
vegetable oil	liquid	no	no	molecular

Topic 2.2 Review (Student textbook pages 139)

Please also see **BLM 2-29 Topic 2.2 Review (Alternative Format)**.

Answers

1. Answers may vary. For example:



2. a) Answers may vary. For example: sodium, Na.

b) Group 17 are the most reactive non-metals. They need one electron to become stable.

c) Cesium is the most reactive metal. It has one electron that is very far from its nucleus.

3. a) N_2H_2 **b)** $CaCO_3$

c) Ca_3P_2 **d)** $Na_2S_2O_3$

4. a) ionic **b)** ionic

c) molecular **d)** molecular

e) ionic

5. a) cesium bromide

b) barium oxide

c) calcium phosphide

d) KCl

e) $AlBr_3$

f) K_2O

6. a) diphosphorus pentoxide

b) carbon tetrafluoride

c) phophorus trihydride

d) N_2F_4

e) SCl_6

f) SBr_2

7. Na_2O. Each unit has two connections showing the +1 ions (in grey) and the –2 ion (in white).

8. Step 1: Does the compound have a metal in its name? Yes, calcium, so the compound is ionic.

Step 2: Look up the charges on each ion.
Ca is +2 and N is –3.

Step 3: Cross over to get subscripts.

Step 4: Write the formula, Ca_3N_2.