

# *A Guide to Chemical Bonding*

## **Teaching Approach**

Chemical Bonding is the formation of new substances, with new physical and chemical properties, when atoms and molecules join together. It is important for learners to understand the difference between macroscopic and microscopic properties of matter in the lead up to models of bonding.

Lesson 1 is a recap of the atom (Gr 9), emphasizing the microscopic nature of the atom and because of this, the need for different models to show how atoms can bond. This lesson can be used to consolidate the learner's understanding of the Periodic Table developed during earlier grades. Terms such as valence and valency are addressed and reinforced by examples of energy level diagrams.

Lessons 2, 3 and 4 can be used to discuss, evaluate and simply explain the three types of chemical bonding: covalent, ionic and metallic, each type depends on the elements involved. Naming and stock notation is methodically addressed.

Lesson 5 recaps the various models of bonding. This video can be used in such a way as to reinforce the link between matter at the macroscopic level and the influence of the bonding within the microscopic level. Relative molecular mass of covalent molecules and formula mass unit of ionic lattices is explained clearly. Naming of ionic compounds is addressed. The task video is provided as either additional practice for the learners, or as an assessment tool to evaluate learning of this section of work.

## Video Summaries

Some videos have a 'PAUSE' moment, at which point the teacher or learner can choose to pause the video and try to answer the question posed or calculate the answer to the problem under discussion. Once the video starts again, the answer to the question or the right answer to the calculation is given

Mindset suggests a number of ways to use the video lessons. These include:

- Watch or show a lesson as an introduction to a lesson
- Watch or show a lesson after a lesson, as a summary or as a way of adding in some interesting real-life applications or practical aspects
- Design a worksheet or set of questions about one video lesson. Then ask learners to watch a video related to the lesson and to complete the worksheet or questions, either in groups or individually
- Worksheets and questions based on video lessons can be used as short assessments or exercises
- Ask learners to watch a particular video lesson for homework (in the school library or on the website, depending on how the material is available) as preparation for the next days lesson; if desired, learners can be given specific questions to answer in preparation for the next day's lesson

### 1. Introduction to Chemical Bonding

The focus is on the concept of generating new substances with new physical and chemical properties on a microscopic level. The evidence on the Periodic Table is revisited emphasizing pure substances. Lewis diagrams are clearly defined in examples.

### 2. Covalent Bonding

The model of covalent bonds between non-metal and non-metal, forming molecules, is explained. This is applied in examples of covalent bonding using concentric circles and energy level /Lewis diagrams.

### 3. Ionic Bonding

This video explains the model of ionic bonding. Emphasis is on the transfer of electrons between metals and non-metals, resulting in anions and cations, held together by electrostatic forces in rigid crystal lattices made up of formula units.

### 4. Metallic Bonding

This video describes the simple model of metallic bonding. Metallic bonding is emphasized as having a positive core kernel, shielded by full energy levels and "delocalized" electrons.

### 5. Comparisons of Bonding and Formula Calculations

The three types of bonding are compared. Relative formula mass of covalent molecules is explained using examples. Formula mass unit is explained using an example. The naming of ionic compounds is addressed in detail.

## Resource Material

<b>1. Introduction to Chemical Bonding</b>	<a href="http://www.webelements.com/">http://www.webelements.com/</a>	Explore key information about the chemical elements through this periodic table.
	<a href="http://www.everythingscience.co.za/grade-10/06-chemical-bonding">http://www.everythingscience.co.za/grade-10/06-chemical-bonding</a>	A chapter on chemical bonding in Grade 10 textbook “Everything Science”
	<a href="http://cnx.org/content/m38131/latest/">http://cnx.org/content/m38131/latest/</a>	Chemical Bonding-Grade 10 [CAPS]
	<a href="http://youtu.be/PvsUpdi1oEQ">http://youtu.be/PvsUpdi1oEQ</a>	Mindset Learn video: Grade 10 Chemical Bonding
<b>2. Covalent Bonding</b>	<a href="http://www.kentchemistry.com/links/bonding/covalentlewisdot.htm">http://www.kentchemistry.com/links/bonding/covalentlewisdot.htm</a>	Lewis Dot Structures–covalent bonding diagrams.
	<a href="http://www.wisc-online.com/Objects/ViewObject.aspx?ID=GCH6404">http://www.wisc-online.com/Objects/ViewObject.aspx?ID=GCH6404</a>	Lewis Dot Structures–covalent bonding diagrams
	<a href="http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/lewis.html">http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/lewis.html</a>	Lewis dot structures –covalent bonding compounds
<b>3. Ionic Bonding</b>	<a href="http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/lewis.html">http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/lewis.html</a>	Lewis dot structures –ionic bonding compounds.
	<a href="http://www.kentchemistry.com/links/bonding/IonicLewisDots.htm">http://www.kentchemistry.com/links/bonding/IonicLewisDots.htm</a>	Lewis dot structures –ionic bonding compounds
	<a href="http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson6">http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson6</a>	Representing bonding with Lewis dot structures.
<b>4. Metallic Bonding</b>	<a href="http://www.everythingscience.co.za/grade-10/06-chemical-bonding/06-chemical-bonding-05.cnxmlplus">http://www.everythingscience.co.za/grade-10/06-chemical-bonding/06-chemical-bonding-05.cnxmlplus</a>	A chapter on nature of metallic bonding in Grade 10 textbook “Everything Science”
	<a href="http://www.drkstreet.com/resources/metallic-bonding-animation.swf">http://www.drkstreet.com/resources/metallic-bonding-animation.swf</a>	Metallic Animation
	<a href="http://www.usetute.com.au/metallc.html">http://www.usetute.com.au/metallc.html</a>	

