Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Science Grade 10 Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Unit 1 Matter
Time Frame	4 weeks for Chemistry and Chemistry Enriched 3 weeks for Chemistry Honors

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

- **HS-PS1: Matter and its interactions**
- **HS-PS3: Energy**

Unit Summary

Chemistry is the study of matter, its structure, and the changes matter undergoes. In this unit, students will learn about the states of matter, classification and conservation of matter, illustrated representations of matter, how to separate matter, and finally calorimetry and heat calculations.

Chemistry

Safety; States of matter; Classification of matter; Conservation of matter; Particle diagrams; Separation techniques; Phase and temperature changes; Calorimetry with heat of temperature change calculations.

Chem Enriched

Safety; States of matter; Classification of matter; Conservation of matter; Particle diagrams; Separation techniques; Phase and temperature changes; Phase diagrams; Heating curves; Calorimetry with heat of temperature change calculations.

Chem Honors

Safety; States of matter; Classification of matter; Conservation of matter; Particle diagrams; Separation techniques; Phase and temperature changes; Phase diagrams; Heating curves; Calorimetry with heat of temperature change and phase change calculations.

Standard Number(s)

- Science
  - HS-PS1-3
    - Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
  - HS-PS1-7
    - Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

- HS-PS3-1
  - Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- HS-PS3-4
  - Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

- English Language Arts (ELA)
  - RST.11-12.1
  - WHST.11-12.8
  - WHST.9-12.9
  - SL.11-12.5

- Mathematics
  - MP.2
  - MP.4
  - HSN-Q.A.1
  - HSN-Q.A.2
  - HSN-Q.A.3

Essential Question(s)

- How do you distinguish between an element and a compound?
- How do you distinguish between pure substances and mixtures?
- How do you distinguish between different states of matter?
- How can mixtures be separated?
- What are the indications that a chemical reaction (or chemical change) has taken place?
- How do you distinguish between a chemical property and a physical property?
- How does mass change during a chemical reaction?
- How can the energy transferred during a chemical or physical process be measured?
- How can macroscopic laboratory data be analyzed to determine energy changes?

Enduring Understandings

- Everything is made up of atoms.
- Matter is defined as anything that has mass and takes up space.
- The three phases of matter include solid, liquid, and gas.
- All matter may be categorized as a pure substance or a mixture.
- All pure substances can be categorized as an element or a compound.

- A physical change does not change the identity of a substance, but a chemical change does change the identity of a substance.
- Compounds are composed of elements bonded together, and their structure can only be changed through chemical means.
- Mixtures may be separated based on differences in physical properties.
- Chemical and physical changes can absorb or release heat energy.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Check all that apply.* **21st Century Skills**	
X	**Global Awareness**	X	**Creativity and Innovation**
X	**Environmental Literacy**	X	**Critical Thinking and Problem Solving**
	Health Literacy	X	**Communication**
	Civic Literacy	X	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will be able to = SWBAT)

Safety

- SWBAT conduct laboratory experiments in accordance with all safety rules.

States of matter

- SWBAT describe and draw particle diagrams representing substances in the solid, liquid, and gas states.
- SWBAT name and characterize the 3 states of matter.
- SWBAT classify whether changes in matter are chemical or physical.

Classification of matter

- SWBAT classify matter as an element, compound, homogenous mixture, or heterogeneous mixture.
- SWBAT describe the differences between an element, compound, homogeneous mixture, or heterogeneous mixture.
- SWBAT draw particle diagrams representing elements, compounds, and mixtures.

Conservation of matter

- SWBAT calculate the mass of a missing product or reactant, given all other masses.
- SWBAT explain how laboratory data corroborates the Law of Conservation of matter.

Separation techniques

- SWBAT explain how a heterogeneous solution consisting of a liquid and a solid can be separated using filtration.

- SWBAT explain how a homogenous solution can be separated based on differences in boiling point using distillation. (Assessed in Chem E and Chem H only)
- SWBAT explain how a homogenous solution can be separated based on differences in molecular polarity using chromatography. (Assessed in Chem H only)

Phase and temperature changes

- SWBAT state the name of all phase changes between solid, liquid, and gas.
- SWBAT state which temperature and phase changes are endothermic.
- SWBAT state which temperature and change changes are exothermic.

Phase diagrams (assessed in Chem E and Chem H only)

- SWBAT determine the state(s) of matter at any location on a phase diagram.
- SWBAT identify the critical point and triple point on a phase diagram.
- SWBAT determine if a substances' solid state is denser than its liquid state, using a particle diagram.

Heating and cooling curves (assessed in Chem E and Chem H only)

- SWBAT identify which state(s) of matter is/are present on each part of a heating curve and cooling curve.
- SWBAT identify which portion of a heating curve corresponds to a temperature change, and which corresponds to a phase change.
- SWBAT identify where fusion and boiling occur on the heating curve.
- SWBAT identify where solidification and condensation occur on the cooling curve.
- SWBAT recognize that each portion of a heating curve is endothermic for the substance being observed.
- SWBAT recognize that each portion of a cooling curve is exothermic for the substance being observed.

Calorimetry with heat of temperature change and phase change calculations.

- SWBAT calculate the heat associated with a temperature change.
    - SWBAT use calorimetry data to solve for any variable or constant in the equation $q = mc\Delta T$.
- SWBAT calculate the heat associated with a phase change (Assessed in Chem H only).
    - SWBAT use calorimetry data to solve for any variable or constant in the equation $q = mH_{phase\ change}$.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

District Common Assessment

Study guide for Benchmark 1 Part 1

Study guide to Benchmark 1 Part 2

Lab Activities

Specific heat of a metal*

Teaching and Learning Activities

Activities	Chem Is it made of chemicals? Classification of matter POGIL Reaction in a bag lab Conservation of mass lab	*Additional for E/H* Heat of fusion of water lab	Link to resources All these resources can be found here

	Chromatography activity Specific heat of a metal lab		
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Key topic #1: Matter	*Below Expectations* See Matter Worksheet version A.	*Meeting Expectations* See Matter Worksheet version B.	*Exceeding Expectations* See Matter Worksheet version C.
Resources			

- Experience Chemistry Workbooks
- Atomsmith.co
- pHet simulations
- Powerpoints / Video Lessons
- Appropriate YouTube Channels

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Science Grade 10 Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Unit 2 Measurement
Time Frame	3 weeks for Chemistry and Chemistry Enriched 2 weeks for Chemistry Honors

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

- **HS-PS1: Matter and its interactions**

Unit Summary

Chemists follow conventions when they record measurements and perform calculations. In this unit, students will practice scientific conventions with regards to measurement. They will also perform percent error and density calculations.

