Unit 4 - Molecules, Compounds, and Chemical Equations (Physical Science, Engineering Design)

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Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Honors Chemistry 10-11

Unit 4 - Molecules, Compounds, and Chemical Equations

Belleville Board of Education

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Unit Overview

- Hydrogen, oxygen, and water
- Chemical bonds
- Representing compounds: Chemical formulas and molecular models
- An atomic-level view of elements and compounds
- Ionic compounds: Formulas and names
- Molecular compounds: Formulas and names
- Inorganic nomenclature
- Formula mass and the mole concept for compounds
- Composition of compounds
- Determining a chemical formula from experimental data
- Organic compounds

Enduring Understanding

1. The mole is a unit that describes a certain amount and that the mole can express the number of atoms, molecules, mass and volume.
2. The atomic mass unit is a relative unit developed in order to make the mass of the subatomic particles easier to express.
3. The average atomic mass is different from the mass number of an isotope and that the average atomic mass is a calculated mass from all possible isotopes.

Essential Questions

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Essential Questions are:

- Questions that lie at the heart of a subject or a curriculum;
- Questions that promotes inquiry and the discovery of a subject.

Essential Questions:

- Help students discover patterns in knowledge and solve problems;
- Support inductive teaching?guiding students to discover meaning, which increases motivation to learn;
- Are one of the most powerful tools for helping students think at more complex levels;
- Engage the personal intellect?something that traditional objectives usually fail to do;
- Have no obvious ?right? answer;
- Raise other important questions, across the curriculum in other content areas;
- Address a concept;
- Recur naturally and appropriately;
- Stimulate critical thinking, ongoing reflection and re-thinking;
- Are framed to provoke and sustain student interest.

What makes a Question "Essential"?

- Continues throughout all our lives
- Refers to core ideas and inquiries within a discipline
- Helps students effectively ask questions and make sense of important and complex ideas, knowledge,

and know-how
- Engages a specific and diverse set of learners

Two Types of Essential Questions are:

Overaching ones:

- Include the "Big Idea"
- Are broader & generalized;
- Point beyond specific topics or skills;
- Promote the transfer of understanding.

Topical ones:

- Are specific to the unit or lesson specific;
- Guides individual units or lessons;
- Promotes inquiry;
- Resists obvious answers;
- Requires explanation and justification.

Examples:

- What is a true friend?
- What makes an artist amazing?
- In what sense is the body a system?
- What is the law of nature, and how is it like or unlike social laws?
- To what extent is U.S. history a history of progress?
- In what ways do diet and exercise affect health?
- Must heroes be flawless?
- How do effective writers hook and hold their readers?
- How do cultures affect one another?
- Does practice make perfect?
- What is healthy eating?
- What is healthy living?
- How and when do we use mathematics?
- How does something acquire value?

Exit Skills

1. Write molecular and empirical formulas
2. Classify substances as atomic elements, molecular elements, molecular compounds, or ionic compounds
3. Write formulas for ionic compounds
4. Name ionic compounds
5. Name ionic compounds containing polyatomic ions
6. Name molecular compounds
7. Name acids
8. Name uncategorized inorganic compounds
9. Calculate formula mass
10. Use formula mass to count molecules by weighing
11. Calculate mass percent composition
12. Use mass percent composition as a conversion factor
13. Use chemical formulas as conversion factors
14. Obtain an empirical formula from experimental data
15. Calculate a molecular formula from an empirical formula and molar mass
16. Obtain an empirical formula from a combustion analysis
17. Balance chemical equations

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

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.
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between

	systems relevant to the problem.
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.
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-PS1-4	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.
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.
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.
HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
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.

Interdisciplinary Connections

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Please list all and any additional **Interdisciplinary Connections/Cross-Curricular** New Jersey Student Learning Standards that link to this unit, and which are not included in the NJSLS section above.

LA.RH.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem.
LA.RH.11-12.8	Evaluate an author's claims, reasoning, and evidence by corroborating or challenging them with other sources.
LA.RH.11-12.9	Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
LA.RST.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
LA.RST.11-12.3	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.
MA.A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.3	Represent constraints by equations or inequalities, and by systems of equations and/or

	inequalities, and interpret solutions as viable or nonviable options in a modeling context.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

