



SPRINGFIELD PUBLIC SCHOOLS
ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

Springfield Public Schools
Springfield, New Jersey 07081

Chemistry
Grades 10 & 11

Curriculum Guide

2021

This curriculum may be modified through varying materials, techniques, and strategies as per an individual student's IEP.

Springfield Board of Education
Approved June 14, 2021



SPRINGFIELD PUBLIC SCHOOLS
ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

**Springfield Public Schools
Springfield, New Jersey**

**Rachel Goldberg
Superintendent of Schools**

**Erica Scudero
Assistant Superintendent of Curriculum and Instruction**

Curriculum Developed By:

Dr. Norman Francis ~ Principal of Jonathan Dayton High School

Gregory Salmon ~ Math and Science Supervisor

Jennifer Beal ~ Chemistry Teacher



Introduction

This template is the product of an initiative led by the New Jersey Department of Education, Office of Academic Standards, in partnership with the New Jersey Association for Supervision and Curriculum Development (NJASCD) and the New Jersey Principals and Supervisors Association (NJPSA). The project was undertaken with the assistance of New Jersey content area supervisors, curriculum coordinators, and teachers during spring-summer 2009. The goal of the project was to design exemplar unit plans and accompanying lesson plans aligned with the New Jersey Student Learning Standards that may be used by districts as models for the development of local curricula.

The Unit Overview Template, which follows, is a tool that can help districts define one unit plan of several that comprise a specific course in the curriculum for any content area. It is designed, once completed, to summarize the content and objectives for the unit, outline lessons and assessments that support the unit, and provide links to documents that facilitate delivery of the unit, such as student materials, background information, resources, and performance rubrics. To see how the units fit together in the design of a course, see the Curriculum Design Template included at the end of this document.

Seven content area Unit Overviews were created as part of the project to serve as exemplar unit plans that are aligned with the New Jersey Student Learning Standards and that assist in achieving the goal of engaging students, fostering achievement, and cultivating 21st century global skills. The units stress the integration of 21st century themes and skills, global perspectives, technology, and cross-curricular connections.

We encourage districts to use the exemplars in conjunction with the curriculum development tools and templates that emanated from this project as models for teaching and learning based on the New Jersey Student Learning Standards.

EXTRACT OF THE MINUTES OF A MEETING OF
THE BOARD OF EDUCATION OF
THE TOWNSHIP OF SPRINGFIELD
COUNTY OF UNION, NEW JERSEY
AS RECORDED IN THE OFFICIAL MINUTE BOOK

The Board of Education of the Township of Springfield, in the County of Union, New Jersey, convened in Regular Session on June 14, 2021 at 7:26 PM.

The following members of the Board of Education were present:

Present: Mr. Anthony Delia, Mr. Hector Munoz, Mrs. Meredith Murphy, Mrs. Kristy Rubin, Mrs. Paula Saha, Mr. Scott Silverstein, Mrs. Hilary Turnbull, Mrs. Laura Gamarekian

Absent: Mr. Marc Miller

The following resolution was offered by Mrs. Saha, seconded by Mr. Silverstein and adopted by the Board of Education by the Roll Call vote as indicated.

TITLE: REVISED CURRICULUM

RESOLVED :

At the recommendation of the Superintendent, I move to approve the following revised curriculum –

- | | | |
|------------------------------|---|--------------|
| • Intro to Engineering | - | High School |
| • Principles of Engineering | - | High School |
| • AP Biology | - | High School |
| • AP Chemistry | - | High School |
| • AP Physics | - | High School |
| • Biology | - | High School |
| • Biology Honors | - | High School |
| • Chemistry | - | High School |
| • Chemistry Honors | - | High School |
| • Conceptual Physics | - | High School |
| • Environmental Science | - | High School |
| • Forensics | - | High School |
| • Human Anatomy & Physiology | - | High School |
| • Oceanography | - | High School |
| • Physics | - | High School. |

ROLL CALL:

Yeas: Unanimous by all Members present.

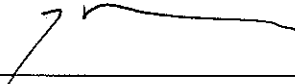
MOTION CARRIED

STATE OF NEW JERSEY)

COUNTY OF UNION)

I, Matthew A. Clarke, Business Administrator/Board Secretary of the Township of Springfield in the County of Union, State of New Jersey, hereby, certify that the foregoing extract from the minutes of the meeting of the Board of Education of said District duly called and held on June 14, 2021 has been compared by me with the original minutes as officially recorded in my Office in the Minute Book of said Township of Springfield Board of Education and is a true, complete copy thereof and of the whole of said original minutes so far as the same relates to the subject matter referred to on said extract. In witness, I have hereunto set my hand and affixed the corporate seal of said Board of Education this 15th day of June 2021.

SEAL



Matthew A. Clarke
Business Administrator/Board Secretary



Unit Overview Template

Content Area: *Science* **Grade Level:** *10/11* **Unit Title:** *Structure and Properties of Matter*

Unit Summary: *In this unit students will learn about the foundations of chemistry including periodic trends, atomic structure, and chemical compounds. They will also investigate through research and data collection the effectiveness of materials and their uses.*

Primary Interdisciplinary Connections:

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ ICT Literacy
☐ Information Literacy ☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: *In learning about atomic structure, periodic trends, and chemical compounds students will be able to access the functionality and use of designed materials.*

Career Readiness (Standard 9):

9.2.12.CAP.4: Evaluate different careers and develop various plans.

9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.

9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.

Learning Targets

Standards: *HS-PS1; HS-PS2*

Content Statements: *Matter and Its Interactions; Motion and Stability: Forces and Interactions*

CPI#: (DCI)	Cumulative Progress Indicator (CPI):
<i>HS-PS1-1</i>	<i>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.</i>
<i>HS-PS1-3</i>	<i>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.</i>
<i>HS-PS1-8</i>	<i>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.</i>
<i>HS-PS2-6</i>	<i>Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</i>
<i>Math.A-CED.A.4</i>	<i>Rearrange formulas to highlight a quantity of interest, using the same reasoning as in</i>



	<i>solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R.</i>
8.2.12.ED.6	<i>Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).</i>
8.2.12.ETW.1	<i>Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.</i>
8.2.12.EC.2	<i>Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.</i>

Science and Engineering Practices:

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- *Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4), (HS-PS1-8)*
- *Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)*

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- *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. (HS-PS1-3)*

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.

- *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). (HS-PS2-6)*

Disciplinary Core Ideas (DCIs):

PS1.A: Structure and Properties of Matter

- *Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)*
- *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. (HS-PS1-1), (HS-PS1-2)*



- *The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3), (secondary to HS-PS2-6)*

PS1.C: Nuclear Processes

- *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. (HS-PS1-8)*

PS2.B: Types of Interactions

- *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. (HS-PS2-6), (secondary to HSPS1-1), (secondary to HS-PS1-3)*

Crosscutting Concepts:

Patterns

- *Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-2), (HS-PS1-3), (HS-PS1-5)*

Energy and Matter

- *In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8)*

Structure and Function

- *Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6)*

Unit Essential Questions:

- *What is the periodic table and how is it used to predict trends amongst the elements?*
- *How is atomic structure related to the properties of each element?*
- *How is the function of a material related to the structure of material on a molecular level?*
- *What is the difference between intramolecular and intermolecular forces and how do they determine the relative strength of the bonds between elements?*
- *How do you differentiate between elements, compounds, and mixtures?*

Unit Enduring Understandings: (Cross Cutting Concepts)

- *Patterns: Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.*
- *Structure and Function: Investigating new systems requires a detailed examination of the properties of different materials, the structure of different components, and connections of components to reveal its function and/or solve a problem.*



Unit Learning Targets:

Students will be able to:

- Determine the protons, neutrons, and electrons of an atom.*
- Use the periodic table to predict the properties of elements based on periodic trends and electrons in the outermost energy levels.*
- Write simple chemical reactions and investigate the relative electric forces within and between atoms.*
- Understand basic nuclear processes including fission, fusion, and radioactive decay.*
- Investigate how the design and structure of materials alters its function and usability.*
- Develop models that represent the processes of fission, fusion, and radioactive decay.*



