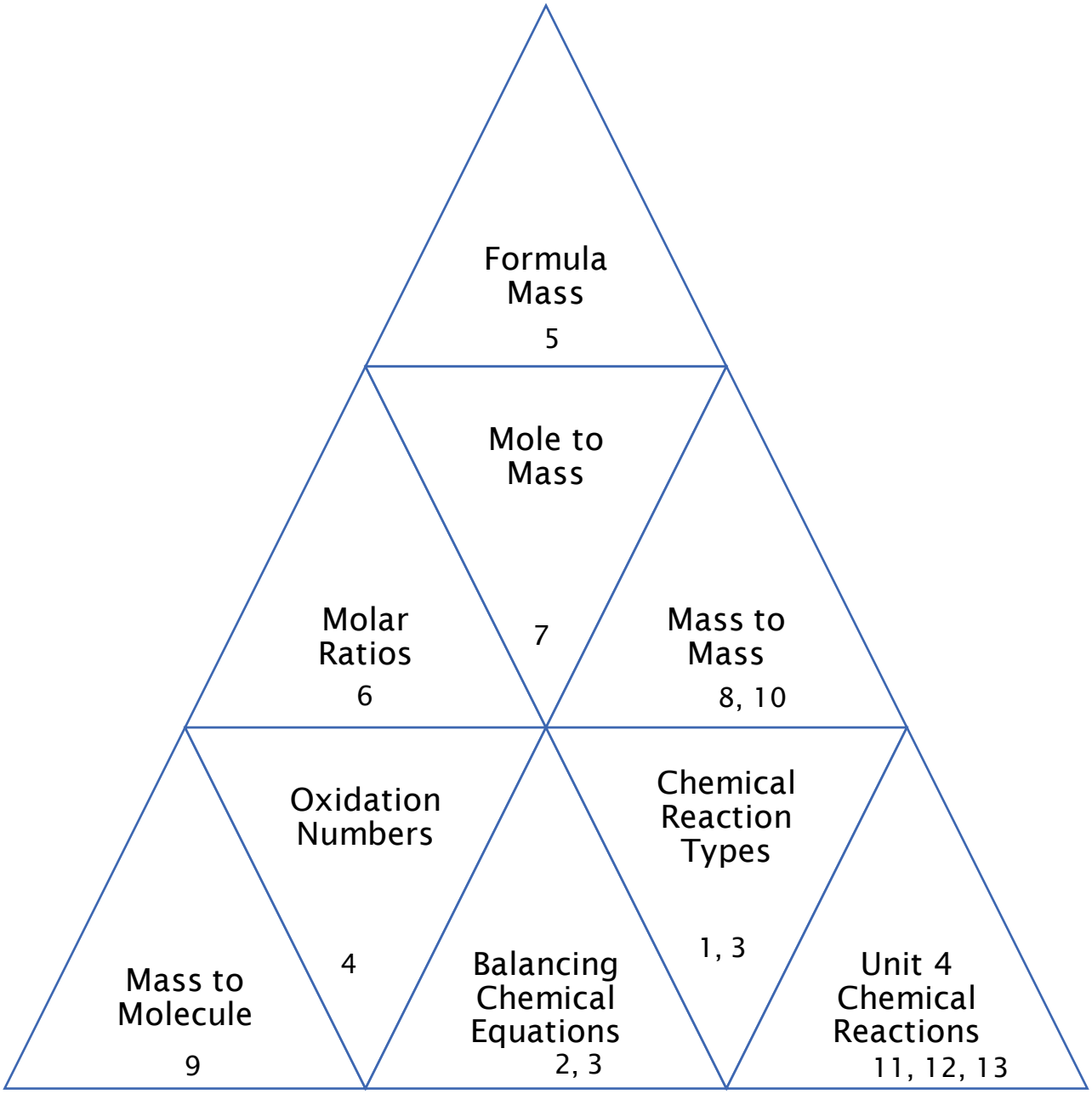
AP CHEMISTRY SUMMER SKILLS PROBLEM SET FERRELL 2022



