Important Concepts . . .

Preview Review

Science *Grade 9* *TEACHER KEY*

W2 - Lesson 3: Using the Periodic Table

V5-07

Important Concepts of Grade 9 Science

W1 - Lesson 1 ..... Electrical Principles
W1 - Lesson 2 .....Electrical Circuits
W1 - Lesson 3A ..... Energy Consumption
W1 - Lesson 3B ..... The Distribution of Matter in Space
W1 - Lesson 4 .....Objects in Space
W1 - Lesson 5 ..... Optical and Radio Telescopes
W1- Quiz
W2 - Lesson 1 ..... Physical and Chemical Properties of Materials
W2 - Lesson 2 ..... Chemical Reactions
W2 - Lesson 3 ..... Using the Periodic Table
W2 - Lesson 4 ..... Naming Chemical Compunds
W2 - Lesson 5 ..... Writing Chemical Equations
W2 - Quiz
W3 - Lesson 1 .....Variation
W3 - Lesson 2 ..... Reproduction and Patterns of Inheritance
W3 - Lesson 3A ..... Genes and Cell Division
W3 - Lesson 3B .....Organisms and Matter in their Environment
W3 - Lesson 4 .....Biological and Chemical Monitoring/Acids and Bases
W3 - Lesson 5 ..... Transfer of Materials through the Air, Ground, and Water/Biological Impacts of Hazardous Chemicals
W3 - Quiz

Materials Required

Textbook:
Science in Action 9

Science Grade 9
Version 5
Preview/Review W2 - Lesson 3 TEACHER KEY

Publisher: Alberta Distance Learning Centre
Author: Nicole Bondarchuk
In-House Reviewer: Barb Philips

Project Coordinator: Dennis McCarthy
Preview/Review Publishing Coordinating Team: Nina Johnson, Laura Renkema, and Donna Silgard

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Preview/Review Concepts for Grade Nine Science

TEACHER KEY

W2 - Lesson 3

Using the Periodic Table

OUTLINE

By the end of this lesson, you should

- understand what an atom is made of
- understand how the periodic table is organized
- use the periodic table to identify characteristics of different elements
- outline the structure and characteristics of an ionic compound
- outline the structure and characteristics of a molecular compound

GLOSSARY

element - pure substance that can not be broken down chemically into other substances; substance made of only one type of atom

ionic compound - pure substance formed when at least one metal and one non-metal combine

molecular compound - pure substance formed when non-metals combine

periodic table - a table in which the elements are organized by their physical and chemical properties

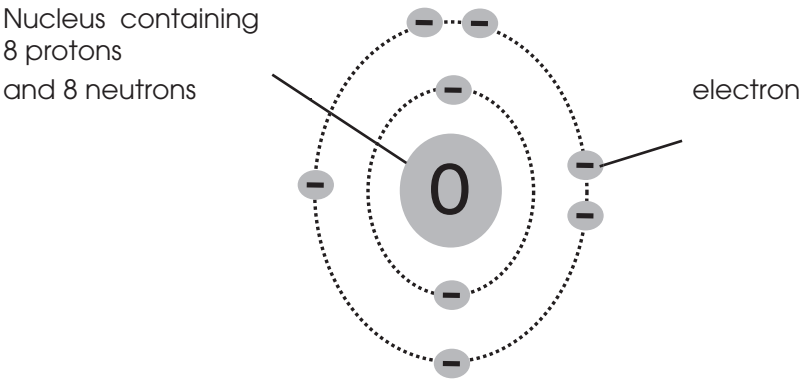
W2 - Lesson 3: Using the Periodic Table

Did you know that the element symbol for gold is **Au**? The periodic table outlines similarities and differences between the ninety-two elements that exist in nature. After you finish this lesson, you will be familiar with how the table is organized and how to use the information on the table to find characteristics of elements that are around you. Can you find the element symbol for silver?

Atomic Structure

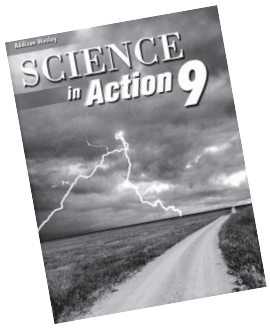
The periodic table that you will be using (page 126 of your textbook) outlines patterns and characteristics of one hundred and twelve elements, some of which can only be created in a laboratory under special conditions. You need to remember that an **element** is a pure substance made of only one kind of atom. So what is an atom?

An **atom** is the smallest part of an element. It is electrically **neutral** and has a nucleus that contains positive protons and neutral neutrons. Negative electrons that are physically smaller in size surround the nucleus of an atom. The basic model used to describe an atom was identified by scientist Niels Bohr. Here is a diagram of an atom.