Chemistry

Scientific notation; Measurement; Dimensional Analysis; Identifying significant figures (optional); Accuracy and precision (optional); Percent error; Density

Chem Enriched

Scientific notation; Measurement; Dimensional Analysis; Identifying significant figures; Significant figure rules for multiplication and division; Accuracy and precision; Percent error; Density

Chem Honors

Scientific notation; Measurement; Dimensional Analysis; Identifying significant figures; Significant figure rules for multiplication and division, addition and subtraction; Accuracy, precision; Percent error; Density

Standard Number(s)

- Science
  - HS-PS1-7
    - Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- English language arts
  - RST.9-10.7
- Mathematics
  - MP.2
  - MP.4
  - HSN-Q.A.1

- HSN-Q.A.3

Essential Question(s)

- How can we easily represent very small and very large numbers?
- How do chemists show conversions in units?
- What is a valid measurement?
- What are the rules for rounding and sum, product, difference, or quotient?
- How can density be used to identify a substance?

Enduring Understandings

- Chemists use scientific notation, SI units, and SI prefixes to represent measurements.
- Chemists use a mathematical technique known as *dimensional analysis* to perform most unit conversions.
- Chemists do not report a better measurement than an instrument is capable of.
- Significant figures tell scientists which digits were measured and which digit was estimated.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Check all that apply.* **21st Century Skills**	
X	**Global Awareness**	X	**Creativity and Innovation**
	Environmental Literacy	X	**Critical Thinking and Problem Solving**
	Health Literacy	X	**Communication**
	Civic Literacy	X	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will be able to = SWBAT)

Scientific notation

- SWBAT convert measurements into and out of scientific notation.

Measurement

- SWBAT use the base units gram, meter, second, and liter appropriately.
- SWBAT convert between different SI prefixes (ex. kilo-, centi-, milli-, and nano-)

Dimensional analysis

- SWBAT show and perform unit conversions via dimensional analysis.

- SWBAT convert units in the denominator. (Chem E and H only)
- SWBAT convert squared and cubed units. (Chem H only)

Making valid measurements

- SWBAT make valid measurements using different rulers.
- SWBAT record valid measurements from electronic instruments. (ex. 1.20 g will *not* be recorded as 1.2 g)

Significant figures

- SWBAT determine the number of significant figures in a measurement. (Chem E and H only)
- SWBAT round a product or quotient based on the measurement with the fewest significant figures. (Chem E and H only)
- SWBAT round a sum or difference based on the measurement that is rounded to the highest place. (Chem H only)

Accuracy and precision

- SWBAT explain the difference between accuracy and precision.
- SWBAT evaluate the relative precision and accuracy of a set of measurements.

Percent error

- SWBAT perform percent error calculations.

Density

- SWBAT use density as a conversion factor in dimensional analysis. (Chem H only)
- SWBAT solve for mass, volume, or density.
- SWBAT experimentally determine the density of irregularly shaped objects.
- SWBAT identify an unknown substance based on its calculated density.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

District Common Assessment

Study guide for Benchmark 1 Part 1

Study guide to Benchmark 1 Part 2

Lab Activities

Density of solids and liquids lab

Teaching and Learning Activities

Activities	Chem -Number sense -Making a valid	*Additional for E/H* Converting squared and cubed units practice	Link to resources All these resources can be found here.

	measurement POGIL -Ancient measurements -Dimensional analysis card activity -Indiana Jones and density		
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Key topic #1: Dimensional Analysis	*Below Expectations* See Dimensional Analysis worksheet version A.	*Meeting Expectations* See Dimensional Analysis worksheet version B.	*Exceeding Expectations* See Dimensional Analysis worksheet version C.
Resources			

- Experience Chemistry Workbooks
- Atomsmith.co
- pHet simulations
- Powerpoints / Video Lessons
- Appropriate YouTube Channels

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Science Grade 10 Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Unit 3 The Mole
Time Frame	3 weeks for Chemistry 2 weeks for Chemistry Enriched and Chemistry Honors

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

- **HS-PS1: Matter and its interactions**

Unit Summary

The mole represents a large number of extremely small particles. A mole always contains the same number of particles; however, moles of different substances have different masses. Therefore, large numbers of small particles can be counted using mass. The molar mass of a compound can be calculated from its chemical formula and can be used to convert from mass to moles of that compound.

Chemistry

The mole; molar mass; mole conversions; percent composition

Chem Enriched

The mole; molar mass; mole conversions; percent composition

Chem Honors

The mole; molar mass; mole conversions; percent composition; empirical and molecular formulas; hydrate formulas; molarity as a conversion factor

Standard Number(s)

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

- English Language Arts (ELA)
  - (none)

- Mathematics
  - MP.2
  - MP.4
  - HSN-Q.A.1
  - HSN-Q.A.2
  - HSN-Q.A.3

Essential Question(s)

- How can we easily count particles that are too small to see?
- How large is Amedeo Avogadro's number in comparison to other large numbers?
- How can we mathematically convert from grams of a substance to particles? Or to liters of a gas?

Enduring Understandings

- Molar masses are based on atomic masses.
- The molar mass of any element is equal to the atomic mass value *in grams*.
- Matter cannot be destroyed or created in a chemical reaction; therefore, the amounts of products and reactants can be determined for a chemical reaction. **(PS1.B)**

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Check all that apply.* **21st Century Skills**	
X	**Global Awareness**	X	**Creativity and Innovation**
	Environmental Literacy	X	**Critical Thinking and Problem Solving**
	Health Literacy	X	**Communication**
X	**Civic Literacy**	X	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will be able to = SWBAT)

The mole

- SWBAT explain how many particles are in one mole, and why it is convenient for it to be this particular number.

Molar mass

- SWBAT calculate the molar mass of ionic and covalent compounds, and hydrates. Masses can be provided to the nearest 1 g/mol.

Mole conversions

- SWBAT convert between the moles of a substance, and the grams and particles of that substance.
- SWBAT convert between the moles of a gaseous substance and its volume in liters at standard temperature and pressure.

Percent composition

- SWBAT calculate the percent by mass of any element in a compound, provided the compound formula.
- SWBAT calculate the percent by mass of water in a hydrate, provided the hydrate formula.
- (Chemistry Honors only) SWBAT calculate the mass of an element in a sample of a compound, provided the compound formula and the mass of the sample.

Empirical and molecular formulas (Chemistry Honors only)

- SWBAT mathematically determine the empirical formula of a compound, given the percent by mass of each element in the compound.
- SWBAT mathematically determine the molecular formula of a compound, given the molar mass of the molecular formula and the empirical formula.
- SWBAT mathematically determine both the empirical and molecular formula of a compound, given percent by mass of each element and the molecular formula mass.

Hydrate formulas (Chemistry Honors only)

- SWBAT mathematically determine the chemical formula of a hydrate.

