Lesson Introduction

Aim: Welcome to Chemistry

Instructional Objectives:
1) Hand out the class syllabus
2) Give books and book receipts to students
3) Determine the cause of an explosion
4) Know that Chemistry is the study of matter

Do Now
• If there was a movie created about your life which actor/actress would be cast as you?

Introduction
• Interactions of matter
• Tennis ball can explosion
• Rubber Balloon demo
• Student Surveys
  o Group work
  o Individual work

Closure
• Chemistry is the study of matter

Homework
• Bring home syllabus and have it signed
Lesson Intro Day 2

Aim: How a Candle Works

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Understand the importance of questions
2) Understand the importance of observations
3) Understand how to question everyday events

Do Now
- Describe how you would go about answering the question, “How does a candle work?”

Discussion
1. How does a candle work?
2. What are the components of a candle?
3. What does the flame of a candle look like?
   a. Different types of questions
      i. Knowledge (Recall information)
      ii. Comprehension (Organize ideas into categories)
      iii. Application (Take information you already know and apply it in a new situation)
      iv. Analysis (Break something down into its component parts)
      v. Synthesis (Engage in create and original thinking; produce original ideas and solve problems)
      vi. Evaluation (Make a judgment about something)
   b. Of these different types of questions what do #2 and 3 deal with?

Demos
1. Glass over candle (needs oxygen)
2. Light the wax
3. Light the wick
4. Put wax and wick together and light
5. Put a glass plate of the top of the flame
6. Test the middle of the flame
7. Melt wax and light it

Closure
- Why is an understanding of chemistry important?
- Why have scientists developed experimental methods?
CPA Chemistry Unit I Mathematical Introduction

Lesson #1

Aim: Units and Measurement

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Define a base unit as a defined unit in a system of measurement that is based on an object or event in the physical world
2. Define SI base units for time, length, mass, and temperature
3. Explain how adding a prefix changes a unit

Do Now / Hook
Why do we trust the time on our cell phone?
They are based on an atomic clock

Discussion
• Give examples of base units
  o Second – measured by the frequency of the radiation given off by a cesium-133 atom (find video)
  o Meter – distance that light travels in a vacuum in 1/299,792,458 of a second.
  o Mass – a kilogram weight made of platinum and iridium in France is stored under a triple bell jar vacuum system
  o Temperature – average kinetic energy of particles
  o Amount of a substance - mole

• Describe the Systeme Internationale d’Unites in terms of base units
  o Table of the base units and their units
• Prefix system
  o King Henry’s Drunken Uncle Drinks Chocolate Milk
  o Practice Problems

Closure
• How does adding a prefix change a unit?
• How do mechanics apply the SI Unit system to cars and trucks?
  o Gas Tank (gallons/litres)
  o Circuitry (watts/ampere)
  o Windshield wipers length (meters)

Text
Pg 32-35

Homework

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Lesson #2

Aim: How do scientists express numbers?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Express numbers in scientific notation
2) Perform calculations with numbers in scientific notation

Do Now
- Put Homework on Desk
- Index Card activity at lab tables (5 minutes)

Introduction
- Powers of 10 video (9 minutes)

Discussion
- $1.77 \times 10^{-10} \text{ m} =$ Radius of a Platinum atom; $4 \times 10^{-5} \text{ m} =$ Radius of a Red Blood Cell
- $1.14 \times 10^{-1} \text{ m} =$ Radius of a basketball; $6.96 \times 10^{8} \text{ m} =$ Radius of the Sun
- Scientific Notation notes and practice

Closure
Explain why scientists use scientific notation.

Text
40-43

Homework
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CPA Chemistry; Unit 1 Mathematical Introduction
Lesson #3

Aim: How do Scientists deal with Uncertainty: Instrumentation

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Define and compare accuracy and precision
2) Read an instrument to one degree of uncertainty
3) Create and analyze a set of class generated data

Do Now
• Copy objectives
• Take out HW

Introduction
• Find a “different” measuring tool to get the students interest

Discussion
• Class notes on accuracy and precision
• Brief introduction to measuring
• Students measure, generate data, input it into class data
• Analyze data; what is most accurate, precise, etc.

Closure
• Which tool is the most/least accurate/precise?

Text
• Pg 47-48

Homework
CPA Chemistry; Unit 1 Mathematical Introduction

Lesson #4

Aim: How do Scientists deal with Uncertainty: Calculation

Instructional Objectives:

At the conclusion of the lesson students will be able to:

1) Know and express the five rules of significant figures in calculated values
2) Know and express the rules for rounding numbers

Do Now

- Copy Objectives
- Take out HW

Introduction

- Today we will be looking at how to count significant digits but instead of me telling you how to do it you are going to try and come up with some rules on your own based on information I am going to give you
- Hand out worksheets and tell them to work in groups of three (20 minutes)

Discussion

- Discuss the decisions that people came up with regarding the rules
- Write them down on the computer while projecting on Smart Board
- Give them the Rules hand out and discuss similarities and differences of what they came up with to the actual
- Have students practice doing problems on the back of the sheet

Closure

Text

Pgs 50-54

Homework

- Finish up the problems on the back of the hand out
CPA Chemistry
Unit 1 Mathematical Introduction
Lesson #5

**Aim:** How do Scientists Represent Data?

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1) Create graphs to reveal patterns in data
2) Interpret graphs

**Do Now**
- Copy Objectives
- Take out HW

**Introduction**

**Discussion**
- Go through graphing problem #1 with the students step by step explaining
  - Dependent and Independent variable
  - Line of best fit

**Closure**

**Text**
Pgs 55-58

**Homework**
- Complete graphing assignment
CPA Chemistry Unit 1 Mathematical Introduction

Lesson #6

Aim: Bunsen Burner Lab

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Know all the parts of a Bunsen Burner and their function
2) Use the Bunsen burner properly
3) Adjust the various parts of the Bunsen burner for the complete combustion of the fuel

Do Now
- Copy objectives
- Take out HW

Introduction
- The purpose of the lab is to know the function of all the parts of a Bunsen burner
- The end goal is that students will be able to use a Bunsen burner efficiently.
- Go through the procedure and lite the Bunsen burner and adjust the air / fuel ratio for a complete combustion of the fuel.

Discussion
- Students will go into their lab groups and look at all the parts of a Bunsen burner
- Once that is complete students will turn the gas valve of the Bunsen burner and lite the Bunsen burner
  - Once that is complete they will adjust the air valve to get the correct proportion of fuel and air for an intense blue flame for a complete combustion
- Once fuel is burning completely students will adjust the gas valve to adjust the height of their flame
- Students must answer questions on the lab

Closure

Text
- N/A

Homework
- Complete the lab for homework following lab guidelines
CPA Chemistry
Unit 1 Mathematical Introduction
Lesson #7

**Aim:** Massing Stopper Lab

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:

1. Mass and collect data in an organized fashion by creating and putting it into a table
2. Graph the data collected manually and on a calculator
3. Interpret the graph by attempting to find the mass of two unknown stoppers

**Do Now**
- Copy objectives
- Take out HW

**Introduction**
- The purpose of the lab is to find the relationship between the stopper number and the mass of the stopper
- The end goal is to find out the mass of stopper #4 and stopper #13
- Go through the procedure highlighting creating a good data table and making sure the x and y axis are as the lab reports (max value x = 15; max value y = 120)

**Discussion**
- Students will go into their lab groups and develop a hypothesis about the relationship between stopper mass and stopper number along with the mass of the unavailable stoppers
- Once that is complete they must make a data table for the stoppers and pennies
  - Once that is complete students must check with teacher in order to start making measurements
- Once the data table is complete with measurements the students will plot a graph by hand
- Students will then graph with a calculator and find the best fit equation
- Students must answer questions on the lab
- Go through percent error with students on front board

**Closure**
- We measured the mass of different numbered stoppers, what is the relationship between the two?
- How did you find that information out?

**Text**
- N/A

**Homework**
- Complete the lab for homework following lab guidelines
CPA Chemistry; Unit 1 Mathematical Introduction

Unit #1 Review

Aim: Review Material for Unit 1

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine what they must spend time studying

Do Now
• Problem from each section in unit

Discussion
• Group work on review packet
• Students go to the front of the room and explain how they got their answers

Closure

Text
N/A

Homework
N/A

Test 10/05
Westwood High School Lesson Plans

CPA Chemistry Unit 2 Density (Chem skills) 10/9
Lesson #1

Aim: Introduction to Density

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Define density as the amount of matter packed into a given space
2) Understand that liquids separate based on their density
3) Know that density of an object is effected by temperature
4) Know that density is independent of shape or volume
5) Solve for density using basic algebra skills
6) Determine how a lava lamp works

Do Now
• Copy objectives and homework

Introduction
• Density of Solids Demo: Soda Can
  o Coke Classic, Caffeine free, Diet Coke, Diet Coke Caffeine Free
  o Place each can of soda into a large beaker/containers so students can see whether the can floats or sinks
  o Why is one can floating and the other sinking?
    ▪ One can is floating and the other is not because while they both have the same volume, one can weighs more than the other due to the sugar content, making it more dense than the other can.
  o What are some things that would contribute to the one can sinking?
    ▪ Weigh both the cans to confirm that one weighs more than the other
    ▪ Density defines how much matter is packed into a given space
• Density of Liquids Demo: Column
  o Motor oil, oil, water, antifreeze, and syrup are placed into a column
  o Why are the liquids separated into distinct layers?
    ▪ The liquids are separated into distinct layers because each liquid contains a different number of molecules packed into a given space
• Density and Temperature: Colored Hot and Cold Water
  o Why does the cold water mix with the hot water? Why does the hot water NOT mix with the cold water?
    ▪ The cold water is more dense than the hot water because the molecules are more tightly packed together.
    ▪ As objects heat up the atoms will spread out more
      • Provide other examples of heated materials becoming less dense
        o Heating a liquid to a gas

Discussion
• Transition into practice problems
Closure

- Using the principals of density we learned in class, explain how a lava lamp works. These lamps consist of the following elements:
  - A compound that makes up the floating "blobs"
  - A compound that the blobs float in
  - A lamp that illuminates the display and provides the heat necessary to move the blobs

Text

- Pg 37-38

Homework

- Finish up worksheet
Westwood High School Lesson Plans

CPA Chemistry Unit 2 Density (Chem skills)

Lesson #2

Aim: Using Volume and Mass to Determine Density

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Understand that density is a defining characteristic of a substance by plotting the mass and volume of two different liquids to find they have different slopes
2) Know how to mass a liquid using a graduated cylinder
3) Know how to read 3 different types of graduated cylinders by reading at the meniscus and making the measurement to one uncertain figure
4) Properly handle glassware and liquids in the lab
5) Apply knowledge of graphing by plotting the class data on a graph

Do Now

Introduction
- Density can be found if you know the mass and volume of a particular object
- It is found by dividing the mass by the volume
- Review how to find the volume of a solid object through water displacement
- Show diagram on board

Discussion
- Each group will be assigned a certain amount of water to be massed and the volume recorded
- They will enter the volume and mass into a spreadsheet up front and then record the data onto their own separate table and make a graph

Closure

Text
N/A

Homework
CPA Chemistry Unit 2 Density (Chem skills)

Lesson #3

**Topic:** Introduction to Density through finding the volume and mass of different objects; Day 1

**Objective:**
At the conclusion of the lesson students will be able to:
1) Understand that density is a defining characteristic of a substance by plotting the mass and volume of pennies pre and post 1983
2) Find the volume of a solid object using water displacement
3) Measure using the correct amount of significant figures
4) Measure the percent error of the class and individual measurements to assess how good lab techniques were
   a. Extra point to anyone below 3% error
5) Know that density is an intensive property by seeing that as the volume changes the density remains the same

**Materials:**
- Water
- Pre – ’83 Pennies
- Mass Balance
- Post – ’83 Pennies
- Graduated Cylinders

**Procedure:**

**Introduction**
- The previous day was spent figuring out the density of a liquid which is found by dividing the mass by volume
- Ask students how they measured the volume of the liquid
- Ask how they would measure the volume of a solid
  - Water displacement method; write notes on the board with picture of graduated cylinder
- Ask students how they will find the mass of the pennies

**Middle Phase**
- Every lab group must have a set of 3 graduated cylinders
- They must use a 50 mL graduated cylinder
- Each group will be assigned a certain # of pennies to be massed and the volume recorded
- They will enter the volume and mass into a spreadsheet up front and then record the data onto their own separate table and make a graph

**Conclusion**
- Tell the students to look at their data and make a conclusion about the density of the object as the weight increased/decreased

**Homework**
- Finish Graphs and data tables
CPA Chemistry

Unit 2 Density (Chem skills)

Lesson #3

Topic: Introduction to Density through finding the volume and mass of different objects; Day 2

Objective:
At the conclusion of the lesson students will be able to:

6) Understand that density is a defining characteristic of a substance by plotting the mass and volume of pennies pre and post 1983
7) Find the volume of a solid object using water displacement
8) Measure using the correct amount of significant figures
9) Measure the percent error of the class and individual measurements to assess how good lab techniques were
   a. Extra point to anyone below 3% error
10) Know that density is an intensive property by seeing that as the volume changes the density remains the same

Materials:

Water
Pre – ‘83 Pennies
Mass Balance
Post – ‘83 Pennies
Graduated Cylinders

Procedure:

Introduction
• The previous day was spent figuring out the density of a liquid which is found by dividing the mass by volume
• Ask students how they measured the volume of the liquid
• Ask how they would measure the volume of a solid
  o Water displacement method; write notes on the board with picture of graduated cylinder
• Ask students how they will find the mass of the pennies

Middle Phase
• Every lab group must have a set of 3 graduated cylinders
• They must use a 50 mL graduated cylinder
• Each group will be assigned a certain # of pennies to be massed and the volume recorded
• They will enter the volume and mass into a spreadsheet up front and then record the data onto their own separate table and make a graph

Conclusion
• Tell the students to look at their data and make a conclusion about the density of the object as the weight increased/decreased

Homework
• Finish Graphs and data tables
Westwood High School Lesson Plans

CPA Chemistry Unit 2 Density (Chem skills)

Lesson #4

**Topic:** Finding the Thickness of Thin Coatings Using the Properties of Density

**Objective:**
At the conclusion of the lesson students will be able to:
1) Correctly measure to three significant figures using a ruler
2) Perform a chemical reaction while satisfying the laboratory safety rules
3) Manipulate the density formula to find the height of a difficult to measure object

**Standards:**
5.1.B.2 – Show that experimental results can lead to new questions and further investigations
5.3.B.1 – When performing mathematical operations with measured quantities, express answers to reflect the degree of precision and accuracy of the input data
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

**Materials:**
6M HCl  Galvanized Steel  Bowls  Balance  Rulers

**Procedure:**

**Introduction**
- Go through and check to see if HW was completed
- Post answers online, show it on projector and have students check answers
- Go to lab tables for five minutes to go through work and try to get what they missed
- Come back to desks and go over one or two problems
- 

**Middle Phase**
- Hand out lab activity and have students read through the intro, purpose, and procedure
  Ask what galvanized steel is to check to see if they read it
- Discuss what the purpose is, have a student read it aloud
- Go through procedures and show them where the data table is and what they need to fill in
- Make sure they are all reading to 3 significant figures on the ruler
- Perform experiment; make sure each student steps away from the reaction so they are not breathing in sulfuric acid
- Once they have collected all the data students will clean up, put lab seats under the benches and return to their seats
- Go through calculations as a class
- Get the class data

**Conclusion**
- Remember to make as precise as a reading as the instrument you are using allows
- Read to the most certain number and then make a guess for the next digit

**Homework**
- Find the % error in comparison to the entire class and answer the questions on the bottom of the page
Unit #2 Review

**Topic:** Review for Density Quiz

**Objective:**
   At the conclusion of the lesson students will be able to:
   1) Do density problems without assistance
   2) Work together to figure out the problems

**Standards:**
5.3.A.1 – Reinforce indicators from previous grade level
5.3.B.1 – When performing mathematical operations with measured quantities, express answers to reflect the degree of precision and accuracy of the input data

**Materials:**
Worksheet

**Procedure:**
- **Introduction**
  - Students will go through the questions on the pre-quiz individually for 20 minutes to a half hour
  - Teacher circulates the room helping students with problems that they have tried to work

- **Middle Phase**
  - Students will go to the board and do the necessary work to get the problem done and will explain how they got their answer

- **Conclusion**
  - Make up note cards for the quiz

- **Test #2**
CPA ChemistryUnit 3 Matter and Change

Lesson #1

Topic: Matter and states of matter: Types of Changes

Objective: At the conclusion of the lesson students will be able to:
1) Know that matter is anything that has mass and takes up space
2) Distinguish Extensive and Intensive properties
3) Distinguish Physical and Chemical properties
4) Distinguish Physical and Chemical Change
5) Recognize the signs of a chemical change
6) Know that all Phase changes are Physical Changes

Standards:
5.6.A.6 – Know that many biological, chemical, and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Refer to attached hand out

Procedure:
- Introduction
  Ask students what is matter?

