# **Chemistry Academic**

**Curriculum Guide** 

**Dunmore School District** 

Dunmore, PA



#### **Chemistry Academic**

#### Prerequisite:

- Successful completion of biology.
- Strong algebra skills, including solving for variables, scientific notation, and working with exponents.

This is an introductory course in theories and concepts of modern chemistry. This course is designed to prepare students for college chemistry. Topics will be presented to increase awareness and understanding of the role of chemistry in everyday life and environmental issues. The course emphasizes the atomic and molecular structure, chemical bonding, stoichiometry, properties of gases, solutions, acid-base reactions, thermodynamics, and oxidation-reduction/electrochemistry, all with a strong emphasis on the mathematics of chemistry. The laboratory work will develop students reasoning power, the ability to apply chemical principles; as well as acquaint students with chemical laboratory techniques. This course meets seven periods each week. Two of the periods are dedicated to laboratory experiments. The laboratory experiences are an essential part of the course and are related to the topics and concepts being discussed at the time in class.

Year-at-a-glance

ject: Chemistry Academic	Grade Level: 11	Date Completed: 2/26/2018
--------------------------	-----------------	---------------------------

# 1<sup>st</sup> Quarter

Topic	Resources	Standards
Measuring	Teacher prepared	A.1.1.2, A.1.1.3
Nomenclature	Teacher prepared	A.1.1.1, A.1.1.5, A.1.2.2
Moles	Teacher prepared	A.1.1.1, A.1.2.4, B.1.1.1, B.2.2.2
More Moles	Teacher prepared	B.1.2.1, B.1.2.2, B.1.2.3

# 2<sup>nd</sup> Quarter

Topic	Resources	Standards
Balancing equations and some qualitative chemistry	Teacher prepared	B.2.1.4, B.2.1.5
Predicting products	Teacher prepared	B.2.1.3, B.2.1.4, B.2.1.5
Stoichiometry	Teacher prepared	B.2.1.1, B.2.1.2, B.2.2.2
Atomic Theory Part I	Teacher prepared	A.1.1.4, A.1.2.4, A.2.1.1, A.2.1.2, A.2.2.1, A.2.2.2, A.2.2.3, A.2.2.4, A.2.3.1

# 3<sup>rd</sup> Quarter

Topic	Resources	Standards
Coulomb's law, the shell model, and Atomic Theory Part II	Teacher prepared	A.2.2.1, A.2.2.2, A.2.2.3,
		A.2.2.4, A.2.3.1, A.2.3.2
Periodic trends	Teacher prepared	A.2.2.2, A.2.3.1, A.2.3.2
Introduction to Bonding	Teacher prepared	A.1.2.3, A.1.2.5, B.1.3.1,
		B.1.3.2, B.1.3.3, B.1.4.1,
		B.1.4.2

# 4<sup>th</sup> Quarter

Topic	Resources	Standards
Unit twelve: Introduction to the kinetic theory. Solids and	Teacher prepared	A.1.1.1, B.1.4.1
liquids. Heat calculations and calorimetry.		
Unit thirteen: Gas behavior	Teacher prepared	B.2.2.1
Unit fourteen: Gas laws and math	Teacher prepared	B.2.1.1, B.2.1.2, B.2.2.1, B.2.2.2
Unit fifteen: Electrochemistry	Teacher prepared	A.1.1.1, B.2.1.2
Review and Final Exam		

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested Time
	PA Academic and Core Standards	Essential Knowledge, Skills & Vocabulary	Activities		(In Days)
Measuring	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	13 days
	CHEM.A.1.1 Identify and	The scientific method		tests, quizzes, etc.	
This first unit is	describe how observable and	Metrics			
used as an	measurable properties can be	Measuring techniques			
introduction to	used to classify and describe	Significant digits			
chemistry,	matter and energy.	Scientific notation			
particularly the		Dimensional analysis			
•	Framework Concept:	Density			
lab aspect of	Stable forms of matter are	Percent Error			
chemistry, and	those in which the electric	Graphing			
how it relates to	potential energy is minimized.				
proper measuring		Lab Experiments:			
and handling of	PA Academic Standards:	B			
measurements.	Science:	Proper measuring with			
We will also learn		significant digits			
to deal with	(The following standards apply to	Density of water- inquiry			
conversions.	all units, but are not repeated in	Density of metal cylinder			
Conversions.	the document)	Identifying a metal using density			
MODULE A 4	2440 D. Avellerede en et	Density by graphing			
MODULE A.1—	3.1.10.D: Apply scale as a way of	Density of plastics- inquiry			
Structure and	relating concepts and ideas to one another by some measure.	Density of metal BB's- inquiry			
Properties of	Apply dimensional analysis	Bensity of Metal BB's inquiry			
Matter	and scale as a ratio.	Eligible Content:			
	<ul> <li>Convert one scale to another.</li> </ul>	CHEM.A.1.1.2 Classify			
Framework Big	Convert one scale to another.	observations as qualitative			
Idea: Matter can	3.1.10.E: Describe patterns of	and/or quantitative.			
be understood in	change in nature, physical and	, '			
terms of the	man-made systems.	CHEM.A.1.1.3 Utilize			
terms or the	Describe how fundamental	significant figures to			

	<del>_</del>	Curriculum Guide		 ,
types of atoms	science and technology	communicate the uncertainty		
present and the	concepts are used to solve	in a quantitative observation.		
interactions both	practical problems (e.g.,			
between and	momentum, Newton's laws of	Framework Competency:		
within atoms.	universal gravitation, tectonics,	Utilize significant figures to		
	conservation of mass and	communicate the precision in		
	energy,	a quantitative observation		
	<ul> <li>Recognize that stable systems often involve underlying</li> </ul>	Accuracy discussion:		
	dynamic changes (e.g., a	Calculate error and percent		
	chemical reaction at equilibrium	error given experimental		
	has molecules reforming	data and the accepted value.		
	continuously).	data and the accepted value.		
	Describe the effects of error in	Vocabulary:	1	
	measurements.	Density		
		Dimensional analysis		
	3.2.10.B: Apply process	,		
	knowledge and organize			
	scientific and technological			
	phenomena in varied ways.			
	Describe materials using			
	precise quantitative and			
	qualitative skills based on observations.			
	<ul> <li>Develop appropriate scientific</li> </ul>			
	experiments: raising questions,			
	formulating hypotheses, testing,			
	controlled experiments,			
	recognizing variables,			
	manipulating variables,			
	interpreting data, and producing		<u> </u>	
	solutions.			
	Use process skills to make			
	inferences and predictions using			
	collected information and to		<sup>1</sup>	

		Curricularii Guide		
communi	cate, using space /			
time relat	tionships, defining			
operation	nally.			
3.2.10.C:	Apply the elements of			
	inquiry to solve			
problems	· ·			
• Genera	te questions about			
	organisms and/or			
I	at can be answered			
through s	scientific investigations.			
	e the appropriateness			
of question				
I	an investigation with			
adequate	control and limited			
variables	to investigate a			
question.	-			
Conduc	t a multiple step			
experime	nt.			
Organiz	e experimental			
informati	on using a variety of			
analytic n	nethods.			
• Judge th	he significance of			
experime	ntal information in			
answering	g the question.			
• Suggest	additional steps that			
might be	done experimentally.			
3.2.10.D:	Identify and apply the			
technolog	gical design process to			
solve pro				
• Examine	e the problem, rank all			
necessary	/ information and all			
questions	s that must be			
answered	d.			

	Curriculum Guide		
Propose and analyze a			
solution.			
• Implement the solution.			
Evaluate the solution, test,			
redesign and improve as			
necessary.			
Communicate the process and			
evaluate and present the			
impacts of the solution.			
3.7.10.A: Identify and safely use			
a variety of tools, basic			
machines, materials and			
techniques to solve problems			
and answer questions.			
Select and safely apply			
appropriate tools, materials and			
processes necessary to solve			
complex problems.			
Apply advanced tool and			
equipment manipulation			
techniques to solve problems.			
3.7.10.B: Apply appropriate			
instruments and apparatus to			
examine a variety of objects and			
processes.			
Describe and use appropriate			
instruments to gather and			
analyze data.			
Compare and contrast			
different scientific measurement			
systems; select the best			
measurement system for a			
specific situation.			

	Curriculum Guide		
Explain the need to estimate			
measurements within error of			
various instruments.			
Apply accurate measurement			
knowledge to solve everyday			
problems.			
Describe and demonstrate the			
operation and use of advanced			
instrumentation in evaluating			
material and chemical			
properties (e.g., scanning			
electron microscope, nuclear			
magnetic resonance machines).			
3.7.10.D: Utilize computer			
software to solve specific			
problems.			
Identify legal restrictions in			
the use of software and the			
output of data.			
Apply advanced graphic			
manipulation and desktop			
publishing techniques.			
Apply basic multimedia			
applications.			
Apply advanced word			
processing, database and			
spreadsheet skills.			
Describe and demonstrate			
how two or more software			
applications can be used to			
produce an output.			
Select and apply software			
designed to meet specific needs.			