Evidence of Learning

Summative Assessment: *This unit will be covered in an amount of 60 School Days. Information covered in this unit will be tested on the midterm examination and as individual chapter tests in addition to the formative assessments listed below.*

Equipment Needed: *Computer, software, laboratory equipment, Vernier GoDirect*

Teacher Resources: *Chemistry textbook and online resources by Pearson.*

Formative Assessments:

- *Quizzes will be given to assess student learning after every 3-4 lessons.*
- *In class assignments will be completed to practice a lesson.*
- *Homework will be given 2-3 times per week.*
- *Students will be given projects and may be differentiated into individual or group assignments.*
- *Lab Reports*
- *Do Now Questions*
- *Exit Slips*
- *Group Assignments*



Lesson Plans

Lesson	Time Frame
<i>Lesson 1: Periodic Trends</i>	<i>6 Hours</i>
<i>Lesson 2: Band of Stability</i>	<i>2 Hours</i>
<i>Lesson 3: Properties of Metals and Alloys</i>	<i>2 Hours</i>

Teacher Notes:

Each of the following lessons may take several days to complete. Student research and data collection will be conducted inside and outside of class.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

http://www.algebra-lab.org/practice/practice.aspx?file=reading_thebandofstability.xml

<http://resources.schoolscience.co.uk/CDA/11-14/biology/copch31pg3.html>

http://chemwiki.ucdavis.edu/Core/Inorganic_Chemistry/Descriptive_Chemistry/Periodic_Trends_of_Elemental_Properties/Periodic_Trend

<http://blog.hubspot.com/marketing/how-to-use-excel-tips#sm.001ajowjb3dldph11u82b4l4hvib5>



Lesson Plan 1 Template

Content Area: *Chemistry*

Lesson Title: *Periodic Trends*

Time Frame: *6 hours*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect

Equipment Needed:

Laptop Computers, Vernier System

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • <i>Construct graphical representations how atomic size changes with respect to nuclear charge.</i> • <i>Design a model which represents how atomic size is related to atomic number and position in the periodic table.</i> • <i>Predict the relative size of any additional elements based on its position in the periodic table.</i>	Lesson Sequence • <i>Students will collect information on the first 20 elements on the periodic table including atomic number, atomic mass, and atomic radius on an Excel spreadsheet.</i> • <i>Create a model using materials such as paper or straws to show how the size of each of the first 20 elements is related.</i> • <i>Choose 5 out of 10 additional elements and predict their relative size.</i> • <i>Write a conclusion paragraph explaining how each element's periodic table location relates to its atomic size.</i>	• <i>Complete an Elements Information Chart by conducting research on the first 20 elements.</i> • <i>Draw conclusions from data collected.</i> • <i>Design a model showing how the relative size of atoms relates to their position in the periodic table.</i> • <i>Interpret the relative size of 5 other additional elements.</i>



Differentiation:

Students may work at their own pace to complete all assignments.
An Excel template will be provided for those that need one.
Models may be constructed using any material to fit student needs.

Resources Provided:

- *Internet resources*
- *Excel Template*
- *Design materials and tools such as paper, markers, straws and scissors.*



Lesson Plan 2 Template

Content Area: *Chemistry* Lesson Title: *The Band of Stability* Time Frame: *2 Hours*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect

Equipment Needed:

Laptop Computers, Vernier System

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Conduct research about the neutron to proton ratio for 50 stable isotopes of various elements. - Create a chart in excel using their research. - Draw conclusions about the stability of isotopes.	Lesson Sequence - Students will work in groups of 2 people. - Both students will conduct research on the protons and neutrons of several stable isotopes. - Students will input their information into an Excel spreadsheet to display their data as a scatter plot. - Students will use their graphs to draw conclusions about the stability of isotopes.	- Benchmark checks will be conducted throughout the activity. - Students will be assessed on their ability to research effectively and collect data. - Students will construct and print out their graphs. - Students will use their graphs to respond in complete sentences to conclusion questions provided.
Differentiation: <i>Students may choose any 50 elements they wish to research between elements number 1 and 86.</i> <i>Students may need instruction on how to use Excel and create a scatter plot of data.</i>		
Resources Provided: - Internet resources - Excel template - Textbook		