Molarity as a conversion factor (Chemistry Honors only)

- SWBAT convert from moles of a substance in solution to the volume of solution when provided the molarity.
- SWBAT the moles of a substance within a certain volume of a solution when provided the molarity.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

District Common Assessment

Study guide for Benchmark 1 Part 1

Study guide to Benchmark 1 Part 2

Lab Activities

Mole conversions lab

Teaching and Learning Activities

Activities	"Chem 1" -Relative mass and the mole	*Additional for E/H* -Moles and molecules lab	Link to resources All these resources can be

	POGIL -Moles in chalk activity -Mole circle/mole map reference -Percent of water in corn lab	-Moles coloring activity	found here.
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Key topic #1: *Mole conversions*	*Below Expectations* See Mole Conversion Worksheet version A.	*Meeting Expectations* See Mole Conversion Worksheet version B.	*Exceeding Expectations* See Mole Conversion Worksheet version C.
Resources			
● Experience Chemistry Workbooks ● Atomsmith.co ● pHet simulations ● Powerpoints / Video Lessons ● Appropriate YouTube Channels			

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Science/High School/Chemistry
Unit Plan Title:	Unit 4: Stoichiometry
Time Frame	approximately 2-3 weeks

Anchor Standards/Domain*

HS-PS1-7

Unit Summary: The mole represents a large number of extremely small particles. A mole always contains the same number of particles; however, moles of different substances have different masses. Therefore, large numbers of small particles can be counted using mass. The molar mass of a compound can be calculated from its chemical formula and can be used to convert from mass to moles of that compound. Mass relationships in chemical reactions confirm the law of conservation of mass. The amount of each reactant present at the start of a chemical reaction determines how much product can form. A chemical reaction stops when one of the reactants is used up. Percent yield is a measure of the efficiency of a chemical reaction.

Chemistry

- Conversions
  - mole-mole
  - mol- mass
  - mass-mass
- Students will be given map FOR ALL
- Percent Yield
- Limiting and excess reactant (MOLES ONLY)

Chemistry Enriched

- Conversions
  - mole-mole
  - mol- mass
  - mass-mass
- Limiting reactant (no excess)
- Percent Yield
- Mixed Stoichiometry

Chemistry Honors

- Conversions
  - mole-mole
  - mol- mass
  - mass-mass

- Limiting Reactant (calculating leftover excess)
- Percent Yield
- Hydrocarbon combustion analysis
- Mixed stoichiometry

Standard Number(s)

Science

- **HS-PS1-7** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem solving techniques.]
- [Assessment Boundary: Assessment does not include complex chemical reactions.]

Math

- MP.2
- HSN-Q.A.1
- HSN-Q.A.2
- HSN-Q.A.3

Essential Question(s)

- How can the number of particles of substance be determined by measuring the mass?
- How can we determine the amount of product produced or reactant needed for a chemical reaction?
- How can we predict the amount of product formed?

Enduring Understandings

- Matter cannot be destroyed or created in a chemical reaction; therefore, the amounts of products and reactants can be determined for a chemical reaction. **(PS1.B)**

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. 21st Century Themes		*Check all that apply.* 21st Century Skills	
	Global Awareness		Creativity and Innovation
	Environmental Literacy	x	Critical Thinking and Problem Solving
	Health Literacy	x	Communication
	Civic Literacy	x	Collaboration
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Convert between particles, moles, and mass.
- Define stoichiometry.
- Calculate the moles/mass of product or reactant in a chemical reaction.
- Determine the limiting and excess reactants.
- Determine the percent yield.

- Analyze hydrocarbon combustion (Honors only)

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

Assessments

Pre- and formative assessments at the discretion of the teacher.

Unit 4 Benchmark*

Study Guide

https://docs.google.com/document/d/13SHgVfCP6bkzxs5ktFh3knVUKO3ZqYbv7assm7_piFs/edit?usp=sharing

Most important labs:

Limiting Reactant Lab*

Teaching and Learning Activities

Activities	*Chemistry* ● Percent Composition Calculations ● Gizmos ○ Stoichiometry	*Additional for E and Honors* ● Percent Composition Calculations ● Gizmos ○ Stoichiometry ○ Limiting Reactant	Link to resources
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
The Mole (All materials are available in the shared folder.)	Below Expectations ● Introduction to Chemical Quantities Discussion Worksheet-This should be completed as a discussion to ensure understanding.	Meeting Expectations ● Chemical Quantities Worksheet-Students who can complete this independently using provided resources (Periodic Table, possible Mole Road Map) are meeting expectations	Exceeding Expectations ● Molar Volume Animal

Resources

- Explore Chemistry textbook (workbook and online)
- Gizmos

- Worksheets

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Science/High School/Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Atomic Structure
Time Frame	Approximately 2-3 weeks

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

HS-PS1-8
HS-ESS1-1
HS-ESS1-3
HS-ESS1-6

Unit Summary

Chemistry

- Scientists (results of experiments)
- Subatomic particles
- Atomic mass (straight calc)
- Nuclear (alpha, beta, gamma)
- Fission/fusion

Chemistry Enriched

- Scientists (results of experiments)
- Subatomic particles
- Atomic mass (X and 1-X)
- Nuclear (alpha, beta, gamma)
- Fission/fusion

Chemistry Honors

- Scientists (results of experiments)
- Subatomic particles
- Atomic mass (all types)
- Nuclear (alpha, beta, gamma)
- Fission/fusion
- Half-life

Standard Number(s)

Science

- **HS-PS1-8.** Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.]
- **HS-ESS1-1**. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.[Clarification

Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.][Assessment Boundary: Assessment does not include details of the atomic and subatomic processes involved with the sun's nuclear fusion.]

- **HS-ESS1-3**. Communicate scientific ideas about the way stars, over their life cycle, produce elements.[Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.][Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.]
- **HS-ESS1-6**. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.[Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]

ELA

- RST.11-12.1
- RST.11-12.8
- WHST.9-12.1
- WHST.9-12.2
- SL.11-12.4

Math

- MP.2
- MP.4
- HSN-Q.A.1
- HSN-Q.A.2
- HSN-Q.A.3

Essential Question(s)

Unit Essential Questions:

- What are atoms composed of?
- What is the significance of atomic mass?
- What factors lead to nuclear stability?
- What are the advantages and disadvantages of nuclear energy?
- Where do the elements originate from?

Enduring Understandings

Content:

- Define proton, neutron, electron
- Define average atomic mass
- Calculate average atomic mass
- Calculate the average atomic mass
- Calculate the number of protons, neutrons, and electrons using Periodic Table
- Use Isotopic symbols to express the numbers of subatomic particles in an atom.
- Alpha/Beta/ Gamma Radiation
- Half-Life
- Nuclear Reactions **(E,H)**
- Define fission and fusion

Unit Enduring Understandings:

- All matter came from the Big Bang. **(ESS1.A)**
- Nuclear reactions have the ability to release massive amounts of energy. **(PS1.C)**

Skills:

- Write radioactive decay equation for alpha/beta/ gamma **(E,H)**
- Write radioactive decay equation for neutron bombardment, positron emission, electron capture **(E,H**

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**	*Check all that apply.* **21st Century Skills**

x	**Global Awareness**		**Creativity and Innovation**
	Environmental Literacy	x	**Critical Thinking and Problem Solving**
x	**Health Literacy**	x	**Communication**
	Civic Literacy	x	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Describe the historical development of a model for the atom.
- Identify and define the location and arrangement of subatomic particles.
- Calculate the average atomic mass
- Determine the number of protons, neutrons, and electrons in neutral atoms.
- Define isotope.
- Relate the stability of an atom to the number of neutrons and protons.
- Describe the forms of radioactive decay.
- Write and balance nuclear equations. (E,H)
- Relate the half-life to nuclear stability (H)
- Calculate the half-life of an isotope. (H)
- Describe useful applications of radioactive isotopes.**(H)**
- Explain how the study of radioactivity lead to the discovery of protons and neutrons **(H)**
- Explain how scientists synthesize new elements **(H)**
- Explain nuclear fission and fusion.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

Assessments

- Pre- and formative assessments at the discretion of the teacher.
- Unit 5 Benchmark*
- Study Guide https://docs.google.com/document/d/1s6hkz7w1-JzNeIVeJ4Ms9ygy0ui2U6p51yvLfhyILqU/edit?usp

More important labs:

- Uranium Decay Activity

Teaching and Learning Activities

Activities	*Chemistry* • The History of Atomic Models • Explore Atomic Particles • Average Atomic Mass POGIL • Beanium Lab	*Additional for E and Honors* • Half Life Gizmo	https://drive.google.com/drive/folders/1rxp3IPMoKVw42AKHY-wpIV9DhH899JNS?usp=drive_link

	• Gold Foil Lab • Average Atomic Mass Gizmo • Isotopes Gizmo • Nuclear Decay Gizmo • Isotope Lab to determine atomic mass		
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Atomic Mass and Radioactive Decay (All Materials are in the Shared Folder)	Below Expectations • Preparation for Average Atomic Mass	Meeting Expectations • Determine Atomic Mass	Exceeding Expectations • Inquiry Lab- Radioactive Decay
Resources			
• Explore Chemistry textbook (workbook and online) • Gizmos • Worksheets			

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	High School Chemistry
Unit Plan Title:	Electrons
Time Frame	Approximately 2-3 weeks

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

HS-PS4-4
HS-PS4-1
HS-PS4-3

Unit Summary

Chemistry

- Bohr's Model of the Atom
- The Electromagnetic Spectrum
- Speed of Light Equation (solo - give all forms of equation)
- Energy Equation (solo - give all forms of equation)
- Electron Config (using large PT) long and abbreviated
- Valence Electrons
- Lewis Dot Diagrams
- Photoelectric effect

Chemistry Enriched

- Bohr's Model of the Atom
- The Electromagnetic Spectrum
- Speed of Light Equation (mixed with Energy equation also)
- Energy Equation (mixed with Speed Equation also - and nm conv)
- Electron Config (long and abbreviated)
- Valence Electrons
- Lewis Dot Diagrams
- Orbital Diagrams
- Photoelectric effect

Chemistry Honors

- Bohr's Model of the Atom
- The Electromagnetic Spectrum
- Speed of Light Equation
- Energy Equation (kJ/mol questions)
- Electron Config (long and abbreviated)
- Valence Electrons
- Lewis Dot Diagrams
- Orbital Diagrams
- Electron Config exceptions
- Photoelectric effect

Standard Number(s)

- **HS-PS4-4.** Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary : Assessment is limited to qualitative descriptions.]
- **HS-PS4-1.** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary : Assessment is limited to algebraic relationships and describing those relationships qualitatively .]
- **HS-PS4-3.** 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. [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary : Assessment does not include using quantum theory .]

ELA

- RST.9-10.8
- RST.11-12.1
- RST.11-12.7
- RST.11-12.8
- WHST.11-12.8

Math

- MP.2
- MP.4
- HSA-SSE.A.1
- HSA-SSE.B.3
- HSA.CED.A.4

Essential Question(s)

- Does the organization of the Periodic Table reflect the arrangement of the energy levels within the atoms?
- How can spectroscopy tell us which elements are present in a sample?

Enduring Understandings

- The arrangement of the Periodic Table provides information about the properties of the elements. **(PS1.A)**

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Check all that apply.* **21st Century Skills**	
	Global Awareness		**Creativity and Innovation**
	Environmental Literacy	x	**Critical Thinking and Problem Solving**
	Health Literacy	x	**Communication**
	Civic Literacy		
	Financial, Economic, Business, and Entrepreneurial Literacy		

		x	**Collaboration**

Student Learning Targets/Objectives (Students will know/Students will understand)

Students will be able to:

- Identify the major regions of the electromagnetic spectrum.
- Explain the mathematical relationship between wavelength, frequency, energy, and speed of light waves.
- Distinguish between a continuous and line spectrum.
- Explain the quantized nature of energy.
- Explain how atoms emit light.
- Explain the Bohr model of the hydrogen atom.
- Explain the photoelectric effect.
- Explain the experiments that showed that electrons can behave as particles or waves
- Explain the significance of Heisenberg's uncertainty principle
- Explain how atomic orbitals were determined by the Schrodinger equation
- Explain the shapes of atomic orbitals.
- Write an expanded electron configuration.
- Explain how electron configurations connect to the shape of the Periodic Table.
- Write an abbreviated electron configuration.
- Draw orbital diagrams
- Define Hund's Rule, Aufbau Principle, and Pauli Exclusion Principle
- Define valence electrons.
- Draw an electron dot structure.
- Explain how the arrangement of electrons determines the properties of elements.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

Assessments

Pre- and formative assessments at the discretion of the teacher.

Unit 6 Benchmark*

Study Guide https://docs.google.com/document/d/10PUzsYuWt4aV0rdidkx1l-_GvZrPW6cLx48xuIZBwJk/edit?usp=sharing

Most important lab:

Flame test lab

Teaching and Learning Activities

Activities	Chemistry ● Element Spectra Lab ● Electron Energy and Light POGIL	Additional for E/H ● Electron Configuration POGIL	Link to resources https://drive.google.com/drive/folders/1AQsYLqyYUPWjuVpUfpnJLjgDnffA1poa?usp=drive_link
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		

Electron Configuration (All Materials are Available in the Shared Folder)	Below Expectations ● Analyzing Data: Patterns in Electron Configurations	Meeting Expectations ● Inquiry Lab-Model Electron Configuration	Exceeding Expectations ● Advanced Inquiry Lab-Evaluate the Bohr Model of the Atom
Resources			
● Explore Chemistry textbook (workbook and online) ● Gizmos ● Worksheets			

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Chemistry/High School
Unit Plan Title:	Unit 7: The Periodic Table
Time Frame	Approximately 1.5-2 weeks

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

HS-PS1-1

Unit Summary

Chemistry

- Scientists (testing optional)
- Organization of the Periodic Table
- Periodic Trends (no explanation) using graphic organizer
- Optional: Explain periodic trends

Chemistry E

- Scientists (testing optional)
- Organization of the Periodic Table
- Periodic Trends (no electron affinity)
- Explain Periodic Trends (Coulomb's and nuclear charge)
- Successive ionization energy

Chemistry Honors

- Scientists (testing optional)
- Organization of the Periodic Table
- Periodic Trends (electron affinity)
- Explain Periodic Trends (Coulomb's and nuclear charge)
- Ionization Exceptions
- Successive Ionization Energy

Standard Number(s)

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]
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.