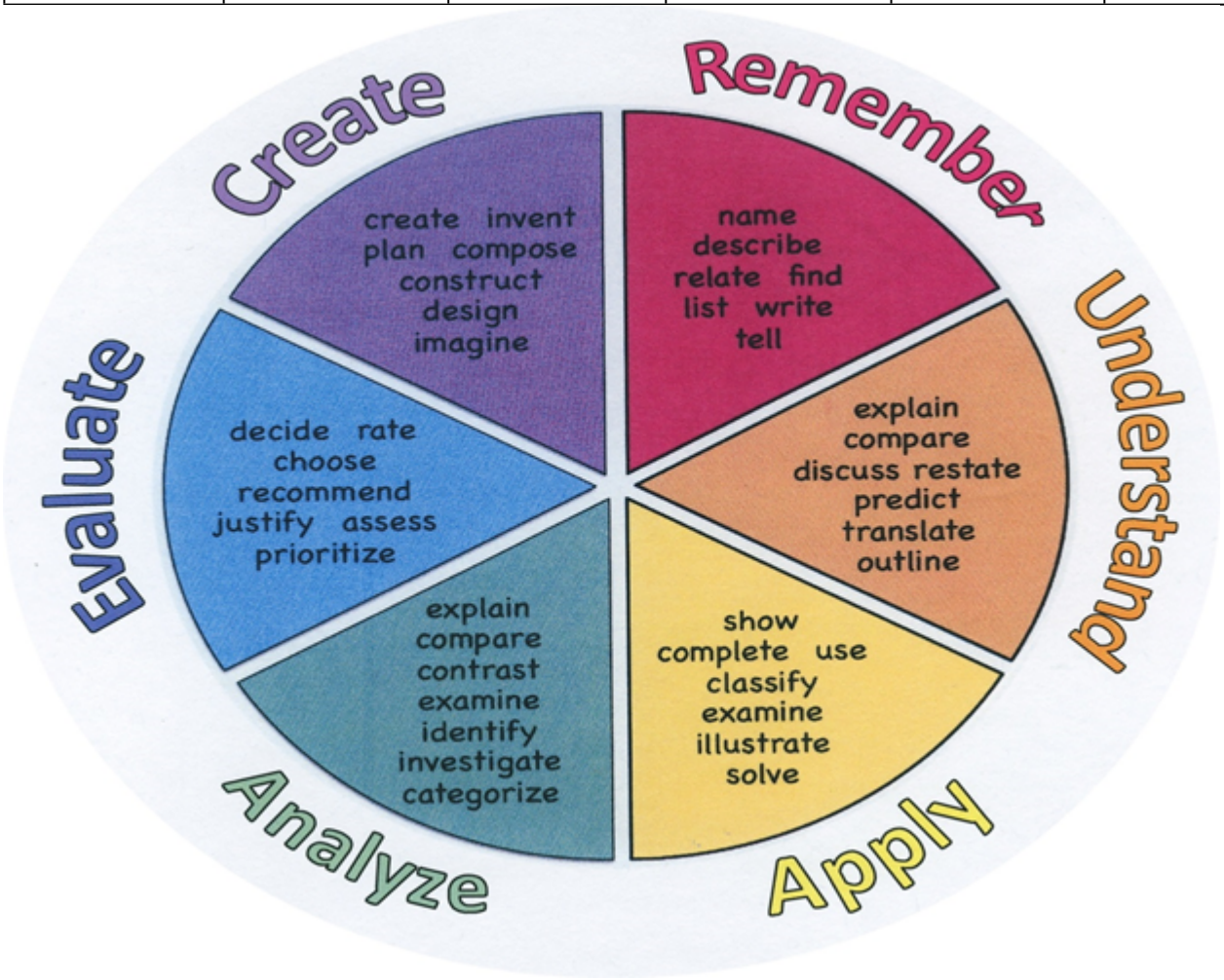
Learning Objectives

1. The student can justify the observation that the ratio of the masses of the constituent elements in any pure sample of that compound is always identical on the basis of the atomic molecular theory.
2. The student is able to select and apply mathematical routines to mass data to identify or infer the composition of pure substances and/or mixtures.
3. The student is able to connect the number of particles, moles, mass, and volume of substances to one another, both qualitatively and quantitatively
4. The student is able to apply conservation of atoms to the rearrangement of atoms in various processes.
5. Students can predict properties of substances based on their chemical formulas, and provide explanations of their properties based on particle views.
6. Students can translate among macroscopic observations of change, chemical equations, and particle views.
7. The student can translate an observed chemical change into a balanced chemical equation and justify the choice of equation type (molecular, ionic, or net ionic) in terms of utility for the given circumstances.
8. The student is able to use stoichiometric calculations to predict the results of performing a reaction in the laboratory and/or to analyze deviations from the expected results.
9. The student is able to relate quantities (measured mass of substances, volumes of solutions, or volumes and pressures of gases) to identify stoichiometric relationships for a reaction, including situations involving limiting reactants and situations in which the reaction has not gone to completion.
10. The student is able to use data from synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions.

Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize
Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive
Outline	Represent	Calculate	Diagram	Support	Devise
Point	Restate	Change	Discriminate	Test	Generate
Quote	Rewrite	Classify	Illustrate		Integrate
Recall	Select	Complete	Outline		Prescribe
Recognize	Show	Compute	Point out		Propose
Repeat	Summarize	Discover	Separate		Reconstruct

Reproduce	Tell Translate Associate Compute Convert Discuss Estimate Extrapolate Generalize Predict	Divide Examine Graph Interpolate Manipulate Modify Operate Subtract			Revise Rewrite Transform



Suggested Activities & Best Practices

Assessment Evidence - Checking for Understanding (CFU)

1. Lab Reports: Molecular Geometry, Types of Chemistry Reactions, and Inorganic Nomenclature

(Alternate)
2. POGIL - Nomenclasture (Alternate)
3. Quizzes - Molecular Geometry and VSEPR, Chemical Reactions, organic nomenclature (Summative)
4. Tests : Test 1 Molecular Geometry and VSEPR, Test 2: Chemical Reactions, and Test 3 organic nomenclature (Summative)
5. "Do Now/Exit Ticket" Activity (Formative)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests

- Web-Based Assessments
- Written Reports

Primary Resources & Materials

Chemistry – Matter and Change; McGraw Hill

Buthelezi, Dingrando, Hainen, Wistrom, and Zike

Tro - The Molecular Approach

Ancillary Resources

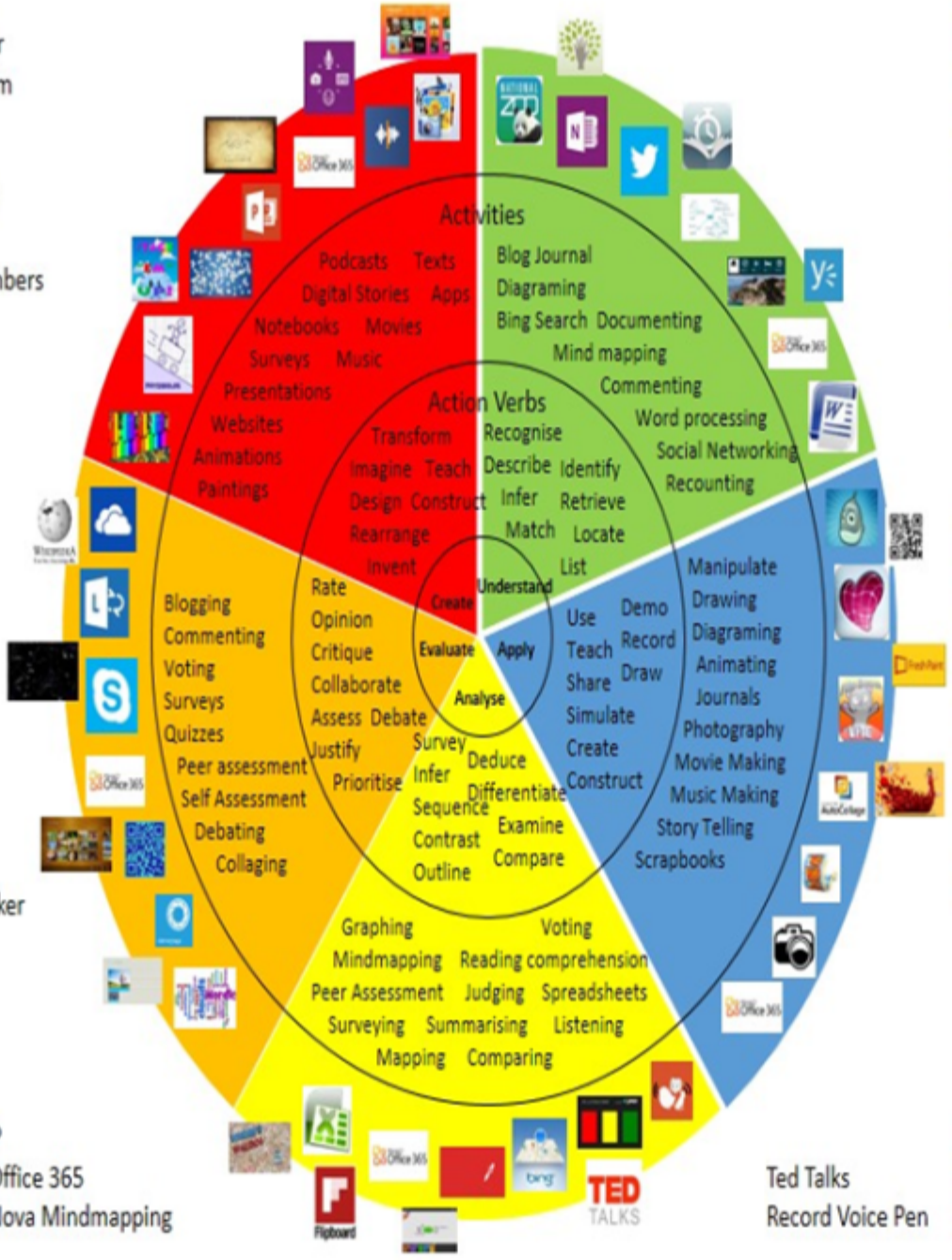
1. Teacher and Publisher supplied powerpoints, notes, laboratory guides, and worksheets
2. Textbooks
3. Resource Manuals
4. Internet Resources
5. Computer and smartboard Activities

