Chemistry Honors

Curriculum Guide

Dunmore School District

Dunmore, PA



Chemistry Honors

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.

This is an honors level chemistry course. As such, more is required than the standard, academic course. This includes, but is not limiting to: memorization of more monatomic and polyatomic ions; knowledge of additional conversion factors; more strenuous prediction of net ionic equations; higher level thinking skills in lab and computational problems; a more inquiry approach to many lab activities; and a more indepth, faster-paced study of each unit.

Dunmore School District Curriculum Guide Year-at-a-glance

Subject: Chemistry Honors	Grade Level: 11	Date Completed: 3/14/2018
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1st Quarter

Торіс	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	

2nd Quarter

Торіс	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

3rd Quarter

Торіс	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

4th Quarter

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

General Topic	Anchor Descriptor	Eligible Content, Essential Knowledge,	Resources & Activities	Assessments	Suggested Time
	PA Academic and Core Standards	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: Stable	Density			
lab aspect of	forms of matter are those in	Percent Error			
chemistry, and	which the electric potential	Graphing			
how it relates to	energy is minimized.				
proper measuring		Lab Experiments:			
and handling of	PA Academic Standards:				
measurements.	Science:	Proper measuring with			
We will also learn		significant digits			
to deal with	(The following standards apply to	Density of water- inquiry Density of metal cylinder			
conversions.	all units, but are not repeated in	Identifying a metal using			
conversions.	the document)	density			
	3.1.10.D: Apply scale as a way of	Density by graphing			
MODULE A.1—	relating concepts and ideas to one	Density of plastics- inquiry			
Structure and	another by some measure.	Density of metal BB's- inquiry			
Properties of	Apply dimensional analysis and				
Matter	scale as a ratio.	Eligible Content:			
	 Convert one scale to another. 	CHEM.A.1.1.2 Classify			
Framework Big		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 of the	 Describe how fundamental 	significant figures to			

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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,Recognize that stable systems	a quantitative observation		
	often involve underlying	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).			
	• Describe the effects of error in			
	measurements.	Vocabulary:		
	3.2.10.B: Apply process	Density		
	knowledge and organize	Dimensional analysis		
	scientific and technological			
	phenomena in varied ways.			
	Describe materials using			
	precise quantitative and			
	qualitative skills based on			
	observations.			
	Develop appropriate scientific			
	experiments: raising questions,			
	formulating hypotheses, testing, controlled experiments,			
	recognizing variables,			
	manipulating variables,			
	interpreting data, and producing			
	solutions.			
	 Use process skills to make 			
	inferences and predictions using			
	collected information and to			

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communicate, time relations	hips, defining			
operationally.				
	y the elements of			
scientific inqui	iry to solve			
problems.				
-	lestions about			
objects, organ				
	n be answered			
through scient	tific investigations.			
	appropriateness			
of questions.				
 Design an inv 	vestigation with			
adequate cont	trol and limited			
variables to in	vestigate a			
question.				
• Conduct a m	nultiple step			
experiment.				
Organize exp	perimental			
information us	sing a variety of			
analytic metho	ods.			
• Judge the sig	gnificance of			
experimental i	information in			
answering the	question.			
• Suggest addi	itional steps that			
	e experimentally.			
3.2.10.D: Iden	tify and apply the			
	design process to			
solve problem				
-	problem, rank all			
	ormation and all			
questions that				
answered.				

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 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.			

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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.			

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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	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core Standards	Essential Knowledge, Skills & Vocabulary			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			
starting with		Chemical changes			
-	CHEM.A.1.2 Compare the	Physical changes			
classifying matter	properties of mixtures.	Chemical properties			
and changes in		Physical properties			
matter, then	Framework Concept: Stable	Recognizing ionic vs covalent			
moving through	forms of matter are those in	Writing binary and ternary			
nomenclature.	which the electric potential	ionic formulae			
	energy is minimized.	Naming binary and ternary			
MODULE A.1-		ionic compounds			
Structure and	PA Academic Standards:	Writing and naming			
	Science	molecular compounds			
Properties of	3.4.10.A: Explain concepts about	Writing and naming acids and			
Matter	the structure and properties of	bases			
	matter.	Lab Experiments:			
Framework Big	 Recognize formulas for simple 	Lab Experiments:			
Idea: Matter can	inorganic compounds.	Conductivity tests- inquiry			
be understood in	 Apply knowledge of mixtures 	Using a Bunsen burner			
terms of the	to appropriate separation	Reaction in a bag- inquiry			
types of atoms	techniques.	Separating a mixture			
present and the		inquiry			
interactions both	PA Core Standards:	Chemical or physical change-			
	Reading for Science and	inquiry			
between and	Technical Subjects, 6-12	Elements vs compounds-			

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within atoms.	3.5 Reading Informational Text	inquiry		
	Students read, understand, and	Pure substance vs mixture-		
	respond to informational text-	inquiry		
	with emphasis on	Intro to chromatography		
	comprehension, making	Chromatography whodunit-		
	connections among ideas and	inquiry		
	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).		
		CHEM.A.1.2.2 Differentiate		
		between homogeneous and		
		heterogeneous mixtures		
		(e.g., how such mixtures can		
		be separated).		
		Framework Competency:		
		Apply a systematic set of		
		rules (IUPAC) for naming		
		compounds and writing		
		chemical formulas (e.g.,		