ELA

- RST.9-10.7

Essential Question(s)

- Why is it called the Periodic Table?
- How can we predict the chemical properties of an element using the Periodic Table?

Enduring Understandings

- The arrangement of the Periodic Table gives information about the properties of the elements. **(PS1.A)**

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Check all that apply.* **21st Century Skills**	
	Global Awareness		**Creativity and Innovation**
	Environmental Literacy	x	**Critical Thinking and Problem Solving**
	Health Literacy	x	**Communication**
	Civic Literacy	x	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Explain Mendeleev's organization of the elements.
- Explain the significance of Mendeleev's periodic table.
- Define groups and periods on the Periodic Table
- Locate metals, nonmetals, and metalloids on the Periodic Table.
- Distinguish between the properties of metals and nonmetals
- Identify the location and properties of alkali metals, alkaline earth metals, halogens, transition metals, and noble gases.
- Define electronegativity, atomic radius, ionization energy, electron affinity
- Identify the trends in electronegativity, atomic radius, ionization energy, electron affinity.
- Explain the trends based on atomic structure.
- Determine the relative size of ions.
- Explain the size of ions based on atomic structure.
- Explain how patterns in successive ionization energies are related to electron arrangement.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

Assessments

Pre- and formative assessments at the discretion of the teacher.

Unit 7 Benchmark*

Study Guide https://docs.google.com/document/d/1BhXVhO-rBrgMJRQ9GZaUGs9kBYcrKi7LATpfKoGmoLE/edit?usp=sharing

https://docs.google.com/document/d/1pPa-gBVqEAKFI1lvfmWPBJzbfHs0lgzdnUVwRR_Khxs/edit?usp=sharing

Most important lab:

Periodic Trend of Density: Inquiry Lab*

Teaching and Learning Activities

Activities	**Chemistry**	**Additional for E/H**	Link to resources

	• Interactivity: Periodic Properties (Savvas Experience Chemistry) • Periodic Trends Gizmo • Guided Inquiry Lab: Periodic Trends and Properties • Graphing Periodic Properties	• Advanced Inquiry Lab: Periodic Trends and Properties • Discussion Rubric: Make a Claim about Effective Nuclear Charge and Shielding • Animation: Ionization Energy (Savvas Experience Chemistry)	https://drive.google.com/drive/folders/1SzCKsjZzj4IHRMwGhjzL5HBDEwEqX61O?usp=drive_link
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Organization of the Periodic Table (All materials are available in the shared folder.)	Below Expectations Guided Inquiry Lab: Develop a Periodic Table (Savvas Experience Chemistry)	Meeting Expectations Open Ended Inquiry Lab: Elemental Metals, Nonmetals, and Metalloids (Savvas Experience Chemistry)	Exceeding Expectations Advanced Inquiry Lab: Elemental Metals, Nonmetals, and Metalloids (Savvas Experience Chemistry)

Resources

- Explore Chemistry textbook (workbook and online)
- Gizmos
- Worksheets

Wayne School District

Curriculum Format

Content Area/ Grade Level/ Course:	Chemistry / Grades 9-10 Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Unit 8-9: Ionic and Covalent Bonding
Time Frame	Chemistry (Ionic Bonding ~4 weeks ; Covalent Bonding ~5 weeks) Chemistry Enriched/Honors (Ionic Bonding ~2.5 weeks ; Covalent Bonding ~2.5 weeks)

Anchor Standards/Domain

HS-PS1-1
HS-PS1-3
HS-PS2-6

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Unit Summary

Most atoms on the periodic table are more stable when they bond with other atoms. Valence electrons are responsible for bonding and each element seeks to reach a noble gas electron configuration. Ions form when atoms gain or lose valence electrons to achieve a stable octet electron configuration. Ionic bonds are formed by the attraction of oppositely charged ions, forming electrically neutral compounds. Covalent bonds form when atoms share electrons. Metals form crystal lattices and can be modeled as cations surrounded by a "sea" of freely moving valence electrons. The type of chemical bond is influenced by the attraction each atom has for electrons. Structural formulas show the relative positions of atoms within a molecule. The VSEPR Model is used to determine molecular shape. Forces of attraction between molecules influences the physical properties of substances.

Chemistry:

Ionic Bonding

- Formation of Ions
- Naming and Formula Writing
  - Simple Binary
  - Polyatomic Ions
  - Transition Metals (optional)
- Properties of Ionic Compounds
- Properties and Characteristics of Metals
  - Alloys (optional)

Covalent Bonding

- Properties of Covalent Molecules
- Naming and Formula Writing
- Simple Lewis Structures
- VSEPR
  - Linear, Trigonal Planar, Tetrahedral, Trigonal Pyramidal, Bent
  - Bond Angles
- Molecular Polarity
  - Intermolecular Forces
  - Relative Strength

Chemistry Enriched:

- All topics covered in Chemistry
- Additional topics include:
  - Ion Electron Configuration (omit transition metals)
  - Naming and Formula Writing
    - Add naming with transition metals

- Properties and Characteristics of Metals
  - Add alloys (interstitial vs substitutional)
- Lewis Structures
  - Add simple polyatomics and multiple central atoms
- VSEPR
  - Add bipyramidal and octahedral, with bond angles
- Molecular Polarity
  - Add identify types of IMF's and relate to physical properties

Chemistry Honors:

- All topics covered in Chemistry and Chemistry Enriched
- Additional topics include:
  - Ion Electron Configuration
    - Add transition metals and exceptions
  - Lewis Structures
    - Add complex structures (e.g. CH_3COOH)
    - Add resonance
  - VSEPR
    - Identify ALL types of shapes with bond angles
  - Molecular Polarity
    - Add Bond polarity

Standard Number(s)

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

[Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.]

[Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

[Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.]

[Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*

[Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.]

[Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]

RST.11-12.7 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.

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Essential Question(s)

- Why do elements form bonds?
- What determines the proportions of each element in an ionic compound?

