Honors Chemistry - Unit 2 - Quantitative Calculations in Chemistry

Unit Focus

Unit 2 begins with students learning the way to write chemical names and formulas for ionic and molecular compounds. Students will apply this knowledge in order to explore the microscopic domain of chemistry. That is, students will apply the fundamental concept of the 'mole' in order to count particles using the mass of a sample. Based on the mole concept, students will be able to determine the percent composition of a substance or deduce the empirical and molecular formula of an unknown compound. Ultimately, students will balance chemical equations and analyze the amounts of reactant and products involved in a chemical reaction. Throughout this unit, students will participate in hands-on activities and laboratory investigations in which they apply stoichiometric methods to quantify a chemical reaction.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science
High School Physical Sciences: 9 - 12

- Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. *HS-PS1-7*

Next Generation Science Standards (DCI)
Science: 10

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. *PS1.9.A2*
- The periodic table orders elements horizontally by the number of protons in the atom"s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. *PS1.9.A3*

Science: 11

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. *PS1.9.A1*
- The fact that atoms are conserved, together with knowledge of the chemical properties of the

Transfer

T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.
T2 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.

Meaning

Understanding(s)	Essential Question(s)
U1 The structure and interactions of matter are determined by electrical forces within and between atoms. **U2** The mole provides a direct relation between the observable macroscopic properties and the submicroscopic atoms that are not visible. **U3** A limiting reactant dictates the outcome of a chemical reaction. **U4** Excess reactant will always exist in a leftover amount when the reaction is completed.	**Q1** How can we use models to represent structure of matter? **Q2** What happens to atoms and energy in a chemical reaction? **Q3** How can we measure what we can't see? **Q4** How can you relate between different quantities in a balanced chemical reaction?

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
K1 Relate individual particles to grams of a substance to moles of a substance **K2** Avogadro's number relates the mass of a sample to the number of representative particles.	**S1** Students will write chemical names and formulas for the following types of compounds: • ionic compounds • hydrates

Stage 1: Desired Results - Key Understandings

elements involved, can be used to describe and predict chemical reactions. *PS1.9.B3*

NGSS/NSTA Science & Engineering Practices
NGSS Science & Engineering Practices: 9-12

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. *SE.9-12.4.1*
- Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.). *SE.9-12.5.6*

Madison Public Schools Profile of a Graduate
Critical Thinking

- Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)

Collaboration/Communication

- Collective Intelligence: Working respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. (POG.3.1)

K3 A mole is the amount of a substance that contains Avogadro's number (6.022 x 1023) of representative particles.
K4 Vocabulary: reactant, product, mole, atom, molecular, formula unit, representative particle, molar mass, coefficient, stoichiometry, percent yield, actual yield

- molecular compounds
- acids
- alkanes (1-10)

S2 Use dimensional analysis to calculate amounts of reactants and products including percent yield and limiting reagents
S3 Describe a sample in terms of mass, moles, and number of representative particles.
S4 Calculate percent composition of compounds and determine empirical and molecular formulas
S5 Interpret a chemical equation for mole relationships of mass, particles, or volume
S6 Define and apply the concepts of theoretical, actual, and percent yield