SNC 2D

Grade 10 Science, Academic

Unit: Chemistry: Chemical Reactions

The Big Ideas:

- Chemicals react with each other in predictable ways.
- Chemical reactions may have a negative impact on the environment, but they can also be used to address environmental challenges.

Some tips on using this manual:

1. Put this manual in your binder, and then remove the staple. As you work on a lesson on any given day, just remove those sheets from your binder to work on them.
2. This manual is available on the class moodle. All links are live links from the moodle.
3. Write dates beside the Lessons on the table of contents.
4. Cross off Days as they are completed. That way, should you miss a lesson, you can easily refer to which lesson you have to make up.

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http://news.nationalpost.com/toronto/up-to-17-injured-after-explosion-at-north-york-high-school-in-toronto-reports-say 6

http://www.thestar.com/news/gta/2010/03/12/student_in_severe_condition_after_science_class_blast.html 6

http://www.cbc.ca/news/canada/toronto/toronto-propane-firm-guilty-in-fatal-2008-blast-1.1301145 6

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Name:_____ Partner 1:_____

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Lesson 1 Changes and Safety

By the end of this lesson, you will be familiar with:

- the difference between physical and chemical properties
- the difference between physical changes and chemical reactions
- Safe practices in the workplace

This lesson applies to sections 5.1 and 5.3 in the text book.

1. Ask your teacher which challenge you begin with – 1 or 2.

Challenge 1 – gather your knowledge

2. **Read** *(Individually)* Read section 5.1 – Properties and Changes
3. **Summarize** *(individually)* On a separate sheet of paper, take detailed notes on the text. If you are not sure of the format for taking notes, consult previous lessons on note taking, or page 174 in your textbook.
4. **Summarize** *(individually)* Re-read all the notes you just took. Pick the two most important things you learned from this section and write them in the space below.

5. **Research** *(individually)* Complete the "Research This" activity found on page 177. For question 2, you are told to GO TO NELSON SCIENCE. Ignore this, and simply do the research by finding your own sources. Answer A, B and C on separate paper.
6. Go directly to challenge 3

Challenge 2 – gather your knowledge

7. **Read** *(Individually)* Read section 5.3 – Hazardous Products and Workplace Safety
8. **Summarize** *(individually)* On a separate sheet of paper, take detailed notes on the text. If you are not sure of the format for taking notes, consult previous lessons on note taking, or page 174 in your textbook.

9. **Summarize** *(individually)* Re-read all the notes you just took. Pick the two most important things you learned from this section and write them in the space below.

10. **Research** *(individually)* Complete the "Research This" activity found on page 183. For question 2, you are told to GO TO NELSON SCIENCE. You can obtain the MSDS sheets on the moodle and you will also need to visit http://www.truthorfiction.com/hydrogen-peroxide/. Answer A, B and C on separate paper.
11. Go directly to Challenge 3

Challenge 3 – Share your results

12. **Compile** *(in pairs)* When you have completed the challenge you were assigned, find someone who has finished the other challenge. Do not wait for someone in particular to finish, simply find anyone who is done.
13. **Communicate** *(individually)* Each of you takes turns describing what you read. You can use your detailed summary notes to assist you, as well as your responses to the Research This activity.
14. **Communicate** *(individually)* Share the 2 most important points with your peer. Copy theirs down on your worksheet.

Homework

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Read the article http://news.uci.edu/press-releases/uci-fellow-chemists-find-a-way-to-unboil-eggs/

Read one of the following articles:

http://www.nydailynews.com/new-york/students-injured-beacon-school-article-1.1564258

http://news.nationalpost.com/toronto/up-to-17-injured-after-explosion-at-north-york-high-school-in-toronto-reports-say

http://www.thestar.com/news/gta/2010/03/12/student_in_severe_condition_after_science_class_blast.html

http://www.cbc.ca/news/canada/toronto/toronto-propane-firm-guilty-in-fatal-2008-blast-1.1301145

Name:_____ Partner 1:_____

Partner 2:_____ Partner 3:_____

Lesson 2 Lewis dot structures

***This lesson is adapted from*

POGIL Activities for High School Biology,

Developed through the High School POGIL Initiative Laura Trout, Editor-in-Chief

Published by FLINN Scientific INC

By the end of this lesson, you will be able to accurately draw Lewis dot structures for atoms and ions

The chemical properties of an element are based on the number of electrons in the outer shell of its atoms. We use Lewis dot structures to map these valence electrons in order to identify stable electron configurations (lay outs). Most atoms tend to lose or gain electrons in order to achieve noble gas stability. For example, the metal sodium will react violently with the gas chlorine, but once the elements form the compound sodium chloride (table salt) they are very stable due to the stable electron configuration

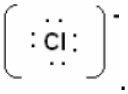
1. **Apply** *(as a group)* What is the product of sodium metal reacting with chlorine gas?

2. **Speculate** *(as a group)* Is energy released or absorbed in the reaction?

3. **Apply** *(as a group)* Is the product of the reaction (sodium chloride) more or less stable than the reactants (sodium metal and chlorine gas)? Explain.

Model: Drawing Lewis Dot Structures for Atoms and Ions

The Lewis dot structure for an atom of chlorine is The number of valence electrons for an atom is the number of electrons in the outer energy level (valence shell) of the atom. Chlorine has 3 shells, with 2 electrons in the 1st shell, 8 electrons in the second, and 7 in the third. For the purpose of this course, we will say the number of electrons in chlorine's shells is 2-8-7; therefore it has seven valence electrons and needs to have seven dots drawn around its symbol.

The Lewis dot structure for a chloride ion is  . Chlorine needs an additional electron to attain (get) the stable noble gas configuration of 8 valence electrons. Since chlorine is a non-metal, it will gain electrons until it achieves a stable octet (until it has 8 valence electrons). When chlorine becomes an ion we add one more dot to the atom's diagram, and put the resulting charge of 1-. The ion has 17 protons in the nucleus, with a total of 18 electrons, giving it a net charge of 1-.

The Lewis dot structure for an atom of sodium is The number of electrons sodium has per shell is 2-8-1, therefore it has one valence electron, and the diagram needs one dot.

The Lewis dot structure for a sodium ion is Na^+ Since sodium is a metal, it is able to achieve the stable noble gas configuration of 8 valence electrons by losing an electron. We must take away 1 dot from the dot diagram of the sodium atom and put the resulting charge of 1+. The ion has 11 protons in the nucleus, but only 10 electrons remain, giving the net charge of 1+.

4. **Apply** *(as a group)* What is a valence electron? If you must look up the definition, be sure to put it in your own words. Include a diagram and a sentence in your explanation.