Enduring Understandings

- Elements form bonds in order to obtain noble gas electron configurations.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**	*Check all that apply.* **21st Century Skills**

	Global Awareness		**Creativity and Innovation**
	Environmental Literacy	x	**Critical Thinking and Problem Solving**
	Health Literacy	x	**Communication**
	Civic Literacy	x	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Explain why atoms form bonds.
- Identify the types of bonding.
- Classify bonding type according to electronegativity differences.
- Define an ion, ionic bond
- Write the electron configuration of an ion (E,H)
- Name Ionic compounds (Transition Metals E, H)
- Write ionic formulas (Transition Metals E, H)
- Explain how the properties of ionic compounds are explained by ionic bonds.
- Describe the electron-sea model of metallic bonding.
- Describe the characteristics of metallic substances
- Define alloy
- Explain the differences between interstitial and substitutional alloys (E,H)
- Define covalent Bond
- Explain characteristics of covalent substances.
- Name covalent molecules
- Write formulas for covalent molecules
- Draw Lewis Structures for neutral compounds
- Draw Lewis Structures for polyatomic ions and expanded (E,H)
- Draw Lewis Structures for deficient octets (H)
- Identify shapes of covalent molecules
- Define bond and molecular polarity
- Define dispersion forces, dipole-dipole, and hydrogen bonding (E, H)
- Identify intermolecular forces in molecules (E, H)
- Relate physical properties to intermolecular forces (E, H)

Assessments (Pre, Formative, Summative, Other)

Assessments

Pre- and formative assessments at the discretion of the teacher

ALL Chemistry levels will take Part 1

Benchmark #3 Part 1 (covering Units 8-9)*

Study Guide

Additionally, Chemistry E and H will take Part 2

Benchmark #3 Part 2 (covering Units 8-9)*

Study Guide

Common Labs

Ionic vs Covalent vs Metallic Properties*

Molecular Modeling Kit*

*see activities section for links

Teaching and Learning Activities

Activities	Chemistry Activities: ● Ions POGIL ● Ionic Compounds Poster ● Putting Ions in Their Hands ● Ionic vs Molecular Properties Poster ● Phet Shapes ● Covalent Dice Game ● Magic Milk Labs: ● Ionic Compound Lab ● Ionic vs Covalent vs. Metallic Properties* ● Molecular Modeling Kit Lab *	Chemistry E Additional Activities to Chemistry level: ● Atomsmith Activities ● Molecular Naming POGIL ● IMF Poster Labs: ● Ionic vs Covalent vs. Metallic Properties* ● Molecular Modeling Kit Lab * ● IMF Lab (Vernier version)	Chemistry H Additional Labs to Enriched Level: ● Ionic vs Covalent vs. Metallic Properties* ● Molecular Modeling Kit Lab *
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Key Topics *#1: Ionic and Covalent Properties & Naming* *#2: Lewis Structures*	Below Expectations #1 Ionic vs Covalent Properties WS #2 Lewis Structure Atomsmith with KEY	Meeting Expectations #1 Simple Naming (Binary) WS #1 Transition Metals WS #1 Polyatomics WS #1 Review All WS #2 Lewis Structures & VSEPR	Exceeding Expectations #2 VSEPR Atomsmith with KEY

Resources

- Experience Chemistry Workbooks
- Atomsmith.co
- pHet simulations
- Powerpoints / Video Lessons
- Appropriate YouTube Channels

Commented [3]: On Friday Kim and I are going to review the rest of these. We are hoping to tag questions in the common assessment that measure these key topics. For example, Benchmark #3 , questions 6,7,9,and 10 are related to naming/formulas; questions 1,2,8, 10 are compound properties, and only question #13 is about Lewis Structures. Part of the idea is we want the common assessment to measure not just all of the standards but also the topics we think are most important. Do either of you have some time left from your 30 hours to tweak any of these if necessary?

Commented [4]: @jbayliss@wayneschools.com @avasicwylykanowitz@wayneschools.com

Commented [5]: yes, we can figure out some time to make any necessary changes

Commented [6]: I don't think it will take long and I can assist with the LinkIt part. My guess is there may just need to be a few extra questions added to the assessments just to make sure we have a couple on each key topic.

Commented [7]: Angela and I have Block 8 off together so we can plan to use this time to make necessary changes

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Chemistry / Grades 9-10 Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Unit #10: Chemical Reactions and Kinetics
Time Frame	Chemistry (4 weeks) Chemistry Enriched (3.5 weeks) Chemistry Honors (5 weeks)

Anchor Standards/Domain

HS-PS1-2.
HS-PS1-4.
HS-PS1-5.

Unit Summary Millions of chemical reactions in and around you transform reactants into products, resulting in the absorption or release of energy. Chemical reactions are represented by balanced chemical equations. Balanced chemical equations convey important information about a reaction. There are different types of chemical reactions, including, synthesis, combustion, decomposition and replacement reactions. Reaction rates tell us how fast a reaction occurs and we can alter the reaction rates by increasing or decreasing interactions between reactants.

Chemistry:

- Chemical Reactions
  - Convert words to symbols (optional)
  - Balance simple reactions
- Types of Chemical Reactions
  - Identify all types: Synthesis, Decomposition, Single Replacement, Double Replacement, Combustion
- Predict Products of Chemical Reactions
  - Predict products of simple synthesis and decomposition reactions
  - Predict whether or not a single replacement reaction will occur (given the Activity Series)
- Factors Affecting Reaction Rates
- Potential Energy Diagrams
  - Identify endothermic vs exothermic
- Le Chatelier's Principle
  - Predict direction of shift with changes in temperature and concentration

Chemistry Enriched:

- All topics EXCEPT Le Chatelier's Principle covered in Chemistry
  - Topic to be covered in Unit 11
- Additional topics include:
  - Balance complex chemical reactions
  - Predict products for single replacement, double replacement, and combustion
    - Predict phases of products for double replacement
    - Using solubility rules, write net ionic equations (optional)
  - Calculate heat of reaction and activation energy from a potential energy diagram

Chemistry Honors:

- All topics covered in Chemistry (except Le Chatelier's Principle) and Chemistry Enriched
- Additional topics include:

- Predict products for all types of chemical reactions
- Using solubility rules, write net ionic equations
- Calculate heat of reaction using bond enthalpies
- Chemical Kinetics
  - Determine reactant order
  - Simple Rate Laws
  - Simple Reaction Mechanisms

Standard Number(s)

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

[Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.]

[Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

[Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.]

[Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

[Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.]

[Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Essential Question(s)

- Why does a chemical reaction need to be balanced?
- How can we predict the products of a chemical reaction?