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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.	lons 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				
concerning this in	chemistry.	Lab Experiments:			
chemistry,		Fundamentals of			
including our first	CHEM.B.2.2 Explain how the	Fundamentals of			
concentration	kinetic molecular theory relates	experimental design Find the hottest part of the			
unit- molarity.	to the behavior of gases.	Bunsen burner flame- inquiry			
unit- molanty.	Framework Concept: The mole,	How many moles of Zn are in			
	as a fundamental unit, is used	a penny?- inquiry			
MODULE A—	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					

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Framework Big	PA Core Standards:	Eligible Content:		
Idea: Matter can	Reading for Science and	CHEM.A.1.1.1 Classify		
be understood in	Technical Subjects, 6-12	physical or chemical changes		
terms of the	3.5 Reading Informational Text	within a system in terms of		
types of atoms	Students read, understand, and	matter and/or energy.		
present and the	respond to informational text-			
•	with emphasis on	CHEM.A.1.2.4 Describe		
interactions both	comprehension, making	various ways that		
between and	connections among ideas and	concentration can be		
within atoms.	between texts with focus on	expressed and calculated		
	textual evidence.	(e.g., molarity, percent by		
	DA Come Chan de vide Muitin e feu	mass, percent by volume).		
	PA Core Standards: Writing for	CUENA D 1 1 1 Apply the mole		
	Science and Technical Subjects,	CHEM.B.1.1.1 Apply the mole		
	6-12	concept to representative		
	3.6 Writing Students write for different	particles (e.g., counting, determining mass of atoms,		
	purposes and audiences.	ions, molecules, and/or		
	Students write clear and focused	formula units).		
	text to convey a well-defined			
	perspective and appropriate	CHEM.B.2.2.2 Predict the		
	content.	amounts of reactants and		
	content.	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 The relationship between Unit two's nomenclature and Unit three's moles is explored by calculating percentages by mass and ratios of moles. It is a preliminary look at the concept of stoichiometry,	StandardsAnchor DescriptorCHEM.B.1.2 Apply the moleconcept to the composition ofmatter.Framework Concept: The mole,as a fundamental unit, is usedto represent a specific quantityof atomic particles such asatoms, ions, formula units, andmolecules.PA Academic Standards:ScienceN/APA Core Standards:	Skills & Vocabulary Essential Knowledge/Skills: Percentage composition Finding ratios of atoms Empirical formulae Molecular formulae Hydrates % of water Lab Experiments: Burning Mg and purifying MgO Finding the formula of a hydrate Finding the % of O ₂ in the air Eligible Content:	Teacher prepared	Teacher prepared tests, quizzes, etc.	(In Days) 10 days
but only within a formula. MODULE B—The Mole Concept and Chemical Interactions Framework Big	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.	CHEM.B.1.2.1 Determine the empirical and molecular formulas of compounds. CHEM.B.1.2.2 Apply the law of definite proportions to the classification of elements and compounds as pure substances.			
Idea: Matter can be understood in	PA Core Standards: Writing for Science and Technical Subjects,	CHEM.B.1.2.3 Relate the percent composition and			

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terms of the	6-12	mass of each element		
types of atoms	3.6 Writing	present in a compound.		
present and the	Students write for different			
interactions both between and within atoms.	purposes and audiences. Students write clear and focused text to convey a well-defined perspective and appropriate content.	Framework Competency: Analyze and interpret data to apply the laws of definite proportions and multiple proportions, to determine empirical and molecular formulas of compounds, percent composition and mass of elements in a 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	Essential Knowledge, Skills & Vocabulary			Time (In Days)
	Standards	Skills & Vocabulary			(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: The fact	nomenclature			
conservation of	that atoms are conserved,	Predict the products of			
mass will be	together with knowledge of	acid/base neutralization			
explored by	chemical properties of the	Strong vs weak acids and			
balancing	elements involved, can be used	bases			
chemical	to describe and predict	The pH scale			
	chemical reactions and				
equations, and	calculate quantities of reactants	Lab Experiments:			
relating the	and products.				
corresponding	Fuerra and Concernts Aside and	Conservation of mass			
chemical	Framework Concept: Acids and	revisited- inquiry			
reactions. Acids	bases are identified by their	Reaction in a bag revisited-			
and bases will be	characteristics and interactions.	inquiry			
discussed,	pH scale is a log scale that	Tests to identify O_2 , H_2 , CO_2 ,			
followed by the	reflects the concentration of	and H ₂ O- inquiry What gas is it? Al + CuCl ₂ -			
first attempts to	protons in a solution.	inquiry			
•		Balancing reactions bead			
predict chemical	PA Academic Standards:	activity			
reactions:	Science	The pH scale and			
neutralizations.	3.1.10.E: Describe patterns of	neutralizations.			
	change in nature, physical and				
MODULE B—The	man-made systems.	Eligible Content:			
Mole Concept	Describe how fundamental	CHEM.B.2.1.4 Predict			
and Chemical	science and technology	products of simple chemical			
Interactions	concepts are used to solve	reactions (e.g., synthesis,			
	practical problems (e.g.,	decomposition, single			