Atomic model of an Oxygen Atom

Read pages 120 of *Science in Action 9*.



1. Identify and explain two differences between a proton and an electron.

   A proton has a large mass (found in the nucleus of an atom) and carries a positive charge. An electron has a small mass (surrounding the nucleus of an atom) and carries a negative charge.

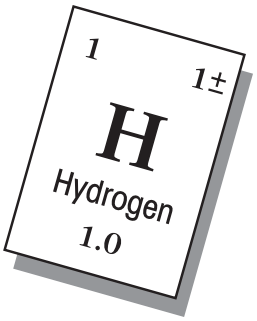
2. To what does the statement *electrically neutral* refer? Explain this statement using the structure of an atom.

   An atom is electrically neutral if it contains the same number of protons (+) and electrons (-) and has a net charge of 0.

3. How many electrons are present in the oxygen atom diagram on the previous page?

   8 electrons

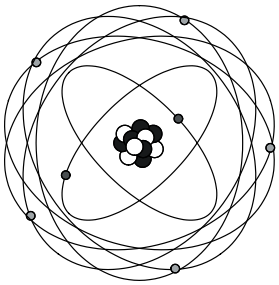
The Periodic Table



The present periodic table is a result of Dimitri Mendeleev's version of the table in 1869. He organized the elements that were known at his time according to the properties of each element. Although there were only 63 elements discovered during his time, he predicted that more elements would be found and would fit into his periodic table in the gaps that were left.

Look at the periodic table on pages 126-127 of your *Science in Action 9* textbook. Another copy of this table is on page 508 at the back of your textbook.

Each element is identified by an **element symbol** that represents it. For example, hydrogen has the element symbol **H**. Some elements have symbols that were identified by their Latin names. Tin has a element symbol of **Sn**, which comes from the Latin word *stannum*.



The periodic table is organized in horizontal rows called **Periods** (#1-7) and **Groups** (or Families) in vertical rows (#1-18).

Other information you will find on the periodic table includes the **atomic number** of an element. This shows how many **protons** are in the nucleus of one atom of the element. Also, below the element symbol you will find the **mass number** of an element. This is the **sum** of the number of protons and neutrons in an element.

By looking at the periodic table, you will notice that many mass numbers are not whole numbers. For example, magnesium (**Mg**) has a mass number of 24.3. The atomic number of magnesium is 12. With this information, we can identify that there are 12 protons and 12 neutrons in this element. Where does the 0.3 come from? Some elements are found with more **neutrons** in nature. A magnesium atom could also have 12 protons and 13 neutrons. The mass number is the **average** of all of the different atoms of an element with varying numbers of neutrons that exist in nature. Another example of this is the substance carbon-14, which is a carbon atom that has 12 protons and 14 neutrons. This substance is radioactive and is used to identify the date of rocks and fossils found on Earth. Carbon also exists as carbon-12 (with 12 neutrons) and carbon-13 (with 13 neutrons.) These forms of carbon are not radioactive.

Read pages 128-129 of Science *in Action 9*.

4. Identify five element symbols from the periodic table that have different letters from their common names. (Example: tin = **Sn**)

Fe – iron, Ag – silver, Au – gold, Hg -mercury,

Pb – lead, Sb – antimony

K – potassium, Na - sodium

5. Find the elements that are located in the following positions on the periodic table:

   a. Period 5, Group 18 ***Xenon***

   b. Period 2, Group 2 ***Berylium***

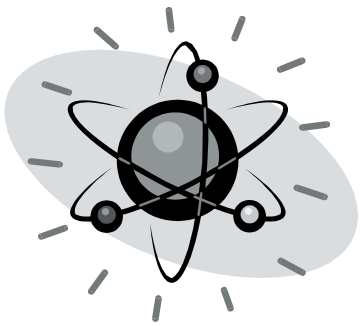
   c. Period 6, Group 11 ***Gold***

   d. Period 4, Group 8 ***Iron***

   e. Period 3, Group 13 ***Aluminum***

6. Use the periodic table to identify the number of protons, electrons, and neutrons found in the following elements.

	Element Symbol	# of Protons	# of Electrons	# of Neutrons
a.	oxygen ***O***	***8***	***8***	***8***
b.	beryllium ***Be***	***4***	***4***	***5***
c.	fluorine ***F***	***9***	***9***	***10***
d.	sodium ***Na***	***11***	***11***	***12***
e.	polonium ***Po***	***84***	***84***	***125***

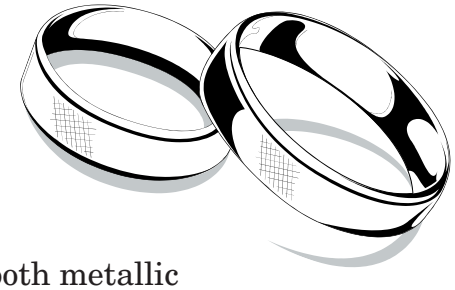


Using the Periodic Table

Now that you are familiar with the basic structure of the periodic table, you can investigate more specific characteristics of the table. The different elements on the table are divided into categories: metals, non-metals, and metalloids.

Metals are shiny, ductile, and malleable solids that conduct electricity. They are outlined by the light green portion of the periodic table found in your textbook.

Non-metals are dull, brittle elements that do not conduct electricity (insulators). They are outlined by the light orange portion of the periodic table in your text.



Metalloids are elements that have both metallic and non-metallic properties. They are outlined by the pink squares on the periodic table in your text.

The different groups or families on the periodic table have similar properties. Group 1 is the **alkali metals**. They are the most reactive metals on the table. They react readily with water and oxygen, and their reactivity increases as you move down the group. For example, potassium **K** is more reactive than lithium **Li**.

Group # 2 is the **alkaline earth metals**. These metals not as reactive as the Group 1 alkali metals; however, they still react with water and air.

Group # 17 is the **halogens**. This group is the most reactive of the non-metals. They become more reactive as you move up the periodic table. For example, chlorine is more reactive than bromine.

Group # 18 is the **noble gases**. These elements are the most stable and unreactive elements found on the periodic table.

Read page 133 of *Science in Action 9*.

7. Identify the following elements as either metal, non-metal, or metalloid.

   a. arsenic ***metalloid***

   b. calcium ***metal***

   c. argon ***non-metal***

   d. carbon ***non-metal***

   e. potassium ***metal***

8. Identify the common group name the following elements fit into.

   a. xenon ***noble gas***

   b. chlorine ***halogen***

   c. calcium ***alkaline earth metals***

   d. lithium ***alkali metals***

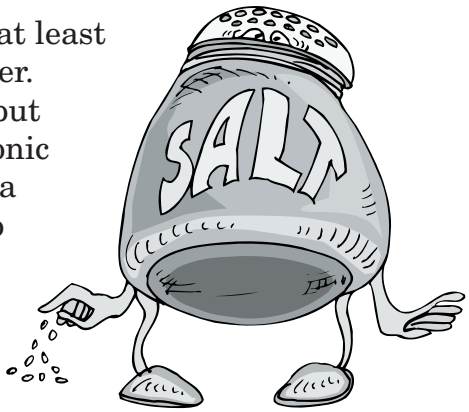
9. Rubidium and sodium are classified as alkali metals. Which is more reactive? Explain your answer.

   Rubidium is more reactive because it is further down the row in group 1. The lower you go in group 1, the more reactive the metal is.

10. Give a definition of a metalloid. Identify a specific example of an element that fits this category.

    Metalloids have properties of both metals and non-metals. An example of a metalloid is silicon.

Ionic & Molecular Compounds

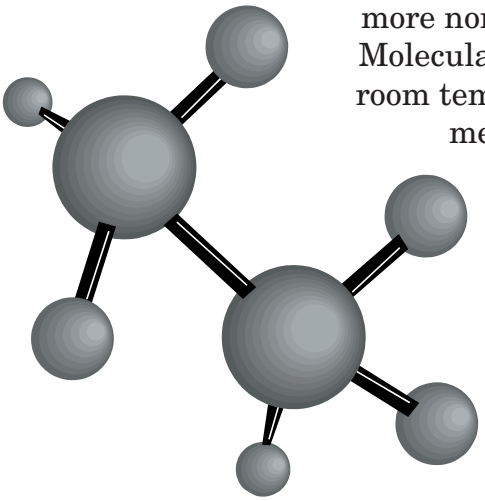


A compound is a substance made of at least two different elements bound together. The salt (sodium chloride) that you put on french fries is an example of an ionic compound. An **ionic compound** is a pure substance that is formed due to the attraction between particles of opposite charges called **ions**. It is a combination of a metal and a non-metal ion.

Metal atoms lose electrons to become stable ions with a positive charge whereas non-metal atoms gain electrons to become stable negatively charged ions. Metal and non-metal atoms form ions to become stable. You can see what ion charges an element forms by looking at the top right corner of each box on the periodic table (pages 126-127.) Some elements can produce ions with more than one charge. For example, copper can produce a Cu^{+} ion and a Cu^{2+} ion.