Name:_____ Partner 1:_____

Partner 2:_____ Partner 3:_____

5. **Represent** *(individually)* Complete the Lewis dot structures for the following elements (some are done for you as an example)

	Group 1	Group 5	Group 7	Group 8
Lewis dot structure element electrons per shell	H Hydrogen 1			He
Lewis dot structure element name electrons per shell	Li	N	F	Ne
Lewis dot structure element name electrons per shell	Na	P	 Chlorine 2-8-7	Ar
Lewis dot structure element name electrons per shell	K	As	Br	Kr

6. **Reason** *(as a group)* How can you determine the number of valence electrons in an atom?

7. **Explain** *(as a group)* In general terms, what is the difference between an atom and an ion?

There are two types of ions: anions and cations. Anions have a negative ionic charge and cations have a positive ionic charge.

8. **Reason** *(as a group)* Match up the terms anions and cations with metals and non-metals.

9. **Predict** *(as a group)* What will happen when metals and non-metals come into contact with each other?

10. **Explain** *(as a group)* Based on the number of valence electrons for each element, why don't elements in group 8 readily form compounds with other elements?

11. **Apply** *(as a group)* Draw the dot diagram for carbon and identify how carbon can attain the stable noble gas configuration of 8 electrons.

12. **Apply** *(as a group)* Put an X over any of the following examples that do not have a stable noble gas configuration

    Rb C^{4-} S Fr^{1+} Ar Ca^{2+} Cl^{-} O^{2-}

13. **Apply** *(as a group)* Using Lewis dot diagrams, show how some number of atoms of lithium and some number of atoms of oxygen can transfer electrons to form ions of each element with stable octets. Be sure to include the resulting charges of the ions as demonstrated previously. Draw a square around the part of the diagram that shows the formation of one formula unit of lithium oxide.

Homework

Read 5.4 and take notes

Periodic table assignment

Read 5.5 and take notes

Do page 191 #1, 5, 6, 8

Name:_____ Partner 1:_____

Partner 2:_____ Partner 3:_____

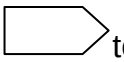
Lesson 3 Introduction to molecules

By the end of this lesson, you will be able to create stable molecules – both ionic compounds and molecular compounds.

Challenge 1 – making connections

There are different ways that we can represent compounds. Today, we are going to use cut-out shapes. You have a sheet of paper with different shapes on it. Each shape can represent an atom. You can combine different shapes (or atoms) together to make a stable compound. You would have a stable compound if you are able to make a square or rectangle.

1. **Communicate** (as a group) On a whiteboard, draw the Lewis dot structure for lithium.

2. **Reason** *(as a group)* Consider all the shapes you have. It would be a good idea to use  to represent a lithium atom. Explain why.

3. **Reason** *(as a group)* Why wouldn't we use to represent lithium?

4. **Explain** *(as a group)* Below, draw one of the other shapes from those available and describe why it is also not a good choice to represent lithium.

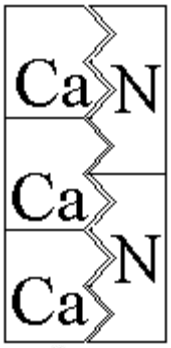
One thing to consider would be that a single point on the right or indent on the left means the atom needs to lose, gain or share one electron.

Challenge 2 – making compounds

5. Here is a list of different compounds. Use cut-out shapes to "build" 3 different compounds. Write the symbol of the element on the shape that represents it. When you have your 3 compounds built, **<u>call your teacher over to have them checked.</u>**

Li_2O	N_2O_3	AlF_3	$BrCl$
SF_2	Mg_3N_2	Br_2	CaI_2
Na_3N	PCl_3	BeS	SI_2

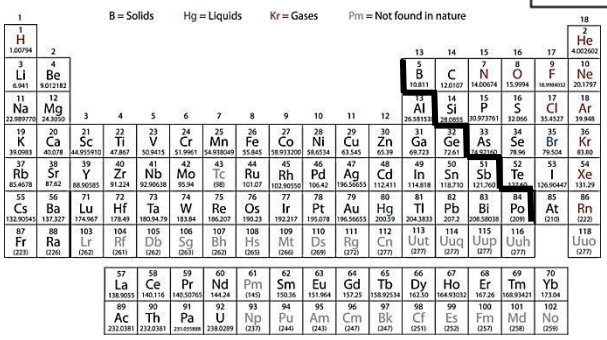
Here you can see what it would look like if we used the shapes to build a model of Ca_3N_2 (calcium nitride)



6. In the chemical formula Ca_3N_2, what does the 3 represent and what does the 2 represent?

Challenge 3 – types of compounds

7. On the periodic table here, there is a staircase dividing the right and left side of the table. Write on the periodic table what type of elements are found on the left side and right side of the staircase.



8. Go back to the list of compounds in challenge 2. Put a square around every element that is a metal. Put a circle around every element that is a non-metal.

9. If you were to divide all the compounds listed in challenge 2 into 2 groups, what would the groups be based on?

Check your results with your teacher!

Compounds can be made up of either a metal and a non-metal or two non metals. If the compound has a metal and a non-metal, we call this an ionic compound. Ionic compounds contain ionic bonds. If a compound has 2 non-metals, we call this a molecular compound. Molecular compounds contain covalent bonds. Two metals cannot form a compound