- Middle Phase
  Demos - Physical change and chemical change

- Conclusion
  - Go through the notes by going over the exact definition of an Physical property chemical property
  - Use Power point to go over some examples of Physical / Chemical changes
  - Have students underline or highlight the important definitions

- Homework
  - Do the practice problems on the bottom of the worksheet
  - Assign Elements and their symbols to memorize
Lesson #2

Topic: Classifying Matter: Determining the purity of a substance

Objective:
At the conclusion of the lesson students will be able to:
7) Know that matter is anything that has mass and takes up space
8) Distinguish between a pure substance and a mixture by looking at various materials placed around the room
9) Know that an element and a compound are both pure substances
10) Understand that an element cannot be broken down any further
11) Know that a compound is made up of two or more different elements
12) Recognize that a mixture is a combination of two or more substances with their individual properties remaining the same

Standards:
5.6.A.6 – Know that many biological, chemical, and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Refer to attached hand out

Procedure:

Introduction
● How would we classify this class’s location to someone on a different continent?
  ○ Go from continent to class seat with all the classifications in between
  ○ We do the same thing with matter where we can be very broad down to very specific
● The students will then receive a handout and directions to rotate to each lab table where they will classify the different items as an element, compound, or mixture
● They will do this based on their prior knowledge and will discuss amongst themselves what they think each is
● Circulate around the room to make sure everyone is on task

Middle Phase
● Tell students to go back to their seats
● On the board set up a list of element, compound, and mixture
● Ask students to raise their hands and offer up some of the elements
  ○ Ask what is similar about all of the elements. They cannot be broken down into simpler substances
● Do the same thing with compounds and mixtures going through some of the more ambiguous items such as air and brass to break the misconceptions
• Provide students with another handout which will serve as their notes on elements, compounds, and mixtures

**Conclusion**
• Go through the notes by going over the exact definition of an element, compound, and mixture
• Have students underline or highlight the important definitions

**Homework**
• Do the practice problems on the bottom of the worksheet
• Assign Elements and their symbols to memorize
CPA Chemistry Unit 3 Matter and Change
Lesson #3

Topic: Classifying Matter; Mixtures

Objective:
At the conclusion of the lesson students will be able to:
1) Know the difference between a mixture and a pure substance
2) Understand that heterogeneous mixture is composed of different types of matter
3) Classify a homogenous mixture as one that is the same throughout and know that it is also called a solution
4) Define solute and solvent

Standards:
5.6.A.6 – Know that many biological, chemical, and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Salt  Sugar  Liquids of differing density  Sulfur  Iron
Magnets

Procedure:
- Quiz on naming the Periodic Table of Elements
- Students will take 10 minutes to complete the quiz
- They will exchange their quiz with the person next to them and the teacher will give the answers from the front and they will mark up the quizzes themselves

Introduction
- Ask some of the students what they had for breakfast this morning
- Based on what they had classify each item as a compound, element, or mixture
- Have students come to the front of the room and show them sulfur and iron separate and ask them to name the specific characteristics
- Mix them together and ask whether it is a mixture or a compound
  - Separate them using a magnet and talk about how each maintains its individual properties
- Show them that when sulfur and iron are chemically combined they form pyrite
  - Has unique set of properties different than that of individual iron and sulfur

Middle Phase
- So far matter has been classified into two different categories; pure substances and mixtures
- Give definition of pure substance and show that the elements and compounds are under this specific category
- Give the definition of a mixture and a few examples
- Give the example of cereal and ask whether it is a uniform mixture or not
- Give the definition of heterogeneous mixture
  - Give the example of salt and sugar and ask whether it is a uniform mixture or not. Uniform
    - Give the definition of a homogenous mixture
    - Have them recognize that a solution is a homogenous mixture
    - Define the solute and solvent

**Conclusion**
- Draw on the board a beaker filled with one type of atom, one type of compound, multiple compounds and multiple atoms and ask students to classify each one

**Homework**
- Do the practice problems on the worksheet classifying matter and types of changes
Aim: How did the atomic theory develop?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Identify four elements of early Greeks
2) State who first proposed the idea of atoms
3) Identify 3 out of 4 statements of Dalton’s Atomic Theory
4) Describe the Thompson Atom
5) Describe the gold foil experiment
6) Describe the Rutherford atom

Do Now
• Objectives
• Homework

Introduction
• Rotate around the room and determine whether an object is an element, compound, or mixture

Discussion
• How did the Greeks classify matter?
• What is Dalton’s Atomic Theory?
• What do we call the invisible particles which make up matter?
• What did Thompson prove? Explain.
• What did Rutherford prove? Explain.
• What were failure of each of the above?

Closure
• Starting from the Greeks and ending with Bohr, summarize how we came to understand the atom.
Aim: What is the structure of an atom?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Know the location, charge, and mass of the 3 subatomic particles
2) Define mass number
3) Define atomic number
4) Interpret a chemical symbol
5) Define isotope
6) Define ion

Do Now
• Copy Objectives

Introduction
• Through experimentation we have found out that the atom breaks down into three subatomic particles

Discussion
• 25 minutes on Inquiry activity
• 10 minutes go over activity
• 10 minutes of notes
• 10 minutes of practice

Closure
• Students will perform the 1st question on the homework

Text

Homework
• Isotope worksheet
CPA Chemistry Unit 3 Matter and Change

Lesson #6

Aim: How can we navigate the periodic table?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Define atomic mass
2) Calculate relative abundance of an atom
3) Understand why the atomic mass is not a whole number
4) Distinguish between mass number and atomic mass
5) Identify the groups and periods on the periodic table
6) Know the location and characteristics of metals, non-metals, and metalloids
7) Identify diatomic elements

Do Now
• Copy Objectives

Introduction

Discussion
• Define atomic mass- the weighted average mass of the isotopes of that element

• Why are the numbers that represent that atomic mass of the element not whole numbers?
• 10 minutes of practice

Closure
• What is the difference between the mass number and atomic mass?

Homework
• Study for chapter 3 and 4 test
Test 10/28
Lesson #1
Topic: Into to Chemical Bonding and Nomenclature

Objective:
At the conclusion of the lesson students will be able to:
1) Assign charges to different ions
2) Know the difference between a cation, anion, and polyatomic ion
3) Describe ionic bonding
4) Describe covalent bonding
5) Classify bond types according to electronegativity

Standards:
5.3.A.1 – Reinforce indicators from previous grade level.
5.6.A.3 – Know that an atom’s electron arrangement, particularly the outermost electrons, determines how
the atom can interact with other atoms.
5.6.A.4 – Explain that atoms form bonds (ionic and covalent) with other atoms by transferring or sharing
electrons

Materials:
Worksheet            PowerPoint Presentation
M

Procedure:
Introduction
• Ask Why elements Bond?

Middle Phase
• Go through the notes worksheet Intro to Chemical Bonding explaining the difference between types of
  Bonds
• Explain the Octet Rule
• Explain how difference in electronegativity can be used to predict bond type
• Practice using other handout

Conclusion
• Summarize Ionic and Covalent Bonding
• Remember that all compounds want to be neutral

Homework
• Finish up the rest of the problems for HW
CPA Chemistry Unit 4 Chemical Nomenclature
Lesson #2
Topic: Into to Chemical Bonding and Nomenclature

Objective:
At the conclusion of the lesson students will be able to:
1. Assign charges to different ions
2. Know the difference between a cation, anion, and polyatomic ion
3. Correctly balance the charges on the compound by using the criss-cross method
4. Determine the symbol of an element from its name

Standards:
5.3.A.1 – Reinforce indicators from previous grade level.
5.6.A.3 – Know that an atom’s electron arrangement, particularly the outermost electrons, determines how the atom can interact with other atoms.
5.6.A.4 – Explain that atoms form bonds (ionic and covalent) with other atoms by transferring or sharing electrons

Materials:
Worksheet
PowerPoint Presentation
Comic of two headed man three headed woman

Procedure:
Introduction
- Put the comic on the front board and ask why the relationship will not work
- Write on the board $M^2W^3$ and do the criss cross method to show the method for formula writing

Middle Phase
- Go through the notes worksheet for formula writing explaining the difference between elements, diatomic molecules, compounds, and ions
- Go through the examples on bottom of sheet on how to criss cross
- Practice using other handout

Conclusion
- Remember that all compounds want to be neutral
- The reason for the criss cross is to provide a simple method of balancing the charges on the compounds

Homework
- Finish up the rest of the problems for HW
CPA Chemistry Unit 4 Chemical Nomenclature
Lesson #3

Topic: Into to Chemical Bonding and Nomenclature

Objectives:
At the conclusion of the lesson students will be able to:
1) Determine the oxidation number of a transition element based on the chemical formula
2) Determine the charge of a transition element based on the chemical formula
3) Name a type II ionic compound

Do Now
• Practice writing/naming chemical formulas
• Copy Objectives

Introduction
• Go over homework
• Work next 5 problems

Discussion
• Introduce transition metals with multiple oxidation numbers
• How can you tell the difference between MgCl$_2$ and MnCl$_2$
• Go over rules for naming with Type II ionic compounds
• Practice naming on the worksheet

Closure
• How can you tell the difference between K$_3$N, Fe$_3$N$_2$, CaCl$_2$, Ni$_2$S$_3$?

Homework
• Complete the back of the notes handout
Westwood High School Lesson Plans

CPA Chemistry Unit 4 Chemical Nomenclature
Lesson #4

Topic: Into to Chemical Bonding and Nomenclature

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Write type I formulas
2) Write type I names
3) Write type II formulas
4) Write type II names

Do Now
• Copy Objectives

Introduction
• Each students will have one minute to talk about
  o Their favorite healthy activity outside of school

Discussion
• 5 minutes reviewing how to name and write a type I formula
• 10 minutes working on Type I naming and formula writing
  o Person A will take first problem B will coach
  o Roles switch after each problem
• 5 minutes reviewing how to name and write a type II formula
• 5 minutes to go over
• 10 minutes working on Type II naming and formula writing
  o Person A will take first problem B will coach
  o Roles switch after each problem
• 5 minutes to go over

Conclusion
• Interactive Nomenclature worksheet
• Go around the room checking for understanding
• Put away nomenclature: finish for homework
• Give students the pre-lab

Homework
• Finish the worksheets for HW
Westwood High School Lesson Plans

CPA Chemistry Unit 4 Chemical Nomenclature

Lesson #5
Topic: Into to Chemical Bonding and Nomenclature

Aim: Observing the Law of Conservation of Matter

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Understand that mass is conserved in a chemical reaction
2) Understand that reactants can combine to form products
3) Know how to separate a heterogeneous mixture

Materials
Glass stirring rod  Bunsen Burner  Matches  Filter Paper  Funnel  Flask
Beaker  Pb(NO₃)₂  Na₂SO₄  Distilled Water  Wash Bottles  Ring Stands
Iron Ring  Wire Mesh  Balance  Goggles  Aprons  Bin for filter paper + beakers
Sharpie

Do Now
• Period 9 (finish by 11:37)
  o Complete questions 1 and 3 on the first page
  o Use the book on the back shelf and the front board to complete question 3
• Filtrate – liquid that has been passed through a filter
• Coagulate – to change from a liquid to a thickened mass

Introduction
• Go through the first section of the pre-lab with students

Discussion
• Procedure 1+2
  o Model up front
  o 7 minutes to complete this step
• Procedure 3+4
  o Make sure flask into beaker
  o Appx 7 minutes to complete this step
  o Answer questions while waiting to cool
• Procedure 6
  o Model filtering out a liquid from a solid using large beads of metal
  o Main point is to keep solid in beaker; filter paper is to catch any solid that might spill over
  o 10 minutes to compete
  o Label Beaker with a sharpie and put in bin
• Procedure 8
  o Evaporate all water in the flask
  o Label with masking tape; initials and period number
CPA Chemistry Unit 4 Chemical Nomenclature
Lesson #6
Topic: Into to Chemical Bonding and Nomenclature

Aim: How do scientists name Molecular compounds and Acids?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Recognize a compound as an acid when it starts with a hydrogen ion
2) Name the acid based on a set of rules where you change the name based on the suffix of the non-metal ion
3) Understand that a molecular compound consists of two non-metals
4) Know how to name a molecular compound using the prefix system

Do Now
- Copy Objectives
- Name some sour foods
  - Soda, fruits, vinegar, lemons, strawberries
- All contain acids; they were first identified by taste
- All acids have a H ion with a non-metal ion attached to the end

Discussion
- Practice naming the acids in three separate steps
  1. Determine the formula name of the compound
  2. Figure out the ending of the non-metal (ide, ate, ite)
  3. Change the ending to the appropriate acid name
- Practice figuring out the formula from the name
  1. Determine the regular formula name from the ending of the acid
  2. Assign charges to the ions and make sure they are balanced
  3. Write the balanced formula
- Using the electron dot diagram explain the difference between ionic bonding and covalent bonding
- Ask students how they would tell the difference between an ionic bond and a covalent bond.
  1. Ionic bonding -> metal + non-metal
  2. Covalent -> non-metal + non-metal
- Naming Rules worksheet
  1. Go through the example and first two problems with students

Conclusion
- Ask students what two components an acid is made up of
  - Hydrogen and a non-metal
- Ask students to explain the difference between an ionic compound and a molecular compound

Homework
- Finish the worksheets for HW
- Review Test for Unit 4 Intro to Chemical Bonding and Nomenclature
Test for Unit 4 Intro to Chemical Bonding and Nomenclature
CPA Chemistry Unit 5 Mole Concept

Lesson #1

Aim: Introducing the Mole Concept

Instructional Objectives:
At the conclusion of the lesson students will be able to:
• Understand the concept of average mass
• Explore how counting can be done by weighing
• Understand atomic mass and its experimental determination

Standards:
5.3.A.1 – Reinforce indicators from previous grade level.