	Carricalani Galac		
PA Core Standards:			
Reading for Science and			
Technical Subjects, 6-12			
3.5 Reading Informational Text			
Students read, understand, and			
respond to informational text-			
with emphasis on comprehension,			
making connections among ideas			
and between texts with focus on			
textual evidence.			
PA Core Standards: Writing for			
Science and Technical Subjects,			
6-12			
3.6 Writing			
Students write for different			
purposes and audiences.			
Students write clear and focused			
text to convey a well-defined			
perspective and appropriate			
content.			

General Topic	Anchor Descriptor  PA Academic and Core  Standards	Eligible Content, Essential Knowledge, Skills & Vocabulary	Resources & Activities	Assessments	Suggested Time (In Days)
Nomenclature	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	11 days
	CHEM.A.1.1 Identify and	Classify matter		tests, quizzes, etc.	
In this unit we	describe how observable and	Heterogeneous			
will begin to learn	measurable properties can be	Solutions- solute and solvent			
the language of	used to classify and describe	Compounds			
chemistry,	matter and energy.	Elements Chemical changes			
starting with	CHEM.A.1.2 Compare the	Physical changes			
classifying matter	properties of mixtures.	Chemical properties			
and changes in	properties of mixtures.	Physical properties			
matter, then	Framework Concept:	Recognizing ionic vs covalent			
moving through	Stable forms of matter are	Writing binary and ternary			
nomenclature.	those in which the electric	ionic formulae			
	potential energy is minimized.	Naming binary and ternary ionic compounds			
MODULE A.1—		Writing and naming			
Structure and	PA Academic Standards:	molecular compounds			
Properties of	Science	Writing and naming acids and			
Matter	3.4.10.A: Explain concepts about	bases			
Framework Big	the structure and properties of matter.	Lab Experiments:			
Idea: Matter can	Recognize formulas for simple	Conductivity tests- inquiry			
be understood in	inorganic compounds.	Using a Bunsen burner			
terms of the	Apply knowledge of mixtures	Reaction in a bag- inquiry			
types of atoms	to appropriate separation	Separating a mixture			
present and the	techniques.	inquiry			
interactions both		Chemical or physical change-			

between and	PA Core Standards:	inquiry		
within atoms.	Reading for Science and	Elements vs compounds-		
	Technical Subjects, 6-12	inquiry		
	3.5 Reading Informational Text	Pure substance vs mixture-		
	Students read, understand, and	inquiry		
	respond to informational text-	Intro to chromatography		
	with emphasis on comprehension,	Chromatography whodunit-		
	making connections among ideas	inquiry		
	and between texts with focus on			
	textual evidence.	Eligible Content:		
		CHEM.A.1.1.1 Classify		
	PA Core Standards: Writing for	physical or chemical changes		
	Science and Technical Subjects,	within a system in terms of		
	6-12	matter and/or energy.		
	3.6 Writing	,		
	Students write for different	CHEM.A.1.1.5 Apply a		
	purposes and audiences.	systematic set of rules		
	Students write clear and focused	(IUPAC) for naming		
	text to convey a well-defined	compounds and writing		
	perspective and appropriate	chemical formulas (e.g.,		
	content.	binary covalent, binary ionic,		
		ionic compounds containing		
		polyatomic ions).		
		polyatornic ions).		
		CHEM.A.1.2.2 Differentiate		
		between homogeneous and		
		heterogeneous mixtures		
		(e.g., how such mixtures can		
		I		
		be separated).		
		Framework Competency:		
		Apply a systematic set of		
		rules (IUPAC) for naming		
		compounds and writing		

-	Curriculum Guide		
	chemical formulas (e.g.,		
	binary covalent, binary ionic,		
	ionic compounds containing		
	polyatomic ions)		
	Vocabulary:		
	Nomenclature		
	IUPAC		
	Cation		
	Anion		
	Polyatomic ion		
	·		

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core Standards	Essential Knowledge, Skills & Vocabulary			Time (In Days)
Moles	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	11 days
	CHEM.A.1.1 Identify and	Moles		tests, quizzes, etc.	
This unit goes	describe how observable and	Avogadro's number			
back to the	measurable properties can be	Atoms to molecules to moles			
quantitative	used to classify and describe	to grams			
nature of	matter and energy.	Ions to formula units to			
chemistry with an		moles to grams			
introduction to	CHEM.A.1.2 Compare the	Molarity			
	properties of mixtures.	Making a solution			
moles, and the		Dilutions			
many possible	CHEM.B.1.1 Explain how the	Volume of a gas at STP			
calculations	mole is a fundamental unit of	Lab E and an also			
concerning this in	chemistry.	Lab Experiments:			
chemistry,	CUENA D 2 2 Evaloia how the	Fundamentals of			
including our first	CHEM.B.2.2 Explain how the kinetic molecular theory relates	experimental design			
concentration	to the behavior of gases.	Find the hottest part of the			
unit- molarity.	to the behavior of gases.	Bunsen burner flame- inquiry			
unic molarity.	Framework Concept: The mole,	How many moles of Zn are in			
MODULE A—	as a fundamental unit, is used	a penny?- inquiry			
	to represent a specific quantity	Law of conservation of mass-			
Structure and	of atomic particles such as	inquiry			
Properties of	atoms, ions, formula units, and	Making a solution with			
Matter	molecules.	volumetric flask.			
		Testing the solution by			
MODULE B—The	PA Academic Standards:	evaporation			
Mole Concept	Science	How many atoms thick is the			
and Chemical	N/A	Al foil?- inquiry			
Interactions					
	PA Core Standards:				

		Curriculum Guide		
Framework Big	Reading for Science and	Eligible Content:		
Idea: Matter can	Technical Subjects, 6-12	CHEM.A.1.1.1 Classify		
be understood in	3.5 Reading Informational Text	physical or chemical changes		
terms of the	Students read, understand, and	within a system in terms of		
types of atoms	respond to informational text-	matter and/or energy.		
present and the	with emphasis on comprehension, making connections among ideas			
•	and between texts with focus on	CHEM.A.1.2.4 Describe		
interactions both	textual evidence.	various ways that		
between and	textual evidence.	concentration can be		
within atoms.	PA Core Standards: Writing for Science and Technical Subjects, 6-12 3.6 Writing Students write for different purposes and audiences. Students write clear and focused text to convey a well-defined perspective and appropriate content.	expressed and calculated (e.g., molarity, percent by mass, percent by volume).  CHEM.B.1.1.1 Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).		
		CHEM.B.2.2.2 Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.		
		Vocabulary: Avogadro's Number		
		Molar mass		
		Molar Volume		
		Standard Temperature		
		Standard Pressure		

General Topic	Anchor Descriptor PA Academic and Core Standards	Eligible Content, Essential Knowledge, Skills & Vocabulary	Resources & Activities	Assessments	Suggested Time (In Days)
More Moles	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	10 days
	CHEM.B.1.2 Apply the mole	Percentage composition		tests, quizzes, etc.	
The relationship	concept to the composition of	Finding ratios of atoms			
between Unit	matter.	Empirical formulae			
two's		Molecular formulae			
nomenclature	Framework Concept:	Hydrates			
and Unit three's	The mole, as a fundamental	% of water			
	unit, is used to represent a				
moles is explored	specific quantity of atomic	Lab Experiments:			
by calculating	particles such as atoms, ions,				
percentages by	formula units, and molecules.	Burning Mg and purifying			
mass and ratios of		MgO			
moles. It is a	PA Academic Standards:	Finding the formula of a			
preliminary look	Science	hydrate			
at the concept of		Finding the % of O₂ in the air			
stoichiometry,	N/A				
• •		Eligible Content:			
but only within a	PA Core Standards:	CHEM.B.1.2.1 Determine the			
formula.	Reading for Science and	empirical and molecular			
	Technical Subjects, 6-12	formulas of compounds.			
MODULE B—The	3.5 Reading Informational Text				
Mole Concept	Students read, understand, and respond to informational text-	CHEM.B.1.2.2 Apply the law			
and Chemical	with emphasis on comprehension,	of definite proportions to the			
Interactions	making connections among ideas	classification of elements and			
interactions	and between texts with focus on	compounds as pure			
	textual evidence.	substances.			
Framework Big		CHEM.B.1.2.3 Relate the			
Idea: Matter can	PA Core Standards: Writing for	percent composition and			
be understood in	Science and Technical Subjects,	mass of each element			

# Dunmore School District

		Curriculum Guide		
terms of the	6-12	present in a compound.		
types of atoms	3.6 Writing			
present and the	Students write for different			
interactions both	purposes and audiences. Students write clear and focused	Framework Competency:		
between and	text to convey a well-defined	Analyze and interpret data to		
within atoms.	perspective and appropriate	apply the laws of definite		
Within atomor	content.	proportions and multiple		
		proportions, to determine		
		empirical and molecular		
		formulas of compounds, percent composition and		
		mass of elements in a		
		compound.		
		compound.		
		Vocabulary:		
		Avogadro's number		
		Empirical Formula		
		Law of definite proportions		
		Law of multiple proportions		
		Molar mass		
		Molar volume		
		Molecular		
		Percent composition		
		Ratio		

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core Standards	Essential Knowledge, Skills & Vocabulary			Time (In Days)
Balancing	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	10 days
equations and	CHEM.B.2.1 Predict what	Balancing equations		tests, quizzes, etc.	
some qualitative	happens during a chemical	Writing reactions from word			
chemistry	reaction.	equations			
		Review acid/base			
The law of	Framework Concept:	nomenclature			
conservation of	The fact that atoms are	Predict the products of			
mass will be	conserved, together with	acid/base neutralization			
explored by	knowledge of chemical	Strong vs weak acids and			
balancing	properties of the elements	bases			
•	involved, can be used to	The pH scale			
chemical	describe and predict chemical				
equations, and	reactions and calculate	Lab Experiments:			
relating the	quantities of reactants and				
corresponding	products.	Conservation of mass			
chemical		revisited- inquiry			
reactions. Acids	Framework Concept:	Reaction in a bag revisited-			
and bases will be	Acids and bases are identified	inquiry			
discussed,	by their characteristics and	Tests to identify O <sub>2</sub> , H <sub>2</sub> , CO <sub>2</sub> ,			
ŕ	interactions. pH scale is a log	and H <sub>2</sub> O- inquiry			
followed by the	scale that reflects the	What gas is it? Al + CuCl <sub>2</sub> -			
first attempts to	concentration of protons in a	inquiry			
predict chemical	solution.	Balancing reactions bead			
reactions:	Solution.	activity The pure scale and			
neutralizations.	PA Academic Standards:	The pH scale and neutralizations.			
	Science	incuti diizations.			
MODULE B—The	3.1.10.E: Describe patterns of				
Mole Concept	change in nature, physical and	Eligible Content:			
and Chemical	man-made systems.	CHEM.B.2.1.4 Predict			
	Describe how fundamental	products of simple chemical			
Interactions	science and technology concepts	reactions (e.g., synthesis,			

		Curriculum Guide	
Framework Big	are used to solve practical	decomposition, single	
dea: Matter can	problems (e.g., conservation of	replacement, double	
e understood in	mass and energy, atomic theory,	replacement, combustion).	
terms of the	gas laws, feedback systems).		
types of atoms	Describe the effects of error in measurements.	CHEM.B.2.1.5 Balance	
present and the	measurements.	chemical equations by	
•	3.4.10.A: Explain concepts about	applying the Law of	
interactions both	the structure and properties of	Conservation of Matter.	
between and	matter.	Superior and Comment and a superior	
within atoms.	Describe various types of	Framework Competency:	
	chemical reactions by applying	Develop and use models to	
	the laws of conservation of mass	explain that atoms (and	
	and energy.	therefore mass) are	
		conserved during a chemical	
	PA Core Standards:	reaction. Models can include	
	Reading for Science and Technical Subjects, 6-12	computer models, ball and	
	3.5 Reading Informational Text	stick models, and drawings.	
	Students read, understand, and	otion models, and aratimger	
	respond to informational text-	Framework Competency:	
	with emphasis on comprehension,	Using models, differentiate	
	making connections among ideas	between acid and bases and	
	and between texts with focus on		
	textual evidence.	acid-base systems.	
	PA Core Standards: Writing for	Vocabulary:	
	Science and Technical Subjects,	Balance	

**Chemistry Academic** Page 20

рΗ

Mole ratio

**Products** 

Reactants

Proton

Neutralization

6-12

3.6 Writing

content.

Students write for different

perspective and appropriate

Students write clear and focused text to convey a well-defined

purposes and audiences.

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Predicting	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	9 days and 6
products	CHEM.A.1.2 Compare the	The 5 types of reactions		tests, quizzes, etc.	days for net
	properties of mixtures.	Reactions with water			ionic
Predicting the		Anhydrides			equations
products of a	CHEM.B.2.1 Predict what	The activity series			
chemical reaction	happens during a chemical	The solubility rules			
will now be	reaction.	Precipitates			
accomplished by		Classifying electrolytes			
learning the five	Framework Concept:	Molecular to Ionic to Net			
types of	The fact that atoms are	ionic reactions.			
reactions.	conserved, together with				
Followed by a	knowledge of chemical	Lab Experiments:			
mini-unit on net	properties of the elements				
ionic equations.	involved, can be used to	Exploring the five types of			
	describe and predict chemical	reactions			
MODULE B—The	reactions and calculate	Precipitate lab			
<b>Mole Concept</b>	quantities of reactants and	Making an activity series			
and Chemical	products.	Electrolyte?			
Interactions					
	PA Academic Standards:	Eligible Content:			
Framework Big	Science	CHEM.A.1.2.1 Compare			
•	3.4.10.A: Explain concepts about	properties of solutions			
Idea: Matter can	the structure and properties of	containing ionic or molecular			
be understood in	matter.	solutes (e.g., dissolving,			
terms of the	Describe various types of	dissociating).			
types of atoms	chemical reactions by applying				
present and the	the laws of conservation of mass	CHEM.B.2.1.3 Classify			
interactions both	and energy.	reactions as synthesis,			
between and	DA Cana Standandar	decomposition, single			
DC CVV CEIT ATTU	PA Core Standards:	replacement, double			

		1		 Т
within atoms.	Reading for Science and	replacement, or combustion.	 	
	Technical Subjects, 6-12	_	 	
	3.5 Reading Informational Text	CHEM.B.2.1.4 Predict	 	
	Students read, understand, and	products of simple chemical	 	
	respond to informational text-	reactions (e.g., synthesis,	 	
	with emphasis on comprehension, making connections among ideas	decomposition, single	 	
	and between texts with focus on	replacement, double	 	
	textual evidence.	replacement, combustion).	 	
	DA Core Standards Muiting for	CHEM.B.2.1.5 Balance	 	
	PA Core Standards: Writing for Science and Technical Subjects,	chemical equations by	 	
	6-12	applying the Law of	 	
	3.6 Writing	Conservation of Matter.	 	
	Students write for different	Framework Competency:		
	purposes and audiences. Students write clear and focused	Develop and use models to	 	
	text to convey a well-defined	explain that atoms (and	 	
	perspective and appropriate	therefore mass) are	 	
	content.	conserved during a chemical	 	
		reaction. Models can include	 	
		computer models, ball and	 	
		stick models, and drawings.	 	
		Vocabulary:	 	
		Balance	 	
		Chemical properties	 	
		Combustion	 	
		Decomposition	 	
		Double replacement	 	
		Mole ratio	 	
		Net ionic equations	 	
		Physical properties Products	 	
		Reactants	 	

	Redox		
	Single replacement		
	Synthesis		

<b>General Topic</b>	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Stoichiometry	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	10 days
	CHEM.B.2.1 Predict what	Stoichiometry of a balanced		tests, quizzes, etc.	
The unit is a	happens during a chemical	reaction			
culmination of all	reaction.	Limiting reactants			
of the work done		Grams of an excess reactant			
since the start of	CHEM.B.2.2 Explain how the	left over			
the course. A	kinetic molecular theory relates	% yield			
quantitative look	to the behavior of gases.				
at chemical		Lab Experiments:			
reactions will	Framework Concept:				
encompass units	The fact that atoms are	Intro to stoichiometry-			
one to six.	conserved, together with	inquiry			
	knowledge of chemical	Finding stoichiometric			
MODULE B—The	properties of the elements	equivalents			
Mole Concept	involved, can be used to	Limiting reactant lab			
and Chemical	describe and predict chemical	% yield lab			
Interactions	reactions and calculate	Sodium carbonate			
interactions	quantities of reactants and	production study- inquiry			
	products.	% of CO <sub>2</sub> in a carbonate			
Framework Big					
Idea: Matter can	Framework Concept:	Eligible Content			
be understood in	The mole, as a fundamental	CHEM.B.2.1.1 Describe the			
terms of the	unit, is used to represent a	roles of limiting and excess			
types of atoms	specific quantity of atomic	reactants in chemical			
present and the	particles such as atoms, ions,	reactions.			
interactions both	formula units, and molecules.				
		CHEM.B.2.1.2 Use			
between and	PA Academic Standards:	stoichiometric relationships			
within atoms.	Science	to calculate the amounts of			
	N/A	reactants and products			

	Carricalani Calac		
PA Core Standards:	involved in a chemical		
Reading for Science and	reaction.		
Technical Subjects, 6-12			
3.5 Reading Informational Text	Framework Competency:		
Students read, understand, and	Develop and use models to		
respond to informational text- with emphasis on comprehension,	explain that atoms (and		
making connections among ideas	therefore mass) are		
and between texts with focus on	conserved during a chemical		
textual evidence.	reaction. Models can include		
	computer models, ball and		
PA Core Standards: Writing for	stick models, and drawings.		
Science and Technical Subjects,	-		
6-12	Vocabulary:		
3.6 Writing Students write for different	Balance		
purposes and audiences.	Mole ratio		
Students write clear and focused	Products		
text to convey a well-defined	Reactants		
perspective and appropriate			
content.			