Name:_____ Partner 1:_____

Partner 2:_____ Partner 3:_____

Homework

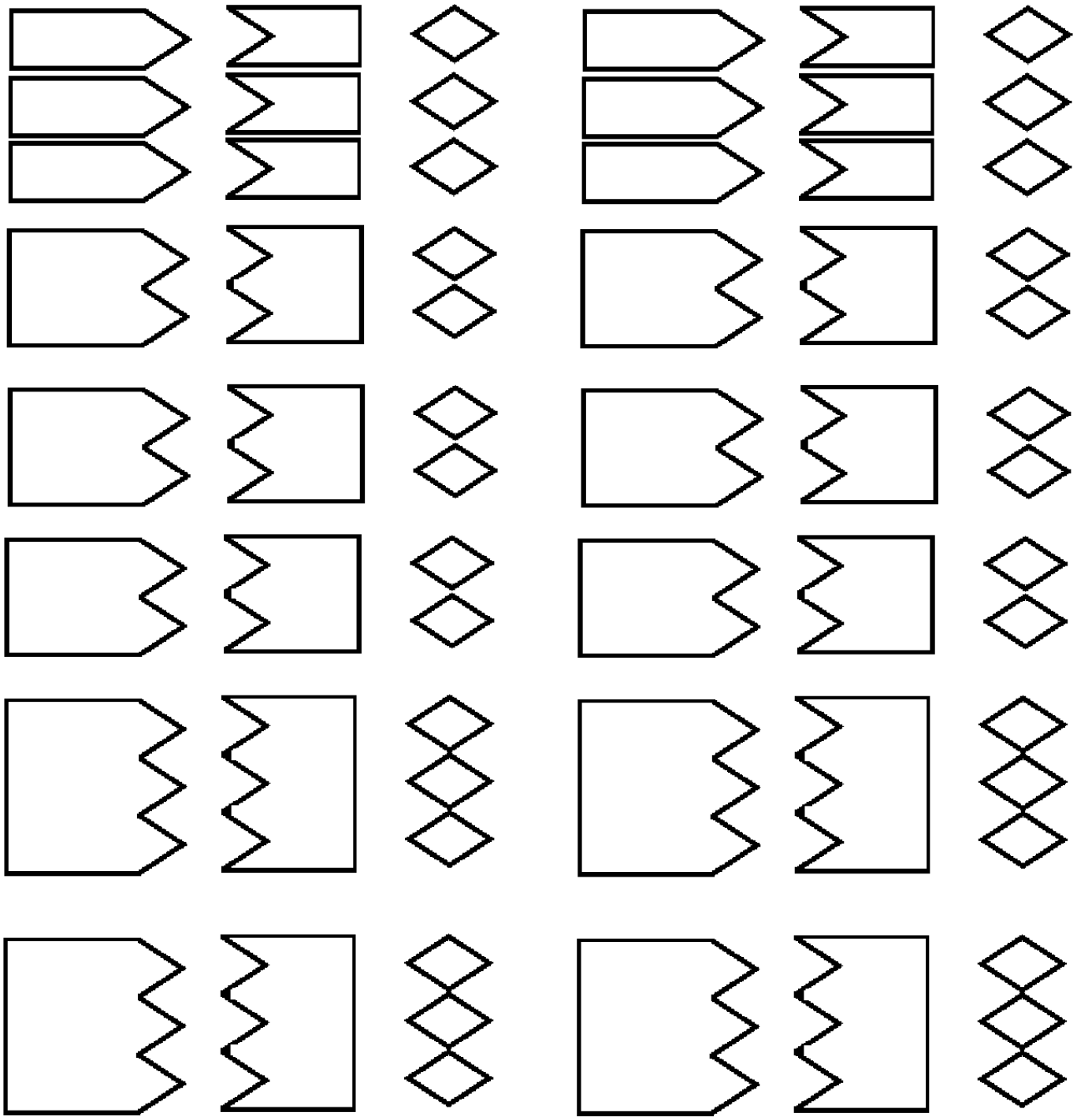
Read 5.6 and take notes

Do page 195 #2, 5, 7, 9,

Read 5.7 and take notes

Do page 200 #2, 3, 6, 7

The “diamonds” can be used to fill voids if 2 pieces on the “right side” are used to make a molecule.



Name:_____ Partner 1:_____

Partner 2:_____ Partner 3:_____

Lesson 4 Naming molecules

By the end of this lesson, you will be able to name different molecules.

Challenge 1 – naming

Li_2O	N_2O_3	AlF_3	$BrCl$
SF_2	Mg_3N_2	Br_2	CaI_2
Na_3N	PCl_3	BeS	SI_2

1. Here are the names for the compounds above. Try to match them up:
   a) ~~mono~~sulfur difluoride _____
   b) calcium iodide _____
   c) lithium oxide _____
   d) aluminum fluoride _____
   e) dinitrogen trioxide _____
   f) beryllium sulfide _____
   g) bromium chloride _____
   h) phosphorous trichloride _____
   i) sodium nitride _____
   j) bromine gas _____
   k) ~~mono~~sulfur diiodide _____
   l) magnesium nitride _____

Aside

Match up the prefixes with the numbers they represent

octa	tetra	mono	nona	penta
di	hexa	tri	Hepta	deca

1 _____ 6 _____
2 _____ 7 _____
3 _____ 8 _____
4 _____ 9 _____
5 _____ 10 _____

2. You probably noticed that some of the names contain prefixes while others don't. What do all the compounds without prefixes have in common? What do all the compounds with prefixes have in common?

3. For the compounds listed below, put a square around every metal and a circle around every non-metal. Some of the names SHOULD have prefixes - add the correct prefix to those names.

Li_2S	___lithium ___sulfide	N_2S_3	___nitrogen ___sulfide
OF_2	___oxygen ___fluoride	Ca_3N_2	___calcium ___nitride
Na_3P	___sodium ___phosphide	PF_3	___phosphorus ___fluoride

Names of molecular compounds can require a prefix to indicate how many atoms of a particular element exist in the molecule. Ionic compounds do not require prefixes.

Name:_____ Partner 1:_____

Partner 2:_____ Partner 3:_____

Challenge 2 – summary

Your friend Isaac is trying to come up with a compound using aluminum and chlorine. He says that, *"since aluminum has a charge of 3+ (Al^{3+}) and chlorine has a charge of 1- (Cl^{-}), the formula would be Al_3Cl_1. But, I also know that in chemistry, the number "1" is always implied, so I never have to write it. So, the formula is actually Al_3Cl."*

4. Isaac is correct about the "1", but his formula is incorrect. Review the drawing techniques practiced in Lesson 1 Challenge 1 and 2, and use them along with a written explanation to show how Isaac is wrong, as well as what the formula should be.

Ionic compounds arise from the transfer of electrons. The metal loses electrons. The non-metal gains electrons. An atom that has gained or lost an electron is called an ion. A positive ion has lost electrons and is called a cation (all metals). A negative ion has gained electrons and is called an anion (all non-metals). The number of electrons gained or lost is related to the group in which that element resides on the periodic table. How many electrons gained or lost by an element gives the charge of the stable ion. Molecular compounds arise from the sharing of pairs of electrons. Each shared pair of electrons represents a covalent bond and consists of one electron from each atom in the bond. Two atoms can share more than 1 pair of electrons, and therefore have more than a single bond. For example, a nitrogen molecule consists of 2 atoms of nitrogen. They each have 5 valence electrons. Each atom will share 3 of its electrons with the other nitrogen atom, so they both have a total of 8 electrons. This is called a triple bond.

5. Your friend Marie says, *"oxygen gas is made up of 2 atoms of oxygen. Because the molecule is made up of 2 non-metals, it has a covalent bond."* Is she correct?