Name:_____

Date:_____

*Day 1 Each Student

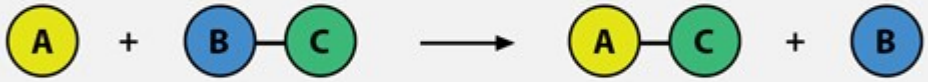
*Please Bring 26oz NaCl

Types of Chemical Reactions

1. Combination or Synthesis Reaction

2. Decomposition Reaction

3. Single-replacement Reaction



4. Double-replacement Reaction

5. Combustion Reaction

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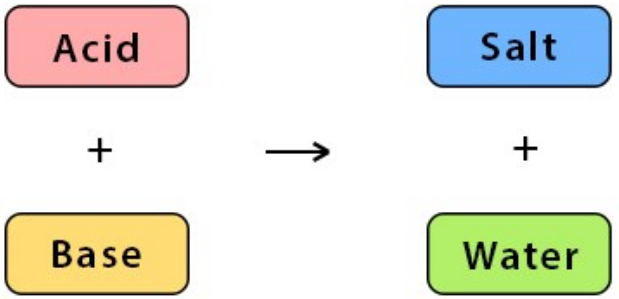
Acid-Base Reaction



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How to Balance a Chemical Equation

Balancing a chemical equation involves inserting coefficients in front of formula. To do it successfully, you have to be able to conduct an **Atom Count**. You will insert coefficients until the count for the number of atoms of each element is the same for both sides of the equation.

CAUTION: Never change a formula. Changing a formula changes the reaction to a different set of reactants and products. You want to balance the reaction … not change it to another reaction.

Know How to Count Atoms

Parenthesis Rule
When a subscript of 2 follows a parenthesis, multiply everything inside the parenthesis by 2.

Formula	# of atoms of element …			
	Ca	Cl	C	O
$CaCl_2 + 4\ CO_2$	1	2	4	8
$2\ CaO + 3\ CO_2$	2	0	3	8
$3\ Ca(ClO_3)_2$	3	6	0	18
$Ca(ClO_4)_2 + 3\ C$	1	2	3	8

Step-by-Step Balancing Method:

1. Write the skeleton equation with proper reactant and product formulae.
2. Select an element that is present in only 1 formula on each side of the equation. Place coefficients in front of those formula to balance that element.
3. Select another element … preferrably one that is present in only 1 formula on each side of the equation; balance that element using cofficients.
4. Repeat the process for all remaining elements.
5. Once all elements have been balanced, conduct a final atom count to insure correctness.

Example: Balance … $Al(OH)_3 \rightarrow Al_2O_3 + H_2O$

1. Start with the element Al. Place a **2** in front of $Al(OH)_3$ to balance Al.
   $2\ Al(OH)_3 \rightarrow Al_2O_3 + H_2O$
2. Now balance the element H. There are 6 atoms of H on reactant side. So place a 3 in front of H_2O: $2\ Al(OH)_3 \rightarrow Al_2O_3 + 3\ H_2O$
3. As is often the case, using the above procedure will result in the third element being balanced. There are 6 atoms of O on each side. Done!

Types of Reactions Worksheet THEN Balancing!

First, begin by telling which type of reaction is taking place. Then go back and balance the following equations:
To practice balancing, you may use the Phet Lab online. When finished, check your answers.

