Unit 1: Safety and Scientific Method (Physical Science)

Content Area: **Science**
Course(s): **Chemistry**
Time Period:
Length: **40 days**
Status: **Published**

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Academic Chemistry - Unit 1

Safety and Scientific Method

Belleville Board of Education

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Board Approved: September 23, 2019

Unit Overview

1. Safety in the Laboratory - Proper laboratory techniques and safety protocols are essential in the high school science laboratory
2. Introduction to Chemistry and Chemistry as a Physical Science - Chemical reactions, including rates of reactions and energy changes, can be understood by students at this level in terms of the collisions of molecules and the rearrangements of atoms.
3. Introduction to Chemistry and Chemistry as a Physical Science - Students are expected to communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
4. Data Collection and Analysis - The crosscutting concepts of *structure and function*, *patterns*, *energy and matter*, and *stability and change* are called out as the framework for understanding the disciplinary core ideas. Students use *developing and using models*,*planning and conducting investigations*, *using mathematical thinking*, and *constructing explanations and designing solutions*.
5. Data Collection and Analysis -Students are also expected to use the science and engineering practices to demonstrate proficiency with the core ideas.
6. Define Si Base Units for time, length, mass, and temperature.
7. Compare the derived units for volume and density.
8. Analyze data through dimensional analysis, scientific notation, significant figures, and accuracy.

Enduring Understanding

1. In these lessons students learn what the science of chemistry means and how will we approach learning chemistry through a combination of didactic and practical exercises. A learning schedule and procedures are imperative to create a safe, structured, and enthusiastic learning environment. In this first unit students will receive necessary information from instructor regarding applicable classroom and lab policies of the school.

2. If the end product of science, engineering, and design was compared to a great work of literature - the metric system and scientific notation are the language used behind a great work. Strengthening the mathematics and comprehension of our students must take place during the introduction of the coursework in order to allow the students to communicate in the language of science.

Essential Questions

1. What is science and what are the methods that will be utilized in order to solve real world problems?
2. What are classroom expectations and rules? What is safety first?
3. How is data collected and analyzed?
4. What kinds of science are used to create products that we use every day?
5. How is density related to matter?

Exit Skills

Skills Checklist:

1. know, understand, and practice safety protocols and measures

- read and understand MSDS sheets
- understand the selection process of safety equipment
- follow safety procedures and respond during an emergency

2. Identify basic laboratory materials

- select which measurement tools should be used balances, rulers, thermometers, and graduated cylinders

3. Use units and measure in the metric system

- demonstrate the ability to measure using electronic balances, rulers, thermometers, and graduated cylinder
- show proficiency in units of measurement
- identify the differences between accuracy and precision as they pertain to measurement
- use the rules of significant figures in order to perform mathematical operations using significant figure
- use significant notation to express numerical equations
- use dimensional analysis to complete calculations
- preform simple density equation

4. use the scientific method

- collect, organize, and analyze data
    - identify the independent and dependent variables when given a set of data
    - identify the independent and dependent variables in an experiment when given a research question
    - identify two or more variables that must be controlled in an experiment.
    - write a research question for an experiment stating the independent and dependent variables.

- transfer learning of scientific method in use of the scientific method to address a specific practice or problem
- organize the data in coordination of the specific problem
- analyze the data and note errors and possible sources of error
- analyze data noting errors
- identification of errors within experimental design and experimental process

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

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

9-12.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.
9-12.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.
9-12.HS-PS1-3.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-PS1-1.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-PS1-2.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-PS1-1.2.1	Use a model to predict the relationships between systems or between components of a system.
9-12.HS-PS1-8.2.1	Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS1-3.3.1	Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
9-12.HS-PS1-8.5.1	In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
9-12.HS-PS1-2.6	Constructing Explanations and Designing Solutions
9-12.HS-PS2-6.6.1	students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
9-12.HS-PS1-2.6.1	Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
9-12.HS-PS2-6.8.1	Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
9-12.HS-PS1-3.PS1.A.1	The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
9-12.HS-PS2-6.PS1.A.1	The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
9-12.HS-PS1-1.PS1.A.1	Each atom has a charged substructure consisting of a nucleus, which is made of protons

	and neutrons, surrounded by electrons.
9-12.HS-PS1-1.PS1.A.2	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.
9-12.HS-PS1-3.PS1.A.2	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.
9-12.HS-PS1-1.PS1.A.3	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.
9-12.HS-PS1-2.PS1.B.1	The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
9-12.HS-PS1-8.PS1.C.1	Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.