	<a href="http://www.kentchemistry.com/links/bonding/bondingflashes/bond_type_s.swf">http://www.kentchemistry.com/links/bonding/bondingflashes/bond_type_s.swf</a>	
<b>5. Comparisons of Bonding and Formula Calculations</b>	<a href="http://www.quia.com/jg/65800.html">http://www.quia.com/jg/65800.html</a>	Ionic Compound Naming Flashcards, Matching, Concentration, and Word search.
	<a href="http://www.visionlearning.com/en/library/Chemistry/1/Chemical-Bonding/55">http://www.visionlearning.com/en/library/Chemistry/1/Chemical-Bonding/55</a>	Learn how and why chemical bonds form and the results of these actions. Includes a discussion of the differences between ionic and covalent bonds.
	<a href="http://www.mhhe.com/physsci/chemistry/animations/chang_7e_esp/bom1s2_11.swf">http://www.mhhe.com/physsci/chemistry/animations/chang_7e_esp/bom1s2_11.swf</a>	Animation: Comparison ionic and covalent.
	<a href="http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/atomic/">http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/atomic/</a>	Bonding at the BBC – Five pages of text, images, activities
	<a href="http://www.mhhe.com/biosci/genbio/animation_quizzes/animate_62.htm">http://www.mhhe.com/biosci/genbio/animation_quizzes/animate_62.htm</a>	Interactive Bonding Quizzes at McGraw Hill – just to self-check learning/progress
	<a href="http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/bond2.html#c1">http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/bond2.html#c1</a>	Ionic vs covalent bonding comparison.
	<a href="http://www.okstate.edu/jgelder/bondpage38.html">http://www.okstate.edu/jgelder/bondpage38.html</a>	Chemical Bonding Humor, Games, Limericks

## Task

### Question 1

Give one word or term for each of the following:

- 1.1 The vertical columns on the Periodic Table.
- 1.2 A horizontal row on the Periodic Table.
- 1.3 A very reactive group of elements that has just one electron in the outer shell.
- 1.4 A model for bonding between a metal and a non-metal where a transfer of electrons takes place.
- 1.5 A very reactive element that is missing one electron from its outermost energy level.

### Question 2

Choose the correct answer.

- 2.1 Covalent bonding usually takes place between
  - a) metal/non-metal
  - b) non-metal/non-metal.
- 2.2 Ionic bonding takes place between a
  - a) metal/non-metal
  - b) non-metal/non-metal.

### Question 3

Consider the following compounds. Decide which are covalently bonded and which are ionically bonded.

- 3.1  $\text{CO}_2$ ,
- 3.2  $\text{NaCl}$
- 3.3  $\text{AlCl}_3$ ,
- 3.4  $\text{PCl}_3$ ,
- 3.5  $\text{CaO}$
- 3.6  $\text{F}_2$

### Question 4

Every day we use table salt to season our food. Table salt is the common name for sodium chloride.

- 4.1 Give the chemical formula for sodium chloride
- 4.2 Draw Lewis dot diagrams for the sodium ion ( $\text{Na}^+$ )
- 4.3 Draw Lewis dot diagrams for the chlorine ion ( $\text{Cl}^-$ )
- 4.4 What is a positive ion called?
- 4.5 What is a negative ion called?
- 4.6 What type of bond forms when sodium and chlorine combine to form a compound?
- 4.7 What is the formula unit of such a compound?
- 4.8 Calculate the formula mass of a sodium chloride lattice using the formula mass unit.

### Question 5

Given the chemical formula  $\text{CO}_2$  calculate the relative molecular mass of carbon dioxide.

### Question 6

If the chemical formula for a compound is  $\text{FeCl}_3$  give the Stock notation for the compound.

### Question: 7

Write the formulae for the following:

- 7.1 Lithium fluoride.
- 7.2 Calcium oxide.
- 7.3 Barium chloride.
- 7.4 Sodium sulfide.

### Question: 8

Draw Lewis dot diagrams of these simple covalent molecules:

- 8.1 Water molecule.
- 8.2 Chlorine molecule.

### Question 9

Ammonia is a compound formed when hydrogen and nitrogen react together.

- 9.1 Draw Lewis dot diagrams of nitrogen and a hydrogen atom
- 9.2 Draw the Lewis dot diagram of ammonia.

### Question 10

Use the metallic bond model to explain why metals are good conductors of heat.

## Task Answers

### Question 1

- 1.1 Group
- 1.2 Period
- 1.3 Alkali metal
- 1.4 Ionic bonding
- 1.5 Halogens

### Question 2

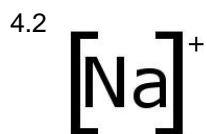
- 2.1 B non-metal/non-metal.
- 2.2 A metal/non-metal.

### Question 3

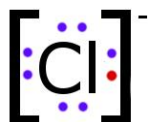
- 3.1 CO<sub>2</sub> covalent
- 3.2 NaCl ionic
- 3.3 AlCl<sub>3</sub>, ionic
- 3.4 PCl<sub>3</sub>, covalent
- 3.5 CaO ionic
- 3.6 F<sub>2</sub> covalent

### Question 4

4.1 NaCl



4.3



- 4.4 Cation
- 4.5 Anion
- 4.6 Ionic bond
- 4.7 Ratio of 1:1 of Na to Cl
- 4.8  $M_r(\text{NaCl}) = 23 + 35.4 = 58.45$ ; the formula mass for NaCl is 58,45 units

### Question 5

$$M_r(\text{CO}_2) = 12 + 2(16) = 44$$

### Question 6

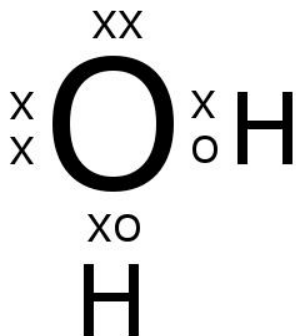
Iron (III) chloride

### Question 7

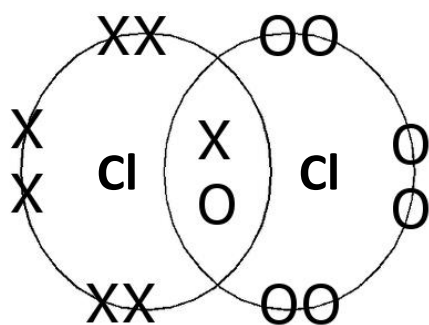
- 7.1 LiF
- 7.2 CaO
- 7.3 BaCl<sub>2</sub>
- 7.4 Na<sub>2</sub>S

**Question: 8**

8.1 A water molecule



8.2



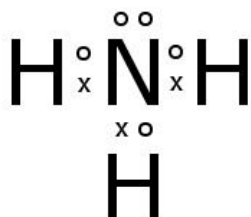
Chlorine Molecule

**Question: 9**

9.1



9.2


**Question: 10**

The atoms are packed closely together in the network structure. As each atom is heated and gains kinetic energy, it vibrates faster. Because the atoms are close together, the vibration is passed on to the neighbouring atoms, and thus the temperature increase spreads easily throughout the metal.



## Acknowledgements

Mindset Learn Executive Head	Dylan Busa
Content Manager Classroom Resources	Jenny Lamont
Content Coordinator Classroom Resources	Helen Robertson
Content Administrator	Agness Munthali
Content Developer	Dawn Clark
Content Reviewers	R Moore
	Liz Harris

## Produced for Mindset Learn by Traffic

Facilities Coordinator	Cezanne Scheepers
Production Manager	Belinda Renney
Director	Alriette Gibbs
Editor	Nonhlanhla Nxumalo
Presenter	Niki Montgomery
Studio Crew	Abram Tjale
	James Tselapedi
	Wilson Mthembu
Graphics	Wayne Sanderson

## Credits



This resource is licensed under a [Attribution-Share Alike 2.5 South Africa licence](https://creativecommons.org/licenses/by-sa/2.5/za/).  
 When using this resource please attribute Mindset as indicated at <http://www.mindset.co.za/creativecommons>