1) ____ $NaBr$ + ____ H_3PO_4 → ____ Na_3PO_4 + ____ HBr Type of reaction: _____

2) ____ $Ca(OH)_2$ + ____ $Al_2(SO_4)_3$ → ____ $CaSO_4$ + ____ $Al(OH)_3$ Type of reaction: _____

3) ____ Mg + ____ Fe_2O_3 → ____ Fe + ____ MgO Type of reaction: _____

4) ____ C_2H_4 + ____ O_2 → ____ CO_2 + ____ H_2O Type of reaction: _____

5) ____ $PbSO_4$ → ____ $PbSO_3$ + ____ O_2 Type of reaction: _____

6) ____ NH_3 + ____ I_2 → ____ N_2I_6 + ____ H_2 Type of reaction: _____

7) ____ H_2O + ____ SO_3 → ____ H_2SO_4 Type of reaction: _____

8) ____ H_2SO_4 + ____ NH_4OH → ____ H_2O + ____ $(NH_4)_2SO_4$ Type of reaction: _____

Balancing Equations Practice Worksheet

Balance the following equations:

1) ___ $NaNO_3$ + ___ PbO → ___ $Pb(NO_3)_2$ + ___ Na_2O

2) ___ AgI + ___ $Fe_2(CO_3)_3$ → ___ FeI_3 + ___ Ag_2CO_3

3) ___ $C_2H_4O_2$ + ___ O_2 → ___ CO_2 + ___ H_2O

4) ___ $ZnSO_4$ + ___ Li_2CO_3 → ___ $ZnCO_3$ + ___ Li_2SO_4

5) ___ V_2O_5 + ___ CaS → ___ CaO + ___ V_2S_5

6) ___ $Mn(NO_2)_2$ + ___ $BeCl_2$ → ___ $Be(NO_2)_2$ + ___ $MnCl_2$

7) ___ $AgBr$ + ___ $GaPO_4$ → ___ Ag_3PO_4 + ___ $GaBr_3$

8) ___ H_2SO_4 + ___ $B(OH)_3$ → __ $B_2(SO_4)_3$ + ___ H_2O

9) ___ S_8 + ___ O_2 → ___ SO_2

10) ___ Fe + ___ $AgNO_3$ → ___ $Fe(NO_3)_2$ + ___ Ag

Oxidation Numbers Worksheet

Directions: Use the *Rules for Assigning Oxidation Numbers* to determine the oxidation number assigned to each element in each of the given chemical formulas.

	Formula	Element and Oxidation Number					
1.	Cl_2	Cl					
2.	Cl^-	Cl					
3.	Na	Na					
4.	Na^+	Na					
5.	O_2	O					
6.	N_2	N					
7.	Al^{+3}	Al					
8.	H_2O	H		O			
9.	NO_3^-	N		O			
10.	NO_2	N		O			
11.	$Cr_2O_7^{2-}$	Cr		O			
12.	KCl	K		Cl			
13.	NH_3	N		H			
14.	CaH_2	Ca		H			
15.	SO_4^{2-}	S		O			

	Formula	Element and Oxidation Number					
16.	Na_2O_2	Na		O			
17.	SiO_2	Si		O			
18.	$CaCl_2$	Ca		Cl			
19.	PO_4^{3-}	P		O			
20.	MnO_2	Mn		O			
21.	FeO	Fe		O			
22.	Fe_2O_3	Fe		O			
23.	H_2O_2	H		O			
24.	CaO	Ca		O			
25.	H_2S	H		S			
26.	H_2SO_4	H		S		O	
27.	NH_4Cl	N		H		Cl	
28.	K_3PO_4	K		P		O	
29.	HNO_3	H		N		O	
30.	KNO_2	K		N		O	

Rules for Assigning Oxidation Numbers

1. The oxidation number of any uncombined element is 0.
2. The oxidation number of a monatomic ion equals the charge on the ion.
3. The more-electronegative element in a binary compound is assigned the number equal to the charge it would have if it were an ion.
4. The oxidation number of fluorine in a compound is always -1.
5. Oxygen has an oxidation number of -2 unless it is combined with F (when it is +2), or it is in a peroxide (such as H_2O_2 or Na_2O_2), when it is -1.
6. The oxidation state of hydrogen in most of its compounds is +1 unless it is combined with a metal, in which case it is -1.
7. In compounds, the elements of groups 1 and 2 as well as aluminum have oxidation numbers of +1, +2, and +3 respectively.
8. The sum of the oxidation numbers of all atoms in a neutrals compound is 0.
9. The sum of the oxidation numbers of all atoms in a polyatomic ion equals the charge of the ion.