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Atomic Theory	<b>Anchor Descriptors:</b>	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	10 days
Part I	CHEM.A.1.1 Identify and	Concentration units of		tests, quizzes, etc.	
	describe how observable and	molality, mass percent, mole			
A mini-unit on	measurable properties can be	fraction			
colligative	used to classify and describe	Freezing point depression			
properties	matter and energy.	Boiling point elevation			
introduces this		History of atom from the			
unit, since at this	CHEM.A.1.2 Compare the	Greeks to today			
time of the year	properties of mixtures.	Dalton's atomic theory and			
icing on sidewalks		its revisions			
is a problem.	CHEM.A.2.1 Explain how atomic	Protons, electrons, and			
Then the	theory serves as the basis for	neutrons			
scientists and	the study of matter.	How are ions formed?			
discoveries that		Isotopes			
led to our current	CHEM.A.2.2 Describe the	The atomic models			
atomic model are	behavior of electrons in atoms.	The quantum theory			
studied.		Bohr's model			
	CHEM.A.2.3 Explain how	Schrodinger's equation			
MODULE A—	periodic trends in the properties	Electron configurations and			
Structure and	of atoms allow for the	the periodic table			
Properties of	prediction of physical and	Orbital notations and dot			
Matter	chemical properties.	diagrams			
Widte		Hund's rule			
	Framework Concept:				
Framework Big	Stable forms of matter are	Lab Experiments:			
Idea: Matter can	those in which the electric				
be understood in	potential energy is minimized.	Freezing point depression			
terms of the	Personal energy is imminized.	Boiling point elevation			
types of atoms	F	What is the law of multiple			
present and the	Framework Concept:	proportions?- inquiry			
interactions both	Each atom has a charged	Gold foil simulation			
ווונפו מננוטווא טטנוו	substructure consisting of a	Atomic map			

		Curriculum Guide		
between and	nucleus, which is made of	What is an isotope?— inquiry		
within atoms.	protons and neutrons,	Isotope- beanium		
	surrounded by electrons. The			
	periodic table orders elements	Eligible Content:		
	in increasing number of protons	CHEM.A.1.1.4		
	and places those with similar	Relate the physical properties of matter to its atomic or		
	chemical properties in columns.	molecular structure.		
	one mean proper tree in columns.	morecular structure.		
	Framework Concept:	CHEM.A.1.2.4 Describe		
	Each atom has a charged	various ways that		
	substructure consisting of a	concentration can be		
	nucleus, which is made of	expressed and calculated		
	protons and neutrons, and	(e.g., molarity, percent by		
	surrounding electrons.	mass, percent by volume).		
	Surrounding crossrons:	CHEM.A.2.1.1 Describe the		
	Framework Concept:	evolution of atomic theory		
	The structure and interactions	leading to the current model		
	of matter at the bulk scale are	of the atom based on the		
		works of Dalton, Thomson,		
	determined by electrical forces	Rutherford, and Bohr.		
	within and between atoms.			
	Properties of chemical	CHEM.A.2.1.2 Differentiate		
	compounds are related to	between the mass number of		
	electrostatic interaction	an isotope and the average atomic mass of an element.		
	between particles.	atomic mass of an element.		
	DA Acadomio Standarda	CHEM.A.2.2.1 Predict the		
	PA Academic Standards: Science	ground state electronic		
	3.1.10.E: Describe patterns of	configuration and/or orbital		
	change in nature, physical and	diagram for a given atom or		
	man-made systems.	ion.		
	Describe how fundamental	CUENA A 2 2 2 Due diet		
	science and technology	CHEM.A.2.2.2 Predict		

concepts are used to solve	characteristics of an atom or		
practical problems (e.g., atomic	an ion based on its location		
theory).	on the periodic table		
	(e.g., number of valence		
3.4.10.A: Explain concepts about	electrons, potential types of		
the structure and properties of	bonds, reactivity).		
matter.			
<ul> <li>Know that atoms are</li> </ul>	CHEM.A.2.2.3 Explain the		
composed of even smaller sub-	relationship between the		
atomic structures whose	electron configuration and		
properties are measurable.	the atomic structure of a		
	given atom or ion (e.g.,		
3.4.10.C: Distinguish among the	energy levels and/or orbitals		
principles of force and motion.	with electrons, distribution of		
<ul> <li>Describe light effects (e.g.,</li> </ul>	electrons in orbitals, shapes		
absorption, emission spectra,	of orbitals).		
polarization, interference).			
<ul> <li>Describe and measure the</li> </ul>	CHEM.A.2.2.4 Relate the		
motion of sound, light and other	existence of quantized		
objects.	energy levels to atomic		
	emission spectra.		
PA Core Standards:			
Reading for Science and	CHEM.A.2.3.1 Explain how		
Technical Subjects, 6-12	the periodicity of chemical		
3.5 Reading Informational Text	properties led to the		
Students read, understand, and	arrangement of elements on		
respond to informational text-	the periodic table.		
with emphasis on	Framework Competency:		
comprehension, making	Construct models showing		
connections among ideas and	that stable forms of matter		
between texts with focus on	are those with minimum		
textual evidence.	electrical field energy.		
DA Considerate to the second			
PA Core Standards: Writing for	Framowork Compatons		
 Science and Technical Subjects,	Framework Competency:		

	Curriculum Guide	1	, ,
6-12	Use the atomic model and		
3.6 Writing	the periodic table to predict		
Students write for different	and explain trends in		
purposes and audiences. Students write clear and focuse	properties of elements.		
text to convey a well-defined	u		
perspective and appropriate	Framework Competency:		
content.	Develop a model showing the		
	likely position of electrons as		
	determined by the quantized		
	energy levels of atoms.		
	Framework Competency:		
	Analyze and interpret data		
	obtained from measuring the		
	bulk properties of various		
	substances to explain the		
	relative strength of the		
	interactions among particles		
	in the substance.		
	Vocabulary:		
	Geometries and orbital		
	shapes		
	Lewis dot structures		
	Molecular		
	Octet rule		
	Configuration		
	Electrons		
	Neutrons		
	Nucleus		
	Orbital diagram		

Carricalani Galac	
Protons	
Subatomic	
Bohr	
Configuration	
Dalton	
Energy levels	
Excited state	
Ground state	
Orbitals	
Quantized	
Sublevels	
Rutherford	
Thomson	
Boiling Point	
Colligative	
Freezing Point	
Molality	

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Coulomb's law,	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	10 days and
the shell model,	CHEM.A.2.2 Describe the	Coulomb's law		tests, quizzes, etc.	11 days
and Atomic	behavior of electrons in atoms.	Ionization energy			
Theory Part II		The shell model			
	CHEM.A.2.3 Explain how	Sublevels			
This unit begins	periodic trends in the properties	Electron configurations			
with an in-depth,	of atoms allow for the	Photoelectron spectroscopy			
inquiry-based	prediction of physical and	Quantum numbers			
look at Coulomb's	chemical properties.	n, l, m and s			
law using Moog's		Electromagnetic radiation			
text on inquiry. It	Framework Concept:	The visible spectrum			
uses an analysis	Stable forms of matter are	Wavelength, frequency, and			
of ionization	those in which the electric	energy			
energies to show	potential energy is minimized.	Bohr's model of the atom			
experimental	Posterior energy to	Bohr's equation			
proof of the shell	Framework Concept:	Electron transitions			
model of the	Each atom has a charged				
atom, culminating		Lab Experiments:			
with	substructure consisting of a				
Photoelectron	nucleus, which is made of	Coulombic potential energy-			
Spectral analysis	protons and neutrons, and	inquiry			
(PES), and	surrounding electrons.	The shell model- inquiry			
relating it to		PES simulations- inquiry			
electron	Framework Concept:	Flame tests			
configurations	Coulomb's Law provides a	Phet simulation- Neon lights			
from the previous	•	and the Bohr model			
unit.	mathematical model that	Vision project			
Ougantum	describes and predicts the				
Quantum	effect of electrostatic forces	Flicible Contents			
numbers are	acting between electrically	Eligible Content:			
introduced,	charged objects.	CHEM.A.2.2.1 Predict the			
relating to	•	ground state electronic			