Interdisciplinary Connections

MA.K-12.4	Model with mathematics.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.WHST.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
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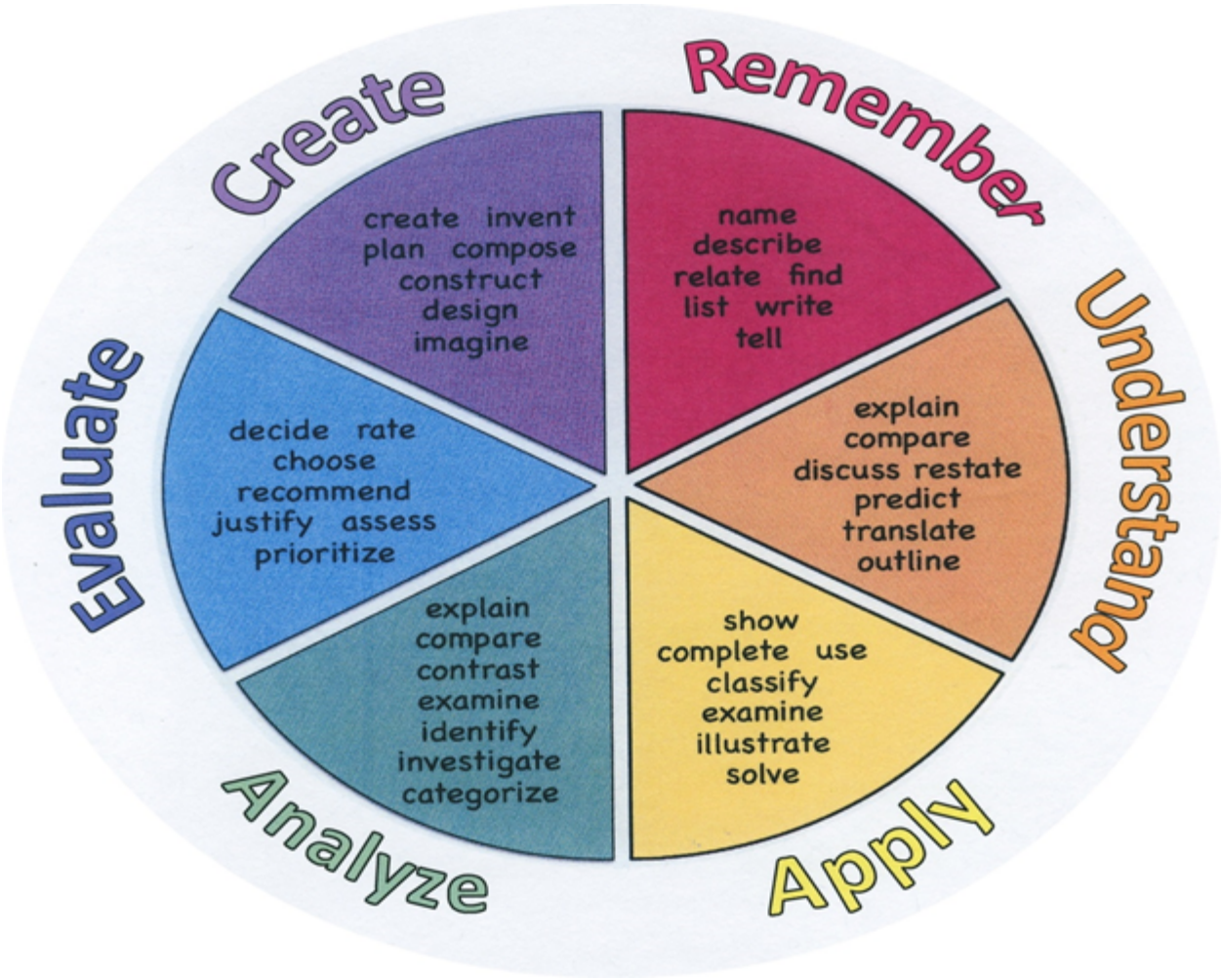
Learning Objectives

