Phoenixville Area School District Understanding by Design (UbD) Science Template

Grade Level &/or HS Subject: 11/ Chemistry **Unit Name: Moles and Stoichiometry**

Stage 1 Desired Results

Overarching NGSS & PA Standards:

PA-CR5: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Which branch(es) of science apply:

PS **E&SS**

Transfer

Students will be able to independently use their learning to…

- *Ask questions and/or define problems*
- *Develop and/or use models*
- *Plan and/or carry out investigations*
- *Analyze and interpret data using computational thinking*

Meaning-Making

Students will understand that…

- *The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe, and predict chemical reactions.*
- *The number of atoms around them is almost incomprehensible without an appropriate unit to work with.*
- *Chemical reactions follow quantifiable ratios that can be used to predict quantities of products and reactions.*

ESSENTIAL QUESTIONS

Students will keep considering...

- *How does one quantize, characterize, and explain reactions in order to make predictions about them?*
- *How can units be used to bring understanding to vastly large numbers?*
- *What relationships exist between chemical equations and amounts of products or reactions*
- *How does stoichiometry relate to technology and engineering?*
- *How do conceptual models allow us to observe and test what we cannot see?*

	Knowledge and Skills Acquisition	
	UNDERSTANDINGS *Students will know…* • Avogadro's number ($6.02x10^{23}$) is known as one mole. • Moles are necessary to work with the incredible amounts of atoms all around students. • The mass of one mole of a substance is known as its molar mass (typically measured in grams per mole.) • Molar mass can be used to determine the percent composition for a compound. • The molar volume of a gas at STP. • The difference between empirical and molecular formulas and how to calculate each. • Mole relationships (moles to mass, volume, and particles) can be quantified using the factor label method. • Molar ratios can be determined for any of the parts of a balanced chemical equation. • Molar ratios can be used to predict amounts of products and/or reactants. • Limiting reactants determine the theoretical yield of a reaction. • Real life reactions typically only yield a percentage of the theoretical yield.	*Students will be skilled at…* • *Use a model to predict the relationships between systems or between components of a system* • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources. • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. • Reason abstractly and quantitatively. • Use mathematical representations of phenomena to support claims.
	KEY VOCABULARY • Mole • Avogadro's number • Molar ratio • STP • Limiting reactant • Excess reactant • Molar mass • Molar volume • Coefficient • Subscript • Empirical formula • Molecular formula • Percent yield • Theoretical yield • Percent composition	

Stage 2 – Evidence		
Evaluative Criteria	***Assessment Evidence***	
Lab Report Rubrics Student Model Rubrics Mathematical Solutions Discussion Rubrics Formative Checks for Understanding	PERFORMANCE TASK(S): • Students will gather data from real world food examples. Students will analyze the data mathematically using percent composition. Students will then make connections between the real-world example and laboratory examples given to them. • Students will predict how many moles and/or atoms are in several laboratory compounds. Students will then collect data and use mathematical representations to support their claims. • Students will determine a method for measuring the volume and mass of butane in a lighter. Students will collect and analyze data to calculate the molar mass of butane. Students will compare percent error and procedures to refine their methods. • Students will build models using food to show mathematical relationships like molar ratios. Students will make comparisons between their models and chemical equations. Student models will be used as evidence to support claims for the amount of product produced. • Students will use mathematical representations to determine the amount of iron necessary to produce a given amount of copper in a reaction with cupric sulfate. Students will then carry out the reaction while making observations and recording data. Students will compare percent yields before collaborating on ways to improve yield.	Differentiation Considerations: • Assignments can be scaffolded to a variety of difficulties. • Example models can be made for students who struggle to start. • Some data can be given at the start of activities. • Teacher prompts to get students talking.
Mathematical Solutions Test Keys / Rubrics Presentation Rubrics	OTHER EVIDENCE: • PHET simulations • Unit tests (multiple choice and written response) • Quizzes (multiple choice and written response) • Mathematical problems: molar conversions, mole ratios, mole-mass, mass-mass, mixed mole • Power point presentations	Differentiation Considerations: • Multiple-choice assessments can be shortened. • Assignments can be made vocabulary based for EL's • Larger assignments can be chunked with multiple student check ins.