electron configurations, Schrodinger's equation, and the electron cloud model.  Framework Concept:  The speed of a wave in any medium is the product of the wave's frequency and wavelength.  CHEM.A.2.2.2 Predict characteristics of an atom or an ion based on its location on the periodic table	
Schrodinger's equation, and the electron cloud model.  Then the  medium is the product of the wave's frequency and wavelength.  CHEM.A.2.2.2 Predict characteristics of an atom or an ion based on its location on the periodic table	
equation, and the electron cloud model.  Then the  Then the  The product of the wave's frequency and wavelength.  Then the  The product of the wave's frequency and wavelength.  CHEM.A.2.2.2 Predict characteristics of an atom or an ion based on its location on the periodic table	
electron cloud model.  Wave s frequency and wavelength.  CHEM.A.2.2.2 Predict characteristics of an atom or an ion based on its location on the periodic table	
model. characteristics of an atom or an ion based on its location on the periodic table	
Then the Framework Concept: Characteristics of an atom of an ion based on its location on the periodic table	
Then the Framework Concept: on the periodic table	1
electromegnetic   Floctromagnetic waves are   16 g number of Valence	
electromagnetic Electromagnetic waves are (e.g., number of valence electrons, potential types of	
honds reactivity)	
introduced, through a vacuum at the speed	
followed by a of light and have an energy that CHEM.A.2.2.3 Explain the	
quantitative is directly proportional to the relationship between the	
analysis of the frequency of the wave. electron configuration and	
experimental     the atomic structure of a	
data behind line PA Academic Standards: given atom or ion (e.g.,	
spectra. This Science energy levels and/or orbitals	
3.1.10.E: Describe patterns of with electrons, distribution of change in patterns and change in patterns of ch	
calculations change in nature, physical and man-made systems. electrons in orbitals, shapes of orbitals).	
involving:  • Describe how fundamental	
wavelength, science and technology CHEM.A.2.2.4 Relate the	
frequency, concepts are used to solve existence of quantized	
energy, changing practical problems (e.g., atomic energy levels to atomic	
energy levels, theory). emission spectra.	
ground state and	
3.4.10.A: Explain concepts about CHEM.A.2.3.1 Explain now	
excited state the structure and properties of the periodicity of chemical	
electron matter. properties led to the	
• Know that atoms are arrangement of elements on	
composed of even smaller sub- the periodic table.  atomic structures whose	
proportion are measurable CHEM A 2.2.2 Compare	
Structure and properties are measurable. CHEM.A.2.3.2 Compare and/or predict the properties	
Properties of and/or predict the properties	

Framework Big
Idea: Matter can
be understood in
terms of the
types of atoms
present and the
interactions both
between and
within atoms.

Matter

Framework Big Idea: Interactions between any two objects can cause changes in one or both of them.

Framework Big
Idea: Waves are a
repeating pattern
of motion that
transfers energy
from place to
place without
overall
displacement of
matter.

3.4.10.C: Distinguish among the principles of force and motion.

- Describe light effects (e.g., absorption, emission spectra, polarization, interference).
- Describe and measure the motion of sound, light and other objects.

### PA Core Standards: Reading for Science and Technical Subjects, 6-12

3.5 Reading Informational Text Students read, understand, and respond to informational textwith emphasis on comprehension, making connections among ideas and between texts with focus on textual evidence.

# PA Core Standards: Writing for Science and Technical Subjects, 6-12

3.6 Writing
Students write for different
purposes and audiences.
Students write clear and focused
text to convey a well-defined
perspective and appropriate
content.

(e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

#### **Framework Competency:**

Construct models showing that stable forms of matter are those with minimum electrical field energy.

#### **Framework Competency:**

Develop a model showing the likely position of electrons as determined by the quantized energy levels of atoms.

#### Framework Competency:

Use mathematical representations of Coulomb's Law to describe and predict the electrostatic forces between objects.

#### **Framework Competency:**

Analyze and interpret data to support the claim that the speed of a wave in a medium is the product of the wave's

1			
	frequency and the wave's		
	wavelength.		
	Framework Competency:		
	Evaluate the claims,		
	evidence, and reasoning		
	behind the idea that		
	electromagnetic radiation		
	can be described either by a		
	wave model or a particle		
	model, and that for some		
	situations one model is more		
	useful than the other.		
	Framework Competency:		
	Generate and analyze data to		
	support the claim that the		
	energy of an electromagnetic		
	wave is directly proportional		
	to the frequency of the wave.		
	, ,		
	Vocabulary:		
	Coulomb's Law		
	Bohr		
	Configuration		
	Dalton		
	Electronic		
	Emission		
	Energy levels		
	Excited state		
	Ground state		

Orbitals	
Quantized	
Sublevels	
Rutherford	
Spectra	
Thomson	
Electrostatic force	
Medium	
Frequency	
Wave	
Wavelength	
Electromagnetic wave	
Particle model	
Photon	
Wave model	
Frequency	
Proportional	

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Periodic trends	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	13 days
	CHEM.A.2.2 Describe the	Trends		tests, quizzes, etc.	
Using the periodic	behavior of electrons in atoms.	Element uses			
table as tool to		Further investigating the			
find trends in	CHEM.A.2.3 Explain how	table			
atomic radius,	periodic trends in the properties	Lab Everagina auto.			
electronegativity,	of atoms allow for the prediction of physical and	Lab Experiments:			
electron affinity,	chemical properties.	Periodic table activities # 1-5			
ionization energy,	chemical properties.	remodic table activities # 1-3			
oxidation state,	Framework Concept:	Eligible Content:			
and various other	Each atom has a charged	CHEM.A.2.2.2 Predict			
properties. The	substructure consisting of a	characteristics of an atom or			
properties are	nucleus, which is made of	an ion based on its location			
used to construct	protons and neutrons,	on the periodic table			
various periodic	surrounded by electrons. The	(e.g., number of valence			
table puzzles, as	periodic table orders elements	electrons, potential types of bonds, reactivity).			
well as to identify	in increasing number of protons	bonds, reactivity).			
common uses for	and places those with similar	CHEM.A.2.3.1 Explain how			
elements and	chemical properties in columns.	the periodicity of chemical			
	chemical properties in columns.	properties led to the			
element families.	PA Academic Standards:	arrangement of elements on			
MACDINE A 4	Science	the periodic table.			
MODULE A.1—	3.1.10.C: Apply patterns as				
Structure and	repeated processes or recurring	CHEM.A.2.3.2 Compare			
Properties of	elements in science and	and/or predict the properties			
Matter	technology.	(e.g., electron affinity,			
	Examine and describe	ionization energy, chemical reactivity, electronegativity,			
Framework Big	recurring patterns that form the	atomic radius) of selected			
Idea: Matter can	basis of chemical periodicity.	elements by using their			
		ciements by using their			

		Curriculum Guide		
be understood in	3.4.10.A: Explain concepts about	locations on the periodic		
terms of the	the structure and properties of	table and known trends.		
types of atoms	matter.			
present and the	Explain the repeating pattern	Framework Competency:		
interactions both	of chemical properties by using	Use the atomic model and		
between and	the repeating patterns of atomic	the periodic table to predict		
within atoms.	structure within the periodic	and explain trends in		
within atoms.	table.	properties of elements.		
	PA Core Standards: Reading for Science and Technical Subjects, 6-12 3.5 Reading Informational Text Students read, understand, and respond to informational text- with emphasis on comprehension, making connections among ideas and between texts with focus on textual evidence.  PA Core Standards: Writing for Science and Technical Subjects, 6-12 3.6 Writing	Vocabulary: Atomic radius Charge Chemical Configuration Effective nuclear charge Electron affinity Electronegativity Electrons Elements Energy Ionization Neutrons Nucleus Orbital diagram Particles		
	Students write for different	Physical properties Protons		
	purposes and audiences.	Reactivity		
	Students write clear and focused	Shielding effect		
	text to convey a well-defined perspective and appropriate content.	Subatomic		

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Introduction to	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	11 days
Bonding	CHEM.A.1.2 Compare the	Differences in		tests, quizzes, etc.	
	properties of mixtures.	electronegativity			
This unit expands		Ionic vs covalent bonding			
on past	CHEM.B.1.3 Explain how atoms	Polar covalent bonds vs polar			
investigations	form chemical bonds.	molecules			
into the atom,		Molecular motions			
specifically how	CHEM.B.1.4 Explain how models	Drawing Lewis structures			
atoms interact to	can be used to represent	Limitations of the VSEPR			
form compounds.	bonding.	theory			
•	5	Geometry and bond angles			
Electronegativity	Framework Concept:	Predicting polarity			
is the focus of the	Stable forms of matter are	Drawing 3-dimensional shapes			
discussion.	those in which the electric	Resonance			
Molecular	potential energy is minimized.	Calculating formal charge			
geometry, 3-		carearding formal charge			
dimensional	Framework Concept:	Lab Experiments:			
shapes, and	Properties of chemical	·			
ultimately	compounds are related to	Creating molecular models #			
polarity are	electrostatic interaction	1-4			
explored through	between particles.	Testing bond properties			
the drawing of		Identifying ionic vs covalent bonds			
Lewis structures.	Framework Concept:	Making an alloy			
The unit ends	The structure and interactions	Shape and polyatomic ions-			
with a discussion	of matter at the bulk scale are	inquiry			
of formal charge	determined by electrical forces				
to evaluate the	within and between atoms.	Eligible Content:			
concept of	Properties of chemical	CHEM.A.1.2.3 Describe how			
•	· · · · · · · · · · · · · · · · · · ·	1		1	