CHEMISTRY COMPUTING FORMULA MASS WORKSHEET

Directions:

Find the formula mass of the following compounds. Round atomic masses to the tenth of a decimal place. Place your final answer in the FORMULA MASS COLUMN.

Problem Set-up example:
Find the formula mass of $Ca(NO_3)_2$

Ca:	1	x	40.1	= 40.1
N:	2	x	14.0	= 28.0
O:	6	x	16.0	= 96.0
				____
Formula Mass				= 164.1

Must Show Your Work

COMPOUND	FORMULA MASS
$AgNO_2$	
$NiSO_3$	
$Ca_3(PO_4)_2$	
$HgSO_4$	
$Fe(NO_3)_3$	
KBr	
$BeCr_2O_7$	
$Co(ClO_3)_2$	
$Cu_2C_4H_4O_6$	
$CuSO_4 \cdot 7\ H_2O$	

COMPOUND	FORMULA MASS
$ZnCl_2$	
K_3PO_4	
$Al_2(SO_4)_3$	
$MgCrO_4$	
$CaC_4H_4O_6$	
$NaCl$	
$K_2Cr_2O_7$	
H_2SO_4	
$Cu(OH)_2$	
$MgSO_4 \cdot 5\ H_2O$	

CHEMISTRY MOLAR RATIOS WORKSHEET

Molar Ratios

The molar ratio is an important comcept in solving stoichiometry problems. The sources for these ratios are the coefficients of a balanced equation.

Example 1:

$2\ H_2 + O_2 \rightarrow 2\ H_2O$

What is the molar ratio between $H_2$and O_2?

Answer:

two to one. So this ratio is written as a fraction is

$\frac{2}{1}$

What is the molar ratio between $O_2$and H_2O?

Answer:

one to two. As a fraction, it is:

$\frac{1}{2}$

What is the molar ratio between H_2 and H_2O?

Answer: two to two or:

$\frac{2}{2}$

This reduces to one to one, but leave it written as 2 to 2.

Example 2:

$2\ O_3 \rightarrow 3\ O_2$

The exact molar ratio you would use depends on how the problem is worded.

What is the molar ratio between $O_3$and O_2?

$\frac{2}{3}$

What is the molar ratio between $O_2$and O_3?

$\frac{3}{2}$

Practice Problems

Following each equation are two requests for molar ratios from the equation.

1) **$N_2 + 3\ H_2 \rightarrow 2\ NH_3$**

Write the molar ratios for:

N_2 to H_2 and NH_3 to H_2

____ ____

2) **$2\ SO_2 + O_2 \rightarrow 2\ SO_3$**

Write the molar ratios for:

O_2 to SO_3 and O_2 to SO_2

____ ____

3) **$PCl_3 + Cl_2 \rightarrow PCl_5$**

Write the molar ratios for

PCl_3 to Cl_2 and PCl_3 to PCl_5

____ ____

4) **$4\ NH_3 + 3\ O_2 \rightarrow 2\ N_2 + 6\ H_2O$**

Write the molar ratios for

NH_3 to N_2 and H_2O to O_2

____ ____

5) **$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$**

Write the molar ratios for

CO to CO_2 and Fe to CO

____ ____

Must Show Your Work

CHEMISTRY **Stoichiometry Practice [Mole-Mass]**

Multiple Choice: Show your set-up in the space provided and circle the answer of your choice.