Materials:
Electronic Balance, 5 different types of atoms

Do Now
• Grab a hand-out and copy down the lesson objectives

Introduction
• Lay out above objects
• Ask the question how can you count objects by weighing them

Procedure
Start the activity Counting atoms

Conclusion
• Explain that different samples contain the same number of components if the ratio of the sample masses is the same as the ratio of the masses of the individual components
• Ask the students to summarize the principle of the activity
• Convert mass of samples to # of atoms

Homework
• 5 problems for H.W
CPA Chemistry Unit 5 Mole Concept
Lesson #2

Aim: Introducing the Mole Concept

Instructional Objectives:
At the conclusion of the lesson students will be able to:
- Explain how a mole is used to count the # of particles of matter
- Relate the mole to a common everyday counting unit
- Convert between moles and # of representative particles

Standards:
5.3.A.1 – Reinforce indicators from previous grade level.

Materials:
Ream of paper pair of socks box of pens roll of coins

Do Now
- Grab a hand-out and copy down the lesson objectives

Introduction
- Lay out above objects
- Each unit has a particular # of items associated with it
- Name some other units that are familiar
  - Dozen roses, pack of cards, roll of toilet paper
- A mole is the unit that is used by scientists to count particles (Objective #1+2)

Discussion
- Def’n: The mole is an SI unit that scientists use to measure the amount of a substance
  - 1 mole = 6.02x10^{23}
    = 602000000000000000000000
  - 1 mole = 6.02x10^{23} = Avogadro’s Number
- This huge number is one of the reasons why scientific notation is very useful

  Conversion between moles and particles (Objective #3)
  - Example of roses
  - Using conversion factors
  - Moles to particles using conversion factor

Conclusion
- Ask the students what the mole is used for in science

Homework
- 5 problems for HW
CPA Chemistry Unit 5 Mole Concept

Lesson #3

Aim: Mass and the Mole

Objective:
At the conclusion of the lesson students will be able to:

- Relate the mass of an atom to the mass of a mole of atoms
- Convert between the number of moles and the mass of an element
- Convert between the # of moles and # of atoms of an element

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.5 – Explain how the Periodic Table of Elements reflects the relationship between the properties of elements and their atomic structure
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
PPT  Handout  1 mole of different elements

Introduction
- Objects
  - Roll of pennies, dimes, nickels, and quarters
  - Determine what is the same about this group of objects
  - Determine what is different about this group of objects
    - Same amount of coins
    - Differing weights
- Ideal to show the actual elements
  - 1 mol of C-atoms weighs 12 g
  - 1 mol of S-atoms weighs 32 g
  - 1 mol of U-atoms weighs 238 g
- Just as the roll of coins contains the same number of coins but has different weights...
The same goes for atoms which will have one mole of particles but will have different weights...
- The mass of 1 mol of any pure substance is called its molar mass
  - Unit is shown with the units g/mole
  - The molar mass of a substance is given to you on the periodic table

Discussion
- 1 mol of different elements will have different weights
- Go through worksheet

Conclusion
- Show the different elements and ask how many moles are in each one
- Ask what the mole represents

Homework
- Finish up the backside of the worksheet for homework
**CPA Chemistry Unit 5 Mole Concept**  
**Lesson #4**

**Aim:** Reinforcing the Mole Concept

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:

- Understand the concept of calculating Atomic radius of an atom
- Understand how to solve problems by answering a series of questions
- Understand atomic mass and its experimental determination

**Standards:**
5.3.A.1 – Reinforce indicators from previous grade level.

**Materials:**
Electronic Balance, Sample of various elements

**Do Now**

- Grab a hand-out and copy down the lesson objectives

**Introduction**

- Lay out above objects
- Ask the question how can you calculate the radius of an atom

**Procedure**
Start the activity finding radius of an atom

**Conclusion**

- Explain how to solve problems in a flexible, creative way based on the understanding the fundamental idea of chemistry, this approach is called Conceptual problem solving
- Ask the students to summarize the principle of the activity
- Convert mass of samples to # of atoms

**Homework**

- Review for mole concept quiz
Lesson #5

Aim: % Composition and Formula Mass

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Explain what is meant by the percent composition of a compound
2) Calculate the formula mass for different compounds
3) Determine the percent composition of a compound

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.5 – Explain how the Periodic Table of Elements reflects the relationship between the properties of elements and their atomic structure
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Worksheet

Introduction
• Ask students to figure out the percentage of guys and girls in the classroom
• Write it on the board as they count
• Highlight the fact that they are dividing the part into the whole
• Example of MgO
  o The whole in this case is the formula mass
• Example of MgCl₂

Discussion
• Students will practice writing the formula mass of compounds in groups of two
• Once complete go back to example of MgO and MgCl₂ and figure out the % composition of each element
  o After giving them two examples have them go back into groups of two in order to work on finding the % composition of the elements on the back

Conclusion
• Figure out the % composition of students wearing watches

Homework
• Finish the rest of the worksheet for HW
CPA Chemistry Unit 5 Mole Concept
Lesson #6

Aim: The law of definite composition

Instructional Objectives:
   At the conclusion of the lesson students will be able to:
   1) Know the law of definite composition that states a compound is composed of elements that combine in a definite or fixed mass ratio
   2) Apply knowledge of the law to specific problems

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Worksheet

Introduction
   • Law of definite composition
   • Ratio of the class to ratio of a different class in school

Middle Phase
   • Go through example problem with the students
   • Break up into groups to do the next problem

Conclusion
   • In your own words write down what the law of definite composition states

Homework
   • Finish up the worksheet for HW
CPA Chemistry Unit 5 Mole Concept
Lesson #7

Aim: % composition of a Chlorate Lab

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine an unknown chlorate by finding the % composition of oxygen
2) Use good lab practices to get a good percent error

Standards:
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Refer to Lab handout for materials

Introduction
• The other day I was working in the back and I mixed up some chemicals. I have it narrowed down to two different chemicals and I put them in containers in the back in order for us to figure out what they are.
  o One chemical is KClO₃ and the other is NaClO₃

Discussion
• Students go through the lab

Conclusion
• The class will collect the data as a whole and determine whether they did well as a class and check to see if any of the points need to be discarded

Homework
• Finish up the lab and the questions
CPA Chemistry Unit 5 Mole Concept

Lesson #8

Aim: % Composition Quiz

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Complete the unknown chlorate lab
2) Show knowledge of % composition and the law of definite composition by taking a quiz

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Chlorate Lab  Quiz

Do Now
• Calculate the % of NO₃ in
  o MgNO₃
  o Ba(NO₃)₂

Introduction
• Review what happened in lab

Discussion
• Go through calculations
• Discuss percent error and the reasons for error in the lab

Transition to quiz
• Find the % composition of C₆H₁₂O₆.
• If 11 g of C react, how many grams of compound will there be?
• How many grams of O will be made using 28 g of C?
  o Go over

Conclusion
• Students will take quiz
**CPA Chemistry Unit 5 Mole Concept**  
**Lesson #9**

**Aim:** Empirical and Molecular Formulas

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1) Point out the difference between a molecular and empirical formula
2) Determine the empirical formula for a compound from the mass percent and actual mass data

**Standards:**
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.5 – Explain how the Periodic Table of Elements reflects the relationship between the properties of elements and their atomic structure
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

**Materials:**
Worksheet

**Introduction**
- Percent to mass; Mass to mole; Divide by small; Multiply ‘til whole
- Have students apply this rhyme to
  - 43.6% phosphorus and 56.4% oxygen
  - Percent to mass:
  - Mass to mole:
  - Divide by small:
  - Multiply ‘til whole:

**Middle Phase**
- Steps to calculate E.F.
  - Take the mass or % for every element, divide it by molar mass, carry division out to at least 5 figures
  - Divide all answers for step 1 by the smallest of them
  - Answers in 2 should be small whole numbers. These are the subscripts
  - If any of the answers from 2 are .5 then multiply them all by 2, these are the subscripts
- Work on empirical formula problems while teacher circulates
- Go over law of definite composition HW

**Conclusion**
- Work problems on board
Aim: Empirical Formula Lab

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine the empirical formula of MgO
2) Demonstrate good lab procedures

Standards:
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Crucible  Magnesium strips  Steel wool  burners

Introduction
• Have students read through the background information and purpose of the lab
• Model the proper set up of the lab equipment
• Show them where materials are located

Discussion
• Students will work on lab procedure

Conclusion
• Work on the questions together as a class

Homework
• Finish lab assignment and questions
CPA Chemistry Unit 5 Mole Concept
Lesson #11

Aim: Molecular and Empirical Formulas

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Define molecular formula.
2) Determine the molecular formula from the empirical formula and the molecular weight.

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.5 – Explain how the Periodic Table of Elements reflects the relationship between the properties of elements and their atomic structure
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Handout

Do Now
1. Take out Homework and Labs
2. Copy Notes
   - Steps to calculate E.F.
     - Take the mass or % for every element, divide it by molar mass, carry division out to at least 5 figures
     - Divide all answers for step 1 by the smallest of them
     - Answers in 2 should be small whole numbers. These are the subscripts
     - If any of the answers from 2 are .5 then multiply them all by 2, these are the subscripts
3. If a compound has 40% S and 60% O what is the empirical formula?
4. A compound contains 66% calcium and 34% phosphorus

Introduction
- Hand back quizzes (students working Do Now)
- Questions for quiz
- Ask if anyone needs to go through any of the homework problems

Discussion
Molecular Formula: this is the true formula of the compound. It is either the EF or some multiple higher

<table>
<thead>
<tr>
<th>EF</th>
<th>MF</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH₂O</td>
<td>CH₂O, C₂H₄O₂, C₃H₆O₃</td>
</tr>
<tr>
<td>HO</td>
<td>HO, H₂O₂, H₃O₃</td>
</tr>
</tbody>
</table>
Westwood High School Lesson Plans

| CH₄ | CH₄, C₂H₄, C₃H₁₂ |

To find the MF:

1. Calculate the EF
2. Calculate the mass of EF
3. \( \frac{\text{Given mass in the problem}}{\text{EF mass}} \)
4. Answer to 3 multiplied into every subscript in EF

Example;
A compound is 11% H and 89% O and its mass is 72 g/mole. What is the MF?

\[
\begin{align*}
H &= \frac{11}{1} = \frac{11}{5.5625} = 2 \\
O &= \frac{89}{16} = \frac{5.5625}{5.5625} = 1
\end{align*}
\]

Step 1: EF = H₂O
Step 2: H = 2x1 = 2
\[
O = 16x1 = 16
\]
FM: 18g
Step 3: 72/18 = 4
Step 4: MF = H₂O *₄ = H₈O₄

- Go through hand out with students
- Do first two problems of determining EF
  - Students finish up rest on their own
- Go through problems 1 and 2 with them and have them work on the rest for homework

**Conclusion**
- Empirical formula: a compound shows the simplest whole number ratio for the elements in the compounds
- Molecular formula: this is the true formula of the compound. It is either the EF or some multiple higher
CPA Chemistry Unit 5 Mole Concept
Lesson #12

Aim: Hydrates

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Define hydrate
2) Determine the formula of a hydrate through % composition

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.5 – Explain how the Periodic Table of Elements reflects the relationship between the properties of elements and their atomic structure
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Dried Fruit  Fruit  Hydrate  Bunsen Burner

Do Now
• Take out Homework

Introduction
• Dried and regular fruit
  o What is the difference between the two?
• Demo of heating a hydrate
  o What is taking place?
    ▪ The color of the substance is changing
  o Why is that happening?
    ▪ The compound no longer has water molecules attached to it

Discussion
• Notes

Hydrate: a compound that has a specific number of water molecules bound to its atoms.

Naming Hydrates
• The water attached is signified by a dot that follows the formula of the anhydride.
• The number that comes before the water molecule tells how many waters are attached
• Naming convention

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>Mono-</td>
<td>1</td>
</tr>
<tr>
<td>Di-</td>
<td>2</td>
</tr>
</tbody>
</table>
Analyzing a hydrate (example problems)

What is the percentage of water found in CaCl$_2$$\bullet$2H$_2$O?

A 6.0 gram sample of a hydrate of CaCl$_2$ was heated, and 2.6 grams of the anhydrous salt remained. What percentage of water was in the hydrate?

A mass of 2.50 g of blue, hydrated copper sulfate (CuSO$_4$$\bullet$xH$_2$O) is placed in a crucible and heated. After heating there is 1.59 grams of the anhydrous salt (CuSO$_4$) left. What is $x$ and the name of this compound?

- Worksheet has practice problems

Conclusion
- By definition, what must a compound have in order to be a hydrate?
- What are the two different components of a hydrate?
  - What are their names?

Homework
- Finish the backside of the worksheet on Molecular formula practice
**Westwood High School Lesson Plans**

**CPA Chemistry Unit 5 Mole Concept**

**Lesson #13**

**Aim:** Moles of Compounds

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1) Determine the molar mass of a compound
2) Solve mole to mass problems
3) Solve mass to mole problems
4) Solve particle to mole problems

**Standards:**
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

**Materials:**
Worksheet

**Procedure:**

**Do Now**
1. Find the molar mass of AgNO₃.
2. Find the formula mass of Ammonium nitrate.
3. Find the molar mass of dinitrogen pentoxide

**Introduction**
- Show mole of different compounds at front of the room

**Discussion**
- Practice problems together
- Individual work
- Group work

**Conclusion**
- This is the same process of converting from moles to grams/particles as we did with single atoms
  - Only difference is we use the formula/molar mass of the compound

**Homework**
- Finish the Review sheet for the mole test
Test
**CPA Chemistry Unit 6 Chemical Reactions**  
**Lesson #1**

**Aim:** Balancing Reactions

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1) Define a reactant  
2) Define a product  
3) Determine the correct coefficients for a chemical reaction  
4) Identify Types of Chemical Reactions

**Standards:**
5.3.A.1 – Reinforce indicators from previous grade level  
5.4.C.1 – Apply mathematical models that describe physical phenomena to predict real world events  
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

**Materials:**
Various Chemicals  
Worksheets

**Do Now**
- Go to the back of the room and grab a worksheet

**Introduction**
Demos showing different types of chemical reactions

**Discussion**
- Guided practice (Sheet 1)  
- Practice (Sheet 2, 3)
  - Notes  
  - Transition into practice using actual equations

**Conclusion**
- Discuss the difference between reactants and products, coefficients and subscripts  
- Discuss clues to identify the different types of Chemical Reactions

**Homework**
- Finish the backside of the worksheet on types of chemical reactions
CPA Chemistry Unit 6 Chemical Reactions

Lesson #2

Aim: Equation Writing, Balancing and Identifying Chemical Reactions

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Review writing formulas and naming
2) Write a complete chemical equation from the word equation
3) Balance a reaction using the correct coefficients
4) Identify the type of Chemical Reaction

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.4.C.1 – Apply mathematical models that describe physical phenomena to predict real world events
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

Do Now
• Take out Homework
• Copy Objectives

Introduction
• Go over homework

Discussion
• Writing Skeleton chemical equations
• Balance Chemical Equations
• Identifying Chemical Equations

Conclusion
• Go over Practice equations with students

Homework
Finish the Practice Equation writing and balancing worksheet
CPA Chemistry Unit 6 Chemical Reactions

Lesson #3

**Aim:** Review Equation Writing and Balancing Reactions + Quiz

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1) Review writing formulas and naming
2) Write a complete reaction from the formula
3) Balance a reaction using the correct coefficients

**Standards:**
5.3.A.1 – Reinforce indicators from previous grade level
5.4.C.1 – Apply mathematical models that describe physical phenomena to predict real world events
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

**Do Now**
- Take out Homework
- Copy Objectives

**Introduction**
- Go over homework

**Discussion**
- Review writing equations
  - Go over
- Take quiz

**Conclusion**
- Go over quiz with students
CPA Chemistry Unit 6 Chemical Reactions

Lesson #4

Aim: Double Replacement Reactions

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Write the products for a double replacement reaction
2. Know when a reaction will occur based on the possible products it will form
3. Know the three criteria a product of double replacement reaction should meet for the reaction to go to completion

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.4.C.1 – Apply mathematical models that describe physical phenomena to predict real world events
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

Do Now
- Copy Objectives
- What is the difference between a chemical and physical change?
  - The identity of an element doesn’t change in a physical change
  - In a chemical change the atoms in the reaction are rearranged to form a different substance

Introduction
- Demonstration of double-replacement reactions (10 minutes)
  - Water product (Acid/Base Reaction)
    - HCH₃COOₐq + KOHₐq → CH₃COOKₐq + H₂O(l)
  - Precipitate product
    - BaCl₂ₐq + K₂CO₃ₐq → BaCO₃₃(s) + 2KClₐq
    - 2NaOHₐq + CuCl₂ₐq → 2NaClₐq + Cu(OH)₂₃(s)
  - Gas product
    - HCl + NaHCO₃ → NaCl + H₂O + CO₂

Discussion
- Notes
- Work on problems

Conclusion
- Go over problems

Homework
Finish the Practice double displacement reaction worksheet
Westwood High School Lesson Plans

CPA Chemistry Unit 6 Chemical Reactions

Lesson #5
Lesson Review after break

Aim: Review after break

Instructional Objectives:
At the conclusion of the lesson students will be able to:
4. Write the products for a double replacement reaction
5. Know when a reaction will occur based on the possible products it will form
6. Know the three criteria a product of double replacement reaction should meet for the reaction to go to completion

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.4.C.1 – Apply mathematical models that describe physical phenomena to predict real world events
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

Do Now
- Copy Objectives
- What is the difference between a chemical and physical change?
  - The identity of an element doesn’t change in a physical change
  - In a chemical change the atoms in the reaction are rearranged to form a different substance

Introduction
- Demonstration of double-replacement reactions
  - Water product (Acid/Base Reaction)
    ▪ HCH₃COO⁻(aq) + KOH(aq) → CH₃COOK(aq) + H₂O(l)
  - Precipitate product
    ▪ BaCl₂(aq) + K₂CO₃(aq) → BaCO₃(s) + 2KCl(aq)
    ▪ 2NaOH(aq) + CuCl₂(aq) → 2NaCl(aq) + Cu(OH)₂(s)
  - Gas product
    ▪ HCl + NaHCO₃ → NaCl + H₂O + CO₂

Discussion
- Notes
- Work on problems

Conclusion
- Go over problems

Homework
Finish the Practice double displacement reaction worksheet

**CPA Chemistry Unit 6 Chemical Reactions**

**Lesson #6**

**Aim:** observing and grouping Double Replacement Reactions lab

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
7. Write the products for a double replacement reaction
8. Know when a reaction will occur based on the possible products it will form
9. Know the three criteria a product of double replacement reaction should meet for the reaction to go to completion

**Standards:**
5.3.A.1 – Reinforce indicators from previous grade level
5.4.C.1 – Apply mathematical models that describe physical phenomena to predict real world events
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

**Introduction**
Students will perform various double displacement reactions
Based on their observations students will group different double displacement reactions into three categories
  o Water product (Acid/Base Reaction)
  o Precipitate product
  o Gas product

**Discussion**
  • Compare results with the class

**Conclusion**

**Homework**
Finish the observing and grouping double displacement reaction lab
CPA Chemistry Unit 6 Chemical Reactions

Lesson #7

Aim: Single Replacement and the Activity Series

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine when one metal will replace another in a single replacement reaction
2) Determine when one nonmetal will replace another nonmetal in a single replacement reaction
3) Understand and use the Activity series and predict if a single replacement reaction will go to completion

Standards:

Materials:
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/redox/home.html
Worksheet
Index Cards

Do Now

- Take out homework
- Quiz on 5 double replacement reactions

Introduction

- How do we know when one element will replace another in a single replacement reaction?
  o Who has more “machismo”? Ex: Two guys going after one girl...
  o Demos showing Single replacement Reactions

Discussion

- We find this out by experimenting
  o Go to website and place index cards on the board
- Go through one by one until we have correctly placed the index cards
- Pass out the activity series hand out and the worksheet
- Go through numbers 1-7 together
- Work on 8-12 individually
  o Go over

Conclusion

- What does it mean to be on top of the activity series?
- How do we know when one element will replace another in a single replacement reaction?

Homework
• Complete the back of the worksheet for HW
Westwood High School Lesson Plans

CPA Chemistry Unit 6 Chemical Reactions

Lesson #8

Aim: Predicting Products

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine the type of reaction that will take place by looking at the reactants
2) Predict the products of a chemical reaction
3) Predict the products of a chemical reaction
4) Predict the products of a decomposition and combination Reactions
5) Balance an equation

Standards:

Materials:
Worksheets

Do Now
● Take a worksheet from the back and begin working on 1-11
● This is a review and people will be putting up their answers after 10 minutes

Introduction
● Look at the other side of the worksheet and go through a few with the class

Discussion
● Have students come up with the notes on how to go through a predicting products question
● Break students up into groups of four and have them work on the questions together
● With ten minutes left in class, go through a few of the answers to make sure everyone is on the same page

Conclusion
● What is useful about coming up with a method on how to do things?
● What step is the most difficult in a predicting product questions?

Homework
● Do questions 12-18 on the other side of the page
CPA Chemistry Unit 6 Chemical Reactions

Lesson 9

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Review concepts of
   a. Balancing
   b. Identifying reaction type
   c. Single and Double Replacement reactions

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.4.C.1 – Apply mathematical models that describe physical phenomena to predict real world events
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

Materials:
Worksheet

Introduction
• Looking at the science of Skiing vs Snowboarding
  o Who has the upper hand?

Discussion
• Balancing reactions from formula names
• Review on board the 5 different types of reactions and ID previous reactions
• Single replacement reaction
• Double Replacement reactions

Conclusion
• Exit Slip
• Test Equations
CPA Chemistry Unit 7 Chemical Quantities
Lesson #1

Aim: Introduction to Stoichiometry with Smores

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Describe the types of relationships indicated by a balanced chemical equation
2) State the mole ratios from a balanced chemical equation

Standards:
5.1.A.1 – When making decisions, evaluate conclusions, weight evidence, and recognize that arguments may not have equal merit
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

Materials:
Worksheet  Microwaves  Graham crackers (3 boxes per 2 classes)
Marshmallows (2 bags per 2 classes)  Chocolate (6 pack per 2 classes)

Do Now
• Go over Mole Concept Review

Introduction
• Hand out worksheet and have students write out the equation using words
  o Any chemical equation reads exactly like a recipe
• Fill in reactants and products table

Discussion
• What do the coefficients in a chemical reaction represent?
• What is the ratio of chocolates to smores?
• What is the ratio of Half grams to smores?
  This is called the mole ratio and is very important in figuring out how much product will come from a certain amount of reactant
• 2 KClO₃ → 2 KCl + 3 O₂
• How many moles of O₂ will be produced if you have 2 moles of KClO₃?
• 4 mole of KClO₃? 35 moles KCl?
• Go through worksheet with students
• Individual practice on the back
Conclusion
- How do you begin a stoichiometry problem when you have a balanced equation?
- How do you begin a stoichiometry problem when you don’t have a balanced equation?

Homework
- Reaction Stoichiometry Mole – Mole Problems Worksheet
CPA Chemistry Unit 7 Chemical Quantities

Lesson #2
Aim: Mole to Mole Relationships in Stoichiometry

Stoichiometry: mole to gram, gram to gram

Instructinal Objectives:
At the conclusion of the lesson students will be able to:
1) Define a mole-to-mole ratio
2) Solve mole-to-mole stoichiometric problems
3) Perform mole to gram stoichiometry calculations
4) Calculate gram to gram stoichiometry problems

Standards:
5.1.A.1 – When making decisions, evaluate conclusions, weight evidence, and recognize that arguments may not have equal merit
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds
5.6.B.1 – Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst

Materials:
Worksheet

Do Now
• Given the following equation: 2 KClO₃ → 2 KCl + 3 O₂
• How many moles of O₂ can be produced by letting 12.00 moles of KClO₃ react?
• Check hw; Go over

Introduction
• PPT presentation

Discussion
• Do a problem with students on handout
• Have them try to do it individually
  ○ Go over
• Do 3 practice problems (guided practice)
• Have students work on the problems on the back of the worksheet for classwork

Conclusion
• Talk about the different types of stoichiometry problems they may see and how to solve them

Homework
• Practice problems on handout
**CPA Chemistry Unit 7 Chemical Quantities**

**Lesson #3 Stoichiometry**

**Aim:** To find the Mole / Mole Ratio in a Chemical Reaction of Fe and CuSO$_4$

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1) Theoretically and experimentally determine the mass of one product in a reaction
2) Determine the important information that must be recorded to achieve the goal of the lab
3) Find the percent error of an experiment

**Standards:**
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

**Materials:**
See lab hand out

**Do Now**
- Answer Pre Lab question

**Introduction**
- How can you determine which reaction takes place?
  a) Fe + CuSO$_4$ → FeSO$_4$ + Cu
  b) 2Fe + 3CuSO$_4$ → Fe$_2$(SO$_4$)$_3$ + 3Cu

  o How will you determine if it is Fe II or Fe III?
  o How can you separate Cu and CuSO$_4$ solution and FeSO$_4$ solution?

**Discussion**
- Creating a Data Table Example
- Create a data table
- Do lab

**Conclusion**
Place your collected and filtered Cu Ppt in the oven for drying
Lesson7-4 Stoichiometry Lab

Aim: Stoichiometry Quiz

Instructional Objectives:
At the conclusion of the lesson students will be able to:
3) Complete the unknown chlorate lab
4) Show knowledge of the concept of Stoichiometry by taking a quiz

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Stoichiometry Lab  Quiz

Do Now
- Calculate the mass of water produced in the following chemical reaction
- $2\text{HCl} + \text{Mg(OH)}_2 \rightarrow 2 \text{H}_2\text{O} + \text{MgCl}_2$
- 10 grams

Introduction
- Review what happened in lab

Discussion
- Go through calculations
- Discuss percent error and the reasons for error in the lab

Transition to quiz
- Find the mass of $\text{CO}_2$ produced in the combustion of 10 grams $\text{C}_6\text{H}_{12}\text{O}_6$.
  $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
- How many grams of $\text{O}_2$ will be needed for the above reaction?
  - Go over

Conclusion
- Students will take quiz
Lesson Midterm Review 1/24 - 1/25

**Aim:** Midterm Review

**Topic:** Midterm Review

**Objective:**
- At the conclusion of the lesson students will be able to:
  1) Take the midterm

**Standards:**

**Materials:**
Review Packet

**Procedure:**
- Work on Review Packet
CPA Chemistry Unit 7 Chemical Quantities

Lesson 7-5
Aim: How do you determine which reactant is limiting?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine the limiting reactant of a reactions
2) Define limiting and excess reactant
3) Perform a stoichiometry problem using the correct reactant

Standards:
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:

Do Now
• Find the number of moles in 5 g of salt, NaCl, and 5 g of sugar, C₆H₁₂O₆.

Introduction
• Smore Ingredients on front table
  o How do I know which of the reactants is the limiting reactant?
  o How can you determine which reactants are in excess?
• Formation of a Precipitate Lead(II) Iodide video.
  o I have 10 g of Pb(NO₃)₂ and 10 g of KI

Discussion
• Step by step of determining the limiting reactant with example
• Individual practice
• Group Practice

• Put all steps together to solve a limiting problem

Conclusion
• Complete a limiting problem and hand in before leaving classroom

Homework
• Practice problems on handout
CPA Chemistry Unit 7 Chemical Quantities

Lesson 7-6 Limiting Reactant lab
Aim: To find the effect of a limiting reactant on the amount of product produced in a chemical reaction

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine the limiting reactant in a chemical reaction
2) Determine how the limiting reactant determines the amount of product produced in a chemical reaction
3) Theoretically and experimentally determine the mass of one product in a reaction
4) Find the percent error of an experiment

Standards:
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
See lab hand out

Do Now
• Answer Pre Lab question

Introduction
• How can you determine which reactant is limiting?
  \[
  \text{Pb(NO}_3\text{)}_2 + \text{NaI} \rightarrow \text{PbI}_2 + \text{NaNO}_3
  \]
  o How will you determine the mass of the PbI\textsubscript{2} PPT?
  o How can you separate NaNO\textsubscript{3} and PbI\textsubscript{2} from the solution?

Discussion
• Creating a Data Table Example
• Create a data table
• Do lab

Conclusion
Place your collected and filtered PbI\textsubscript{2} ppt in the oven for drying

Homework
• Practice problems on handout
CPA Chemistry Unit 7 Chemical Quantities

Lesson 7-7 Limiting reactant lab
Aim: Limiting Reactant Quiz

Instructional Objectives:
At the conclusion of the lesson students will be able to:
5) Complete the Limiting reactant lab
6) Show knowledge of Limiting Reactant by taking a quiz

Standards:
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Limiting Reactant Lab Quiz

Do Now
• Calculate the Mass of water produced in the following reaction
  o 2HCl + Mg(OH)₂ → 2 H₂O + MgCl₂
  10 grams 10 grams

Introduction
• Review what happened in lab

Discussion
• Go through calculations
• Discuss percent error and the reasons for error in the lab

Transition to quiz
• Find the % yield of PbI₂ by calculating the theoretical mass of PbI₂ produced

Conclusion
• Students will take quiz
Aim: What are some factors that cause air pressure?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Explain the cause for air pressure
2) Predict the changes of pressure with changes in altitude
3) Predict the changes of pressure with change in water content
4) Describe an instrument for measuring air pressure

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Do Now
- Copy objectives

Introduction
- Imploding soda can demo
- Why does the can implode?
- Why does water rush into the can?