resonance.	compounds are related to	factors (e.g., temperature,		
resonance.	· ·	concentration, surface area)		
140DUUE 1	electrostatic interaction	can affect solubility.		
MODULE A—	between particles.	can affect solubility.		
Properties and		CHEM.A.1.2.5 Describe how		
Classification of	PA Academic Standards:	chemical bonding can affect		
Matter	Science	whether a substance		
		dissolves in a given liquid.		
MODULE B— The	3.4.10.A: Explain concepts about	grand grant quan		
Mole and	the structure and properties of	CHEM.B.1.3.1 Explain how		
Chemical	matter.	atoms combine to form		
Interactions	Explain the formation of	compounds through ionic		
interactions	compounds and their resulting properties using bonding	and covalent bonding.		
	theories (ionic and covalent).			
Framework Big	theories (lottic and covalent).	CHEM.B.1.3.2 Classify a bond		
Idea: Matter can	PA Core Standards:	as being polar covalent, non-		
be understood in	Reading for Science and	polar covalent, or ionic.		
terms of the	Technical Subjects, 6-12			
types of atoms	3.5 Reading Informational Text	CHEM.B.1.3.3 Use		
present and the	Students read, understand, and	illustrations to predict the		
interactions both	respond to informational text-	polarity of a molecule.		
between and	with emphasis on comprehension,	<b>5</b>		
within atoms.	making connections among ideas	Framework Competency:		
within atoms.	and between texts with focus on	Construct models showing		
	textual evidence.	that stable forms of matter		
	PA Core Standards: Writing for	are those with minimum		
	Science and Technical Subjects,	electrical field energy.		
	6-12			
	3.6 Writing	Framework Competency:		
	Students write for different	Use Lewis Structures and		
	purposes and audiences.	VSEPR to predict and explain		
	Students write clear and focused	charge distribution across a		
	text to convey a well-defined			
	perspective and appropriate	particle (atom, ion, molecule		
	content.	or formula unit).		

Framework Competency:
Analyze and interpret data
obtained from measuring the
bulk properties of various
substances to explain the
relative strength of the
interactions among particles
in the substance.
Vocabulary:
Geometries and orbital
shapes
Lewis dot structures
Molecular
Octet rule
Atoms
Covalent bond
Electronegativity scale
lons
Ionic Bond
Metallic Bonding
Molecules
Polarity
VSEPR/shape Boiling point
Bonding
Dispersion Forces
Freezing point
Hydrogen
Intermolecular
"Like dissolves like"

	London		
	Van der Waals		
	Melting point		
	Polarity		
	Vapor pressure		

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Introduction to	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	9 days
the kinetic	CHEM.A.1.1 Identify and	Solids, liquids, gases		tests, quizzes, etc.	
theory. Solids	describe how observable and	The 7 crystal systems			
and liquids. Heat	measurable properties can be	A unit cell			
calculations and	used to classify and describe	Bonding in diamonds vs			
calorimetry.	matter and energy.	graphite			
		Amorphous material			
This unit begins	CHEM.B.1.4 Explain how models	The pitch drop experiment			
with a discussion	can be used to represent	Viscosity			
of intermolecular	bonding.	Defining temperature			
forces and what		Absolute zero			
makes a solid a	AP Chemistry Enduring	Reversible changes			
solid, which leads	understanding 5.A:	Dynamic equilibrium			
to understanding	Two systems with different	Phase changes			
the dynamics of a	temperatures that are in	Standard pressure values			
beaker of water	thermal contact will exchange	Vapor pressure			
with and without	energy. The quantity of thermal	Phase diagrams			
a lid on it. This	energy transferred from one	Specific heat capacity			
continues to the	system to another is called heat.	Enthalpy			
interpretation of		Calorimetry			
a phase diagram	Framework Concept:				
and relating it to	A stable molecule has lower	Lab Experiments:			
a heating curve.	energy, by an amount known as				
Heat calculation	the binding energy, than the	Models of the crystal systems			
follow including	same set of atoms separated;	Heating curve			
extensive work	this energy must be provided to	Specific heat of a metal			
with calorimetry.		Temperature of a Bunsen			
	break the bond.	burner flame			
MODULE A—					
Properties and	Framework Concept:				
Classification of	The structure and interactions				
Matter	of matter at the bulk scale are				

			ı		
	determined by electrical forces	Eligible Content:			
MODULE B— The	within and between atoms.	CHEM.A.1.1.1			
Mole and	Properties of chemical	Classify physical or chemical			
Chemical	compounds are related to	changes within a system in			
Interactions	electrostatic interaction	terms of matter and/or energy.			
	between particles.	energy.			
AP Chemistry Big	-	CHEM.B.1.4.1 Recognize and			
Idea 5: The laws	Framework Concept:	describe different types of			
of	The energy an object has within	models that can be used to			
thermodynamics	a system depends on the	illustrate the bonds that hold			
describe the	object's motion and	atoms together in a			
Essential role of	interactions with other objects	compound (e.g., computer			
energy and	in that system.	models, ball-and-stick models, graphical models,			
explain and	c.i.de oyote	solid-sphere models,			
predict the	Framework Concept:	structural formulas, skeletal			
direction of	Any change in an object's	formulas, Lewis dot			
changes in	energy is the result of	structures).			
matter.	interactions with other objects				
matter.	•	AP Chemistry Essential			
Framework Big	in a system or a transfer of	knowledge 5.A.1:			
Idea: Matter can	energy between systems,	Temperature is a measure of			
be understood in	changing in the total energy of	the average kinetic energy of atoms and molecules.			
	the systems involved.	atoms and molecules.			
terms of the					
types of atoms	Framework Concept:	All of the molecules in a			
present and the	Any energy gain or loss in a	sample are in motion.			
interactions both	system will result in a	The Kelvin temperature of a			
between and	corresponding energy loss or	sample of matter is			
within atoms.	gain in another system.	proportional to the average			
		kinetic energy of the particles			
Framework Big	PA Academic Standards:	in the sample. When the			
Idea: Interactions	Science	,		_	

of objects or
systems of objects
can be predicted
and explained using
the concept of
energy transfer and
conservation.

- 3.1.10.B: Describe concepts of models as a way to predict and understand science and technology.
- Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory).
- 3.1.10.E: Describe patterns of change in nature, physical and man-made systems.
- Recognize that stable systems often involve underlying dynamic changes (e.g., a chemical reaction at equilibrium has molecules reforming continuously).
- 3.4.10.A: Explain concepts about the structure and properties of matter.
- Describe phases of matter according to the Kinetic Molecular Theory.
- 3.4.10.B: Analyze energy sources and transfers of heat.
- Evaluate energy changes in chemical reactions.

## PA Core Standards: Reading for Science and

average kinetic energy of the particles in the sample doubles, the Kelvin temperature is doubled. As the temperature approaches 0 K (zero Kelvin), the average kinetic energy of a system approaches a minimum near zero.

The Maxwell-Boltzmann distribution shows that the distribution of kinetic energies becomes greater (more disperse) as temperature increases.

# AP Chemistry Essential knowledge 5.A.2:

The process of kinetic energy transfer at the particulate scale is referred to in this course as heat transfer, and the spontaneous direction of the transfer is always from a hot to a cold body.

On average, molecules in the warmer body have more kinetic energy than the molecules in the cooler body.

Collisions of molecules that are in thermal contact transfer energy.

	Curriculum Guide		
Technical Subjects, 6-12	Scientists describe this		
3.5 Reading Informational Text	process as "energy is		
Students read, understand, and	transferred as heat."		
respond to informational text-			
with emphasis on	Eventually, thermal		
comprehension, making	equilibrium is reached as the		
connections among ideas and	molecular collisions		
between texts with focus on	continue.		
textual evidence.			
	The average kinetic energy		
PA Core Standards: Writing for	of both substances is the		
Science and Technical Subjects,	same at thermal		
6-12			
3.6 Writing Students write for different	equilibrium.		
purposes and audiences.	Heat is not a substance, i.e.,		
Students write clear and focused	it makes no sense to say		
text to convey a well-defined	that an object contains a		
perspective and appropriate	certain amount of heat.		
content.	Rather, "heat exchange" or		
l something	"transfer of energy as heat"		
	refers to the process in		
	which energy is transferred		
	from a hot to a cold body in		
	thermal contact.		
	thermal contact.		
	The transfer of a given		
	amount of thermal energy		
	will not produce the same		
	temperature change in		
	equal masses of matter with		
	differing specific heat		
	capacities.		
	AP Chemistry Enduring		

Curriculum Guide						
		understanding 5.B:				
		Energy is neither created nor				
		destroyed, but only				
		transformed from one form				
		to another.				
		AP Chemistry Essential				
		knowledge 5.B.3:				
		Chemical systems undergo				
		three main processes that				
		change their energy:				
		heating/cooling, phase				
		transitions, and chemical				
		reactions.				
		Heating a system in crosses				
		Heating a system increases				
		the energy of the system,				
		while cooling a system				
		decreases the energy. A liter				
		of water at 50°C has more				
		energy than a liter of water				
		at 25°C.				
		The amount of a series				
		The amount of energy				
		needed to heat one gram of				
		a substance by 1°C is the				
		specific heat capacity of that				
		substance.				
		Energy must be transferred				
		to a system to cause it to				
		melt (or boil). The energy of				
		the system therefore				
		increases as the system				
		mercases as the system				