Ionic compounds have the following properties. They have high melting points. They conduct electricity. They have distinct crystal shapes. Ionic compounds are also in a solid state at room temperature.

Examples of ionic compounds are nickel chloride (NiCl), calcium oxide (CaO), copper chloride ($CuCl_2$), and potassium chloride (KCl).

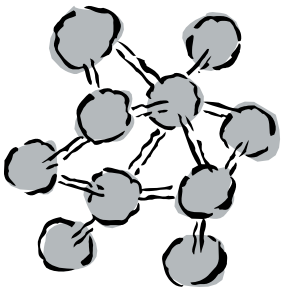


Molecular compounds are pure substances made of two or more non-metals. They **share** electrons between the elements. Molecular compounds can be in a solid, liquid, or gas state at room temperature. They tend to be insulators and have low melting and boiling points.

Examples of molecular compounds are carbon dioxide (CO_2), water (H_2O), carbon tetrachloride (CCl_4), sulfuric acid (H_2S), and oxygen (O_2).

Read pages 144-150 of *Science in Action 9*.

11. How does the structure of an ionic compound compare to the structure of a molecular compound?



Ionic compounds are in a solid state at room temperature. They are made of a metal atom combined with a non-metal atom. Electrons are transferred for the compound to be formed.

Molecular compounds exist as either solid, liquid, or gas at room temperature. They are non-metal atoms that share electrons.

12. What is the difference in the formation of metal ions compared to non-metal ions?

Metal ions carry positive charges and have lost electrons to become stable.

Non-metal ions carry negative charges and have gained electrons to become stable

13. Identify the following compounds as either ionic or molecular.

a. ozone (O_3) ***molecular***

b. aluminum oxide (Al_2O_3) ***ionic***

c. carbon tetrafluoride (CCl_4) ***molecular***

d. methane (CH_4) ***molecular***

e. silver bromide (AgBr) ***ionic***

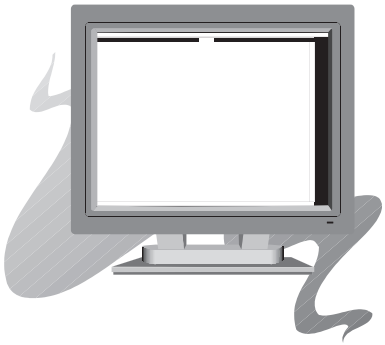
Websites

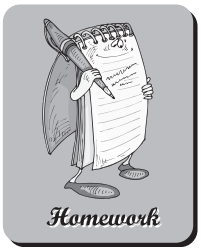
The addresses for the websites below were valid at the time of printing.

www.chem4kids.com/files/elem_intro.html

www.edu4kids.com/chem

www.chemicalelements.com





Homework

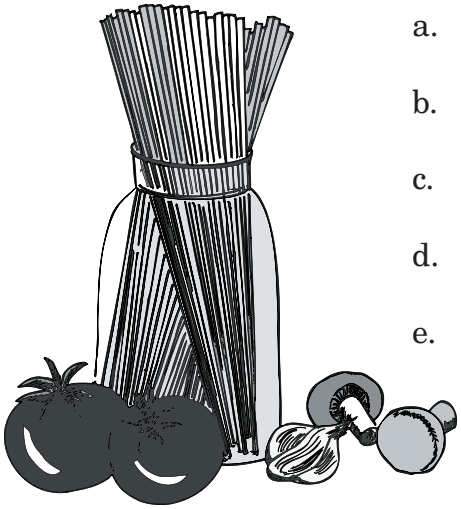
14. Look at the label of boxes of baking soda and baking powder in your family's baking cupboard. Identify the chemical names of the substances present in each. Try to identify whether they are ionic or molecular compounds.

Baking soda – 100% sodium bicarbonate – ionic compound
Baking powder – monocalcium phosphate – ionic compound
Sodium bicarbonate – ionic compound

15. Find a box of macaroni and cheese in the cupboard at home. Identify the names of chemical compounds that are present in the box. Again, try to identify whether they are ionic or molecular compounds.

Macaroni & Cheese –
calcium chloride – ionic compound
sodium chloride – ionic compound
sodium phosphates – ionic compound
citric acid – molecular compound

16. Open your textbook to "Toolbox 12" on page 506 of the *Science in Action 9* Textbook. Identify the chemical names of some substances you should be familiar with.



a. dry ice ***carbon dioxide***

b. limestone ***calcium carbonate***

c. bleach ***sodium hypochlorite***

d. rotten egg gas ***hydrogen sulfide***

e. vitamin C ***ascorbic acid***