Discussion
- What is air?
  - Mixture of variety of different gases
- What does air consist of?
  - 78% - N₂  20% - O₂  1% - Noble Gases  0.03% - CO₂  0.97% H₂O
- Why do people say that cold weather in New Jersey is worse than cold weather in Colorado when the thermometer reads the same temperature?
  - Humidity
  - Water content in air varies considerable
  - Humid and rainy days have lower pressure than dry days because the water replaces the N₂
    - H₂O mass = 18
    - N₂ mass = 28
- Why is it useful to measure the weight of air? Who could this information help?
  - It can help us determine what type of weather we could have
- What type of instruments are used to measure the weight of air?
  - Barometer (Show video) (Diagram)
- How would an increase in air pressure effect the barometer?
  - An increase in air pressure raises the height of the Hg in the column
  - A decrease in air pressure lowers the height of the Hg in the column
- Why does the height of Hg decrease as we go up in elevation?
Less air pressure at higher elevations because there are less air molecules
As we increase elevation the air pressure decreases

- Units of measuring pressure
  - Practice problems

**Conclusion**
- Explain why the can was crushed.

**Homework**
- Practice problems on handout
CPA Chemistry Unit 8 Gases
Lesson #8-2

Aim: How is the pressure of a gas affected by volume at constant temperature?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Mathematically develop the relationship between pressure and volume of a gas
2) State Boyle’s Law
3) Explain that volume and pressure are inversely related
4) Use Boyle’s law to solve problems

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Do Now
• Copy Objectives
• Take out homework

Introduction
• Relationship of the volume and pressure of a gas
• Go through the introduction of the lab

Discussion
• Guide students through the use of Vernier equipment

Conclusion
• Write up
  o Cover Page; Purpose; Procedure; Data Table; Questions

Homework
• Complete the Lab write up
CPA Chemistry Unit 8 Gases

Lesson #8-3

Aim: How is the volume of a gas affected by pressure?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) State Boyle’s Law.
2) Use Boyle’s Law to solve problems.
3) State Charles’ Law
4) Use Charles Law to solve problems

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Marshmallow, Syringe, ivory soap, regular soap, microwave

Do Now
• Students will put hw problems on the board

Introduction
• Show students what happens when you pull the syringe back (marshmallow expands) and push syringe in (contracts)
  ○ Discuss
• Show the difference between ivory soap and regular soap in a beaker of water
• Put the ivory soap in the microwave

Discussion
• Go through notes on gas laws and do problems
• Students work problems by themselves
• Go over

Conclusion
• What is Boyle’s Law?
• What is Charles’ Law?

Homework
• Practice Problems handout
CPA Chemistry Unit 8 Gases

Lesson #8-4

**Aim:** How is the pressure of a gas affected by temperature at constant volume?

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
5) Mathematically develop the relationship between pressure and temperature of a gas
6) State Guy Lussac’s Law
7) Explain that temperature and pressure are directly proportional to each other
8) Use Guy Lussac’s law to solve problems

**Standards:**
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

**Do Now**
- Copy Objectives
- Take out homework

**Introduction**
- Relationship of the Temperature and pressure of a gas
- Go through the introduction of the lab

**Discussion**
- Guide students through the use of Vernier equipment

**Conclusion**
- Write up
  - Cover Page; Purpose; Procedure; Data Table; Questions

**Homework**
- Complete the Lab write up
- Practice Problems Handout
CPA Chemistry Unit 8 Gases

Lesson #8-5

**Aim:** How is the volume of a gas determined at STP conditions?

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:

1) Explain that all 3 laws are special cases of combined law and can be derived from combined gas law
2) Solve problems using combined gas law
3) Determine the Volume of a gas at STP conditions using the Combined gas law

**Standards:**
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

**Materials/Activities:**
Balloon in ice video; Nerf rocket

**Do Now**
- Students will be chosen to show their work on the document camera and explain how they did the homework problem

**Introduction**
- Show the nerf rocket demo
  - Discuss
- Show the video on what happens to a balloon when it is placed in ice
  - Discuss
- Put in notes section “examples”

**Discussion**
- Show powerpoint to get notes for Gay-Lussac’s Law and combined gas law
- Go through example problems
- Have students work on the problems
- Go over

**Conclusion**
- List all of the laws we covered and go over the description and the formula

**Homework**
- Practice Problems Handout
** CPA Chemistry Unit 8 Gases

**Lesson #8-6**

**Aim:** How is the behavior of gases explained?

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1) Describe the motion of gas particles
2) State the Kinetic Molecular Theory
3) Explain Boyle’s and Charles’ Laws using the Kinetic Molecular Theory
4) Cite proof for each part of the Kinetic Molecular Theory
5) Know the difference between ideal and real gases

**Standards:**
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

**Materials/Activities:**
Absolute zero video; vernier equipment

**Do Now**
- Question about absolute zero

**Introduction**
- Video on absolute zero
- Vernier Lab Demo for gay lussac’s law
  - Questions

**Discussion**
- Powerpoint on Kinetic Molecular Theory
- Work on problems

**Conclusion**
- Show Ghostbuster’s video and ask students how they would properly handle the Stay Puft Marshmallow man
CPA Chemistry Unit 8 Gases
Lesson #8-7
Topic Review  Gas Laws

Objective:
At the conclusion of the lesson students will be able to:
1. Take a quiz the following class period

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under curious physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet
Challenge problem on nitroglycerin

Do Now
• Take homework out

Introduction
• Show video on Nitroglycerin explosions and explain that a tremendous amount of gas is released during this reaction
• Be sure to let me know when 10 minutes are left in the class so you can work the challenge problem

Discussion
• In groups of two
• Pick a Law (Boyle, Charles, Guy)
  o Review how to do it
  o Practice problems
• Combined gas Law
  o Review how to do it
  o Practice problems
• Kinetic molecular theory
  o Postulates of The K.M.T
  o Implications of K.M.T

Conclusion
• Put the nitroglycerin problem on the board with the last 10 minutes left in class and allow students to work on it.

Homework
• Study for the Gas Law Test
• Test
CPA Chemistry Unit 8 Gases

Lesson #8-8
Aim: Avogadro’s Law

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. State Avogadro’s law; *as you increase the amount of gas in a balloon the volume increases*
2. State Avogadro’s law; Equal Volumes of gas contain Equal Molecules at constant Temperature and Pressure
3. Know that in one mole of a gas there is 22.4 L at STP

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under carious physical circumstances, such as heating or cooling

Materials/Activities:
Water Electrolysis Demo using Hoffman’s Apparatus

Do Now
- Copy objectives

Introduction
- How can you tell which of the two gases will be hydrogen in the electrolysis of water?

Discussion
- Get notes on Avogadro’s law
- Do problems

Conclusion
- Finish up Chart counting molecules, moles, volume and masses

Homework
- Problems using Avogadro’s Law 1 mole of any gas = 22.4 Liters @ STP
CPA Chemistry Unit 8 Gases
Lesson #8-8

Aim: Molar Volume of a gas Lab

Instructional Objectives:
At the conclusion of the lesson students will be able to:
3) Determine the Density of four different gases
4) Determine the molar mass of four gases using their molar volumes

Standards:
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Four different gases    Vacuum pump    Graduated Cylinders    Flasks

Introduction
• Have students read through the background information and purpose of the lab
• Model the proper set up of the lab equipment
• Show them where materials are located

Discussion
• Students will work on lab procedure

Conclusion
• Work on the questions together as a class

Homework
• Finish lab assignment and questions
Aim: Ideal (universal) Gas Law

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Derive the ideal gas law’s formula
2. Know that 1 mole of any gas is equal to 22.4 L
3. Use the ideal gas law to solve problems
4. Know the three assumptions about Ideal Gases
5. Know the Universal gas law constant R and its Value

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under carious physical circumstances, such as heating or cooling

Materials/Activities:
Ideal Gas Law animation
PowerPoint
22.4 L box

Do Now
- Take out homework
- Copy objectives

Introduction
- Trying to find out how much air is in a bicycle tire

Discussion
- Hand out guided notes for powerpoint
- Go through powerpoint with students having them take down the example problems
- Do few problems with them on the practice worksheet
- Have students work on problems in groups of two

Conclusion
- Put a problem on the board that the students must do on a half piece of paper and hand it in as they exit the classroom
HW
- Finish additional practice worksheet for homework
CPA Chemistry Unit 8 Gases
Lesson #8-10

Aim: Value of R Lab

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine the Value of universal gas law constant R in torr
2) Determine the volume of a gas collected over water
3) Understand and Define Dalton’s law of partial pressures

Standards:
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Magnesium strip Conc HCl eudiometer tube Beaker

Introduction
• Have students read through the background information and purpose of the lab
• Model the proper set up of the lab equipment
• Show them where materials are located

Discussion
• Students will work on lab procedure

Conclusion
• Work on the questions together as a class

Homework
• Finish lab assignment and questions
CPA Chemistry Unit 8 Gases
Lesson #8-11
Aim: Gas Stoichiometry

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Know that the volume to volume stoichiometry problems are based on the ratios of the substances in the formula
2. Perform volume to volume gas stoich problems
3. Perform mass to volume and volume to mass gas stoich problems

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Video on nitroglycerin
Worksheets

Do Now
• Check homework; go over with the person next to you

Introduction
• Show video on Nitroglycerin explosions and explain that a tremendous amount of gas is released during this reaction
• At the end of class you will have to determine how much gas is actually released

Discussion
• Go through the worksheet with the students
  o Give notes
  o Go through problems; independent practice

Conclusion
• Put the nitroglycerin problem on the board with the last 10 minutes left in class and allow students to work on it.
• When liquid nitrogen, C₃H₅(NO₃)₃, explodes, the products are carbon dioxide, nitrogen, oxygen, and water vapor. If 500 g of nitroglycerin explode what is the total volume, at STP, for all gases produced?

HW
• Finish sheet worked on in class for extra practice
Westwood High School Lesson Plans

Took 2 days to go through

CPA Chemistry Unit 8 Gases
Lesson #8-12

Aim: Gas Stoichiometry

Instructional Objectives:
At the conclusion of the lesson students will be able to:

4. Know that the volume to volume stoichiometry problems are based on the ratios of the substances in the formula
5. Perform volume to volume gas stoich problems
6. Perform mass to volume and volume to mass gas stoich problems

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Video on nitroglycerin
Worksheets

Do Now
• Check homework; go over with the person next to you

Introduction
• Show video on Nitroglycerin explosions and explain that a tremendous amount of gas is released during this reaction
• At the end of class you will have to determine how much gas is actually released

Discussion
• Go through the worksheet with the students
  o Give notes
  o Go through problems; independent practice

Conclusion
• Put the nitroglycerin problem on the board with the last 10 minutes left in class and allow students to work on it.
• When liquid nitrogen, C3H5(NO3)3, explodes, the products are carbon dioxide, nitrogen, oxygen, and water vapor. If 500 g of nitroglycerin explode what is the total volume, at STP, for all gases produced?

HW
• Finish sheet worked on in class for extra practice
CPA Chemistry Unit 8 Gases
Lesson #8-13

Topic: Gas Review 2

Objective:
At the conclusion of the lesson students will be able to:
2. Take a Test the following class period

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet
Challenge problem on nitroglycerin

Do Now
• Take homework out

Introduction
• Show video on Nitroglycerin explosions and explain that a tremendous amount of gas is released during this reaction
• Be sure to let me know when 10 minutes are left in the class so you can work the challenge problem

Discussion
• In groups of two
• Avogadro’s Law
  o Review how to do it
  o Practice problems
• Ideal Gas Law
  o Review how to do it
  o Practice problems
• Gas Stoich
  o Review how to do it
  o Practice problems

Conclusion
• Put the nitroglycerin problem on the board with the last 10 minutes left in class and allow students to work on it.

Homework
• Study for gas Stoichiometry Test
• Test
Westwood High School Lesson Plans

CPA Chemistry Unit 9 Thermochemistry
Lesson #9-1

Aim: What is heat and how is heat transfer measured?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Know the difference between heat and temperature
2. Define and identify an exothermic reaction
3. Define and identify an endothermic reaction
4. Know factors that affect the amount of heat transferred

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Hot packs, ice packs, straw, thermometer, t-shirt

Introduction
• Demonstration of different thermochromic objects

Discussion
• Heat – total energy of the molecule
• Temperature – average kinetic energy of the molecule (how fast the molecules are moving)

<table>
<thead>
<tr>
<th>Exothermic</th>
<th>Endothermic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat out</td>
<td>Heat In</td>
</tr>
<tr>
<td>Energy Diagram</td>
<td>Energy Diagram</td>
</tr>
<tr>
<td>• Energy Released</td>
<td>• Energy is absorbed</td>
</tr>
<tr>
<td>• Products have less stored energy than reactants</td>
<td>• Products have more stored energy than reactants</td>
</tr>
<tr>
<td>• Generally, the beaker feels warmer after the reaction is over</td>
<td>• Need to add heat; beaker feels cooler</td>
</tr>
<tr>
<td>• Heat is being given off</td>
<td>• Instant cold pack- $H_2O + NH_4NO_3$</td>
</tr>
<tr>
<td>• Heat Pack = Fe + O$_2$ -&gt; Fe$_2$O$_3$</td>
<td>• Decomposition reactions</td>
</tr>
<tr>
<td>• Reusable instant hot pack – super saturated NaNO$_3$</td>
<td>• Melting</td>
</tr>
<tr>
<td>• Combustion reaction</td>
<td>• Vaporization</td>
</tr>
<tr>
<td>• Synthesis reaction</td>
<td>• Condensing</td>
</tr>
</tbody>
</table>
| • Freezing | • Heat as $\Delta H$
  o 2Ag + Cl$_2$ -> 2AgCl $\Delta H$=-254kJ |
| • Heat as $\Delta H$ | • Heat as a term in an reaction |
| • Heat as a term in an reaction | $2AgCl$ -> 2Ag + Cl$_2$ $\Delta H$=+254kJ |

Heat as $\Delta H$
- If 85 g of Ag react, how much heat will be released?