	Curriculum Guide		
	undergoes a solid-liquid (or		
	liquid-gas) phase transition.		
	Likewise, a system gives off		
	energy when it freezes (or		
	condenses). The energy of		
	the system decreases as the		
	system undergoes a liquid-		
	solid (or gas-liquid) phase		
	transition.		
	The amount of energy		
	needed to vaporize one mole		
	of a pure substance is the		
	molar enthalpy of		
	vaporization, and the energy		
	released in condensation has		
	an equal magnitude. The		
	molar enthalpy of fusion is		
	the energy absorbed when		
	one mole of a pure solid		
	melts or changes from the		
	solid to liquid state and the		
	energy released when the		
	liquid solidifies has an equal		
	magnitude.		
	When a chemical reaction		
	occurs, the energy of the		
	system decreases		
	(exothermic reaction),		
	increases (endothermic		
	reaction), or remains the		
	same. For exothermic		
	reactions, the energy lost by		
<u></u>	21 2112112, 1112 3110.01 1000 01		

the reacting molecules (system) is gained by the surroundings. The energy is transferred to the surroundings by either heat or work. Likewise, for endothermic reactions, the system gains energy from the surroundings by heat transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome integred out the force and for		Curriculum Guide		
surroundings. The energy is transferred to the surroundings by either heat or work. Likewise, for endothermic reactions, the system gains energy from the surroundings by heat transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		the reacting molecules		
transferred to the surroundings by either heat or work. Likewise, for endothermic reactions, the system gains energy from the surroundings by heat transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.8.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		(system) is gained by the		
surroundings by either heat or work. Likewise, for endothermic reactions, the system gains energy from the surroundings by heat transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		surroundings. The energy is		
or work. Likewise, for endothermic reactions, the system gains energy from the surroundings by heat transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		transferred to the		
endothermic reactions, the system gains energy from the surroundings by heat transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		surroundings by either heat		
system gains energy from the surroundings by heat transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		or work. Likewise, for		
surroundings by heat transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		endothermic reactions, the		
transfer or work done on the system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		system gains energy from the		
system.  The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		surroundings by heat		
The enthalpy change of reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		transfer or work done on the		
reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		system.		
reaction gives the amount of energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		The enthalpy change of		
energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome				
values) or absorbed (for positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		_		
positive values) by a chemical reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome				
reaction at constant pressure.  AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome				
AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome				
AP Chemistry Essential knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		pressure.		
knowledge 5.B.4: Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		•		
Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		AP Chemistry Essential		
experimental technique that is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		knowledge 5.B.4:		
is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		Calorimetry is an		
is used to determine the heat exchanged/transferred in a chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		•		
Chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome				
Chemical system.  Framework Competency: Construct models showing that energy is needed to break bonds and overcome		exchanged/transferred in a		
Construct models showing that energy is needed to break bonds and overcome				
Construct models showing that energy is needed to break bonds and overcome				
that energy is needed to break bonds and overcome		Framework Competency:		
break bonds and overcome		Construct models showing		
		that energy is needed to		
intermolecular forces and		break bonds and overcome		
intermolecular forces affu		intermolecular forces and		

that energy is released when	
bonds form.	
Framework Competency:	
Analyze and interpret data	
obtained from measuring the	
bulk properties of various	
substances to explain the	
relative strength of the	
interactions among particles	
in the substance.	
Framework Competency:	
Construct an explanation for	
the energy of an object has in	
a system based on the	
object's motion and the	
object's interaction with	
other objects in the system.	
Framework Competency:	
Develop and use a model to	
explain how an object's	
energy is transferred or	
transformed as objects	
interact within a system.	
Framework Competency:	
Identify problems and	
suggest design solutions to	
optimize the energy transfer	
optimize the energy transfer	

Curriculum Guide						
		between objects or systems				
		of objects.				
		Vocabulary:				
		Activation Binding Energy				
		Bond Energy				
		Endothermic				
		Energy				
		Enthalpy				
		Exothermic				
		Lattice energy				
		Physical properties				
		Boiling point				
		Bonding				
		Dispersion Forces				
		Freezing point				
		Hydrogen				
		Intermolecular				
		"Like dissolves like"				
		London				
		Van der Waals				
		Melting point				
		Polarity				
		Vapor pressure				
		Kinetic energy				
		Potential energy				
		Energy transfer				
		Model				
		System				
		Design				
		Energy transfer				
		2.10.01 (10113101				

		Solution			
1		1	l e e e e e e e e e e e e e e e e e e e	1	

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Gas behavior	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	10 days
	CHEM.B.2.2 Explain how the	The kinetic theory revisited		tests, quizzes, etc.	
An explanation of	kinetic molecular theory relates	Hooke			
what causes	to the behavior of gases.	Pressure			
pressure starts		Manometer calculations			
this unit on gases.	Framework Concept:	Absolute zero, again			
Then after	The kinetic molecular theory	Boyle's law			
learning how	and Gas Laws are used to	Charles' law			
pressure is	explain and predict the	Gay-Lussac's law			
measured, we	behavior of gases.	Avogadro's law			
discuss the		Diffusion and effusion			
relationship	PA Academic Standards:	Graham's law			
between	Science	Real gases			
pressure,		Joule-Thompson effect			
temperature, and	3.1.10.B: Describe concepts of				
volume of a gas	models as a way to predict and	Lab Experiments:			
and what makes a	understand science and				
gas ideal.	technology.	Determining absolute zero			
Followed by a	<ul> <li>Distinguish between different</li> </ul>	Boyle's law			
discussion of	types of models and modeling	Charles' law			
diffusion.	techniques and apply their	Gay-Lussac's law			
	appropriate use in specific	Graham's law			
MODULE B— The	applications (e.g., kinetic gas	Online Gas simulation			
Mole and	theory).	activities			
Chemical					
Interactions	3.1.10.E: Describe patterns of	Eligible Content:			
	change in nature, physical and	CHEM.B.2.2.1 Utilize			
F	man-made systems.	mathematical relationships			
Framework Big	Describe how fundamental	to predict changes in the			
Idea: Matter can	science and technology	number of particles, the			
be understood in					<u> </u>

	1	Curriculum Guide		1
terms of the	concepts are used to solve	temperature, the pressure,		
types of atoms	practical problems (e.g., gas	and the volume in a gaseous	_	
present and the	laws).	system (i.e., Boyle's law,	_	
interactions both		Charles's law, Dalton's law of	_	
between and	3.4.10.A: Explain concepts about	partial pressures, the		
within atoms.	the structure and properties of	combined gas law, and the	_	
	matter.	ideal gas law).		
	<ul> <li>Predict the behavior of gases</li> </ul>			
	through the use of Boyle's,	Framework Competency:		
	Charles' or the ideal gas law, in	Utilize mathematical	_	
	everyday situations.	relationships to predict	_	
	Describe phases of matter	changes in the number of		
	according to the Kinetic	particles (moles), the		
	Molecular Theory.	temperature, the pressure,		
		and the volume in a gaseous		
	PA Core Standards:	system (i.e., Boyle's Law,		
	Reading for Science and	Charles' Law, Avogadro's		
	Technical Subjects, 6-12	Law, Dalton's Law of partial		
	3.5 Reading Informational Text	pressures, the combined gas		
	Students read, understand, and	law, and the ideal gas law).		
	respond to informational text-			
	with emphasis on comprehension,	Vocabulary:	_	
	making connections among ideas	Absolute Zero		
	and between texts with focus on	Avogadro's law		
	textual evidence.	Boyle's law		
		Charles's law		
	PA Core Standards: Writing for	Gay-Lussac's law		
	Science and Technical Subjects,	Molar mass		
	6-12	Molar volume		
	3.6 Writing	Pressure		
	Students write for different	STP		
	purposes and audiences. Students write clear and focused			
	text to convey a well-defined			
	perspective and appropriate			
	content.			
	content.		<u> </u>	 <u> </u>