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Framework Big	conservation of mass and	replacement, double		
Idea: Matter can	energy, atomic theory, gas laws,	replacement, combustion).		
be understood in	feedback systems).			
terms of the	• Describe the effects of error in	CHEM.B.2.1.5 Balance		
types of atoms	measurements.	chemical equations by		
present and the	2 4 10 A. Eveloin concents about	applying the Law of Conservation of Matter.		
interactions both	3.4.10.A: Explain concepts about the structure and properties of	conservation of Matter.		
between and	matter.	Framework Competency:		
within atoms.	Describe various types of	Develop and use models to		
within atoms.	chemical reactions by applying	•		
	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	computer models, ball and		
	Technical Subjects, 6-12	stick models, and drawings.		
	3.5 Reading Informational Text			
	Students read, understand, and 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	acid-base systems.		
	textual evidence.			
		Vocabulary:		
	PA Core Standards: Writing for	Balance		
	Science and Technical Subjects, 6-12	Mole ratio		
	3.6 Writing	Neutralization		
	Students write for different	рН		
	purposes and audiences.	Products		
	Students write clear and focused	Proton		
	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)
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: The fact	Molecular to Ionic to Net			
types of	that atoms are conserved,	ionic reactions.			
reactions.	together with knowledge of				
Followed by a	chemical properties of the	Lab Experiments:			
mini-unit on net	elements involved, can be used				
ionic equations.	to describe and predict	Exploring the five types of			
	chemical reactions and	reactions			
MODULE B—The	calculate quantities of reactants	Precipitate lab			
Mole Concept and	and products.	Making an activity series			
Chemical		Electrolyte?			
Interactions	PA Academic Standards:				
	Science	Eligible Content:			
Framework Big	3.4.10.A: Explain concepts about	CHEM.A.1.2.1 Compare			
Idea: Matter can be	the structure and properties of	properties of solutions			
understood in	matter.	containing ionic or molecular			
terms of the types	 Describe various types of 	solutes (e.g., dissolving,			
of atoms present	chemical reactions by applying	dissociating).			
and the	the laws of conservation of mass				
interactions both	and energy.	CHEM.B.2.1.3 Classify			
between and		reactions as synthesis,			
within atoms.	PA Core Standards:	decomposition, single			
	Reading for Science and	replacement, double			
	Technical Subjects, 6-12	replacement, or combustion.			
	3.5 Reading Informational Text				

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Students read, understand, and	CHEM.B.2.1.4 Predict	
respond to informational text-	products of simple chemical	
with emphasis on	reactions (e.g., synthesis,	
comprehension, making	decomposition, single	
connections among ideas and	replacement, double	
between texts with focus on	replacement, combustion).	
textual evidence.		
	CHEM.B.2.1.5 Balance	
PA Core Standards: Writing for	chemical equations by	
Science and Technical Subjects,	applying the Law of	
6-12	Conservation of Matter.	
3.6 Writing		
Students write for different	Framework Competency:	
purposes and audiences.	Develop and use models to	
Students write clear and focused	explain that atoms (and	
text to convey a well-defined	therefore mass) are	
perspective and appropriate content.	conserved during a chemical	
content.	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	

General Topic	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: The fact				
encompass units	that atoms are conserved,	Intro to stoichiometry-			
one to six.	together with knowledge of	inquiry			
	chemical properties of the	Finding stoichiometric			
MODULE B—The	elements involved, can be used	equivalents			
Mole Concept	to describe and predict	Limiting reactant lab			
and Chemical	chemical reactions and	% yield lab			
Interactions	calculate quantities of reactants	Sodium carbonate			
Interactions	and products.	production study- inquiry			
		% of CO_2 in a carbonate			
Framework Big	Framework Concept: The mole,				
Idea: Matter can	as a fundamental unit, is used	Eligible Content:			
be understood in	to represent a specific quantity	CHEM.B.2.1.1 Describe the			
terms of the	of atomic particles such as	roles of limiting and excess			
types of atoms	atoms, ions, formula units, and	reactants in chemical			
present and the	molecules.	reactions.			
•					
interactions both	PA Academic Standards:	CHEM.B.2.1.2 Use			
between and	Science	stoichiometric relationships			
within atoms.	N/A	to calculate the amounts of			
		reactants and products			

		Curriculum Guide		
PA Core Standa	ards:	involved in a chemical		
Reading for Sci	ence and	reaction.		
Technical Subj	ects, 6-12			
Students read,		Framework Competency: Develop and use models to explain that atoms (and therefore mass) are		
connections an between texts textual evidence	nong ideas and with focus on	conserved during a chemical reaction. Models can include computer models, ball and stick models, and drawings.		
Science and Te 6-12 3.6 Writing Students write purposes and a	udiences. clear and focused a well-defined	Vocabulary: Balance Mole ratio Products Reactants		

General Topic	Anchor Descriptor	Eligible Content,	Resources & Activities	Assessments	Suggested
	PA Academic and Core	Essential Knowledge,			Time
	Standards	Skills & Vocabulary			(In Days)
Atomic Theory	Anchor Descriptors:	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			
matter		Hund's rule			
	Framework Concept: Stable				
Framework Big	forms of matter are those in	Lab Experiments:			
Idea: Matter can	which the electric potential				
be understood in	energy is minimized.	Freezing point depression			
terms of the		Boiling point elevation			
types of atoms		What is the law of multiple			
present and the	Framework Concept: Each atom	proportions?- inquiry			
interactions both	has a charged substructure	Gold foil simulation			
interactions both	consisting of a nucleus, which is	Atomic map			