- Ex: \(2H_2 + O_2 \rightarrow 2H_2O\) \(\Delta H= -572kJ\)
If 900 kJ are released, what mass of \(H_2O\) will be produced?
CPA Chemistry Unit 9 Thermochemistry
Lesson #9-2

Aim: Why do some substances get hotter quicker than others?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Know the definition of specific heat
2. Describe why certain objects heat up faster than others and relate it to specific heat
3. Develop the heat equation
4. Apply the heat equation to solve problems

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet

Introduction
• A trip to Long Beach Island; describe the amount of heat the asphalt, sand, and water have

Discussion
• Low CP = Substance heats up and cools down quickly
  o Ex; metals = .1 J/(g K) to 2 J/(g K)
• Units of heat:
  o Joule (J) or kiloJoule (kJ)
  o Calorie (cal) or kcal
• High CP = H2O = 4.18 J/(g K) or 1 cal (g K)
• Asphalt – has a very low Cp because it is heated up by noon
• Sand – has a higher Cp than the asphalt, takes longer to heat up, has a medium Cp
• Water – has a very high Cp which means it’s pretty cold
  o At night, the water doesn’t change temperature, the weather gets cooler which makes it seem that the water is warmer
• Ex; How much heat is needed to raise the temp of 75g of Fe from 21°C to 76°C?

q= m · ΔT · Cp

Homework
• Finish specific heat worksheet
Aim: Investigating the Fuels lab

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Determine the energy released from various fuels as they burn
2) Compare the heat of combustion for various fuels
   3) Compare the heat of combustion for various fuels and find the best fuel

Standards:
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Temperature probe    soda can    candle    alcohol burner
Peanuts              utility clamp  ring stand butane lighter

Introduction
• Have students read through the background information and purpose of the lab
• Model the proper set up of the lab equipment
• Show them where materials are located

Discussion
• Students will work on lab procedure

Conclusion
• Work on the questions together as a class

Homework
• Finish lab assignment and questions
CPA Chemistry Unit 9 Thermochemistry
Lesson #9-05
Aim: Heating in Different Phases

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Understand when to use heat of fusion and heat of vaporization in calculations
2. Know the difference between a phase change and temperature change
3. Know how to calculate heating in different phases

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet
Procedure:

<table>
<thead>
<tr>
<th>Temperature Change</th>
<th>Phase Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Q = m \times \Delta T \times C_p )</td>
<td>( Q = m \times H_{\text{vaporization}} )</td>
</tr>
<tr>
<td>Cp will be different based on if it’s a solid, liquid, or gas</td>
<td>Liq → gas or gas → liq</td>
</tr>
<tr>
<td>Graph pointing to the temp change section</td>
<td>( Q = m \times H_{\text{fusion}} )</td>
</tr>
<tr>
<td></td>
<td>Solid → liquid or liquid → solid</td>
</tr>
<tr>
<td></td>
<td>No temperature change</td>
</tr>
</tbody>
</table>

Graph pointing to the phase change section

- Do back of the Phase Diagram and Temp/Energy Graph problems
- Putting it all together; other worksheet

Heating in Different Phases
1. Draw a heating graph
2. Label where the energy is absorbed or released with Q
3. Determine the correct Q equation to use based on location on the graph
4. Solve for individual Q
5. Find the total Q
- Do handout

HW
- Finish sheet worked on in class for extra practice
CPA Chemistry Unit 9 Thermochemistry
Lesson #9-06

Aim: Calorimetry

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Know the definition of calorimetry
2. Describe a practical calorimeter and how it works
3. Do a calorimetry problem
4. Apply knowledge of calorimetry to a lab

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under curious physical circumstances, such as heating or cooling

Materials/Activities:
Unknown Metals Lab

Introduction
• We have two unknown metals that we need to identify

Discussion
• Definition – science of determining the heat of chemical reactions or physical changes
• Determining the specific heat of a substance by using a calorimeter
• Calorimeter – Styrofoam cup. It holds the heat very well. Doesn’t give away heat
• Heat
  o \( H = m \cdot \Delta T \cdot Cp \)
  o \( H_{water} = m \cdot \Delta T \cdot Cp \)
  o \( H_{metal} = m \cdot \Delta T \cdot Cp \)

• 57 g of an unknown metal @ 99°C is dropped into 107 g \( H_2O \) @ 23°C. The temp of the water and the metal rises to 25°C. What is the \( Cp \) of the metal?

Conclusion
• Work on the questions together as a class

Homework
• Finish lab assignment and questions
**CPA Chemistry Unit 9 Thermochemistry**

**Lesson #9-6**

**Aim:** Phase Changes and Phase diagram

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1. Know all the different phase changes
2. Read and identify phases on a phase change diagram
3. Know where the triple point, critical point are located on the graph
4. Understand how the phase of a substance can be changed by changing the pressure, temp or both

**Standards:**
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

**Materials/Activities:**
Worksheet
PPT
Demos: water boiling in a vacuum

**Procedure:**
Go through ppt while students take notes
Give follow up worksheet for class work/homework to reinforce concepts

**What students need to know**
Read a temperature/energy graph
   - Label solid, liquid, gas
   - Label phase change
   - Know where kinetic and potential energy are increasing

Read a phase change diagram
   - Label solid, liquid, gas
   - Label triple point, critical temperature
   - Understand concept of inc/dec pressure and the phase change that takes place
   - Understand concept of inc/dec temperature and the phase change that takes place

**Discussion**
Discuss how concept of pressure cooking – speeds up cooking and reduces cooking time

**Homework**
Finish worksheet

**Review**
Test
CPA Chemistry Unit 9 Thermochemistry

Lesson #9-7
Aim: Calculating the Heat of Reaction

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Define and identify an exothermic reaction
2. Define and identify an endothermic reaction
3. Identify the energy diagram that corresponds with an endo or exothermic reaction
4. Calculate the change in enthalpy of a chemical reaction by manipulating a set of equations and applying the Hess law of heat summation

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet

Introduction
• Studying heat in chemistry means we also need to study the heat released or gained during chemical reactions
  Picture on PPT

Discussion
• Go through the worksheet with the students
  o Give notes
    Go through problems; independent practice

Homework
• Finish hess law worksheet
CPA Chemistry Unit 9 Thermochemistry

Lesson #9-8 2days lab

Aim: Hess Law Lab

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Combine equations for three reactions to obtain the equation for the fourth reaction
2) Calculate the heat of reaction, ΔH for all four reactions
3) Use a Calorimeter to measure the temperature change in each of the reactions
4) Use the results to confirm Hess’s Law

Standards:
5.1.C.1 – Understand, evaluate and practice safe procedures for conducting science investigations
5.3.A.1 – Reinforce indicators from previous grade level
5.6.A.7 – Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds

Materials:
Magnesium strip 1M HCl solution MgO Powder Beaker
Thermometer Styrofoam cups Balance

Introduction
• Have students read through the background information and purpose of the lab
• Model the proper set up of the lab equipment
• Show them where materials are located

Discussion
• Students will work on lab procedure

Conclusion
• Work on the questions together as a class

Homework
• Finish lab assignment and questions
CPA Chemistry Unit 9 Thermochemistry
Lesson #9-10

Topic: Calculating the Heat of Reaction

Objective:
At the conclusion of the lesson students will be able to:
1. Understand that the formation of a compound either gains or loses heat energy
2. Write formation reactions for compounds and use the provided table to look up heat of formation of the compounds
3. Combine equations for formation reactions to obtain target equation and ΔH for the target equation

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under curious physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet

Procedure:
Introduction
• Studying heat in chemistry means we also need to study the heat released or gained during chemical reactions
• Each substance will have a Standard Enthalpy (Heat) of Formation
  o Standard Enthalpy (Heat) of Formation – the change in enthalpy (heat) that accompanies the formation of one mole of the compound in its standard state
• Where do standard heats of formation come from?
  o When you look at the height of a mountain it is based off a reference point; sea level
  o Our reference point are the elements which have a ΔH = 0 kJ
  o Picture on PPT

Middle Phase
• How to Calculate ΔH
  1. Write formation reaction for compounds
  2. Look up the ΔH of all compounds in the reaction
  3. Remember that the ΔH of formation for all elements is 0
  4. Combine equations for formation reactions to obtain target equation and ΔH for the target equation

Discussion
• Go through the worksheet with the students
  o Give notes
    Go through problems; independent practice
Homework
- Finish Worksheet

CPA Chemistry Unit 9 Thermochemistry
Lesson #9-11
Aim: Calculating the Heat of Reaction

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Understand Hess Law
2. Apply the short cut of Hess law of summation to calculate the heat of a reaction

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet

Introduction
- Studying heat in chemistry means we also need to study the heat released or gained during chemical reactions
- Each substance will have a Standard Enthalpy (Heat) of Formation
  - Standard Enthalpy (Heat) of Formation – the change in enthalpy (heat) that accompanies the formation of one mole of the compound in its standard state
- Where do standard heats of formation come from?
  - When you look at the height of a mountain it is based off a reference point; sea level
  - Our reference point are the elements which have a \( \Delta H = 0 \text{ kJ} \)
  - Picture on PPT

Discussion
- How to Calculate \( \Delta H \)
  - \( \Delta H = \Delta H_{\text{products}} - \Delta H_{\text{reactants}} \)
  3. Look up the \( \Delta H \) of all compounds in the reaction
  4. Remember that the \( \Delta H \) of all elements is 0
  5. Multiply each coefficient times the \( \Delta H \) that you just looked up
  6. \( \Delta H = \text{products} - \text{reactants} \)

Ex: \( 2\text{Cu} + S \rightarrow \text{Cu}_2S \) \( \Delta H = -79.5 \text{ kJ} \)
2(0kJ) + 1(0kJ) --> 1(79.5kJ)
0 + 0 --> -79.5kJ
Westwood High School Lesson Plans

\[ P - R \]
\[ (-79.5 \text{kJ}) - 0\text{kJ} \]
\[ \Delta H = -79.5\text{kJ} \]

**Hess’s Law**

The \( \Delta H \) of a reaction is always the same no matter how many steps it takes to get to the products.

If you do the reactions at once it releases 300 kJ, now do the reaction in 5 little steps that makes the same products and all of their \( \Delta H \) will add up to -300kJ

- Go through the worksheet with the students
  - Give notes
  - Go through problems; independent practice

**Homework**

- Finish hess law worksheet

Hess Law quiz
Aim: To understand the process of dissolving?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Understand the process of dissolving
2. Learn why certain components dissolve in water

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:

Procedure:
Introduction
Define solubility by using examples from daily life – Saline solution, Salt water, Koolaid
Do a demo of dissolving salt in water and also dissolving food coloring in water.
Both dissolve in water hence are soluble in water.
Do a demo of dissolving food coloring in hexane and it sinks to the bottom and does not dissolve.
Do a demo of dissolving Iodine crystals in water and also in Hexane. Iodine is insoluble in water but soluble in Hexane.
Show the immiscibility of water and hexane
Explain that a solution
SOLUTIONS
Definition: homogeneous mixture of 2 or more substances
Explain why water is polar and Hexane is nonpolar
Explain that “Like dissolves Like”

Do a demo with packing materials made up of polystyrene and starch

Conclusion
http://www.youtube.com/watch?v=Sg5ed8Lfr08

Homework
Section 15-1 review questions
CPA Chemistry Unit 10 Solutions
Lesson #10-2
Aim: What are the different components of a solution?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Define solute
2. Define solvent
3. Compare how two relate to one another in a coffee solution
4. Define unsaturated and give an example
5. Define saturated
6. Define supersaturated

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:

Procedure:
Introduction
Different ways of brewing coffee: Have you ever been to the store and they asked you if you would like your coffee ground or whole beans?
Have you ever thought about why they ask you that?
Different coffee makers brew coffee differently
1. Percolator
2. Regular Drip
3. Espresso
4. French Press

All the methods are different ways of creating a solution that is drinkable. Each method will provide a unique taste because it will come into contact with the coffee bean in a different manner.

Just like scientists have to take a look at things differently and try new things we should be doing the same thing in our everyday life. Look at things differently, ask questions.

SOLUTIONS
Definition: homogeneous mixture of 2 or more substances
- Made up of a solute and a solvent
- Solute – the substance getting dissolved. Ex; salt, sugar, coffee
- Solvent – the substance doing the dissolving. Ex; water
  o Solute and solvent can be any state of matter
- **Types of solutions**
  - Unsaturated – more solute can dissolve
  - Saturated – no more solute will dissolve at this temperature
  - Supersaturated – contains more dissolved solute than a saturated solution at the same temperature

**Do a demo of a supersaturated solution**

- How to make this type of solution:
  1. Heat up an already saturated solution
  2. Add more solute
  3. Cool it down
- It will be very unstable and the solute will come out of solution very easily in the form of crystallization

**Conclusion**

[http://www.youtube.com/watch?v=Sg5ed8LfR08](http://www.youtube.com/watch?v=Sg5ed8LfR08)

Chocolatiers take this chocolate and form it into what you buy from stores. If you like dark chocolate you can find different percentages of cocoa in the bars.

Is chocolate a solution?
If it is what is the solute and what is the solvent?

**Homework**

Solubility worksheet
**CPA Chemistry Unit 10 Solutions**  
**Lesson #10-3**

**Aim:** How to read a solubility curve

**Instructional Objectives:**
At the conclusion of the lesson students will be able to:
1. Read a solubility curve
2. Determine the mass of solute that will dissolve in 100 g of water at different temperatures
3. Determine if a given amount of solute will create a saturated or unsaturated solution
4. Predict changes of solubility with changes in temperature

**Standards:**
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations  
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies  
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

**Materials/Activities:**
PPT  
Worksheet

**Procedure:**
Go through powerpoint to provide examples on how to read the solubility chart  
Students will work on hand out to interact with the material

**Homework:**
Solubility problems worksheet
Lesson Lab

Aim: To make a graph of Solubility of KNO₃ at different temperatures

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Determine the solubility curve of KNO₃

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
1000 ml Beaker, test tube, test tube holder, thermometer, KNO₃, rubber stopper

Procedure:
Introduction
- Have students read through the background information and purpose of the lab
- Model the proper set up of the lab equipment
- Show them where materials are located

Discussion
- Students will work on lab procedure

Conclusion
- Work on the questions together as a class

Homework
- Finish lab assignment and questions
Westwood High School Lesson Plans

**CPA Chemistry Unit 10 Solutions**  
**Lesson #10-5**  
**Aim:** What is the concentration of a solution?

**Instructional Objectives:**  
At the conclusion of the lesson students will be able to:
1. Define Molarity (M)  
2. Perform molarity problems  
3. Calculate the concentration of a solution.  
4. Describe how to make a solution of known concentration  
5. Describe how to make a solution of a known concentration by diluting a stock solution

**Standards:**  
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations  
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies  
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

**Materials/Activities:**  
Volumetric flasks  
Salt

**Introduction**  
Show two different brews of tea at the front of the room, one clearly darker than the other  
Why is one darker than the other?  
*One has a higher concentration of tea dissolved into the water; water is the solvent and tea is the solute*

**Discussion**  
Molarity: \[
\text{Molarity} = \frac{\text{moles solute}}{\text{total solution (1 L)}}
\]
Ex: What is the molarity of a solution that has a 50 g C₆H₁₂O₆ dissolved to a total volume of 200 mL?  
\[
50 \text{ g} \times \frac{1 \text{ mole}}{180 \text{ g}} = \frac{.28 \text{ moles}}{200 \text{ mL}} = \frac{x}{1000 \text{ mL}}; \quad = 1.4 \text{ M}
\]

How would you prepare 400 mL of 2.9 M glucose solution?  
\[
\frac{2.9 \text{ moles}}{1000 \text{ mL}} = \frac{x}{400 \text{ mL}}; \quad 1.16 \text{ moles} \times \frac{180 \text{ g}}{1 \text{ mole}} = 209 \text{ g}
\]

Mass out 209 g of glucose, put it into a volumetric flask and fill it to the 400 mL line.  
Activity: Each lab table will create a solution of salt or sugar with a certain molarity using a volumetric flask

<table>
<thead>
<tr>
<th>Lab Group</th>
<th>Solution</th>
<th>Mass Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
They must create the solution and write how they found their answer on the board

**Homework:**

Molarity and dilution problems
Westwood High School Lesson Plans

CPA Chemistry Unit 10 Solutions
Lesson #10-6
Aim: What are the colligative properties of a solution?