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Gas laws and	Anchor Descriptor	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	11 days
math	CHEM.B.2.1 Predict what	The named laws		tests, quizzes, etc.	
	happens during a chemical	The combined gas law			
The quantitative	reaction.	The ideal gas law			
study of the gas		Partial pressure and Dalton's			
laws, and	CHEM.B.2.2 Explain how the	law			
stoichiometry of	kinetic molecular theory relates	Graham's law			
gases not at STP.	to the behavior of gases.	Stoichiometry not at STP			
MODULE B— The	Framework Concept:	Lab Experiments:			
Mole and	The kinetic molecular theory				
Chemical	and Gas Laws are used to	Calculate rate of diffusion			
Interactions	explain and predict the	Find the value of R			
interactions	behavior of gases.	Molar mass of butane			
		A gas collected over water			
Framework Big	PA Academic Standards:				
Idea: Matter can	Science	Eligible Content:			
be understood in	3.1.10.B: Describe concepts of	CHEM.B.2.1.1 Describe the			
terms of the	models as a way to predict and	roles of limiting and excess			
types of atoms	understand science and	reactants in chemical			
present and the	technology.	reactions.			
interactions both	Distinguish between different				
between and	types of models and modeling	CHEM.B.2.1.2 Use			
within atoms.	techniques and apply their	stoichiometric relationships			
	appropriate use in specific	to calculate the amounts of			
	applications (e.g., kinetic gas	reactants and products			
	theory).	involved in a chemical			
	- "	reaction.			
	3.1.10.E: Describe patterns of	CHEM.B.2.2.1 Utilize			
	change in nature, physical and	mathematical relationships			

	Curriculum Guide		
man-made systems.	to predict changes in the		
Describe how fundamental	number of particles, the		1
science and technology	temperature, the pressure,		1
concepts are used to solve	and the volume in a gaseous		1
practical problems (e.g., gas	system (i.e., Boyle's law,		1
laws).	Charles's law, Dalton's law of		1
	partial pressures, the		1
3.4.10.A: Explain concepts about	combined gas law, and the		1
the structure and properties of	ideal gas law).		1
matter.			1
<ul> <li>Predict the behavior of gases</li> </ul>	CHEM.B.2.2.2 Predict the		1
through the use of Boyle's,	amounts of reactants and		1
Charles' or the ideal gas law, in	products involved in a		1
everyday situations.	chemical reaction using		1
Describe phases of matter	molar volume of a gas at STP.		1
according to the Kinetic			1
Molecular Theory.	Framework Competency:		1
	Utilize mathematical		1
PA Core Standards:	relationships to predict		1
Reading for Science and	changes in the number of		1
Technical Subjects, 6-12	particles (moles), the		1
3.5 Reading Informational Text	temperature, the pressure,		1
Students read, understand, and	and the volume in a gaseous		1
respond to informational text-	system (i.e., Boyle's Law,		1
with emphasis on comprehension,	Charles' Law, Avogadro's		1
making connections among ideas	Law, Dalton's Law of partial		
and between texts with focus on	pressures, the combined gas		
textual evidence.	law, and the ideal gas law).		ı

# **PA Core Standards: Writing for** Science and Technical Subjects, 6-12

3.6 Writing Students write for different purposes and audiences. Students write clear and focused

## Vocabulary:

Avogadro's law Boyle's law Charles's law Combined gas law Dalton's law of density

text to convey a well-defined perspective and appropriate content.	Partial pressures Gay-Lussac's law Ideal Gas Law Molar mass Molar volume Pressure STP		

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Electrochemistry	Anchor Descriptor:	Essential Knowledge/Skills:	Teacher prepared	Teacher prepared	10 days
	N/A	Redox reactions		tests, quizzes, etc.	
In this final unit	AP Chemistry Enduring	Balance redox in acidic and			
we will study how	understanding 3.B:	basic solutions			
electrons drive	Chemical reactions can be	Standard reduction			
	classified by considering what	potentials			
chemical	the reactants are, what the	Charge produced and			
reactions,	products are, or how they	stoichiometry			
specifically those	change from one into the other.	Voltaic cells			
used to create an	Classes of chemical reactions	Electrolytic cells			
electrochemical	include synthesis,				
battery.	decomposition, acid-base, and				
watte. y.	oxidation-reduction reactions.	Eligible Content:			
AD Chamista Pis		AP Chemistry Essential			
AP Chemistry Big	AP Chemistry Enduring	Knowledge 3.B.3:			
Idea 3: Changes in	understanding 3.C:	In oxidation-reduction			
matter involve	Chemical and physical	(redox) reactions, there is a			
the	transformations may be	net transfer of electrons. the			
rearrangement	observed in several ways and	species that loses electrons is			
and/or	typically involve a change in	oxidized, and the species that			
reorganization of	energy.	gains electrons is reduced.			
atoms and/or the	Framework Concept:	AP Chemistry Essential			
transfer of	The fact that atoms are	knowledge 3.C.3:			
electrons.		Electrochemistry shows the			
electrons.	conserved, together with	inter-conversion between			
	knowledge of the chemical	chemical and electrical			
Framework Big	properties of the elements	energy in galvanic and			
Idea: Matter can	involved, can be used to	electrolytic cells.			
be understood in	describe and predict chemical	Electrochemistry			
terms of the	reactions.	encompasses the study of			
types of atoms		redox reactions that occur			
-71- 3		redox redections that occur			ĺ

		Curriculum Guide		
present and the	PA Academic Standards:	within electrochemical cells.		
interactions both	Science	The reactions either generate		
between and	3.4.10.B: Analyze energy sources	electrical current in galvanic		
within atoms.	and transfers of heat.	cells, or are driven by an		
	Evaluate energy changes in	externally applied electrical		
	chemical reactions.	potential in electrolytic cells.		
	DA Carro Standarder	Visual representations of		
	PA Core Standards:	galvanic and electrolytic cells		
	Reading for Science and Technical Subjects, 6-12	are tools of analysis to		
	3.5 Reading Informational Text	identify where half-reactions		
	Students read, understand, and	occur and the direction of		
	respond to informational text-	current flow.		
	with emphasis on			
	comprehension, making	Oxidation occurs at the		
	connections among ideas and	anode, and reduction occurs		l
	between texts with focus on	at the cathode for all		
	textual evidence.	electrochemical cells.		
		Framework Competency:		
	PA Core Standards: Writing for	Develop and use models to		
	Science and Technical Subjects,	explain that atoms (and		
	6-12	therefore mass) are		
	3.6 Writing Students write for different	conserved during a chemical		
	purposes and audiences.	reaction. Models can include		
	Students write clear and focused			
	text to convey a well-defined	computer models, ball and		
	perspective and appropriate	stick models, and drawings.		
	content.			
		Vocabulary:		
		Balance		
		Mole ratio		
		Net ionic equations		
		Products		
		1		1

Chemistry Academic Page 58

Reactants

	Single replacement			
	Redox			

General Topic	Anchor Descriptor PA Academic and Core Standards	Eligible Content, Essential Knowledge, Skills & Vocabulary	Resources & Activities	Assessments	Suggested Time (In Days)
Review and Final					5 days
Exam					

#### **PA Core Standards:**

## Reading for Science and Technical Subjects, 6-12

## 3.5 Reading Informational Text

Students read, understand, and respond to informational text-with emphasis on comprehension, making connections among ideas and between texts with focus on textual evidence.

#### Grades 9-10

#### CC.3.5.9-10.A.

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

### CC.3.5.9-10.B.

Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

### CC.3.5.9-10.C.

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

#### CC.3.5.9-10.D.

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

#### CC.3.5.9-10.E.

Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

#### CC.3.5.9-10.F.

Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

#### CC.3.5.9-10.G.

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

### CC.3.5.9-10.H.

Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

### CC.3.5.9-10.I.

Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

### CC.3.5.9-10.J.

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

#### **Grades 11-12**

### CC.3.5.11-12.A.

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

#### CC.3.5.11-12.B.

Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

#### CC.3.5.11-12.C.

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

## CC.3.5.11-12.D.

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

#### CC.3.5.11-12.E.

Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

#### CC.3.5.11-12.F.

Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

#### CC.3.5.11-12.G.

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

### CC.3.5.11-12.H.

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

#### CC.3.5.11-12.I.

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

#### CC.3.5.11-12.J.

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

#### **PA Core Standards:**

Writing for Science and Technical Subjects, 6-12

## 3.6 Writing

Students write for different purposes and audiences. Students write clear and focused text to convey a well-defined perspective and appropriate content.

#### Grades 9-10

#### CC.3.6.9-10.A.

Write arguments focused on discipline-specific content.

- Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
- Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

## CC.3.6.9-10B. \*

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

- Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
- Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

#### CC.3.6.9-10.C.

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

#### CC.3.6.9-10.D.

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience

#### CC.3.6.9-10.E.

Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

#### CC.3.6.9-10.F.

Conduct short as well as more sustained research projects to answer a question (including a selfgenerated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

## CC.3.6.9-10.G.

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

## CC.3.6.9-10.H.

Draw evidence from informational texts to support analysis, reflection, and research.

#### CC.3.6.9-10.I.

Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

### **Grades 11-12**

#### CC.3.6.11-12.A.

Write arguments focused on discipline-specific content.

- Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
- Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

CC.3.6.11-12. B \*Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

- Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
- Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic)

#### CC.3.6.11-12.C.

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

#### CC.3.6.11-12.D.

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

#### CC.3.6.11-12.E.

Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

## CC.3.6.11-12.F.

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

#### CC.3.6.11-12.G.

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

#### CC.3.6.11-12.H.

Draw evidence from informational texts to support analysis, reflection, and research.



Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.