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Dunmore School District **Curriculum Guide** between and What is an isotope?— inquiry made of protons and neutrons, Isotope- beanium within atoms. 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 chemical properties in columns. of matter to its atomic or molecular structure. Framework Concept: Each atom CHEM.A.1.2.4 Describe has a charged substructure various ways that consisting of a nucleus, which is concentration can be made of protons and neutrons, expressed and calculated and surrounding electrons. (e.g., molarity, percent by mass, percent by volume). Framework Concept: The structure and interactions of CHEM.A.2.1.1 Describe the evolution of atomic theory matter at the bulk scale are leading to the current model determined by electrical forces of the atom based on the within and between atoms. works of Dalton, Thomson, **Properties of chemical** Rutherford, and Bohr. compounds are related to electrostatic interaction CHFM.A.2.1.2 Differentiate between the mass number of between particles. an isotope and the average atomic mass of an element. **PA Academic Standards:** Science CHEM.A.2.2.1 Predict the 3.1.10.E: Describe patterns of ground state electronic change in nature, physical and configuration and/or orbital man-made systems. diagram for a given atom or • Describe how fundamental ion. science and technology

CHEM.A.2.2.2 Predict

concepts are used to solve

practical problems (e.g., atomic

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

	Curriculum Guide
Students write for different	Framework Competency:
purposes and audiences.	Use the atomic model and
Students write clear and focused	the periodic table to predict
text to convey a well-defined perspective and appropriate	and explain trends in
content.	properties of elements.
	Framework Competency:
	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

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

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

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electron	Framework Concept: The speed	configuration and/or orbital		
configurations,	of a wave in any medium is the	diagram for a given atom or		
Schrodinger's	product of the wave's	ion.		
equation, and the electron cloud	frequency and wavelength.	CUENA A 2 2 2 Dradiat		
model.		CHEM.A.2.2.2 Predict characteristics of an atom or		
model.	Framework Concept:	an ion based on its location		
Then the	Electromagnetic waves are	on the periodic table		
electromagnetic	particle-like photons that travel	(e.g., number of valence		
spectrum is	through a vacuum at the speed	electrons, potential types of		
introduced,	of light and have an energy that	bonds, reactivity).		
followed by a	is directly proportional to the			
quantitative	frequency of the wave.	CHEM.A.2.2.3 Explain the		
analysis of the		relationship between the electron configuration and		
experimental	PA Academic Standards:	the atomic structure of a		
data behind line	Science	given atom or ion (e.g.,		
spectra. This	3.1.10.E: Describe patterns of	energy levels and/or orbitals		
includes	change in nature, physical and	with electrons, distribution of		
calculations	man-made systems.Describe how fundamental	electrons in orbitals, shapes		
involving:	• Describe now fundamental science and technology	of orbitals).		
wavelength,	concepts are used to solve	CHEM.A.2.2.4 Relate the		
frequency,	practical problems (e.g., atomic	existence of quantized		
energy, changing	theory).	energy levels to atomic		
energy levels,		emission spectra.		
.	3.4.10.A: Explain concepts about			
ground state and	the structure and properties of	CHEM.A.2.3.1 Explain how		
excited state	matter.	the periodicity of chemical		
electron	• Know that atoms are composed of even smaller sub-	properties led to the		
transitions.	atomic structures whose	arrangement of elements on		
	properties are measurable.	the periodic table.		
MODULE A.1—		CHEM.A.2.3.2 Compare		
Structure and	3.4.10.C: Distinguish among the	and/or predict the properties		
Properties of	principles of force and motion.		 	

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Matter	Describe light effects (e.g.,	(e.g., electron affinity,		
	absorption, emission spectra,	ionization energy, chemical		
Framework Big	polarization, interference).	reactivity, electronegativity,		
Idea: Matter can	 Describe and measure the 	atomic radius) of selected		
be understood in	motion of sound, light and other	elements by using their		
terms of the	objects.	locations on the periodic		
		table and known trends.		
types of atoms	PA Core Standards:	Framework Competency		
present and the	Reading for Science and Technical Subjects, 6-12	Framework Competency:		
interactions both	3.5 Reading Informational Text	Construct models showing		
between and	Students read, understand, and	that stable forms of matter		
within atoms.	respond to informational text-	are those with minimum		
	with emphasis on comprehension,	electrical field energy.		
Framework Big	making connections among ideas			
Idea: Interactions	and between texts with focus on	Framework Competency:		
between any two	textual evidence.	Develop a model showing the		
objects can cause		likely position of electrons as		
changes in one or	PA Core Standards: Writing for	determined by the quantized		
both of them.	Science and Technical Subjects, 6-12	energy levels of atoms.		
Farmer and Dire	3.6 Writing			
Framework Big	Students write for different	Framework Competency:		
Idea: Waves are a	purposes and audiences.	Use mathematical		
repeating pattern	Students write clear and focused			
of motion that	text to convey a well-defined	representations of Coulomb's		
transfers energy	perspective and appropriate	Law to describe and predict		
from place to	content.	the electrostatic forces		
place without		between objects.		
overall				
displacement of		Framework Competency:		
matter.		Analyze and interpret data to		
		support the claim that the		
		speed of a wave in a medium		
		is the product of the wave's		
		•		

Dunmore School District Curriculum Guide				
	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			