(1) Given the balanced equation:

$2\ NO_2$ --------> N_2O_4

What mass, in grams, of N_2O_4 is produced when 10 moles of NO_2 is consumed?

a) 153 b) 690 c) 368 d) 460 e) 1150

(2) Given the balanced equation:

$ZnSO_4 + SrCl_2$ ------> $SrSO_4 + ZnCl_2$

What number of moles of $SrCl_2$ is consumed when 54 g of $ZnCl_2$ is produced?

a) 0.16 b) 0.3 c) 0.79 d) 1.58 e) 0.4

(3) Given the balanced equation:

$Pb(NO_3)_2 + K_2CrO_4$ ---------> $PbCrO_4 + 2\ KNO_3$

What number of moles of $Pb(NO_3)_2$ is consumed when 54 g of KNO_3 is produced?

a) 0.13 b) 0.18 c) 0.27 d) 1.34 e) 0.67

(4) Given the balanced equation:

$2\ C_8H_{18} + 25\ O_2$ --------> $16\ CO_2 + 18\ H_2O$

What number of moles of CO_2 is produced when 60 grams of C_8H_{18} is consumed?

a) 3.37 b) 7.02 c) 5.26 d) 2.11 e) 4.21

Must Show Your Work

CHEMISTRY **Stoichiometry Practice(Mass-Mass)**

Multiple Choice: Show your set-up in the space provided and circle the answer of your choice.

(1) Given the following reaction:

$2\ AlI_3 + 3\ HgCl_2 \text{ --------> } 2\ AlCl_3 + 3\ HgI_2$

What mass, in grams, of AlI_3 is consumed when 46 grams of HgI_2 is produced?

a) 27.5 b) 6.9 c) 137.6 d) 82.5 e) 68.8

(2) Given the following reaction:

$CaBr_2 + 2\ KOH \text{ -------> } Ca(OH)_2 + 2\ KBr$

What mass, in grams, of $CaBr_2$ is consumed when 96 g of $Ca(OH)_2$ is produced?

a) 173 b) 52 c) 86 d) 155 e) 259

(3) Given the following reaction:

$3\ H_2 + N_2 \text{ -------> } 2\ NH_3$

What mass, in grams, of NH_3 is produced when 77 g of N_2 is consumed?

a) 187 b) 31.2 c) 18.7 d) 46.8 e) 93.5

(4) Given the following reaction:

$3\ AgNO_3 + K_3PO_4 \text{ ------> } Ag_3PO_4 + 3\ KNO_3$

What mass, in grams, of Ag_3PO_4 is produced when 19 g of K_3PO_4 is consumed?

a) 46.8 b) 15 c) 37.5 d) 18.7 e) 112.4

Must Show Your Work

CHEMISTRY **Stoichiometry Practice(Mass-Molecule)**

Multiple Choice: Show your set-up in the space provided and circle the answer of your choice.

(1) Given the balanced equation:

$2\ Al + 6\ NaOH \text{ --------> } 2\ Na_3AlO_3 + 3\ H_2$

What mass, in grams, of Na_3AlO_3 is produced when 6×10^{23} molecules of NaOH is consumed?

a) 240 b) 80 c) 64 d) 9.6 e) 48

(2) Given the balanced equation:

$3\ CuS + 8\ HNO_3 \text{ ---------> } 3\ Cu(NO_3)_2 + 3\ S + 2\ NO + 4\ H_2O$

What number of molecules of $Cu(NO_3)_2$ is produced when 67 g of HNO_3 is consumed?

a) 7.18 b) 3.19 c) 5.98 d) 1.44 e) 2.39 [all $\times 10^{23}$]

3. Given the balanced equation:

$3\ CuS + 8\ HNO_3 \text{ ---------> } 3\ Cu(NO_3)_2 + 3\ S + 2\ NO + 4\ H_2O$

What number of molecules of NO is produced when 8 grams of S is produced?

a) 1.99 b) 2.99 c) 0.33 d) 1.5 e) 1 [all $\times 10^{23}$]

4. Given the balanced equation:

$8\ Fe + S_8 \text{ ---------> } 8\ FeS$

What mass, in grams, of S_8 is consumed when 5×10^{23} molecules of Fe is consumed?