Enduring Understandings

- Matter cannot be destroyed or created in a chemical reaction

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Check all that apply.* **21st Century Skills**	
	Global Awareness		**Creativity and Innovation**
	Environmental Literacy	x	**Critical Thinking and Problem Solving**
	Health Literacy	x	**Communication**
	Civic Literacy	x	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Identify evidence of a chemical reaction.
- Define chemical reaction.
- Represent a chemical reaction with symbols.
- Balance a chemical reaction
- Define synthesis, decomposition, single replacement, double replacement, combustion
- Distinguish between the five types of reactions
- Predict the products of synthesis and decomposition reactions
- Predict the products of single replacement, double replacement, and combustion (E,H)
- Predict phases of products in double replacement reactions (E, H)
- Write net ionic equations (H)
- Define Le Châtelier's Principle (not E, H)
- Predict the shift in a chemical reaction based on Le Châtelier's Principle (not E, H)
- Define reaction rate
- Explain how the rate of a reaction can be altered.
- Analyze Potential Energy Diagrams
- Calculate heat of reaction and activation energy from Potential Energy Diagram (E, H)
- Explain the importance of activation energy in chemical reactions (E, H)
- Calculate heat of reaction from bond enthalpies (H)
- Use collision theory to explain how chemical reactions occur (E, H)
- Explain how chemical reactions can occur in several steps as described in a reaction mechanism (H)
- Write the rate law for a reaction. (H)

Assessments (Pre, Formative, Summative, Other)

Assessments

Pre- and formative assessments at the discretion of the teacher

ALL Chemistry levels will take Part 1
Benchmark #4 Part 1 (covering Units 10-11)*
Study Guide

Chemistry E and H will additionally take Part 2
Benchmark #4 Part 2 (covering Units 10-11)*
Study Guide

Common Labs

Types of Chemical Reactions Lab*

Teaching and Learning Activities

Activities	Chemistry Activities: ● Making Models of Chemical Reactions	Chemistry Enriched Additional Activities: ● Balancing Atomsmith	Chemistry Honors Additional Labs to Enriched Level: ● Bond Enthalpy Lab

	• Patterns of Chemical Reactions Atomsmith Labs: • Types of Chemical Reactions* • Determine an Activity Series Lab • Double Replacement Lab	Additional Labs: • Types of Chemical Reactions* • Reaction Rate Lab	• Determine Rate Law Lab
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Key topic *See Unit 11 Document*	Below Expectations *see Unit 11 document	Meeting Expectations *see Unit 11 document	Exceeding Expectations *see Unit 11 document
Resources			
• Experience Chemistry Workbooks • Atomsmith.co • pHet simulations • Powerpoints / Video Lessons • Appropriate YouTube Channels			

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Chemistry / Grades 9-10 Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Unit #11: Solutions and Equilibrium
Time Frame	Chemistry (3 weeks) Chemistry Enriched (3 weeks) Chemistry Honors (3 weeks)

Anchor Standards/Domain

HS-PS1-6.

Unit Summary Solutions involve a solute and solvent. Solutions can be saturated, unsaturated, or supersaturated. The concentration of a solution affects the physical properties of the solution. Solubility depends on the amount of solute dissolved in a solvent and can be analyzed on a solubility curve. The factors which affect solubility are agitation, increasing surface area and increasing temperature. Intermolecular forces also affect the solubility of substances. We can shift the amount of products and reactants using Le Châtelier's Principle. This principle can be used to show changes for a reaction in equilibrium.

Chemistry

- Solutions only
  - Heterogeneous vs Homogeneous
  - Molarity
  - Dilutions
  - Solubility Curves
  - Solubility Definitions

Chemistry Enriched

- Solutions
  - Heterogeneous vs Homogeneous
  - Calculations: Molarity, Dilutions, % by mass, % by volume
  - Solubility Curves
  - Solubility Definitions
  - Beer's Law (optional)
- Equilibrium
  - Equilibrium constant: Explain and Calculate (no ICE tables)
  - Le Chatelier's Principle
    - Predict direction of shift based on changes in temperature and concentration

Chemistry Honors

- All topics covered in Chemistry Enriched
- Additional topics include:
  - Solution Stoichiometry

- Beer's Law
- Equilibrium constant: Explain and Calculate (with ICE tables)

Standard Number(s)

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*

[Clarification Statement: Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.]
[Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.]

MP.4 Model with mathematics.

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling

Essential Question(s)

- How can we control a reaction in the forward and reverse direction?

Enduring Understandings

- Changing the temperature, concentration, or pressure of a reaction will cause a shift in the equilibrium of the reaction.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Check all that apply.* **21st Century Skills**	
	Global Awareness		**Creativity and Innovation**
	Environmental Literacy	x	**Critical Thinking and Problem Solving**
	Health Literacy	x	**Communication**
	Civic Literacy	x	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Define solution, solute, and solvent
- Define concentration and molarity
- Calculate molarity
- Calculate percent by mass and percent by volume of a solution (E, H)
- Explain how to dilute a solution using proper laboratory techniques (E, H)
- Calculate the molarity of a diluted solution
- Explain what factors affect the solubility of a solution (E,H)
- Define saturated, unsaturated, and supersaturated solutions
- Analyze a solubility curve

- Explain how polarity affects solvation of substances (H)
- Define Beer's Law (H)
- Analyze and interpret a Beer's Law Curve (H)
- Use concentration to determine quantities of substances in a balanced chemical reaction (H)
- Define Le Châtelier's Principle
- Predict the shift in a chemical reaction based on Le Châtelier's Principle
- Define equilibrium constant (E,H)
- Calculate equilibrium constant (E,H)
- Relate K to the amount of reactants and products (E, H)
- Calculate an equilibrium constant given various sets of data as initial conditions or equilibrium condition (E, H)

Assessments (Pre, Formative, Summative, Other)

Assessments

Pre- and formative assessments at the discretion of the teacher

ALL Chemistry levels will take Part 1
Benchmark #4 Part 1 (covering Units 10-11)*
Study Guide

Chemistry E and H will additionally take Part 2
Benchmark #4 Part 2 (covering Units 10-11)*
Study Guide

Common Labs

Molarity and Dilution Solution Prep Lab*

Teaching and Learning Activities

Activities	Chemistry Activities: ● Concentration Phet Activity ● Solubility Curve Graphing Activity Labs: ● Molarity and Dilution Solution Prep Lab* ● Rate of Solvation Lab	Chemistry Enriched Additional Activities: ● Solvation of NaCl Atomsmith ● Saturation POGIL ● Molarity POGIL Additional Labs: ● Molarity and Dilution Solution Prep Lab with Prelab (E and H)* ● Le Chatelier's Lab	Chemistry Honors Additional Labs: ● Determine Equilibrium Constant Lab ● Beer's Law Lab
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		

Key topic *#1: Predicting Products of Reactions (Synthesis & Decomposition)* *#2: Le Châtelier's Principle*	Below Expectations #1: Practice Predicting Synthesis and Decomposition #2: Le Chat Practice	Meeting Expectations #1: More Complex Reactions WS #2: Experiment: What is Equilibrium Atomsmith (key)	Exceeding Expectations #2: Challenging Le Chat WS
Resources			
• Experience Chemistry Workbooks • Atomsmith.co • pHet simulations • Powerpoints / Video Lessons • Appropriate YouTube Channels			

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Chemistry / Grades 9-10 Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Unit 12: Gas Laws
Time Frame	Chemistry (3 weeks) Chemistry Enriched/Honors (2.5 weeks)

Anchor Standards/Domain

HS-PS1-3.