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	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	Leh Europinsenter			
electronegativity,	of atoms allow for the	Lab Experiments:			
electron affinity,	prediction of physical and chemical properties.	Periodic table activities # 1-5			
ionization energy,	chemical properties.	Periodic table activities # 1-5			
oxidation state,	Framework Concept: Each atom	Eligible Content:			
and various other	has a charged substructure	CHEM.A.2.2.2 Predict			
properties. The	consisting of a nucleus, which is	characteristics of an atom or			
properties are	made of protons and neutrons,	an ion based on its location			
used to construct	surrounded by electrons. The	on the periodic table			
	periodic table orders elements	(e.g., number of valence			
various periodic	•	electrons, potential types of			
table puzzles, as	in increasing number of protons	bonds, reactivity).			
well as to identify	and places those with similar				
common uses for	chemical properties in columns.	CHEM.A.2.3.1 Explain how the periodicity of chemical			
elements and		properties led to the			
element families.	PA Academic Standards:	arrangement of elements on			
	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 technology.	and/or predict the properties			
Matter	Examine and describe	(e.g., electron affinity,			
	recurring patterns that form the	ionization energy, chemical			
Eromowerk Dia	basis of chemical periodicity.	reactivity, electronegativity,			
Framework Big	sees of energies periodicity.	atomic radius) of selected			
Idea: Matter can	3.4.10.A: Explain concepts about	elements by using their			

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be understood in	the structure and properties of	locations on the periodic		
terms of the	matter.	table and known trends.		
types of atoms	 Explain the repeating pattern 			
present and the	of chemical properties by using	Framework Competency:		
interactions both	the repeating patterns of atomic	Use the atomic model and		
between and	structure within the periodic table.	the periodic table to predict		
within atoms.		and explain trends in		
	PA Core Standards:	properties of elements.		
	Reading for Science and			
	Technical Subjects, 6-12	Vocabulary:		
	3.5 Reading Informational Text	Atomic radius		
	Students read, understand, and	Charge Chemical		
	respond to informational text-	Configuration Effective		
	with emphasis on	nuclear charge		
	comprehension, making connections among ideas and	Electron affinity		
	between texts with focus on	Electronegativity Electrons		
	textual evidence.	Elements		
		Energy		
	PA Core Standards: Writing for	Ionization Neutrons Nucleus		
	Science and Technical Subjects,	Orbital diagram		
	6-12	Particles		
	3.6 Writing	Physical properties Protons		
	Students write for different	Reactivity		
	purposes and audiences. Students write clear and focused	Shielding effect		
	text to convey a well-defined	Subatomic		
	perspective and appropriate			
	content.			
	I	1	·	I

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

		Curriculum Guide	 	
	between particles.	concentration, surface area)		
MODULE A—		can affect solubility.		
Properties and	PA Academic Standards:			
Classification of	Science	CHEM.A.1.2.5 Describe how		
Matter	3.4.10.A: Explain concepts about	chemical bonding can affect		
	the structure and properties of	whether a substance		
MODULE B— The	matter.	dissolves in a given liquid.		
	• Explain the formation of	CUEM D 1 2 1 Evolain how		
Mole and	compounds and their resulting	CHEM.B.1.3.1 Explain how atoms combine to form		
Chemical	properties using bonding	compounds through ionic		
Interactions	theories (ionic and covalent).	and covalent bonding.		
	PA Core Standards:	and covarent bonding.		
Framework Big	Reading for Science and	CHEM.B.1.3.2 Classify a bond		
Idea: Matter can	Technical Subjects, 6-12	as being polar covalent, non-		
be understood in	3.5 Reading Informational Text	polar covalent, or ionic.		
terms of the	Students read, understand, and			
types of atoms	respond to informational text-	CHEM.B.1.3.3 Use		
present and the	with emphasis on	illustrations to predict the		
interactions both	comprehension, making	polarity of a molecule.		
	connections among ideas and			
between and	between texts with focus on	Framework Competency:		
within atoms.	textual evidence.	Construct models showing		
		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. Students write clear and focused			
	text to convey a well-defined	VSEPR to predict and explain		
	perspective and appropriate	charge distribution across a		
	content.	particle (atom, ion, molecule		
		or formula unit).		

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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"

Dunmore School District				
 r	Curriculum Guide			
	London			
	Van der Waals			
	Melting point			
	Polarity			
	Vapor pressure			

Curriculum Guide General Topic Resources & Activities Anchor Descriptor Eligible Content, Assessments Suggested Time PA Academic and Core Essential Knowledge, Standards **Skills & Vocabulary** (In Days) Introduction to Anchor Descriptor **Essential Knowledge/Skills: Teacher prepared** 9 days **Teacher prepared** the kinetic CHEM.A.1.1 Identify and Solids, liquids, gases tests, quizzes, etc. theory. Solids describe how observable and The 7 crystal systems measurable properties can be and liquids. Heat A unit cell calculations and used to classify and describe Bonding in diamonds vs graphite calorimetry. matter and energy. Amorphous material The pitch drop experiment This unit begins CHEM.B.1.4 Explain how models 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 understanding 5.A: Dynamic equilibrium solid, which leads 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 energy transferred from one a lid on it. This Specific heat capacity continues to the system to another is called heat. Enthalpy interpretation of Calorimetry a phase diagram Framework Concept: A stable and relating it to Lab Experiments: molecule has lower energy, by a heating curve. an amount known as the Heat calculation Models of the crystal systems binding energy, than the same follow including Heating curve set of atoms separated; this extensive work Specific heat of a metal energy must be provided to with calorimetry. Temperature of a Bunsen break the bond. burner flame MODULE A-**Eligible Content: Properties and** Framework Concept: The CHEM.A.1.1.1 **Classification of** structure and interactions of Classify physical or chemical Matter matter at the bulk scale are