a) 1.67 b) 3.34 c) 16.72 d) 5.57 e) 6.69

CHEMISTRY **STOICHIOMETRY WORKSHEET**

A. MASS - MASS PROBLEMS

_____1. What mass of oxygen reacts when 84.9 g of iron is consumed in the follolwing reaction:

"Balance equation 1st"

$Fe + O_2 \text{ ---------> } Fe_2O_3$

Given the following reaction:

"already balanced"

$Al_2(SO_4)_3 + 6\ NaOH \text{ --------> } 2\ Al(OH)_3 + 3\ Na_2SO_4$

_____2. What mass of $Al(OH)_3$ is produced if 22.7 g of NaOH is consumed?

Given the following reaction:

"already balanced"

$P_4 + 5\ O_2 \text{ ----------> } P_4O_{10}$

_____3. What mass of oxygen will react with 7.75 g of P_4?

UNIT AT A GLANCE

Enduring Understanding	Topic	Suggested Skill	Class Periods
			~14–15 CLASS PERIODS
TRA-1	**4.1 Introduction for Reactions**	2.B Formulate a hypothesis or predict the results of an experiment.	
	4.2 Net Ionic Equations	5.E Determine a balanced chemical equation for a given chemical phenomena.	
	4.3 Representations of Reactions	3.B Represent chemical substances or phenomena with appropriate diagrams or models (e.g., electron configuration).	
	4.4 Physical and Chemical Changes	6.B Support a claim with evidence from experimental data.	
SPQ-4	**4.5 Stoichiometry**	5.C Explain the relationship between variables within an equation when one variable changes.	
	4.6 Introduction to Titration	3.A Represent chemical phenomena using appropriate graphing techniques, including correct scale and units.	
TRA-2	**4.7 Types of Chemical Reactions**	1.B Describe the components of and quantitative information from models and representations that illustrate both particulate-level and macroscopic-level properties.	
	4.8 Introduction to Acid-Base Reactions	1.B Describe the components of and quantitative information from models and representations that illustrate both particulate-level and macroscopic-level properties.	
	4.9 Oxidation-Reduction (Redox) Reactions	5.E Determine a balanced chemical equation for a given chemical phenomena.	
	Go to **AP Classroom** to assign the **Personal Progress Check** for Unit 4. Review the results in class to identify and address any student misunderstandings.		

About AP Big Ideas

Based on the Understanding by Design® (Wiggins and McTighe) model, this course framework provides a clear and detailed description of the course requirements necessary for student success. The framework specifies what students must know, be able to do, and understand, with a focus on big ideas that encompass core principles and theories of the discipline. The framework also encourages instruction that prepares students for advanced chemistry coursework.

Big Ideas

The big ideas serve as the foundation of the course and allow students to create meaningful connections among concepts. They are often abstract concepts or themes that become threads that run throughout the course. Revisiting the big ideas and applying them in a variety of contexts allows students to develop deeper conceptual understanding. Below are the big ideas of the course and a brief description of each.

BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ)

Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.

BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP)

Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.

BIG IDEA 3: TRANSFORMATIONS (TRA)

At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events.

BIG IDEA 4: ENERGY (ENE)

Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.

Spiraling the Big Ideas

The following table shows how the big ideas spiral across units.

Big Ideas	Unit 1 Atomic Structure and Properties	Unit 2 Molecular and Ionic Compound Structure and Properties	Unit 3 Intermolecular Forces and Properties	Unit 4 Chemical Reactions	Unit 5 Kinetics	Unit 6 Thermodynamics	Unit 7 Equilibrium	Unit 8 Acids and Bases	Unit 9 Applications of Thermodynamics
Scale, Proportion, and Quantity SPQ	✓		✓	✓					✓
Structure and Properties SAP	✓	✓	✓					✓	✓
Transformations TRA				✓	✓		✓		
Energy ENE					✓	✓			✓