Technology Infusion

Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker



Where's Waldo?
MS Excel Office 365
Flipboard Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.E.CS1	Plan strategies to guide inquiry.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS3	Evaluate and select information sources and digital tools based on the appropriateness for specific tasks.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.
TECH.8.1.12.F.CS4	Use multiple processes and diverse perspectives to explore alternative solutions.
TECH.8.2.12.B.CS2	The effects of technology on the environment.

Alignment to 21st Century Skills & Technology

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are

	excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

21st Century Skills/Interdisciplinary Themes

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

- Civic Literacy
- Environmental Literacy

- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

Differentiation

Content

1. **Using reading materials at varying readability levels;**
2. **Using spelling or vocabulary lists**
3. **Presenting ideas through both auditory and visual means;**
4. **Using small groups and share pairs; and**
5. **Meeting with small groups to re-teach an idea or skill for struggling learners, or to extend the thinking or skills of advanced learners.**

Process

1. **Using tiered activities through which all learners work with the same important understandings and skills, but proceed with different levels of support, challenge, or complexity;**
2. **Developing personal agendas**
3. **Offering manipulatives or other hands-on supports**
4. **Varying the length of time a student may take to complete a task in order to provide additional support for a struggling learner or to encourage an advanced learner to pursue a topic in greater depth.**

Products

1. **Giving students options of how to express required learning**
2. **Using rubrics that match and extend students' varied skills levels;**
3. **Allowing students to work alone or in small groups on their products; and**
4. **Encouraging students to create their own product assignments as long as the assignments contain required elements.**

Learning environment

1. **Making sure there are places in the room to work quietly and without distraction, as well as places that invite student collaboration;**
2. **Providing materials that reflect a variety of cultures and home settings;**
3. **Setting out clear guidelines for independent work that matches individual needs;**
4. **Developing routines that allow students to get help when teachers are busy with other students and cannot help them immediately; and**

Helping students understand that some learners need to move around to learn, while others do better sitting quietly (Tomlinson, 1995, 1999; Winebrenner, 1992, 1996).

Differentiations:

- Small group instruction

- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities

- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

20 Molecular Geometry-S.pdf Types of Chemical Reactions-S.pdf- inorganic nomenclature.pdf

- Textbook for at-home use: Tro
- Additional time for assignments Molecular Geometry, Types of Chemistry Reactions, and Inorganic Nomenclature
- Provision of notes or outlines - Chapter 3 and 4
- Hands-on activities - Labs ball and stick models for molecular geometry, Lab - types of chemistry reactions, and Lab - Inorganic Nomenclature
- Choice of test format (multiple-choice, essay, true-false); Test 1 Molecular Geometry and VSEPR, Test 2: Chemical Reactions, and Test 3 organic nomenclature

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content

- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Use flexible grouping; deliberately pair students heterogeneously by proficiency level.

ELP Level 2: Define vocabulary concepts from illustrations and word/ phrase banks. Chapter 3 and 4

ELP Level 3: Give examples of vocabulary concepts from illustrations and word/phrase banks. Chapter 3 and 4

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test

- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

Special Topics Project, TED Talk, Independent Study Project ; Topics to include visulaization of atoms, Nomenclasture, and types of reactions

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor

- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson