

Bonding Basics 2010

Lesson Objectives:

As a result of this lesson, students will be able to:

- 1 – Identify the number of valence electrons in a given atom.
- 2 – Describe and demonstrate how an ionic bond forms.
- 3 – Describe and demonstrate how a covalent bond forms.
- 4 – Predict the type of bond that will occur between two elements.

Materials Needed:

Element Cards (Cut apart & laminate if desired)
Skittles (or other small candy pieces)
Periodic Tables
Lesson Worksheets

Preparation:

For my classes, I prepare six sets of element cards, which is enough for six small groups of students. I print the cards on card stock, cut them apart, and then laminate them. I store each set in a baggie and also prepare another baggie of Skittles or other small candy (M&Ms, gumdrops, Smarties, etc.) The kids will use the candy pieces to represent valence electrons.

Lesson Directions:

Step 1 – Have students work together to complete Section A on their worksheet related to valence electrons and oxidation numbers and then discuss their answers. You may want to have them use the element cards to create Lewis structures for each element to make it easier to visualize the number of electrons each one needs to gain or lose. I recommend that they use the same colors for each atom, such as all yellow on one atom and red on the other. This will make it easier for them to see what happens in each bond.

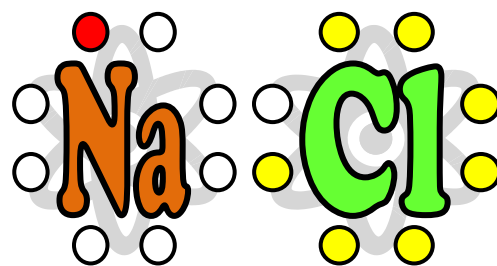
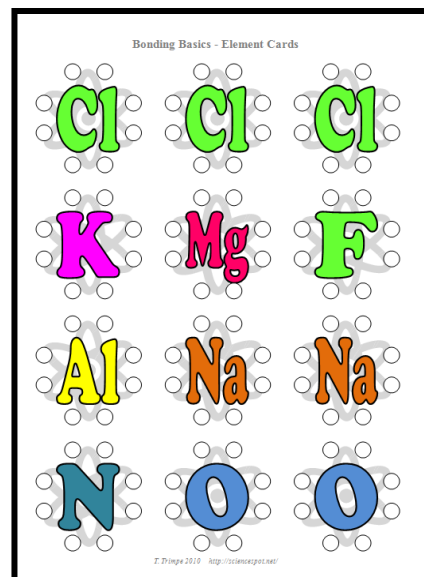
Step 2 - Distribute element cards and candy to each group.

Step 3 – Review the basics of ionic bonds by completing the information in Part B.

Step 4 – Have the students select the element cards for Sodium and Chlorine. Instruct them to use the candy pieces to create the Lewis structures for each by placing the correct number of valence electrons on each card. In this example, Sodium needs 1 candy piece and Chlorine needs 7.

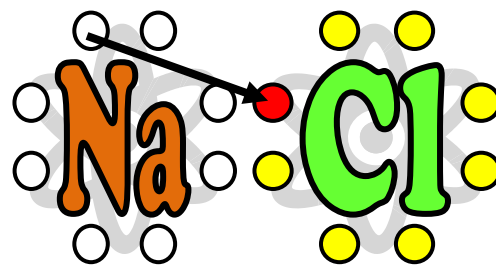
Step 5 - To demonstrate the formation of an ionic bond using the elements in Example B1, ask the students the following questions as they complete the bond:

- 1 – How many valence electrons does Sodium have? (1) How many valence electrons does Chlorine have? (7)
- 2 – How many electrons does Chlorine need to complete its outer shell? (1)



3 – How many electrons does Sodium need to lose to be left with a complete shell? (1)

DO: Have the students take the candy piece from Sodium and place it in the empty circle on the Chlorine atom. They should also draw this on their worksheet.



4 – Since Sodium lost one electron, what is its charge? (1+)
What do we call a positively charged ion? (Cation)

5 – Since Chlorine gained one electron, what is its charge?
(1-) What do we call a negatively charged ion? (Anion)

6 – Do the charges balance? (Yes)

7 - What is the chemical formula for this compound? (NaCl)

8 – What is the name of this compound? (Sodium Chloride or salt.)

DO: Review the formation of the bond by drawing the Lewis structures for the elements on the board and use an arrow to show the transfer of electrons from Sodium to Chlorine. Finish the example by writing the chemical formula with the charges and without. (Note: See the answer key for more details.)