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NODULE B— The Mole and Chemical Properties of chemical electrostatic interaction electrostatic interactions within ad between particles energy and object has within a describe different types of models that can be used to induels, graphical models, structural formulas, skeletal formulas, lewis dot structural formulas, skeletal formulas, lewis dot structuras).Compound (e.g., computer models, ball-and-stick models, graphical models, structuras).direction of the result of interactions with matter.The result of interactions with interactions with models in a system or arrange for energy between transe of energy between transe of energy between transe of energy glas or loss in a system properticual in a corresponding interactions with electrostatic in the sample when the awange are in motion.All of the molecules in a sample are in motion.thereaction bit energy glas or gain in another transe of the ergy glas or gain in another sample are in motion.All of the warage indici energy of the average indici energy of the			Curriculum Guide	 	
InteractionInteractionenergy.ChemicalProperties of chemicalenergy.Interactionscompounds are related to electrostatic interactionCHEM.B.1.4.1 Recognize and describe different types of models that can be used to 	MODULE B— The	determined by electrical forces	o ,		
InteractionsInspective of advanced interactionsCHEM.B.1.4.1 Recognize and describe different types of models that can be used to illustrate the bonds that holdAP Chemistry Big Idea 5: The lawsEnergy an object has within a energy an object has within a describe the system depends on the object's motion and interactions with other objects in that system.CHEM.B.1.4.1 Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, sphical models, solid-sphere models, structural formulas, skeletal formulas, lewis dot structures).explain and predict the framework Concept: Any direction of change in an object's energy is thanges in matter.AP Chemistry Essential knowledge 5.A.1: temperature is a measure of the average kinetic energy of atoms and molecules.Framework Big present and the will result in a corresponding present and the will natoms.All of the molecules in a sample are in motion.Framework Big interactions both present and the within atoms.All of the molecules in a sample are in motion.Framework Big interactions both between and within atoms.Academic Standards: sciencePA Academic Standards: between and within atoms.Academic Standards: sciencePA Academic Standards: between and within atoms.Academic Standards: scienceAll of the wareage kinetic energy of the system between by twich at corresponding timetactions buth between and within atoms.All of the wareage kinetic energy of the average kinetic energy of the average kinetic energy of the average<	Mole and	within and between atoms.			
AP Chemistry Big Idea 5: The lawselectrostatic interaction between particles.CHEM.B.1.4.1 Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball-and-stick models, ball-and-stick models, ball-and-stick models, ball-and-stick models, ball-and-stick models, structural formulas, skeletal formulas, tewis dot structural formulas, skeletal formulas, tewis dotexplain and predict the ramework Concept: Any direction of ther objects in a system or transfer of energy between terms of the present and the will result in a correspondingAP Chemistry Essential knowledge 5.A.1: temperature is a measure of the average kinetic energy of asample are in motion.Framework Big interactions both present and the will result in a corresponding interactions both energy and no loss or gain in another system.All of the molecules in a sample of matter is proportional to the average kinetic energy of the sample of matter is proportional to the average kinetic energy of the system.framework Big interactions both energy and molecules.The Kelvin temperature of a sample of matter is proportional to the average kinetic energy of the system.framework Big interactions both energy alion roloss in a system interactions both interactions both interactions both energy alion rolos in a system or poportional to the average kinetic energy of the particles in the sample. When the average kinetic energy of the particles in the sample.Framework Big idea: Interactions between and with atoms.All of the molecules in a sample of matter is proportional to the average<	Chemical	Properties of chemical	energy.		
aP Chemistry Big Idea 5: The lawsbetween particles.describe different types of models that can be used to illustrate the bonds that holdofFramework Concept: The energy an object has within a describe theatoms together in a compound (e.g., computer models, subl-and-stick models, subl-and-stickexplain andFramework Concept: Any energy of the systems involved be understood in terms of the energy gain or loss in a system present and the energy loss or gain in another proportional to the average kincic energy of the partices in the sample of matter is sample of matter is proportional to the average kincic energy of the partices in the sample. When the average kincic energy of the partices in the sample propertional to the swerage kincic energy of the partices i	Interactions	compounds are related to	CHEM B 1 4 1 Recognize and		
AP Chemistry Big between particles. models that can be used to Idea 5: The laws Framework Concept: The atoms together in a of energy an object has within a compound (e.g., computer describe the system depends on the object's models, ball-and-stick models, ball-and-stick models, ball-and-stick models, surfaundels, solid-sphere models, surfaundels, su		electrostatic interaction	-		
ofFramework Concept: The energy an object has within a describe the system depends on the object's motion and interactions with energy and explain and predict theatoms together in a compound (e.g., computer models, graphical models, solid-sphere m	AP Chemistry Big	between particles.			
thermodynamics describe the system depends on the object's system depends on the object's motion and interactions with other objects in that system.compound (e.g., computer models, graphical models, sulf-sphere models, sufuctural formulas, skeletal formulas, Lewis dotexplain and ergy and explain and models in an object's energy is changes in the result of interactions with other objects in a system or a transfer of energy between terms of the terms of the present and the will result in a corresponding interactions both energy loss or gain in another system.AP Chemistry Essential knowledge S.A.1: temperature is a measure of the average kinetic energy of atoms and molecules.Framework Big terms of the present and the within atoms.Framework Concept: Any systems, changing in the total sample are in motion.All of the molecules in a sample are in motion.transfer of energy loss or gain in another between and within atoms.energy loss or gain in another sample of matter is proportional to the average kinetic energy of the particles in the sample. When the average kinetic energy of the particles in the sample. When the particles in the sample. When the particles in the sample.Framework Big lea: Interactions both glice.PA Academic Standards: binet cenergy of the particles in the sample. When the particles in the sample.Framework Big lea: InteractionsStandards: binet cenergy of the particles in the sample. When the particles in the sample particles in the sampleFramework Big lea: Interactions31.10.8: Describe	Idea 5: The laws		illustrate the bonds that hold		
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Idea: Interactions 3.1.10.B: Describe concepts of doubles, the Kelvin			-		
Idea: Interactions 3.1.10.B: Describe concepts of doubles, the Kelvin	Framework Big	Science			
	Idea: Interactions	2.1.10 B: Describe concents of			
of objects or	of objects or	5.1.10.B: Describe concepts of	doubles, the Kelvin		

Chemistry Honors

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systems of	models as a way to predict and	temperature is doubled. As		
objects can be	understand science and	the temperature approaches		
predicted and	technology.	0 K (zero Kelvin), the average		
explained using	 Distinguish between different 	kinetic energy of a system		
the concept of	types of models and modeling	approaches a minimum near		
energy transfer	techniques and apply their	zero.		
and conservation.	appropriate use in specific			
and conservation.	applications (e.g., kinetic gas theory).	The Maxwell-Boltzmann		
	theory).	distribution shows that the		
	3.1.10.E: Describe patterns of	distribution of kinetic		
	change in nature, physical and	energies becomes greater		
	man-made systems.	(more disperse) as		
	 Recognize that stable systems 	temperature increases.		
	often involve underlying	AP Chemistry Essential		
	dynamic changes (e.g., a	knowledge 5.A.2:		
	chemical reaction at equilibrium	The process of kinetic energy		
	has molecules reforming	transfer at the particulate		
	continuously).	scale is referred to in this		
		course as heat transfer, and		
	3.4.10.A: Explain concepts about	the spontaneous direction of		
	the structure and properties of	the transfer is always from a		
	matter.	hot to a cold body.		
	Describe phases of matter			
	according to the Kinetic	On average, molecules in the		
	Molecular Theory.	warmer body have more		
	3.4.10.B: Analyze energy sources	kinetic energy than the		
	and transfers of heat.	molecules in the cooler body.		
	Evaluate energy changes in	Collisions of molecules that		
	chemical reactions.	are in thermal contact		
		transfer energy.		
	PA Core Standards:	transier energy.		
	Reading for Science and	Scientists describe this		
	Technical Subjects, 6-12	process as "energy is		

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3.5 Reading Informational Text	transferred as heat."		
Students read, understand, and			
respond to informational text-	Eventually, thermal		
with emphasis on comprehension,	equilibrium is reached as the		
making connections among ideas	molecular collisions		
and between texts with focus on textual evidence.	continue.		
	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	equilibrium.		
Students write for different purposes and audiences. Students write clear and focused text to convey a well-defined perspective and appropriate content.	Heat is not a substance, i.e., it makes no sense to say that an object contains a certain amount of heat. Rather, "heat exchange" or		
	"transfer of energy as heat" refers to the process in which energy is transferred from a hot to a cold body in 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 understanding 5.B: Energy is neither created nor destroyed, but only		

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	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 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 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			
	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 reaction, or remains the same. For exothermic reactions, the energy lost by the reacting molecules (system) is gained by the surroundings. The energy is		Curriculum Guide		
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reaction), or remains the same. For exothermic reactions, the energy lost by the reacting molecules (system) is gained by the		(exothermic reaction),		
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(system) is gained by the		reactions, the energy lost by		
		the reacting molecules		
surroundings. The energy is		(system) is gained by the		
	 	surroundings. The energy is		

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	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		
	intermolecular forces and		
	that energy is released when		
	bonds form.		

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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
between objects or systems
of objects.

Curriculum Guide
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
Solution

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: The	Absolute zero, again			
Then after	kinetic molecular theory and	Boyle's law			
learning how	Gas Laws are used to explain	Charles' law			
pressure is	and predict the behavior of	Gay-Lussac's law			
measured, we	gases.	Avogadro's law			
discuss the		Diffusion and effusion			
relationship	PA Academic Standards:	Graham's law			
between	Science	Real gases			
pressure,	3.1.10.B: Describe concepts of	Joule-Thompson effect			
temperature, and	models as a way to predict and				
volume of a gas	understand science and	Lab Experiments:			
and what makes a	technology.				
gas ideal.	Distinguish between different	Determining absolute zero			
Followed by a	types of models and modeling	Boyle's law			
discussion of	techniques and apply their	Charles' law			
diffusion.	appropriate use in specific	Gay-Lussac's law			
	applications (e.g., kinetic gas	Graham's law			
MODULE B— The	theory).	Online Gas simulation			
Mole and		activities			
Chemical	3.1.10.E: Describe patterns of				
Interactions	change in nature, physical and	Eligible Content:			
	man-made systems.	CHEM.B.2.2.1 Utilize			
	 Describe how fundamental 	mathematical relationships			
Framework Big	science and technology	to predict changes in the			
Idea: Matter can	concepts are used to solve	number of particles, the			