Lesson Plan 3 Template

Content Area: *Chemistry* Lesson Title: *Properties of Metals and Alloys* Time Frame: *2 hrs*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect

Equipment Needed:

Laptop Computers, Vernier system

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Investigate the properties of several metals. - Investigate the properties of several known alloys. - Compare and contrast the differences between an alloy and a pure metal. - Investigate the use of alloys in today's society.	Lesson Sequence - Along with a research partner, students will investigate the properties of 15 different pure metals and seven different known alloys containing these pure metals. - Students will create a diagram showing the pros and cons to using pure metals vs alloys. - Students will design a brand new alloy and propose its properties.	- Research forms will be collected. - Pro/con diagrams will be collected. - Students must design their own alloy, then provide evidence as to how their alloy would be used, and the properties of their alloy.
Differentiation: <i>Each group of students will create an alloy of their choosing based on evidence that they have collected.</i>		
Resources Provided: - Research templates and outlines - Pro/Con diagram examples - Alloy Examples		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☒	☐	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: <i>Science</i>	Grade Level: <i>10/11</i>	Course Title: <i>Chemistry</i>
Created: <i>2021</i>	Board Approved on:	



Unit Overview Template

Content Area: *Science* **Grade Level:** *10/11* **Unit Title:** *Matter and Its Interactions*

Unit Summary: *Matter is conserved during a chemical reaction as can be shown through simple chemical reactions and equations based on the electron states of atoms and their position in the periodic table.*

Primary Interdisciplinary Connections:

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ ICT Literacy
☒ Information Literacy ☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: *Problem solving and reasoning skills are improved through the balancing of chemical equations and stoichiometry.*

Career Readiness (Standard 9):

9.2.12.CAP.4: Evaluate different careers and develop various plans.

9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.

9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.

Learning Targets

Standards: *HS-PS1*

Content Statements: *Matter and its Interactions*

CPI#:	Cumulative Progress Indicator (CPI):
HS-PS1-1	<i>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.</i>
HS-PS1-2.	<i>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.</i>
HS-PS1-3	<i>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.</i>
HS-PS1-4	<i>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.</i>



HS-PS1-7	<i>Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</i>
HS-PS1-8	<i>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.</i>
Math.A-CED.A.4	<i>Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R.</i>
8.2.12.ED.6	<i>Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).</i>
8.2.12.ETW.1	<i>Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.</i>
8.2.12.EC.2	<i>Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.</i>

Science and Engineering Practices:

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- *Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4), (HS-PS1-8)*
- *Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)*

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- *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. (HS-PS1-3)*

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- *Use mathematical representations of phenomena to support claims. (HS-PS1-7)*

Constructing Explanations and Designing Solutions



Constructing explanations and designing solutions in 9–12 builds on K–8 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- *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. (HS-PS1-2)*

Disciplinary Core Ideas (DCIs):

PS1.A: Structure and Properties of Matter

- *Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)*
- *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. (HS-PS1-1), (HS-PS1-2)*
- *The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3) A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)*

PS1.B: Chemical Reactions

- *Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4), (HS-PS1-5)*
- *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. (HS-PS1-2), (HS-PS1-7)*

PS1.C: Nuclear Processes

- *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. (HS-PS1-8)*

PS2.B: Types of Interactions

- *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. (secondary to HS-PS1-1), (secondary to HS-PS1-3)*

Crosscutting Concepts:

Patterns

- *Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-2), (HS-PS1-3), (HS-PS1-5)*



Energy and Matter

- *In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8) The total amount of energy and matter in closed systems is conserved. (HS-PS1-7)*
- *Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)*

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- *Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7)*

Unit Essential Questions:

- *What is the difference between ionic and covalent bonds? How does the position of an atom on the periodic table relate to its ability to bond with other elements?*
- *What are the five types of chemical reactions?*
- *How are the products of a chemical reaction predicted?*
- *How can one determine the efficiency of a chemical reaction?*
- *What is stoichiometry and how can it be used to mathematically support the claim that matter is conserved in a chemical reaction?*

Unit Enduring Understandings: Cross Cutting Concepts

- *Patterns: Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.*
- *Energy and Matter: The total amount of energy and matter in closed systems is conserved.*

Unit Learning Targets:

Students will be able to:

- *Write ionic and covalent chemical compounds based on balancing charges obtained from the periodic table.*
- *Investigate the five types of chemical reactions.*
- *Conduct investigations to determine the efficiency of a chemical reaction.*
- *Use stoichiometry to predict the possible outcome of a chemical reaction.*



Evidence of Learning

Summative Assessment: *This unit will be covered over 60 school days. Information covered in this unit will be tested on the midterm and final examinations and as individual chapter tests in addition to the formative assessments listed below.*

Equipment Needed: *Computer and Software, Basic Laboratory Equipment*

Teacher Resources: *Chemistry textbook and online resources by Pearson.*

Formative Assessments:

- *Quizzes will be given to assess student learning after every 3-4 lessons.*
- *In class assignments will be completed to practice a lesson.*
- *Homework will be given 2-3 times per week.*
- *Students will be given projects and may be differentiated into individual or group assignments.*
- *Lab Reports*
- *Do Now Questions*
- *Exit Slips*
- *Group Assignments*



Lesson Plans

Lesson	Time Frame
Lesson 1 <i>Formation of Ionic Bonds</i>	2 hours / 2 days
Lesson 2 <i>Types of Chemical Reactions</i>	2 hours / 2 days
Lesson 3 <i>Basic Stoichiometry</i>	2 hours / 2 days

Teacher Notes: *Each of these lessons is crucial in the foundation of chemistry. Students must understand how atoms form bonds to create compounds, how compounds combine to create new compounds, and how to mathematically justify the efficiency of a chemical reaction through the use of stoichiometry and laboratory techniques. This unit as a whole will span a period of 60 school days.*

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

<https://www.youtube.com/watch?v=IhC42qsk5kQ>

http://chemwiki.ucdavis.edu/Core/Organic_Chemistry/Fundamentals/Ionic_and_Covalent_Bonds

<http://crescentok.com/staff/jaskew/isr/chemistry/class11.htm>

<http://www.wikihow.com/Do-Stoichiometry>



Lesson Plan 1 Template

Content Area: *Science* Lesson Title: *Formation of Ionic Bonds* Time Frame: *2 hours/2 days*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect

Equipment Needed:

Projector and students' laptops, Vernier system

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • <i>Relate the charge of an atom to its position on the periodic table.</i> • <i>Balance the charges of two different elements (one metal and one non-metal).</i>	Lesson Sequence • <i>Students will color and label a blank periodic table based on the oxidation number of each column.</i> • <i>Given a metal and a nonmetal, balance the charges between the elements to create a balanced ionic compound.</i> • <i>Discuss why the charges balance.</i>	• <i>The Periodic table should be colored and labeled correctly.</i> • <i>Element charges should be balanced correctly.</i> • <i>Online Exit Slip used to determine how well students can identify the charge of an element and balance the charges between two elements.</i>
Differentiation: <i>Easy Level Questions will consist of locating various elements to determine their likely charge.</i> <i>Moderate level questions will consist of balancing the charges between two elements correctly.</i> <i>Advanced level questions will consist of separating a balanced chemical compound back into its component ions.</i> <i>At this point, polyatomic ions and variable charge cations will not be used.</i> <i>Students must master each level of questions before moving to the next.</i>		



Lesson Plan 2 Template

Content Area: *Science* Lesson Title: *Types of Chemical Reactions* Time Frame: *2 hours/2 days*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect, teacher and student created PowerPoint presentations, online exit slip questions via OnCourse, videos will be used to show various types of chemical reactions

Equipment Needed:

Projector and students' laptops, Vernier system

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • <i>Identify the five types of chemical reactions</i> • <i>Create a poster illustrating the five types of chemical reactions through pictures.</i>	Lesson Sequence • <i>Students will research the five basic types of chemical reactions.</i> • <i>Create a poster that illustrates the five different types of reactions using pictures of objects, people, or places.</i> • <i>Students will share posters with each other and discuss their choices for illustrations.</i>	• <i>Each student must complete the research template.</i> • <i>Groups of 3 or 4 will construct a poster identifying the five major types of reactions. Pictures of people, places, or objects may be used.</i>
Differentiation: <i>Students may acquire pictures from the internet or draw pictures themselves. During this project, no words may be used (other than the type of reaction). Visual learners will benefit from this group project. The research written component will benefit the linguistic and mathematical learners.</i>		



Lesson Plan 3 Template

Content Area: *Science*

Lesson Title: *Basic Stoichiometry*

Time Frame: *2 hours/2 days*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect, teacher and student created PowerPoint presentations, online exit slip questions via OnCourse, videos will be used to show various types of chemical reactions

Equipment Needed:

Projector and students' laptops, Vernier system

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Identify mole-to-mole ratios of balanced chemical equations. - Predict the moles of product formed based on the moles of reactant used. - Interpret how real life applications of stoichiometry exist in cooking and baking recipes.	Lesson Sequence - Write mole-to-mole ratios for all substances in a balanced chemical equation. - Identify the reactants and products in a baking recipe and predict how the amounts of ingredients used will affect the outcome of the recipe. - Interpret the amount of product formed in a chemical reaction based on the amounts of reactants used.	- Find a basic recipe for baking chocolate chip cookies. List each ingredient and how much of each is needed. How many cookies can be formed from your chosen recipe? - Convert all the units of each ingredient into grams. - Write responses to questions such as: What would happen if you doubled every ingredient in your recipe? How many cookies could you make? - Apply this knowledge of doubling a baking recipe to doubling a chemical reaction.
Differentiation: <i>Each student may look up his or her own chocolate chip cookie recipe. Amounts of ingredients and number of cookies will vary with each student.</i> <i>Students may use an online convertor to help convert between units of measurement, such as liquid ounces to grams.</i>		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly, Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☒	☐	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: <i>Science</i>	Grade Level: <i>10/11</i>	Course Title: <i>Chemistry</i>
Created: <i>2021</i>	Board Approved on:	



Unit Overview Template

Content Area: *Science* **Grade Level:** *10/11* **Unit Title:** *Kinetics and Equilibrium*

Unit Summary: *Outside factors such as temperature and concentration have a great effect on the rate of a reaction and the ability of a reaction to form products.*

Primary Interdisciplinary Connections:

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ ICT Literacy
☒ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: *Problem solving skills will be improved through the discovery of chemical kinetics and equilibrium. Students will investigate how temperature and concentration play a role in altering a reaction's speed and efficiency. Students will apply these topics to real world examples.*

Career Readiness (Standard 9):

9.2.12.CAP.4: Evaluate different careers and develop various plans.

9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.

9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.

Learning Targets

Standards: *HS-PS1*

Content Statements: *Matter and Its Interactions*

CPI#:	Cumulative Progress Indicator (CPI):
<i>HS-PS1-1</i>	<i>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.</i>
<i>HS-PS1-5</i>	<i>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.</i>
<i>HS-PS1-6</i>	<i>Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.</i>
<i>Math.A-CED.A.4</i>	<i>Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R.</i>



8.2.12.ED.6	<i>Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).</i>
8.2.12.ETW.1	<i>Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.</i>
8.2.12.EC.2	<i>Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.</i>

Science and Engineering Practices:

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- *Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)*

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- *Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)*
- *Refine a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS1-6)*

Disciplinary Core Ideas (DCIs):

PS1.A: Structure and Properties of Matter

- *Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)*
- *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. (HS-PS1-1), (HS-PS1-2)*

PS1.B: Chemical Reactions

- *Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4), (HS-PS1-5)*
- *In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)*