Step 6 – Repeat this process for the other ionic bond examples using the other element cards. Once your students have the basic idea they may be able to draw the bond structures on their own.

Step 7 – Discuss the information about covalent bonds in Part C.

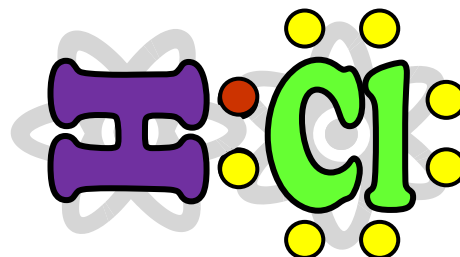
Step 8 - To demonstrate the formation of a covalent bond using the element in Example C1, ask the students the following questions as you demonstrate the bond:

1 – How many valence electrons does Hydrogen have? (1) Students need to place one candy piece in one of the circles on the Hydrogen atom.

2 – How many valence electrons does Chlorine have? (1) Students need to place seven candy pieces in the circles on the Chlorine atom.

3 – How many electrons does each atom need to have a complete shell? (1)

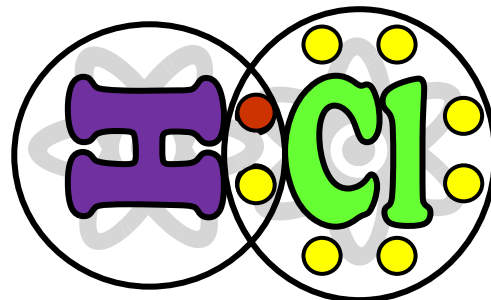
DO: Since Hydrogen isn't likely to give up an electron, it must share one with another atom. Have the students move the Hydrogen atom so its two circles overlap those on the left side of the Chlorine atom. to allow each atom to share one electron with the other as shown below.



4 – Have the students draw this on their worksheets.

5 - How many electrons does the Hydrogen atom now have? (2 – 1 of its own and 1 that is shared) How many does the Chlorine atom have? (8 - 7 of its own and 1 that is shared)

DO: Draw a circle around the Hydrogen atom and the 2 electrons it now has in its outer shell. Draw another circle around the Chlorine atom to show the 8 electrons it now has in its outer shell. Have the students do the same on their worksheet.



6 - What is the chemical formula for this compound? (HCl)

DO: Review the formation of the bond by drawing the Lewis structures for the elements and use circles to show how the electrons are shared between the two atoms. Finish the example by writing the chemical formula. (Note: See the answer key for more details.)

Note: In my experience, the covalent bonds are the most difficult for students to visualize so you may want to do most of these together and discuss each one.

Extension: The element card set includes all the elements through Argon as well as six blank atoms. Students can use these extra cards to make their own ionic and covalent bonds.

Also available ...

The original Bonding Basics lesson is available at <http://sciencespot.net/Pages/classchem.html#Anchorbond>. The answer keys for the ionic and covalent worksheets have more details about each bond that may help if you have questions about how to demonstrate them to your students.

Bonding Basics

Name _____

Section A: Complete the chart using a periodic table to help you.

Element	Atomic Symbol	Total # of Electrons	# of Valence Electrons	# of Electrons Needed to Gain or Lose (to Fill Outer Shell)	Oxidation Number
Chlorine					
Potassium					
Magnesium					
Fluorine					
Aluminum					
Sodium					
Nitrogen					
Oxygen					
Hydrogen					
Carbon					
Iodine					

Answer these questions:

- An atom that gains one or more electrons will have a _____ charge.
- An atom that loses one or more electrons will have a _____ charge.
- An atom that gains or loses one or more electrons is called an _____.
- A positive ion is called a _____ and a negative ion is called an _____.

Section B: Ionic Bonds

What is an ionic bond?

- Atoms will transfer one or more _____ to another to form the bond.
- Each atom is left with a _____ outer shell.
- An ionic bond forms between a _____ ion with a positive charge and a _____ ion with a negative charge.

Example B1: Sodium + Chlorine

Example B2: Magnesium + Iodine

Example B3: Potassium + Iodine

Example B4: Sodium + Oxygen

Example B5: Calcium + Chlorine

Example B6: Aluminum + Chlorine

Challenge: What are some other ionic bonds that can be formed by the elements you see? Remember that you need a metal and a nonmetal to make an ionic bond. Write the chemical formula for the compound and its name.