		Curriculum Guide		-
be understood in	practical problems (e.g., gas	temperature, the pressure,		
terms of the	laws).	and the volume in a gaseous		
types of atoms		system (i.e., Boyle's law,		
present and the	3.4.10.A: Explain concepts about	Charles's law, Dalton's law of		
interactions both	the structure and properties of	partial pressures, the		
between and	matter.	combined gas law, and the		
within atoms.	 Predict the behavior of gases 	ideal gas law).		
	through the use of Boyle's,			
	Charles' or the ideal gas law, in	Framework Competency:		
	everyday situations.	Utilize mathematical		
	 Describe phases of matter 	relationships to predict		
	according to the Kinetic	changes in the number of		
	Molecular Theory.	particles (moles), the		
		temperature, the pressure,		
	PA Core Standards:	and the volume in a gaseous		
	Reading for Science and	system (i.e., Boyle's Law,		
	Technical Subjects, 6-12	Charles' Law, Avogadro's		
	3.5 Reading Informational Text	Law, Dalton's Law of partial		
	Students read, understand, and	pressures, the combined gas		
	respond to informational text-	law, and the ideal gas law).		
	with emphasis on comprehension, making connections among ideas			
	and between texts with focus on	Vocabulary:		
	textual evidence.	Absolute Zero		
		Avogadro's law		
	PA Core Standards: Writing for	Boyle's law		
	Science and Technical Subjects,	Charles's law		
	6-12	Gay-Lussac's law		
	3.6 Writing	Molar mass Molar volume		
	Students write for different	Pressure		
	purposes and audiences.	STP		
	Students write clear and focused	517		
	text to convey a well-defined			
	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)
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: The	Lab Experiments:			
Mole and	kinetic molecular theory and				
Chemical	Gas Laws are used to explain	Calculate rate of diffusion			
Interactions	and predict the behavior of	Find the value of R			
Interactions	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				
	change in nature, physical and	CHEM.B.2.2.1 Utilize			
	man-made systems.	mathematical relationships			
	Describe how fundamental	to predict changes in the			

		Curriculum Guide		
SC	ience and technology	number of particles, the		
со	oncepts are used to solve	temperature, the pressure,		
pr	actical problems (e.g., gas	and the volume in a gaseous		
lav	ws).	system (i.e., Boyle's law,		
		Charles's law, Dalton's law of		
3.4	4.10.A: Explain concepts about	partial pressures, the		
th	e structure and properties of	combined gas law, and the		
m	atter.	ideal gas law).		
•	Predict the behavior of gases			
th	rough the use of Boyle's,	CHEM.B.2.2.2 Predict the		
Ch	narles' or the ideal gas law, in	amounts of reactants and		
ev	veryday situations.	products involved in a		
•	Describe phases of matter	chemical reaction using		
ас	cording to the Kinetic	molar volume of a gas at STP.		
M	olecular Theory.			
		Framework Competency:		
	A Core Standards:	Utilize mathematical		
Re	eading for Science and	relationships to predict		
Те	echnical Subjects, 6-12	changes in the number of		
3.	5 Reading Informational Text	particles (moles), the		
St	udents read, understand, and	temperature, the pressure,		
re	spond to informational text-	and the volume in a gaseous		
	ith emphasis on	system (i.e., Boyle's Law,		
со	omprehension, making	Charles' Law, Avogadro's		
	onnections among ideas and	Law, Dalton's Law of partial		
be	etween texts with focus on	pressures, the combined gas		
te	extual evidence.	law, and the ideal gas law).		
	A Core Standards: Writing for	Vocabulary:		
	cience and Technical Subjects,	Avogadro's law		
	12	Boyle's law		
	6 Writing	Charles's law		
	udents write for different	Combined gas law		
-	urposes and audiences.	Dalton's law of density		
St	udents write clear and focused	Partial pressures		

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text to convey a well-defined perspective and appropriate content.	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		Balance redox in acidic and			
we will study how	AP Chemistry Enduring	basic solutions			
electrons drive	understanding 3.B:	Standard reduction			
chemical	Chemical reactions can be	potentials			
reactions,	classified by considering what the reactants are, what the	Charge produced and stoichiometry			
specifically those	products are, or how they	Voltaic cells			
used to create an	change from one into the other.	Electrolytic cells			
	Classes of chemical reactions				
electrochemical	include synthesis,				
battery.	decomposition, acid-base, and	Eligible Content:			
	oxidation-reduction reactions.	AP Chemistry Essential			
AP Chemistry Big		knowledge 3.B.3:			
Idea 3: Changes in	AP Chemistry Enduring	In oxidation-reduction			
matter involve	understanding 3.C:	(redox) reactions, there is a			
the	Chemical and physical	net transfer of electrons. the			
rearrangement	transformations may be	species that loses electrons is			
and/or	observed in several ways and	oxidized, and the species that			
reorganization of	typically involve a change in	gains electrons is reduced.			
atoms and/or the	energy.				
-	Franciscus and Comparents The fact	AP Chemistry Essential			
transfer of	Framework Concept: The fact	knowledge 3.C.3:			
electrons.	that atoms are conserved,	Electrochemistry shows the inter-conversion between			
	together with knowledge of the	chemical and electrical			
Framework Big	chemical properties of the	energy in galvanic and			
Idea: Matter can	elements involved, can be used	electrolytic cells.			
be understood in	to describe and predict				
terms of the	chemical reactions.				
types of atoms		Electrochemistry			

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

		Curriculum Guide			
General Topic Anchor Descriptor PA Academic and Core	•	Eligible Content,	Resources & Activities	Assessments	Suggested
	Essential Knowledge,			Time	
	Standards	Skills & Vocabulary			(In Days)
Review and Final					15 days
Exams					

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.

Chemistry Honors

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.

Chemistry Honors

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.

CC.3.6.11-12.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.