6. There are a lot of rules to follow when writing the chemical formula or chemical name of a compound. The rules often depend on if you are dealing with an ionic compound or a molecular compound. As a group, and by looking back through the challenges, see if you can see when to apply the rules listed below.
   a) Always use a prefix if you are dealing with _____. Never use a prefix if you are dealing with_____
   b) If the prefix on the first element is _____, we don't write it.
   c) In a molecular formula, if the subscript is _____, we don't write it.
   d) If the subscripts are multiples of each other, they can be reduced (for example, X_2Y_4 can be reduced to X_1Y_2 or XY_2 and X_2Y_2 can be reduced to X_1Y_1 or XY). However, we only do this for _____compounds.

7. When atoms come together to form a molecule, you can think of a before-after situation. Use Lewis dot diagrams to show how an ionic compound is formed between calcium and nitrogen. Use a Lewis dot diagram to show how a molecular compound is formed between oxygen and fluorine.

Before	**After**
calcium and nitrogen (think about how many of each you have to draw)	Ca_3N_2 – calcium nitride
oxygen and fluorine	OF_2 – oxygen difluoride

Homework

Read 5.10 and take notes

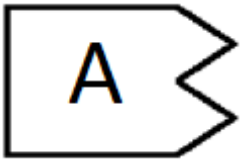
Do page 212 #1, 2, 3, 4, 6, 8

 Name:_____ Partner 2:_____

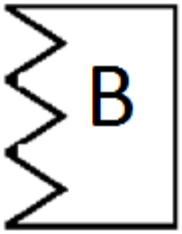
Partner 1:_____ Partner 3:_____

Lesson 5 Multivalent Ions and Polyatomic Compounds

What we know:



Shape A can be used to represent metals. The fact that it has "points" on it indicates that it loses electrons. The number of points that it has is related to the number of electrons it wants to lose in order to become stable, which is also related to its ionic charge and what group the element can be found in on the periodic table.



Shape B can be used to represent a non-metal. Non-metals can either gain or share electrons to become stable. This is indicated by the "indentations". If the non-metal forms an ionic compound, the number of indentations represents how many electrons it must gain to become stable, as well as the element's ionic charge. This is also related to the group the element is found in on the periodic table. If it forms a molecular compound, the number of indentations shows how many pairs of electrons the atom must share in order to become stable.

In an ionic compound, the positive ion always comes first, then the negative ion. This is for both the name and formula. If the two elements are both non-metals, the element closest to the metals on the periodic table is listed first. This is why BrCl exists, not ClBr.

Challenge 1 - Multivalent ions

1. Open your textbook to the periodic table. With your group, locate where on the periodic table the ionic charge for each ion is shown.

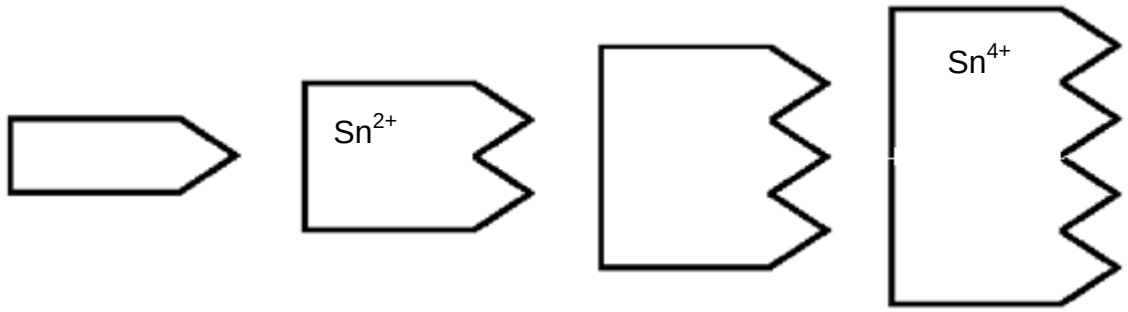
2. Look at the various ionic charges. What general rule can you say about how ionic charges are organized on the periodic table?

3. Looking at the entire periodic table, are there any exceptions to this rule? Where are most of the exceptions found?

4. Look specifically at copper, iron, tin, manganese and lead. Make a table showing the element's name, symbol and ionic charges. Be sure to include column headings.

Because of the complexity of the atomic structure for atoms with an atomic number greater than 20, it is possible for some atoms to become stable by losing different amounts of electrons. The five elements you just listed fall into this category and are called **multivalent ions.** For example, tin ($Sn^{2+/4+}$) can become stable by losing either 2 electrons or 4 electrons. The more common ionic charge is always listed first.

5. Consider the shapes below. They are similar to the ones you used when working on a previous worksheet. Inside each of the shapes, write all the symbols and ionic charges of the multivalent elements from the table on the previous page which that symbol could represent. Tin is done for you.



All the multivalent ions are metals. As such, they all form ionic compounds with non-metals.

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

6. Select 3 ions from the table above and any three non-metals. Use the cut-out shapes from previous classes to form stable molecules. When you have completed this, **call your teacher over to check them.** Once they are correct, write down the 3 chemical formulas in the space below:

Multivalent ion	Non-metal	Molecular formula
Ex: Sn^{4+}	Ex: N^{3-}	Sn_3N_4

Naming molecules that have multivalent ions in them is a little more complex than regular ionic bonds. Here are the names of a few molecules – some involve multivalent ions:

lithium fluoride

iron (II) fluoride

calcium oxide

aluminum sulphide

iron (III) bromide

lead (IV) nitride

7. Circle all the ionic compounds that involve multivalent ions.

8. Describe the difference between naming a regular ionic compound vs one with a multivalent ion. Be as specific as possible.

Show your work to your teacher before moving on to the next section

Challenge 2 – Polyatomic compounds

Previously, it was stated that an ion is an atom with a charge on it – either positive or negative. One or more positive ions can join with one or more negative ions in an ionic compound to make a neutral ionic compound.

It is possible for an ion to be made up of a single atom, as previously learned, or a group of atoms, which act as a single unit, and carry a charge. An ion that has more than one atom is referred to as a **polyatomic ion**.

Polyatomic ions can form ionic bonds with other ions or other polyatomic ions.

9. In your textbook, locate the section that relates to **polyatomic ions**. Copy the table of ions in the space below. Be sure to include the name, formula and ionic charge

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

10. In the space below, draw 3 shapes (similar to the cut-outs used in class) to represent 3 different polyatomic ions. You must include shapes to represent 3 different ionic charges. Also, you must include <u>at least</u> one anion (negative ion) and one cation (positive ion). Label each shape with the polyatomic ion it represents.

<u>Challenge 3 – summary</u>

Atoms form molecules in order to reach a more stable state. They do so by either transferring electrons or sharing electrons. There are many points to consider when naming molecules or writing the formulas for a molecule.