Instructional Objective:
At the conclusion of the lesson students will be able to:
1. Define molality
2. Do problems with molality
3. Know how the boiling point and freezing point change as a result of added solute
4. Explain why salt is put down on the roads in winter
5. Various other concentration terms

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under curious physical circumstances, such as heating or cooling

Materials/Activities:
Volumetric flasks
Salt

Introduction
Why do we use salt on roads in the winter?

Discussion
\[
\text{Molality} = \frac{\text{moles of solute}}{1 \text{ kg (1000 g) of water}}
\]

Ex; what is the molality of a solution that contains 46.6 g of AgNO\(_3\) in 300 g of water?

\[
46.6 \text{ g} \times \frac{1 \text{ mole}}{170 \text{ g}} = \frac{.27 \text{ moles}}{300 \text{ g}} = \frac{x}{1000 \text{ g}} = .9 \text{ m}
\]

How would you prepare a 7 m solution of AgNO\(_3\) and we will have a 5.6 kg of H\(_2\)O?

\[
\frac{7 \text{ moles AgNO}_3}{1 \text{ kg } H_2O} = \frac{x}{5.6 \text{ kg}}; \quad 39.2 \text{ moles } \times \frac{170 \text{ g}}{1 \text{ mole}} = 6660 \text{ g}
\]

Colligative Properties of Solutions
Properties of a solution that change based on how much solute you put in. The more you put in the more it changes.

- Boiling Point Elevation
- Freezing Point Depression

\[ \Delta t = (m)(i)(K_f) \]

- \( m \) = molality
- \( i \) = # of moles that the solute dissociates into
- \( K_f \) = boiling point or freezing point) constant

Ex: What is the new b.p. of a 3.7 m solution of sodium chloride (an electrolyte)?

\[ \Delta t = (m)(i)(K_f) \]
\[ \Delta t = (3.7)(2)(.52) \]
\[ = 3.85^\circ C \]

b.p. = 103.85°C

What would be the f.p. if 57 g of MgCl\(_2\) (electrolyte) is dissolved in .8 kg of water?

\[ \frac{57 \text{ g}}{68 \text{ kg}} = \frac{x}{1 \text{ kg}} \]
\[ 71.25 \text{ g x} \frac{1 \text{ mole}}{95 \text{ g}} = .75m \]

\[ \Delta t = (m)(i)(K_f) \]
\[ = (.75m)(3)(-1.88^\circ C) \]

f.p. = -4.2°C

What is the new b.p. of a 110g of C\(_6\)H\(_{12}\)O\(_6\) dissolved in 2,500 g of H\(_2\)O?

**Homework:**

Freezing point depression problems and boiling point elevation problems
CPA Chemistry Unit 10 Solutions
Lesson #10-7
Aim: Solutions and net ionic reactions

Instructional Objectives:
1. Demonstrate knowledge of solution Stoichiometry including strong, weak and non electrolytes.
2. know the different parts of a solution, how they can influence a solution’s properties
3. Demonstrate knowledge of solution Stoichiometry including Strong, & weak and non electrolytes.
4. Calculate the Molarity of unknown solutions and ions in the solution

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under curious physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet, distilled water and various electrolytes and nonelectrolytes

Procedure:
Demonstrations – Conductivity of soluble Ionic compds
   Electrolytes/ Non Electrolytes
   Weak and strong Electrolytes

Homework
Worksheet compounds in aqueous solutions
CPA Chemistry Unit 10 Solutions

Lesson #10-8

Aim: Solutions and net ionic reactions

Learning Objectives:

Students will be able to:
1. Apply memorized solubility rules in writing precipitation reactions
2. Write the Overall Ionic equations and Net Ionic equations for Double Displacement Reactions
3. Find the amounts of reactants and products
4. Perform calculations involving limiting reactants.
5. Identify and explain the changes in precipitation

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under carious physical circumstances, such as heating or cooling

Materials/Activities:
Worksheet, Solution power point

Procedure:

Solution Power point lecture

Homework

Compounds in aqueous solution worksheet
Molarity of ions in solutions worksheet

Test
CPA Chemistry Unit 11 Chemical Kinetics / Equilibrium

Lesson #11-1 & 2

Aim: How can we change the rate of a chemical reaction?

Main Ideas: Collision theory is the key to understanding why some reactions are faster than others. Factors such as reactivity, concentration, temperature, surface area, and catalysts affect the rate of a chemical reaction.

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Define reaction rates
2. Define an effective collision
3. Explain reactions in terms of collision theory
4. Define activated complex
5. Define activation energy
6. List 5 factors which influence a reaction rate

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:

Procedure:
Introduction
- Chemical kinetics – The area of chemistry that is concerned with reaction rates and reaction mechanisms
- The reaction rate of a chemical reaction is stated as the change in concentration of a reactant or product per unit of time.
  - Collision Theory – Atoms, ions, and molecules must collide in order to react
1. **Effective Collision** – particles must collide while favorably oriented and with enough energy to form new molecule
2. **Ineffective Collision** – two reasons why a collision may fail
   a. The collision is not energetic enough to supply the required energy
   b. The colliding molecules are not oriented in a way that allows them to react

- **Collision Theory Summary**
  1. Reacting substances (atoms, ions, or molecules) must collide
  2. Reacting substances must collide in the correct orientation
  3. Reaction substances must collide with sufficient energy to form an activated complex

- **Activated complex** - is a temporary, unstable arrangement of atoms in which old bonds are breaking and new bonds are forming.
- **Activation Energy** – the minimum energy required to transform the reactants into an activated complex
  1. Fill in the reaction pathways for forward and reverse reactions

- **5 factors that influence a reaction rate**
  1. Nature of Reactants
     a. Depends on the nature of the reactants and how easily their bonds break and reform
     - Copper and Zinc metal in silver nitrate demo
  2. Surface Area
     a. The reactions can only occur when the two substances come in contact with each other.
     b. An increase in surface area increases the rate of reaction
     - Starting a fire you must use kindling instead of a huge log
- Blowing powder into Bunsen burner (ask Nikki what she used)

3. Temperature
   a. Increasing temperature increases the average kinetic energy of the particles in a substance.
   b. Increases the amount of collisions taking place as well as the energy of the collisions
   c. Higher temperatures will increase the reaction rate

4. Concentration
   a. An increase in the concentration of one or more of the reactants will increase the reaction rate

5. Presence of a catalyst
   a. Reaction rate will increase in the presence of a catalyst

![Image of energy of reaction diagram]

Homework
Worksheet with multiple choice questions

Key
**Aim:** How does Energy change in a chemical reaction?

**Main Idea:** The reaction rate law is an experimentally determined mathematical relationship that relates the speed of a reaction to the concentrations of the reactants.

**Instructional Objectives:**

At the conclusion of the lesson students will be able to:

1. Define rate law
2. Define specific rate constant
3. Define reaction order
4. Define method of initial rates
5. Express the relationship between reaction rate and concentration
6. Determine reaction orders using the method of initial rates

**Standards:**

5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations

5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies

5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under curious physical circumstances, such as heating or cooling

**Materials/Activities:**

**Procedure:**

Do Now

- Take out homework to be checked and reviewed

**Introduction to Reaction Rate Laws**

When a bicyclist switches from first gear to second gear, the bicycle travels greater distance with each revolution of the pedals. In the same way, when a chemist increases the concentration of a reactant, the rate of the reaction increases.

**Rate Law** – expresses the relationship between the rate of a chemical reaction and the concentration of reactants

- Rate = \( k[A] \) where \([A]\) is the concentration and \( k \) is a constant.

**Specific rate constant** – numerical value that relates the reaction rate and the concentrations of reactants at a given temperature. The specific rate constant is unique for every reaction and can have a variety of units including: \( \text{L}/(\text{mole} \cdot \text{s}) \), \( \text{L}^2/(\text{mol} \cdot \text{s}) \), and \( \text{s}^{-1} \)

**Reaction order** – defines how the rate is affected by the concentration of that reactant

- Rate = \( k[\text{H}_2\text{O}_2] \)
• The reaction is first order, so the rate changes in the same proportion the concentration of $\text{H}_2\text{O}_2$ changes.

**General Rate Law**
- Rate $= \text{k}[\text{A}]^m[\text{B}]^n$
- Rate $= \text{k}[\text{NO}]^2[\text{H}_2]$
- If $\text{H}_2$ is doubled, the rate doubles.
- If $\text{NO}$ is doubled, the rate quadruples because $2^2 = 4$.
- First-order $\text{H}_2$, second-order $\text{NO}$, third-order overall

**Determining Reaction Order**
Method of initial rates – determining the reaction order by comparing the initial rates of a reaction carried out with varying reactant concentrations

<table>
<thead>
<tr>
<th>Trial</th>
<th>Initial <a href="M">A</a></th>
<th>Initial <a href="M">B</a></th>
<th>Initial Rate (mol/(L·s))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.100</td>
<td>0.100</td>
<td>$2.00 \times 10^{-3}$</td>
</tr>
<tr>
<td>2</td>
<td>0.200</td>
<td>0.100</td>
<td>$4.00 \times 10^{-3}$</td>
</tr>
<tr>
<td>3</td>
<td>0.200</td>
<td>0.200</td>
<td>$16.00 \times 10^{-3}$</td>
</tr>
</tbody>
</table>

• Doubling [A] doubles the reaction rate, so [A] is first order.
• Doubling [B] quadruples the reaction rate, so [B] is second order.
• Rate $= \text{k}[\text{A}][\text{B}]^2$
Example

**Experimental Initial rates for \(aA + bB \rightarrow \) products**

<table>
<thead>
<tr>
<th>Trial</th>
<th>Initial ([A]) (M)</th>
<th>Initial ([B]) (M)</th>
<th>Initial Rate (mol/L·s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.30</td>
<td>0.10</td>
<td>(1.20 \times 10^{-2})</td>
</tr>
<tr>
<td>2</td>
<td>0.60</td>
<td>0.10</td>
<td>(4.80 \times 10^{-2})</td>
</tr>
<tr>
<td>3</td>
<td>0.60</td>
<td>0.20</td>
<td>(9.60 \times 10^{-2})</td>
</tr>
</tbody>
</table>

**What is the order of the reaction for Reactant A?**

Assume that the general rate law for this type of reaction is

\[
\text{Rate} = k[A]^m[B]^n
\]

Determine \(m\) by comparing trials 1 and 2.

**Step 1** Write the rate equations for trials 1 and 2.

\[
\text{Rate 1} = k[A_1]^m[B_1]^n
\]

\[
\text{Rate 2} = k[A_2]^m[B_2]^n
\]

**Step 2** Compare Rate 2 with Rate 1. (Hint: Use the initial rate data.)

Rate 2 = 4 Rate 1

**Step 3** Substitute the rate equations in step 1 into the equation in step 2.

\[
k[A_2]^m[B_2]^n = 4k[A_1]^m[B_1]^n
\]

**Step 4** Compare the concentrations of each reactant. (Hint: Use the concentration data.)

\[
[A_2] = 2[A_1] \quad [B_2] = [B_1]
\]

**Step 5** Substitute the equations from step 4 into the equation of step 3 and simplify.

\[
k(2[A_1])^m[B_1]^n = 4k[A_1]^m[B_1]^n
\]

\[
k(2)[A_1]^m[B_1]^n = 4k[A_1]^m[B_1]^n
\]

\[
(2)^m = 4
\]

\[
m = 2
\]
CPA Chemistry Unit 11 Chemical Kinetics / Equilibrium
Lesson #11-5 & 6

Aim: How can we describe a system at equilibrium?

Main Idea: Many reactions and processes reach a state of chemical equilibrium in which both reactants and products are formed at equal rates. Chemical equilibrium is described by an equilibrium constant expression that relates the concentration of reactants and products.

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Define a reversible reaction
2. State the definition of equilibrium
3. Understand the meaning of a dynamic process
4. Identify examples of physical equilibrium, as solution equilibrium and phase equilibrium, including the concept that a saturated solution is at equilibrium
5. Describe the concentration of particles and rates of opposing reactions in an equilibrium system

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:
Demo: 2 troughs; 250-mL beaker; 600-mL beaker
- Two student volunteers scoop water from their trough and pour into the opposite until it reaches equilibrium
- Before the transfer process began, what did you predict would happen as the process continued?
- Why did you predicted outcome not take place?
- Were the water levels in the two troughs equal when the levels became constant?

Procedure:
Introduction
- Imagine a tug-of-war between two teams. The rope between them is not moving and it seems like neither team is pulling but in reality both teams are pulling but the forces are equal and opposite, so they are in complete balance

Reversible reaction – chemical reaction that can occur in both the forward and reverse reactions
Forward: \( \text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g) \)
Reverse: \( \text{N}_2(g) + 3\text{H}_2(g) \leftarrow 2\text{NH}_3(g) \)
Combined: \( \text{N}_2(g) + 3\text{H}_2(g) \leftrightarrow 2\text{NH}_3(g) \)
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Chemical Equilibrium – the state in which a forward and reverse reactions balance each other because they take place at equal rates

- Tug of war, two ends of a seesaw, cars between two cities, Demo, alcohol in a closed flask

**Equilibrium Expressions**

Equilibrium constant expression if:

$$aA + bB \leftrightarrow cC + dD$$

$$K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Equilibrium constant – $K_{eq}$ is the numerical value of the ratio of the product concentrations to reactant concentrations, with each concentration raised to the power equal to its coefficient in the balanced reaction.