PS2.B: Types of Interactions

- *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. (secondary to HSPS1-1), (secondary to HS-PS1-3)*

Crosscutting Concepts:

Patterns

- *Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-2)*

Stability and Change

- *Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)*

Unit Essential Questions:

- *How can one measure the rate of a chemical reaction?*
- *How does concentration and temperature affect the rate of a chemical reaction?*
- *What does it mean for a reaction to be at equilibrium?*
- *Why does a reaction "shift" to obtain equilibrium?*
- *How is Le Chatelier's Principle used to determine how a reaction will shift to reach equilibrium?*

Unit Enduring Understandings:

- *Stability and Change: Much of science deals with constructing explanations of how things change and how they remain stable.*
- *Patterns: Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.*

Unit Learning Targets:

Students will be able to:

- *Compare the rates of two different substances.*
- *Observe how molar mass can determine the rate between two substances.*
- *Construct and observe tables and charts illustrating data collected to determine the rate of reactants in a chemical reaction.*
- *Determine the order of a reaction and write simple rate laws.*
- *Explore reactions that reach equilibrium vs. reactions that "go to completion."*
- *Discover how changing temperature, pressure, and concentration can shift a chemical reaction.*
- *Use Le Chatelier's Principle to predict how a reaction will shift due to changes in temperature, pressure, and concentration.*



Evidence of Learning

Summative Assessment: *This unit will be covered in an amount of 60 School Days . Information covered in this unit will be tested on the midterm and final examination and as individual chapter tests in addition to the formative assessments listed below.*

Equipment Needed: *Computer and Software, Basic Laboratory Equipment*

Teacher Resources: *Chemistry textbook and online resources by Pearson.*

Formative Assessments:

- *Quizzes will be given to assess student learning after every 3-4 lessons.*
- *In class assignments will be completed to practice a lesson.*
- *Homework will be given 2-3 times per week.*
- *Projects will be given ample time to complete and may be individual or group assignments.*
- *Lab Reports*
- *Do Now Questions*
- *Exit Slips*
- *Group Assignments*



Lesson Plans

Lesson	Time Frame
Lesson 1: <i>Effect of Temperature on Reaction Rates</i>	2 hours/ 2 days
Lesson 2: <i>Effect of Concentration on Equilibrium</i>	2 hours/2 days
Lesson 3: <i>Effect of Temperature on Equilibrium</i>	2 hours/ 2 days

Teacher Notes:

Each of these lessons is substantial in determining how temperature and concentration affect both the rate of reactions and equilibrium. Le Chatelier's principle will be used to determine how a reaction at equilibrium is affected by temperature, concentration, and pressure.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

http://chemwiki.ucdavis.edu/Core/Physical_Chemistry/Kinetics/Factors_That_Affect_Reaction_Rates

http://www.chem4kids.com/files/react_rates.html

<http://www.chemguide.co.uk/physical/equilibria/lechatelier.html>

<https://www.youtube.com/watch?v=7zuUV455zFs>



Lesson Plan 1 Template

Content Area: Lesson Title: *Effect of Temperature on Reaction Rates*

Time Frame: *2 hours / 2 days*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect

Equipment Needed:

Student Computers, Vernier system

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • <i>Conduct an experiment to determine how temperature affects the rate of a reaction</i> • <i>Use technology to predict and test the effects of the rate of reaction.</i> • <i>Label an activation energy diagram.</i>	Lesson Sequence • <i>Locate the parts of an activation energy diagram.</i> • <i>Predict what will happen if the reactants' temperatures are initially hotter and colder than they were previously.</i> • <i>Discuss why these predictions may happen.</i>	• <i>Correctly label an activation energy diagram.</i> • <i>Experimental design must be turned in for review.</i> • <i>Conduct experiments and record results.</i> • <i>Write a conclusion as to how temperature has affected the rate of the reaction and why.</i>
Differentiation: <i>Each group of students is responsible for designing their own experimental design. Conclusions will be based on the results and research of each group individually.</i>		
Resources Provided: • <i>Online videos</i> • <i>Vernier software and hardware</i>		