Unit Summary Each state of matter is governed by the kinetic molecular theory that explains the behavior of particles. Charles Law, Boyle's Law, Gay-Lussac's Law, COmbined Gas Law, Avogadro's Law, and the Ideal Gas Law all express the behavior of gases quantitatively. Amounts of gas in a chemical reaction can also be predicted using stoichiometry

Chemistry:

- Kinetic Molecular Theory
- Simple Gas Laws
    - Boyle, Charles, Gay-Lussac, Dalton, Combined
- Ideal Gas Law (optional)

Chemistry Enriched:

- All topics covered in Chemistry
- Additional topics include:
    - Ideal Gas Law
        - Molar Mass and Density
    - Gas Stoichiometry (not at STP)
    - Graham's Law (qualitative only)

Chemistry Honors:

- All topics covered in Chemistry and Chemistry Enriched
- Additional topics include:
    - Ideal vs Real Gases

Standard Number(s)

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

[Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.]
[Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

MP.4 Model with mathematics.

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling

Essential Question(s)

- How can the behavior of gases be predicted?

Enduring Understandings

- The variables of temperature, volume, and pressure will determine how a sample of gas behaves at varying conditions

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. 21st Century Themes		*Check all that apply.* 21st Century Skills	
	Global Awareness		Creativity and Innovation
	Environmental Literacy	x	Critical Thinking and Problem Solving
	Health Literacy	x	Communication
	Civic Literacy	x	Collaboration
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- List the physical properties of gases
- Use the Kinetic Molecular Theory to explain the physical properties of gases.
- Define Pressure
- Explain how pressure is measured
- Explain how the gas quantities of pressure, volume, and temperature are related
- Explain how the gas quantities of pressure, volume, temperature, and moles are related (E, H)
- Calculate changes in P, V, or T using various gas laws
- Calculate changes in P, V, T, or n using various gas laws (E, H)
- Explain that pressures of gases are additive
- State the ideal gas law (E, H)
- Use the ideal gas law to calculate the pressure, volume, temperature, or number of moles of gas. (E, H)
- Apply the principles of stoichiometry to determine the volume of gas that is produced or consumed in a chemical reaction (E, H)
- Qualitatively determine the relative effusion rates of two different gases. (E, H)
- Explain the deviations from the ideal gas law (H)

Assessments (Pre, Formative, Summative, Other)

Assessments

Formative and summative assessments at the discretion of the teacher

Common Labs

Boyle's Law Vernier Lab

Teaching and Learning Activities

Activities	Chemistry Activities: ● Gas Law Simulation Labs ● Boyle's Law Vernier Lab ● Alka-Seltzer Ideal Gas Lab	Chemistry E Additional Activities to Chemistry level: ● KMT Atomsmith Additional Labs ● Boyle's Law Lab Enriched Version ● Turtle AirBag Lab	Chemistry H Additional Activities to Enriched Level: ● Molecular Speeds Atomsmith Additional Labs ● Inquiry Popcorn Lab

		• Molar Mass of Butane Lab	
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Key topic #1 or 2	Below Expectations N/A	Meeting Expectations N/A	Exceeding Expectations N/A
Resources			
• Experience Chemistry Workbooks • Atomsmith.co • pHet simulations • Powerpoints / Video Lessons • Appropriate YouTube Channels			

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	Chemistry / Grades 9-10 Chemistry, Chemistry Enriched, Chemistry Honors
Unit Plan Title:	Unit 13: Acids and Bases
Time Frame	Chemistry (1 week) Chemistry Enriched (3 weeks) Chemistry Honors (4 weeks)

Anchor Standards/Domain

HS-PS1-2.

Unit Summary Acids and bases can be defined through two models: Arrhenius and Brønsted-Lowry. Each model has its own definition of an acid and base. An acid is defined as a proton donor and a base as a proton acceptor. This Brønsted-Lowry model explains the autoionization of water, which allows the concentration of hydronium ions and hydroxide ions to be calculated for an acid or base. These concentrations are used to calculate the pH of strong acids and bases, while equilibrium expressions (Ka and Kb) are used to determine the pH of weak acids and bases.
Salts can also be identified as acidic, neutral, or basic.

Chemistry:

- Definition of acids and bases
- pH scale

Chemistry Enriched:

- All topics covered in Chemistry
- Additional topics include:
    - pH calculations
    - Titrations
    - Solution Stoichiometry
    - Weak Acids
        - Ka calculations (without ICE tables)

Chemistry Honors:

- All topics covered in Chemistry and Chemistry Enriched
- Additional topics include:
    - Brønsted-Lowry definition
    - Conjugate acid/base pairs
    - Ka and Kb calculations with ICE tables

Standard Number(s)

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
[Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.]
[Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

MP.2 Reason abstractly and quantitatively

MP.4 Model with mathematics.

Essential Question(s)

- Why does a substance behave like an acid or a base?

Enduring Understandings

- Acid-base reactions involve the movement of the hydronium ion (H^+)

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Check all that apply.* **21st Century Skills**	
	Global Awareness		**Creativity and Innovation**
x	**Environmental Literacy**	x	**Critical Thinking and Problem Solving**
	Health Literacy	x	**Communication**
	Civic Literacy	x	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Identify properties of acids and bases
- Define Arrhenius Acids/Bases (E, H)
- Define Brønsted-Lowry Acids/Bases (H)
- Define conjugate acid-base pairs (H)
- Identify conjugate acid-base pairs (H)
- Determine the relative strengths of acids and bases (E, H)
- Identify strong acids and bases (E, H)
- Draw particle representations of acids and bases in solution (E, H)
- Determine $[H^+]$ and $[OH^-]$ (E, H)
- Define pH and pOH
- Calculate pH and pOH (E, H)
- Write a Ka and Kb expression (E, H)
- Differentiate between relative strengths of weak acids and bases (E, H)
- Calculate Ka and Kb from a various types of data (E, H)
- Define titration and equivalence point (E, H)
- Determine the equivalence point of a titration (E, H)
- Analyze a pH titration curve (E, H)
- Differentiate between a strong acid/strong base titration and a weak base/strong acid titration (E, H)

Assessments (Pre, Formative, Summative, Other)

Assessments

Formative and summative assessments at the discretion of the teacher

Common Labs

Titration Lab (E and H ONLY)

Teaching and Learning Activities

Activities	Chemistry Activities: ● Cabbage pH vs Hydrion pH Poster	Chemistry E Additional Activities to Chemistry level: ● Strong vs Weak Acids POGIL ● pH POGIL Additional Labs ● Titration Lab	Chemistry H Additional Labs to Chemistry Enriched level: ● Calculate Ka of a Weak Acid
Differentiation Strategies	Differentiated Strategies for Special Education Students Differentiation Strategies for Gifted and Talented Students Differentiation Strategies for ELL Students Differentiation Strategies for At Risk Students		
Key topic #1 or 2	Below Expectations N/A	Meeting Expectations N/A	Exceeding Expectations N/A

Resources

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