1. Applying the scientific method to real world investigative situations.
2. Demonstrating the proper use of various lab instruments
3. Indicating the accuracy and precision of a given set of data.
4. Relating density to variables mass or volume in problem□solving situations

5. Identifying SI base units, derived units, and using conversion factors to convert between SI units and different metric unit variations of the expressed quantity.
6. Explaining the uncertainty of measurement.
7. Expressing numbers in scientific notation to adhere to significant figure rules.
8. Generating and interpreting graphic representations for direct and indirect 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	Divide			Revise
	Translate	Examine			Rewrite
	Associate	Graph			Transform
	Compute	Interpolate			
	Convert	Manipulate			
	Discuss	Modify			
	Estimate	Operate			
	Extrapolate	Subtract			
	Generalize				
	Predict				



Suggested Activities & Best Practices

- Textbook scavenger hunt. (Pg. xxi Glencoe chemistry matter and change)

-MiniLab -Develop Observation Skills. (Pg. 13 Glencoe chemistry matter and change)

-Chemlab- Identify The Water source (Pg. 24 Glencoe chemistry matter and change)

-MiniLab - Determine Density (Pg. 39 Glencoe chemistry matter and change)

-Chemlab- Density To Date A Coin (Pg. 60 Glencoe chemistry matter and change)

Assessment Evidence - Checking for Understanding (CFU)

-Introduction to chemistry (chapter 1) quiz (Summative)

-Introduction to chemistry (chapter 1) test (Summative)

-Lab journal (Alternate)

-Units and measurements quiz (Summative)

-Scientific notation quiz (Summative)

-Dimensional analysis and accuracy and precision quiz (Summative)

-Significant figures quiz (Summative)

-Working with Significant figures quiz (Summative)

-Analyzing Data (chapter 2) test (Summative)

-Benchmark #1 (Benchmark)

-"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

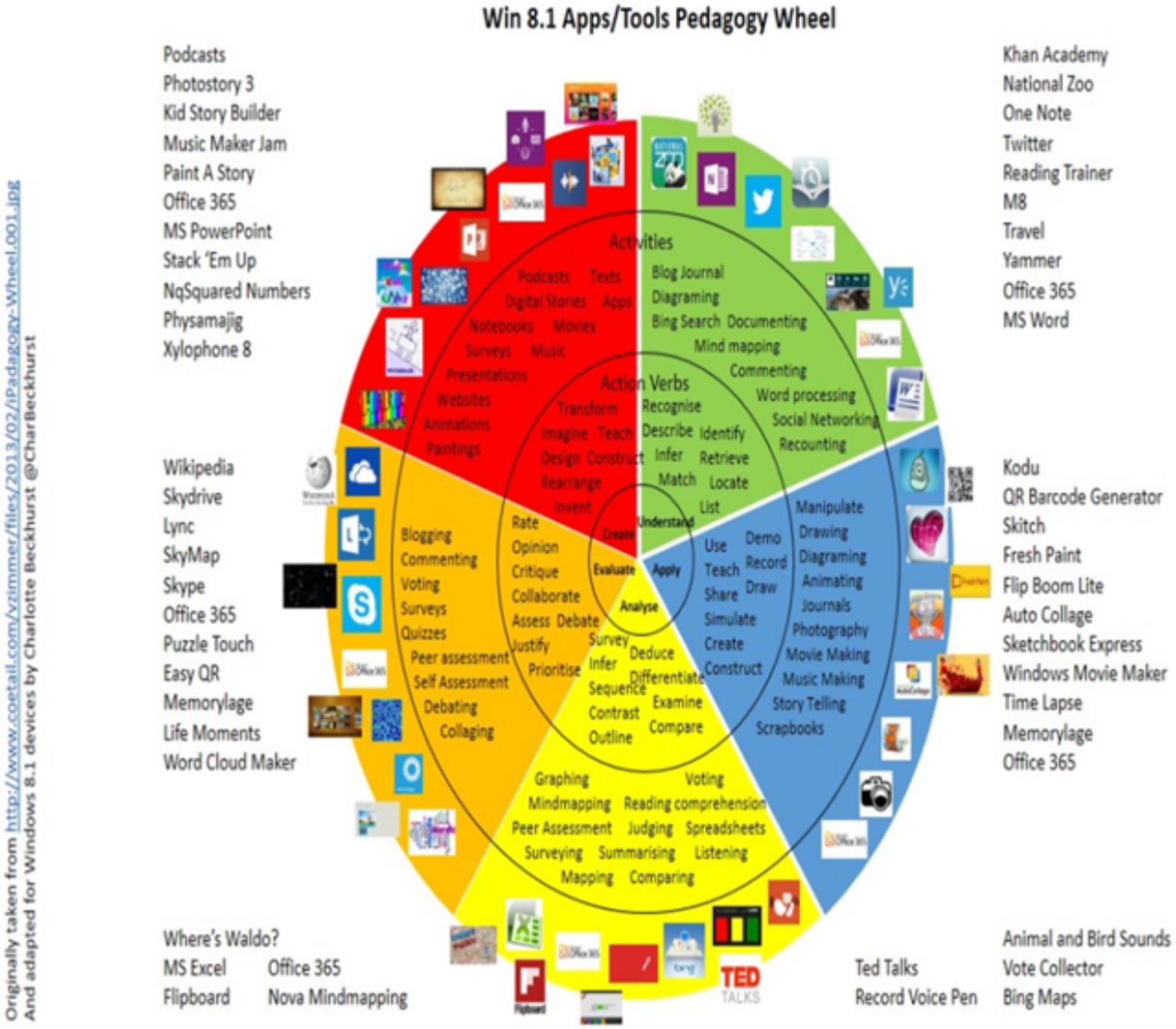
Chemistry textbook and worksheet/lab CD (located in science service center)

Ancillary Resources

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

Technology Infusion

- You tube video on significant figures.
- Use calculator to solve scientific notation.
- Use excel to create a graph to analyze data on temperature patterns in September.



Alignment to 21st Century Skills & Technology

CRP.K-12.CRP10.1	Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.

CRP.K-12.CRP11	Use technology to enhance productivity.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
CAEP.9.2.12.C.5	Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures.
CAEP.9.2.12.C.7	Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.
TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
TECH.8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.

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

- Small group preparing a poster on lab safety.

- Provide large print study guide for chapter 1 test.

- Schedule extra time for students during quiz.

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)

- Pre- test study guides provided.

- Step by step density equations.

- Provide powerpoints on google classroom.

- 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)

- Provide spanish textbook.

- Peers translate notes on lab instruments.

- Provide english to spanish notes on scientific method.

- 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

-Provide modified scientific method tests.

-Provide tutoring times after school.

-Allow test correction for credit.

-Provide Step by step SI base unit conversions.

- 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)

-Provide advanced calculations for SI base unti conversions.

-Provide extra lab assignments for Scientific method.

- 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

Unit Name:Analyzing Data (ChemLab- Use Density To Date A Coin)

NJSLS: 9-12.HS-PS1-3.3.1

Interdisciplinary Connection: LA.RST.9-10.7

Statement of Objective: Student will use density to determine whether a penny was minted before 1982.

Anticipatory Set/Do Now: Read and complete lab safety form.

Learning Activity: Students are tasked with finding the density of a penny. Using this information they will determine is a penny was minted before 1982.

Student Assessment/CFU's: Lab journal

Materials: water, graduated cylinder, balance, pennies, ruler, graph paper

21st Century Themes and Skills: Critical thinking and Problem solving

Differentiation/Modifications: Link a lab safety video for students to view before lab. Link a lab example video for students to view before lab.

Integration of Technology: Student will use computer software to graph and analyze data.