Section C: Covalent Bonds

What is a covalent bond?

- Atoms _____ one or more electrons with each other to form the bond.
- Each atom is left with a _____ outer shell.
- A covalent bond forms between two _____.

Example C1: Hydrogen + Chlorine

Example C2: 2 Hydrogen + Oxygen

Example C3: Chlorine + Chlorine

Example C4: Oxygen + Oxygen

Example C5: Carbon + 2 Oxygen

Example C6: Carbon + 4 Hydrogen

Challenge: What are some other covalent bonds that can be formed by the elements you see? Remember that you need two or more nonmetals to make a covalent bond. Write the chemical formula for the compound and its name if you know it.

Bonding Basics

ANSWER KEY

Section A: Complete the chart using a periodic table to help you.

Element	Atomic Symbol	Total # of Electrons	# of Valence Electrons	# of Electrons Needed to Gain or Lose (to Fill Outer Shell)	Oxidation Number
Chlorine	Cl	17	7	Gain 1	1-
Potassium	K	19	1	Lose 1	1+
Magnesium	Mg	12	2	Lose 2	2+
Fluorine	F	9	7	Gain 1	1-
Aluminum	Al	13	3	Lose 3	3+
Sodium	Na	11	1	Lose 1	1+
Nitrogen	N	14	4	Gain 3	3-
Oxygen	O	8	6	Gain 2	2-
Hydrogen	H	1	1	Gain/Lose 1	1+ or 1-
Carbon	C	6	4	Gain or Lose 4	4+ or 4-
Iodine	I	53	7	Gain 1	1-

Answer these questions:

- An atom that gains one or more electrons will have a **NEGATIVE** charge.
- An atom that loses one or more electrons will have a **POSTIVE** charge.
- An atom that gains or loses one or more electrons is called an **ION**.
- A positive ion is called a **CATION** and a negative ion is called an **ANION**.

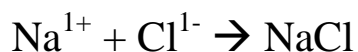
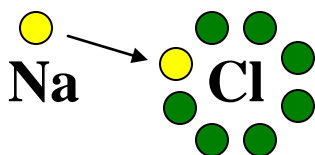
Section B: Ionic Bonds

ANSWER KEY

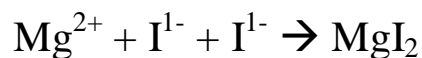
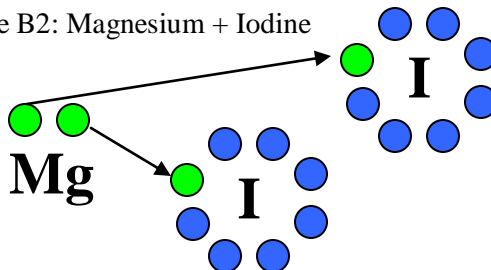
What is an ionic bond?

- Atoms will transfer one or more **electrons** to another to form the bond.
- Each atom is left with a **complete** outer shell.
- An ionic bond forms between a **metal** ion with a positive charge and a **nonmetal** ion with a negative charge.

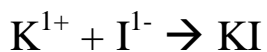
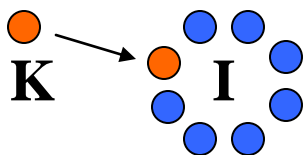
Example B1: Sodium + Chlorine



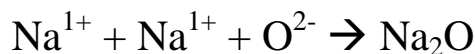
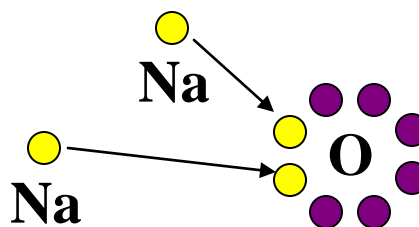
Example B2: Magnesium + Iodine



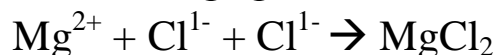
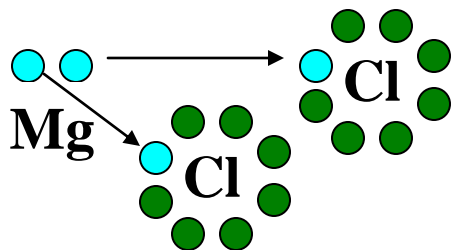
Example B3: Potassium + Iodine



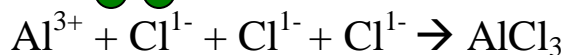
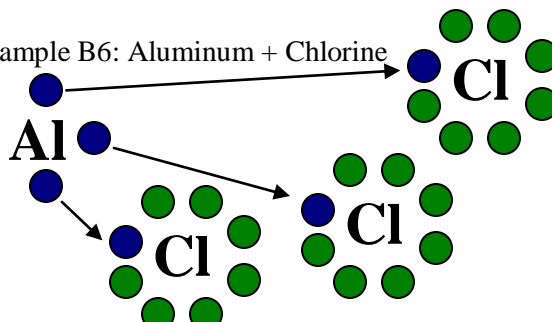
Example B4: Sodium + Oxygen



Example B5: Calcium + Chlorine



Example B6: Aluminum + Chlorine



Challenge: What are some other ionic bonds that can be formed by the elements you see? Remember that you need a metal and a nonmetal to make an ionic bond. Write the chemical formula for the compound and its name.

Answers will vary.

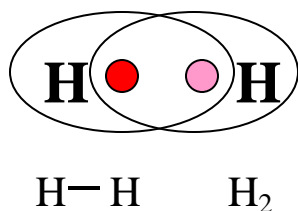
Section C: Covalent Bonds

ANSWER KEY

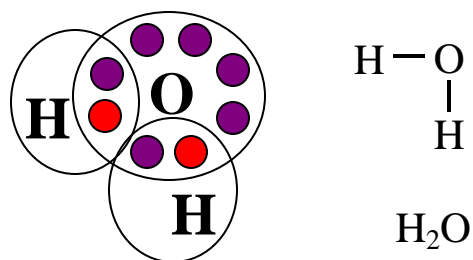
What is a covalent bond?

- Atoms share one or more **electrons** with each other to form the bond.
- Each atom is left with a complete outer shell.
- A covalent bond forms between two **nonmetals**.

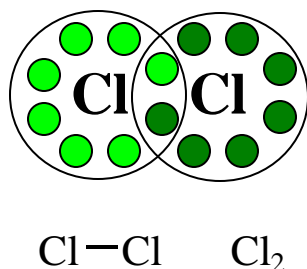
Example C1: Hydrogen + Hydrogen



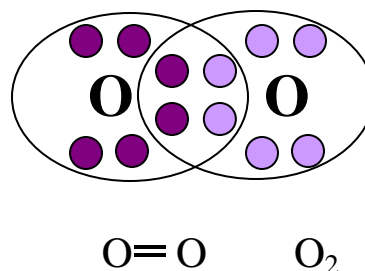
Example C2: 2 Hydrogen + Oxygen



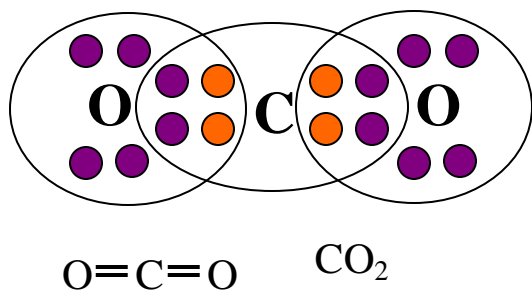
Example C3: Chlorine + Chlorine



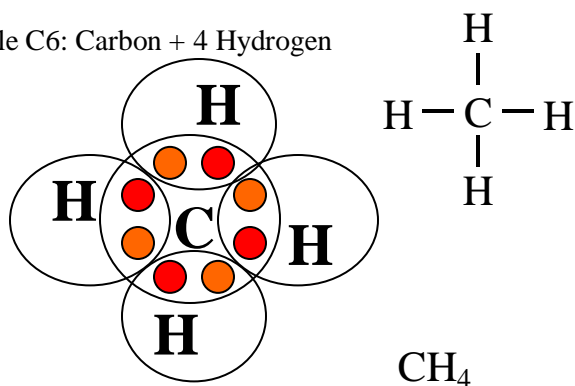
Example C4: Oxygen + Oxygen



Example C5: Carbon + 2 Oxygen



Example C6: Carbon + 4 Hydrogen



Challenge: What are some other covalent bonds that can be formed by the elements you see? Remember that you need two or more nonmetals to make a covalent bond. Write the chemical formula for the compound and its name if you know it.

Answers will vary.