Your friend Albert says, *"all ionic compounds are made up for a metal and a non-metal. This includes compounds like Mg_3N_2 because even though there are 5 atoms in this compound, there are only 2 types of atoms – a metal and a non-metal."*

To which Marie replies, *"Albert, you can improve on your definition of ionic compounds by stating that all ionic compounds are made up of a positive ion and a negative ion".*

11. Why is Marie's definition an improvement over Albert's?

12. In the following table, there are 10 errors in either the molecular formula or name. See if you can find them all and correct them. Not all rows have an error. The first one is done for you.

1st element/ion	**2nd element/ion**	**molecular formula**	**molecular name**	**Correction**
iron Fe^{2+}	oxygen O^{2+}	FeO_2	iron (II) oxide	FeO
magnesium Mg^{2+}	fluorine F^{-}	MgF_2	magnesium fluoride	
potassium K^{+}	sulfur S^{2-}	K_2S	dipotassium monosulfide	
sodium Na^{+}	chlorate $(ClO_3)^{-}$	$Na_3(ClO)$	sodium chlorate	
beryllium Be^{2+}	iodine I^{-}	BeI_2	beryllium (II) iodide	
lead Pb^{4+}	sulfur S^{2-}	PbS_2	lead sulphide	
carbon $C^{4+/4-}$	oxygen O^{2-}	CO_2	carbon dioxide	
copper Cu^{2+}	sulfur S^{2+}	CuS	copper sulfide	
calcium Ca^{2+}	sulfate $(SO_4)^{2-}$	$Ca_2(SO_4)_2$	calcium sulphate	
iron Fe^{3+}	oxygen O^{2-}	Fe_3O_2	iron (III) oxide	
aluminum Al^{3+}	nitrate $(NO_3)^{-}$	$Al(NO_3)_3$	aluminum nitride	

13. If you can't find all the errors, use these hints:

- Circle all non-metals – all compounds with non-metals need a_____ in their name
- Put a triangle around all multivalent ions – all compounds with multivalent ions need a _____ _____ in their name to indicate which ionic charge is used
- Put a star over any polyatomic ions. If the polyatomic ion is negative (so it comes second in the formula and name), it does not end in _____, it will end in "ate" or "ite".
- Put a square around all the metals. If the compound has a metal and non-metal, the second element has the ending "ide".

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Homework

Review your notes you made on 5.7

Do page 200 #9

Read 5.9 and take notes

Do #1, 2, 5, 6, 10

Lesson 6 Gizmos!

By the end of this lesson, you will have had practice creating different molecules.

Log into your explorelearning.com account and complete the Student Exploration Sheets for the following Gizmos:

Ionic Bonds

Covalent Bonds

If you complete this, take the time to catch up on all homework.

Homework

Complete all Exploration Sheets

Study for quiz. It will be held on Lesson 8, and cover up to the end of Lesson 5

Lesson 7 Catch up!

Your teacher has several worksheets for practice related to naming and writing formulas for ionic and molecular compounds. By the end of today's lesson, you should be proficient in these skills.

Homework

Study for quiz. It will be held on Lesson 8, and cover up to the end of Lesson 5

Lesson 8 Balancing chemical reactions

QUIZ today!

By the end of this class, you will know the law of conservation of mass and be able to apply it by balancing a chemical equation.

The law of conservation of mass is very important in our understanding of the universe. It is closely related to the law of conservation of energy, which is studied in senior science courses. The law of conservation of mass states that matter cannot be created or destroyed, only rearranged. The application of this in chemistry is that, when a chemical reaction proceeds, all the atoms that are present as **reactants** are present as **products**.

Consider the reaction $Li_2S + Na_2O \rightarrow Li_2O + Na_2S$

1. How many atoms of each element are present in the reactants? In the products?

Element	Reactant	Product
Li		
S		
Na		
O		

Since there is an equal number of each type of element in the reactants and products, this chemical equation satisfies the law of conservation of mass. We can refer to this as a balanced chemical reaction.

2. Why does the following reaction not obey the law of conservation of mass:

$$Li_2O + NaCl \rightarrow LiCl + Na_2O$$

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Albert is a very astute student. He knows that all chemical reactions must obey the law of conservation of mass. So, he says, *"to fix the equation above, I would change the subscripts so that I have the same number of atoms of a particular element in the reactants as in the products – it would look like this"*

$$Li_2O + Na_2Cl \rightarrow Li_2Cl + Na_2O$$

3. Does Albert solution to satisfying the law of conservation of mass agree with other important concepts you have learned in this class? What is wrong with his solution? Be as specific as possible.

The two chemicals Li_2O and NaCl can react together, and they will form LiCl and Na_2O. When a formula is written with the correct reactants and products, but the law of conservation of mass is not obeyed, we call this a skeleton equation. The equation can also be described as unbalanced.

$Li_2O + NaCl \rightarrow LiCl + Na_2O$ is an example of a skeleton equation.

Work together to balance this equation:

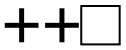
$$Li_2O + NaCl \rightarrow LiCl + Na_2O$$

To get you started, choose a symbol or a colour to represent each type of element. If you have 4 different colours (pens/pencils), use them. If not, use something like hearts, stars, squares, etc.

The reactants of the chemical equation can be represented as shown.

$$Li_2O + NaCl \rightarrow LiCl + Na_2O$$

4. Why are there 2 crosses and only 1 square drawn above?

5. What does the circle around  tell you?

6. In the space above (where the formula is given), represent what the products would be in the equation using the symbols shown in the reactants

Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Lesson 9 Balancing chemical reactions (cont.)

When balancing (or satisfying the law of conservation of mass), the key is that you can add full molecules to either the reactants or products (all the atoms inside a circle), but you cannot simply add atoms (unless you are dealing with a metal by itself).

7. Initially, how many of each atom is in the reactants? How many are in the products (consider creating a table like in question 1)?

8. Lithium is not balanced at this point. Using the shapes, add as many lithium chloride molecules to the diagram as you need to until there are equal numbers of lithium atoms on each side of the arrow. Draw a circle around each molecule you add.

9. At this point, you should be able to add one more molecule to balance the equation. Do so.

10. Is there now an equal number of each type of element in the reactants and products? This is represented by having the same number of each shape in the reactants as in the products.

A balanced chemical equation obeys the law of conservation of mass. It can be expressed by adding coefficients to a skeleton equation to make it a balanced chemical equation. These coefficients tell us how many of each molecule exists in the equation.

11. Complete the balanced chemical equation. Remember the rule about writing the number "1":

$$____Li_2O + ____NaCl \rightarrow ____LiCl + ____Na_2O$$

A chemical reaction can also be represented using a word equation. This is where the name of each molecule is used to describe the chemical reaction. No numbers are used to show how many of each molecule participates in the reaction.

12. Below, write the word equation to represent the equation you just balanced.

13. Choose any 3 pairs of ionic compounds (one compound should include a multivalent ion and another should include a polyatomic ion). Predict what you think the products would be if they reacted.

Verify #11-13 with your teacher before you proceed.

14. Balance the skeleton equation you just came up with.

Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Summary

1. What information can you get from a skeleton equation?

2. Provide an example of a skeleton equation from your text book.

3. What additional information can you get from a balanced chemical equation that you can't get from a skeleton equation?

4. Balance the skeleton equation you provided in the previous question.

5. What does a word equation represent?

Homework

Read 6.1 + 6.3

Read 6.5 + take notes

Do page 227 #1, 2, 34

Do page 232 #2, 3, 6

Do page 236 #2, 3, 4, 5, 6, 7

Lesson 10 Types of reactions

All matter is constantly in motion. Some molecules could be moving a just a little bit – jiggling side to side. Other molecules could be moving around very quickly. When two molecules collide, there is the potential for a chemical reaction to occur.

A chemical reaction occurs when the bonds that are found in the reactants are broken, and new bonds between atoms or ions form, resulting in new compounds. A bond can be broken by adding energy to a molecule or a group of molecules. When a bond forms, it releases energy.

Challenge 1 – smaller to bigger!

Consider what would happen if a molecule of hydrogen gas came in contact with oxygen gas.

1. *(on your whiteboard)* Complete the table below with drawings. You can either use symbols from the periodic table to represent elements in a compound, or shapes as has been done in previous lessons *(don't transfer this information from your whiteboard to your page until we have taken it up as a class)*

Draw a molecule of hydrogen gas and a molecule of oxygen gas floating near each other	Before:
Draw what would things look like if all the covalent bonds were broken (likely by adding a large amount of energy)	During:

When it came time to predict what would happen if a chemical reaction took place, Isaac said, *"I have two hydrogen atoms and two oxygen atoms. Each hydrogen atom can bond with a single oxygen atom."*

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

2. Using the shapes from previous lessons as a template, draw what the "molecule" that Isaac described would look like.

3. Are the molecules discussed by Isaac stable? Explain why or why not.

A possible product in this chemical reaction is water (another is hydrogen peroxide). Assume that water is formed.

4. How many water molecules can be formed with the atoms currently drawn above?

5. There should be a single oxygen atom left over. It also wants to form a water molecule. Add any materials needed to the table above, as well as #3 so that the octet rule is satisfied for all atoms.

6. *(on your whiteboard)* Write the balanced chemical equation for when oxygen gas and hydrogen gas react to form a single product. Also, write a word equation for this balanced chemical equation. Have it checked by your teacher then transfer the correct response to the space below.

Challenge 2 – bigger to smaller!

Consider what would happen if you had some molecules of mercury (II) oxide and heated it up

7. *(on your whiteboard)* Complete the table below with drawings. You can either use symbols from the periodic table to represent elements in a compound, or shapes as has been done in previous lessons.

Draw a molecule of mercury (II) oxide	Before:
Draw what would things look like if all the ionic bonds were broken (likely by adding a large amount of energy)	During:

8. Watch the video clip available on the computer in the classroom called "the decomposition of mercury (II) oxide". This video clip is also available on the class website.

When asked to predict what the products would look like if a reaction took place, Isaac commented, *"You can't have a chemical reaction. You only have one reactant!"*

Marie responded to this by saying, *"Yes you can! If you add enough energy to the mercury (II) oxide, the initial bonds will break. This will provide an opportunity for new bonds to form between any oxygen atoms. The mercury is fine by itself".*

9. Who do you agree with? Explain why.

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

10. *(on your whiteboard)* Write the balanced chemical equation for when mercury (II) oxide breaks down into 2 products. Also, write a word equation for this balanced chemical equation. Have it checked by your teacher then transfer the correct response to the space below.

Challenge 3 – Ditching one partner for another!

Consider what would happen if you had some copper metal and some silver nitrate solution.

11. Watch the video clip called "copper metal and silver solution". This video clip is also available on the class website.

12. *(on your whiteboard)* Complete the table below with drawings. You can either use symbols from the periodic table to represent elements in a compound, or shapes as has been done in previous lessons.

Draw a copper atom and a silver nitrate molecule	Before:
Draw what would things look like if the initial ionic bonds were broken (likely by adding a large amount of energy)	During:

For this scenario, it must be decided if the copper will bond with silver or nitrate. When presented with this situation, one of the two following general outlines can

be followed:

(positive ion)(negative ion) + (positive ion) → (positive ion)(negative ion) + (positive ion)

or

(positive ion)(negative ion) + (negative ion) → (positive ion)(negative ion) + (negative ion)

This can be also be shown as

(cation)(anion) + (cation) →(cation)(anion) + (cation)

or

(cation)(anion) + (anion) →(cation)(anion) + (anion)

13. Interpret what these outlines mean to you.

14. *(on your whiteboard)* Write the balanced chemical equation for when copper metal reacts with silver nitrate in solution. *(Hint: What type of metal is copper? Refer to the periodic table to predict the best charge for copper). Also, w*rite a word equation for this balanced chemical equation. Have it checked by your teacher then transfer the correct response to the space below.

Challenge 4 – Swapping partners!

Consider what would happen if you had some lead (II) nitrate and some potassium chromate (a new polyatomic ion: chromate is $(CrO_4)^{2-}$).

15. Watch the video clip “lead (II) nitrate and potassium chromate”. What evidence is there that a chemical reaction took place? This video clip is also available on the class website.

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

16. *(on your whiteboard)* Develop a general outline similar to those shown fro Challenge 3 that could help determine what the products would be if these chemicals reacted.

17. Write the word and balanced chemical equation that would represent this reaction. If you think it will help, create a table similar to those completed above to answer this question.

Word equation:

Balanced chemical equation:

Challenge 5 – summary

There are 5 main types of reactions – 4 of them are detailed above. The names of those types of reactions are listed below.

18. For each type of reaction, provide a general outline, as well as an example of balanced chemical equation other than the ones provided above.

Synthesis reaction

Decomposition reaction
Single displacement reaction
Double displacement reaction

Challenge 6 – BOOM!

19. Read section 6.9 in your textbook and takes notes on the final type of reaction – Combustion!

Your notes should include:

- Headings and subheadings, which are all underlined
- Page references
- Important diagrams
- A general outline that can be used to represent combustion
- Sample balanced chemical equations
- Should take up one side of one page, or less

Homework

Read 6.5, 6.6, 6.9

Do page 239 # 1, 2, 3

Do page 243 #1, 2

Do page 251 # 2, 3

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Lesson 11 Lab training

By the end of this lesson, you will know what is expected of you when completing different parts of a formal chemistry lab report.

Lab #1: Single Displacement Reactions

Prelab (this must be done in order to get into class to work on the lab):

1. Read the entire lab
2. Get a copy of the scrambled procedure on the moodle (unless it is provided in class). Cut it up and TAPE it in the correct order on the submission sheet.
3. Write an introductory paragraph for this lab.
4. Reread the lab. With a partner, create a data table to record your observations.

How to write an introductory paragraph for a chemistry lab

Your introductory paragraph is intended to display what you already know about the subject being investigated. The first sentence of the paragraph should state the purpose of the lab. The remainder of the paragraph should describe information that you have learned in class. You should definitely include examples (say, of chemical reactions), but they should not be examples of the exact reactions that will be observed during the lab. The paragraph should be less than half a page (typed), and should include some definitions. A skill that you will likely have to practice is how to include a definition without simply stating the word and the definition, but incorporate it into a well-written paragraph.

Here is an example of an introductory paragraph

The purpose of this lab is to investigate chemical reactions that involve combustion. Combustion, or burning, occurs when a fuel reacts with oxygen. The fuel can be one of many different types of compounds. However, the most common fuels are a group of chemicals called hydrocarbons. As the name suggests, hydrocarbons are molecules that contain only hydrogen and carbon. When a hydrocarbon reacts with oxygen, the products are carbon dioxide and water:

$$\text{Hydrocarbon} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(l)}$$

In the near future, you will be performing a lab regarding single displacement reactions. Write your introductory paragraph in the space below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Purpose: copy the following purpose on the lab sheet provided.

- To observe how different metals react with a given solution.

Materials:

- Test tube rack and 3 small test tubes
- Metals: magnesium (ribbon), copper (wire) & aluminum (foil)
- Solutions: silver nitrate, copper(II) chloride, hydrochloric acid (HCl)

Chemical Hazards:

Some of the chemicals in this lab are toxic. If you get any of these chemicals on your hands, wash it off immediately and tell your teacher. Silver nitrate can stain your hands and clothes. Dispose of all chemicals in the bin provided

Observations:

Fill in your data table

Be sure to comment about the vigour of the chemical reaction, if any. If no reaction is observable, write “NR”.

Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Procedure (tape it in order here):

Purpose:

_____

_____

Observations:

Table 1: _____

Discussion Questions:

1. For each observed chemical reaction, what evidence did you observe that indicated there was a chemical reaction?

2. For each metal (Mg, Cu and Al) write the word equation and balanced chemical equation for a reaction you observed.

Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Lab 1 Evaluation

PRELAB	• Prelab components present	0 1
	• Lab safety (goggles, use of equipment, sitting, hair, horseplay)	0 1 2
	• Preparation (late, knowledge of lab in advance, paying attention to instructions, appropriate clothing, socks, shoes, backpacks)	0 1 2
OBSERVATION	• Data table(s) complete & legible with descriptive title • Logically organized with column/row headings • Observations in point form, past tense + passive voice, spelling, grammar • Correct and complete observations	0 1 2 3 4
DISCUSSION	• Complete, correct sentences (passive voice, spelling, grammar) • Reactions complete and balanced	0 1 2 3 4 5
POSTLAB	• Workbench is left clean • Material is cleaned and returned • Chemicals are properly disposed of	0 1 2
TOTAL		/ 16

Homework

Prelab for single displacement lab

Lesson 12 Lab – Single Displacement Reactions

Complete the lab

Lesson 13 Lab review

By the end of this lesson, you will have had a chance to evaluate some lab work in order to improve your report writing skills.

Homework

Complete the prelab in order to get into class

Lesson 14 Lab – Double Displacement Reactions

Handouts will be distributed in class

Lesson 15 Acids and bases

The topic of acids and bases is a very broad one. As you progress through your studies in chemistry, you will be exposed to multiple definitions of these compounds.

The first ever definition of an acid or base is called the Arrhenius definition. It has since been revised. This definition will be used for grade 10 science and is as follows:

A base is an ionic compound that contains a hydroxide ion (OH^-). *Note: there are many exceptions to this rule.* Example: $Mg(OH)_{2\ (aq)}$ – magnesium hydroxide

An acid is a molecular compound that begins with one or more hydrogen atoms. Acids can be subdivided into two groups: oxy-acids (acids that have hydrogen bonded to a polyatomic ion) and binary acids (acids that contain 2 elements - hydrogen usually bonded to a halogen). Examples: $H_2SO_{4\ (aq)}$ – sulphuric acid (an oxy-acid) & $H_2S_{\ (aq)}$ – hydrosuphuric acid (a binary acid)

Challenge 1 – Acid Rain

1. As a group, or individually, read the text *Acid Rain*.

2. *(On your whiteboard)* Divide your white board in half. Re-read the text (or skim through it) and jot down any questions that pop into your head about chemistry or other topics mentioned.

3. *(On your whiteboard)* Select one of the several questions posed throughout the reading selection. Discuss your responses to the question as a group, and write down any summary point on your whiteboard.

4. There are 4 balanced chemical equations in the text. Copy them below and under each one:
    a. write the word equation for the reaction
    b. identify each reaction according to its type of reaction.

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Hydrochloric acid	$H_2SO_{4\ (aq)}$
Nitric acid	$HCl_{(aq)}$
Sulphuric acid	$HNO_{3\ (aq)}$
Hydrosulphuric acid	$HBr_{(aq)}$
Chloric acid	$H_2CO_{3\ (aq)}$
Hydrobromic acid	$H_2S_{(aq)}$
Carbonic acid	$HClO_{3\ (aq)}$

5. *(On your whiteboard)* Create a T-Chart with the headings binary acids and oxy-acids. Categorize the above acids (name and formula), as well as any listed in the text, into those categories. The names and formulas listed above are scrambled. You must unscramble them as you put them in your table. Have it checked by your teacher then transfer the correct response to the space below.

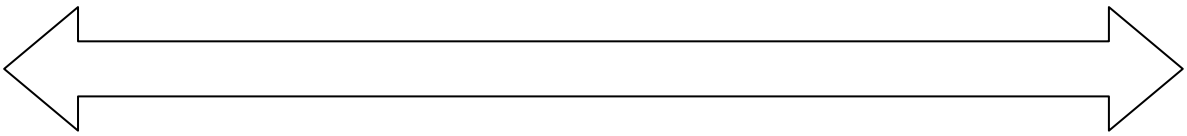
There is a significant difference in the naming of binary acids and oxy-acids, as illustrated in the text.

6. What prefix is added to the name of binary acids (like the one used in your double displacement lab) that is not found when naming oxy-acids?

Challenge 2 – the pH scale

The pH scale (power of hydrogen) is what scientists use to describe how acidic or basic a substance is. Not all substances can be described with the pH scale, only acids and bases.

7. *(On your whiteboard)* Copy the representation of the pH scale on your whiteboard, and use the word bank below to complete the diagram



Coffee	Apple	Most cleaning products	Weak base	1
Bleach	Tomato	14	Sour taste	7
Water	Bitter taste	Feels slippery	Neutral	Strong acid
Weak acid	Vinegar	Has hydrogen ion	Strong base	Has hydroxide ion

8. Have it checked by your teacher then transfer the correct response to the space below.

Summary

Write a letter to a grade 9 student who is just finished their studies in chemistry. Tell them about what they will learn in grade 10 chemistry related to acids and bases.

Homework

Acids and Bases practice sheet

Read 7.2 & 7.3 and take notes

Do page 271 #1, 2, 3, 6

Do page 275 #2, 3, 4, 5, , 7, 9

 Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Lesson 16 Neutralization

For grade 10 science, an acid is drawn as something that starts with hydrogen and a base is something that ends in hydroxide:

$HX_{(aq)}$ (X is some halogen)

$Y(OH)_{(aq)}$ (Y is some positive ion)

1. Consider a double displacement reaction, where an acid is reacted with a base. Write out the general format for the reaction if you were to use the symbols above.

You should notice that one of the products is always water.

2. Where does water fall on the pH scale? If water was written as H-OH (instead of H_2O), explain why the placement of water on the pH scale makes sense.

When an acid and base are mixed together, we call this a neutralization reaction. The products are always water and an ionic solution.

After studying a bit about neutralization reactions, Albert makes the comment that, “if I mix hydrochloric acid and sodium hydroxide, the product is just salt water, so it’s safe to drink”. **Albert is wrong!**

3. Explain why Albert is wrong by stating what else could still be in the final solution, making it unsafe to drink?

Homework

Read 7.5 & take notes

Do page 281 #1, 2, 3, 7, 8, 9, 10

Lesson 17 Indicators and society - Optional

Measuring pH

Introduction

Adapted from Chemistry.

Chemists must be able to measure the pH of the solutions they use. For preliminary pH measurements and for small volume samples, indicators are often used. For precise and continuous measurements, a pH meter is preferred.

An indicator is a weak acid or base that undergoes dissociation (separates into ions) in a known pH range. In this range the acid (or base) is a different colour. Each indicator is only useful over a pH range of approximately two units. Many different indicators are needed to span the entire pH spectrum.

Indicators are useful tools. They have certain characteristics, however, that limit their use. The listed pH values of indicators are usually given for 25˚C. At other temperatures, an indicator may change colour at a different pH. If the solution being tested has a colour of its own, the colour of the indicator may be distorted. Dissolved salts in a solution may also change the indicators dissociation. Often, these problems can be overcome by using indicator strips. An indicator strip is a piece of paper or plastic that is impregnated with the indicator. This strip is dipped into the unknown solution and compared with a colour chart. Some pH paper contains multiple indicators so that it can indicate pHs from 1 to 14.

Most chemistry laboratories have a pH meter. It is used to make rapid, accurate measurements of pH. A pH meter is a valuable instrument. In many situations it is easier to use than liquid indicators or indicator strips. Values of pH obtained with a pH meter are typically accurate to within a 0.01 pH unit of the true pH. The colour and cloudiness of the unknown solution do not affect the accuracy of the pH value obtained. Hospitals use pH meter to find small but meaningful changes of pH in blood and other bodily fluids. Sewage and industrial effluents are easily monitored with a pH meter.

Purpose

To discover for what range of pH is a given indicator useful and then use that indicator to find the pH of an unknown substance.

Name:_____ Partner 2:_____

Partner 1:_____ Partner 3:_____

Materials

Well plate

Pipette

Acids and bases or known pH values

Unknown indicator

Unknown substance (provided by the student)

pH meter

Procedure

When making colour observations, be sure to have a white background!

Use the well plate, pipette and known acids and bases to determine for what range your indicator changed colour. Record your results on your observation sheet.

You only need to use every other pH solution (for example, either use pH 1, 3, 5…13 or pH 2, 4, 6….12)

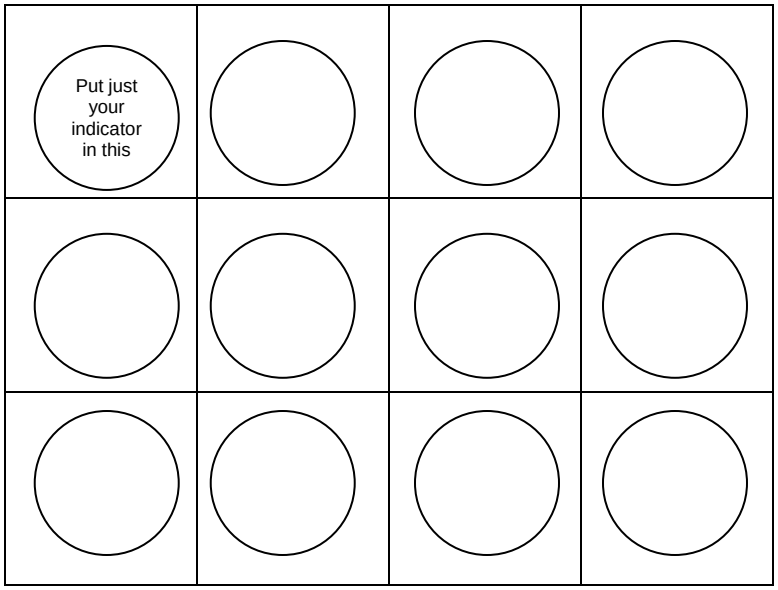
Use your indicator to determine the pH of your unknown substance. Record your results on your observation sheet.

Verify the pH of the unknown substance using the pH meter. Record your results on your observation sheet.

Observation Sheet

Name of indicator:_____

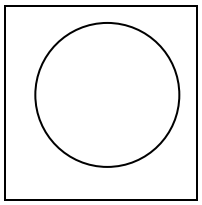
Use pencil crayons (not markers) to record your colour observations:



(This is your well plate)

What sample liquid did you test?_____

Colour of liquid when mixed with indicator.



Based on your colour observation, what is the pH (or pH range) of the liquid?_____

Use a piece of general litmus paper to get an accurate reading of the pH and record it._____