Write equilibrium expressions for the following:

1. $4NH_3(g) + 5O_2(g) \leftrightarrow 4NO(g) + 6H_2O(g)$
2. $2NO_2(g) \leftrightarrow N_2O_4(g)$
3. $N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$
4. $Ag^+(aq) + 2NH_3(aq) \leftrightarrow Ag(NH_3)_2^+(aq)$
5. $2NO(g) + 2H_2(g) \leftrightarrow N_2(g) + 2H_2O(g)$
6. $COCl_2(g) \leftrightarrow CO(g) + Cl_2(g)$
7. $HCN(aq) + H_2O(l) \leftrightarrow H_3O^+(aq) + CN^(-)(aq)**$
8. $H_2O(g) + CO(g) \leftrightarrow H_2(g) + CO_2(g)$

Homogeneous equilibrium – all the reactants and products are in the same physical state

Heterogeneous equilibrium – when the reactants and products are in more than one physical state

- Solids and liquids are pure substances so they can be omitted. Gases and aqueous solutions have a specific concentration so they will be used in the equilibrium expression

$$C_2H_5OH(l) \leftrightarrow C_2H_5OH(g)$$
1) Write the expression
2) Note that the liquid is a pure substance and that concentration will remain constant
3) Rewrite the expression omitting the liquid form of ethanol

\[ I_2(s) \leftrightarrow I_2(g) \]
1) Write the expression
2) Note that the solid is a pure substance and that concentration will remain constant
3) Rewrite the expression omitting the gaseous form of iodine

Ex: \[ 2NaHCO_3(s) \leftrightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g) \]

Practice Problems
1. \[ C_{10}H_8(s) \leftrightarrow C_{10}H_8(g) \]
2. \[ H_2O(l) \leftrightarrow H_2O(g) \]
3. \[ CaCO_3(s) \leftrightarrow CaO(s) + CO_2(g) \]
4. \[ C(s) + H_2O(g) \leftrightarrow CO(g) + H_2(g) \]
5. Solid iron reacts with chlorine gas to form solid iron(III) chloride (FeCl_3). Write the balanced equation and the equilibrium constant expression for the reaction.

Conclusion
1. Can a liquid-vapor equilibrium be established over a liquid in a container open to the atmosphere?
2. Describe the relative amounts of reactants and products in a system at equilibrium.
Lesson #11-7

Aim: How can we predict the effect of stress on a system at equilibrium?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Describe the effect of a stress on equilibrium, using Le Chatelier’s principle
2. Explain how a catalyst does not effect the equilibrium
3. Write an equilibrium expression for a reaction
4. Solve problems using the equilibrium expression of a reaction

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:

Procedure:
Le Chatelier’s Principle states that if a stress is applied to a system at equilibrium, the system will adjust, to partially offset the stress and will reach a new state of equilibrium.

The "stresses" that can be applied to the system include changes in concentration, pressure, volume and temperature.

- Changes in concentration of either reactants or products will change the value of $Q$, the reaction quotient.

  Adding more reactant will drive the forward reaction.
  Adding more product will drive the reverse reaction.

  Removal of reactants or products will shift the equilibrium in the direction needed to produce more of the substance that was removed.

Solids and pure liquids can not change concentration. Changing the amount of these present in the system will have no effect on equilibrium, unless they are removed entirely.

Catalysts are species that speed up the rate of a reaction. However, they speed up both the forward and reverse reactions, leaving $K$ unchanged.

- Changes in pressure and volume will affect the equilibrium of reactions involving gases. In the previous worksheet, you calculated the effect of pressure on gaseous systems.

  Increasing the volume of the system (lowering the pressure) drives the equilibrium toward the state with the larger number of moles of gas.
Increasing the pressure of the system by adding an inert gas has no effect on the equilibrium of the system.

Changes in temperature change the value of the equilibrium constant, $K$. This is a fairly complex process, but can be thought of in simple terms, using Le Chatelier’s Principle.

Heat can be treated as a product in exothermic reactions ($\Delta H < 0$) and as a reactant in endothermic reactions ($\Delta H > 0$).

Raising the temperature of a reaction can be thought of as adding heat. In endothermic reactions (heat = reactant) this will drive the forward reaction. In exothermic reactions (heat = product) and raising the temperature will drive the reverse reaction.

Work on Problems
Review

Test
CPA Chemistry Unit 12 Acids/Bases
Lesson #12-1

Topic: Acids and Bases?

Objective:
At the conclusion of the lesson students will be able to:
1. Know the physical and chemical properties of acids and bases
2. Classify solutions as acidic, basic, or neutral
3. Write the chemical equation of the dissociation of an acid or base
4. Assign acid, base, conjugate acid, and conjugate base to an equation

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:

Introduction
- Demo: Universal indicator to show whether household items are acids and bases
  - Vinegar, Eye wash, baking soda, NaOH, H₂SO₄, drain cleaner

Discussion
- Notes from powerpoint
- Problems

Conclusion
- Discuss main points of acids and bases

HW
- Worksheet
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CPA Chemistry Unit 12 Acids/Bases

Lesson #12-2

Topic: What is pH?

Main Ideas: pH and pOH are logarithmic scales that express the concentrations of hydrogen ions and hydroxide ions in aqueous solutions

Objective:

At the conclusion of the lesson students will be able to:
1. Know the difference between a strong and weak acid
2. Understand the spectrum of the pH scale
3. Know how to determine pH and pOH using logs

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under carious physical circumstances, such as heating or cooling

Materials/Activities:

Procedure:
Strong acids and strong bases – they will dissociate completely into their subsequent ions; will make the light-bulb bright when electricity runs through the aqueous solution
- Acid – hydronium ions
- Base – hydroxide ions

Weak acids and bases – they only dissociate partially; light-bulb dimly lit when electricity runs through the aqueous solution
- Show video on electrolytes

Ion product constant for water
Equilibrium expression for water

There are several ways to define acids and bases, but pH only refers to hydrogen ion concentration and is only meaningful when applied to aqueous (water-based) solutions. When water dissociates it yields a hydrogen ion and a hydroxide.

\[ \text{H}_2\text{O} \leftrightarrow \text{H}^+ + \text{OH}^- \]

When calculating pH, remember that \([\text{]}\) refers to molarity, M.
$K_w = [H^+][OH^-] = 1 \times 10^{-14}$ at 25°C  
for pure water $[H^+] = [OH^-] = 1 \times 10^{-7}$  
Acidic Solution: $[H^+] > 1 \times 10^{-7}$  
Basic Solution: $[H^+] < 1 \times 10^{-7}$

**Calculate pH and $[H^+]$**

$$\text{pH} = \log_{10}[H^+]$$  
$$[H^+] = 10^{-\text{pH}}$$

**Example:**

Calculate the pH for a specific $[H^+]$. Calculate pH given $[H^+] = 1.4 \times 10^{-5}$ M

$$\text{pH} = \log_{10}[H^+]$$  
$$\text{pH} = \log_{10}(1.4 \times 10^{-5})$$  
$$\text{pH} = 4.85$$

**Example:**

Calculate $[H^+]$ from a known pH. Find $[H^+]$ if pH = 8.5

$$[H^+] = 10^{-\text{pH}}$$  
$$[H^+] = 10^{-8.5}$$  
$$[H^+] = 3.2 \times 10^{-9} \text{ M}$$

**Calculating pOH and $[OH^-]$**

Same process only using the concentration of $OH^-$
Lesson Plans

CPA Chemistry Unit 12 Acids/Bases

Lesson #12-3 &4

Topic: How can you find the equivalence point of a solution?

Objective:
At the conclusion of the lesson students will be able to:
1. Define neutralization reaction
2. Define equivalence point
3. Perform titration problems

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:

Procedure:
Introduction
- Show Fight Club clip to show a neutralization reaction
- Discuss
  - Why to put acid instead of water, lye is a base

Middle
- Example problem
- Practice
- Group work

Conclusion
- Complete one question from the homework

HW
- Complete worksheet with questions
Lesson #12-5

Topic: Titration Lab

Objective:
At the conclusion of the lesson students will be able to:
1. Perform titration problems
2. Perform a titration

Standards:
5.1.12.A.1 – Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations
5.1.8.D.3 – Demonstrate how to safely use tools, instruments, and supplies
5.2.8.A.3 – Use kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling

Materials/Activities:

Procedure:
Introduction

- Go through an example of how to titrate

Middle

- Lab Work

Conclusion

- Perform Lab Calculations
Review

Quiz
CPA Chemistry Unit 13 Electron Configuration/Periodic Trends

Lesson #13-1

Aim: How are electrons arranged in an atom? What is the nature of light?

Instructional Objectives:

At the conclusion of the lesson students will be able to:

1) Understand the wave nature of light as being part of the electromagnetic spectrum
2) Define wavelength
3) Define frequency
4) Define amplitude
5) Know the different forms of electromagnetic radiation

Standards:

5.6.A.1 – Know that atoms are made of a positive nucleus surrounded by negative electrons and that the nucleus, a tiny fraction of the volume of an atom, is composed of protons and neutrons, each almost 2,000 times more massive than an electron

Materials:
Spring/Slinky (demonstrate a wave)

Introduction

• Video on Atomic Theory
• DO NOW section

Discussion

• Video on light
• Notes
• Problems

Conclusion

• How Fireworks are made
Aim: Quantum Mechanics

Instructional Objectives:
At the conclusion of the lesson students will be able to:

5) Define the quantum mechanical model of the atom; atomic model where electrons are treated as waves
6) Define the principal quantum number \( n \); indicates the relative size and energy of atomic orbitals
7) Define the orbital quantum number \( l \); sublevel of the principal quantum number that defines the shape of the orbital
8) Define the magnetic quantum number \( m_l \); describes the orientation of the orbital in space
9) Define the spin quantum number \( m_s \); describes the spin of an electron

Standards:
5.6.A.1 – Know that atoms are made of a positive nucleus surrounded by negative electrons and that the nucleus, a tiny fraction of the volume of an atom, is composed of protons and neutrons, each almost 2,000 times more massive than an electron

Materials:
PPT

Introduction
- Each electron has a certain region of space that it occupies that is labeled using an address
  - County
  - Town
  - House
  - Room

Discussion
- PPT
- Notes

Quantum numbers
- There are 4 numbers that chemists use to try to pinpoint the location of electrons in an atom. Since electrons are in constant motion they are more often predicting where the electron is most likely to be and each successive quantum number narrows down each electron’s location. Areas where electrons are most likely to be found are called electron clouds.

1. Principal energy level \( n \): indicates the relative size and energy level of the orbital
   - There are 7 possible energy levels
2. Orbital quantum number \( l \): sublevel of the principal quantum number that defines the shape of that orbital
   - 4 possible sublevels in any energy level
Westwood High School Lesson Plans

i. s, p, d, f
   ii. stadium seating picture

3. Magnetic quantum number (m): describes the orientation of the orbital in space
   a. s sublevel has 1 orbital
   b. p sublevel has 3 orbitals
   c. d sublevel has 5 orbitals
   d. f sublevel has 7 orbitals

4. Spin quantum number (s): describes the spin direction of the electron
   a. Clockwise (up arrow)
   b. Counter clockwise (down arrow)

Conclusion

Draw the way the electron orbitals look using the “room” picture
Aim: Electron Configurations

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Define Aufbau principle
2) Define Pauli exclusion principle
3) Define Hund’s Rule
4) Apply above rules to write electron configurations using orbital diagram and electron configuration notation
5) Create a list of rules that will tell you how to fill in electrons to their proper orbital

Standards:
5.6.A.1 – Know that atoms are made of a positive nucleus surrounded by negative electrons and that the nucleus, a tiny fraction of the volume of an atom, is composed of protons and neutrons, each almost 2,000 times more massive than an electron

Materials:
http://www.chem.arizona.edu/chemt/ido.html
Work sheet
Do Now (5 minutes)
• Make a list of the four principal quantum numbers in order from broadest to most specific
• What do these numbers tell us about electrons?

Introduction (5 minutes)
• Getting a room at a hotel

Discussion (2x20 minute sections)
• Working in groups of four to complete the work sheet
• Use the information to complete questions 1-4; call teacher over to check work before going on to 5
• Have three students write out the three rules that define how electrons are arranged in atoms
• Have student from each group write answers to problems on the board

Conclusion (10 minutes)
• Write the three rules that define how electrons are arranged in atoms
• Go through the sublevel diagram as another tool to write electron configurations

Rules for filling orbitals
1. Put electron in the orbital with the lowest available energy level
2. Populate each orbital with one electron
3. Add the second electron to each orbital
4. Go to the next lowest energy orbital
5. Repeat until all electrons are used
Lesson 13-4

Aim: How is the Periodic Table arranged?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1) Know that Dimitri Mendeleev proposed that elements could be ordered based on their increasing atomic mass
2) Know that Henry Moseley discovered that atoms of each element have a certain amount of protons, also called the atomic number
3) State the Modern Periodic Law is organized in periods according to the increasing atomic number and corresponding electron configuration
4) Groups (vertical columns) have the same number of valence electrons. Their properties are similar because of this electron arrangement
5) Periods (horizontal rows) have valence electrons in the same outermost principal energy level
6) Label the 8 different families on the Periodic Table

Standards:
5.1.12.A.2 – Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories
5.1.12.C.2 – Use data representations and new models to revise predictions and explanations
5.2.8.A.5 – Predict the physical and chemical properties of elements base on their position on the Periodic Table

Materials: PPT, wksht
CPA Chemistry Unit 13 Electron Configuration/Periodic Trends

Lesson 13-5

Aim: How do we identify trends across the periodic table?

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Define atomic radius as one half the distance between adjacent nuclei
2. Understand that within a period, as the atomic number increases, the atomic radius decreases
3. Understand that within a group, as the atomic number increases, the atomic radius increases
4. Understand that within a period, as the atomic number increases, the ionization energy increases
5. Understand that within a group, as the atomic number increases, the ionization energy decreases
6. Know that electronegativity increases as you go across a period and decreases as you go down a group
7. Know how effective nuclear charge and electron-electron repulsion factors in to each of the trends

Standards:
5.1.12.A.2 – Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories
5.1.12.C.2 – Use data representations and new models to revise predictions and explanations
5.2.8.A.5 – Predict the physical and chemical properties of elements base on their position on the Periodic Table

Materials:
Lab handout, ppt

Procedure:

Do Now
• Take out homework
• What do all elements in the same period have in common?
• What do all elements in the same group have in common?

Introduction
• Students will work on a lab that will allow them to discover the atomic radius and ionization energy trends of the periodic table (30 minutes at lab tables)

Middle Phase
• Go through ppt and discuss effective nuclear charge and electron-electron repulsion
• Go through notes on the trends

Conclusion
• Sum up the trends of atomic radius, ionization energy, and electronegativity

HW
• Do the questions on the back of the notes; finish lab
Aim: Applying trends to the periodic table

Instructional Objectives:
At the conclusion of the lesson students will be able to:
1. Know the properties of metals, nonmetals, metalloids
2. Apply knowledge of the atomic radius trend in the periodic table to questions
3. Apply ionization energy trend to questions
4. Apply electronegativity trend to questions

Standards:
5.1.12.A.2 – Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories
5.1.12.C.2 – Use data representations and new models to revise predictions and explanations
5.2.8.A.5 – Predict the physical and chemical properties of elements base on their position on the Periodic Table

Materials:
Metals, nonmetals, metalloids

Procedure:
Do Now
- Take out homework
- What contribution did Mendeleev and Moseley make to the Periodic Table?

Introduction
- Go through the different properties of metals, nonmetals, metalloids
  - Explanation of why they exhibit these trends (15-20 minutes)

Middle Phase
- Work in groups of two to complete the worksheet
- Every ten minutes we will stop and discuss a set amount of questions

Conclusion
- Sum up the trends of atomic radius, ionization energy, and electronegativity

HW
- Finish the questions and lab; quiz next class period