Lesson Plan 2 Template

Content Area: Lesson Title: *Effect of Concentration on Equilibrium*

Time Frame: *2 hours/2 days*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect

Equipment Needed:

Student computers, Vernier Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Investigate how changes in concentration to the reactants and products causes the reaction to shift to re-establish equilibrium. - Apply their knowledge of the Vernier software.	Lesson Sequence - Students will act out what happens when equilibrium reactions are put under stress by adding or taking away reactants and products by using the "See Saw" method. - Videos illustrate what happens during equilibrium reactions under stress due to changes in concentration. - Review equilibrium diagrams and determine how each substance is affected due to changes in concentration.	- Informal suggestions from students as to which way the reaction will shift. - Video response questions used to gauge understanding and level of understanding. - Identify the components of an equilibrium diagram before and after the stress has occurred.



Differentiation:

Scaffolding is used to introduce students to equilibrium first by acting out several scenarios using the students as reactants and products. Then students will watch videos of experiments being conducted on their own. They will have several questions to answer about each video. Finally students will look at equilibrium diagrams to determine how each substance is affected by changes in concentration to one of either the reactants or products.

Resources Provided:

- *Online videos*
- *Vernier software and hardware*



Lesson Plan 3 Template

Content Area: Lesson Title: *Effects of temperature on equilibrium*

Time Frame: *2 hours/2 days*

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

Excel or Google Sheets, Vernier GoDirect

Equipment Needed:

Student laptops, Vernier system

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Investigate how temperature affects reactions at equilibrium. - Explore how exothermic and endothermic reactions are affected during equilibrium reactions.	Lesson Sequence - Witness the color of iodine tubes in both hot and cold-water baths. - Discuss why the iodine tubes have these properties. - Research the difference between exothermic and endothermic reactions and how they relate to equilibrium. - Discuss findings in small groups.	- Students will write what they see happening when two identical tubes filled with an iodine substance are placed in hot and cold conditions. - Identify whether this reaction is exothermic or endothermic. Provide evidence and support. - Based on data given for other reactions, determine how temperature changes affect shifts in equilibrium.
Differentiation: <i>Scaffolding and modeling techniques are used to show how temperature affects changes at equilibrium. Advanced theories include knowledge of exothermic and endothermic reactions and how each responds to changes in temperature.</i>		
Resources Provided: - Online videos - Vernier software and hardware		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly, Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☐	☒	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☐	☒	☐
Are differentiated based on student needs	☐	☒	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☐	☒	☐

Curriculum Design Template

Content Area: <i>Science</i>	Grade Level: <i>10/11</i>	Course Title: <i>Chemistry</i>
Created: <i>2021</i>	Board Approved on:	



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

IEP AND 504 ACCOMMODATIONS AND MODIFICATIONS FOR EARLY CHILDHOOD AND ELEMENTARY SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
Review of directions
Use of mnemonics
Have student restate information
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Use of a study carrel
Assistance in maintaining uncluttered space
Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Use of manipulatives
No penalty for spelling errors or sloppy handwriting
Follow a routine/schedule
Alternate quiet and active time
Teach time management skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Adjusted assignment timelines
Visual daily schedule



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Untimed tests
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book tests
Read test and directions to student
Provide study outline prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator and/or number line for math tests
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS MODIFICATIONS:



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Breaks between tasks
Cue expected behavior
Daily feedback to student
Have contingency plans
Use de-escalating strategies
Use positive reinforcement
Use proximity/touch control
Use peer supports and mentoring
Model expected behavior by adults
Have parent sign homework
Have parent sign behavior chart
Set and post class rules
Chart progress and maintain data



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

IEP AND 504 ACCOMODATIONS AND MODIFICATIONS FOR MIDDLE AND HIGH SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
A locker with adapted lock
Review of directions
Review sessions
Use of mnemonics
Have student restate information
Provision of notes or outlines
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Weekly or bi-weekly home-school communication
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Lab and math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of tape recorder for lectures
Use of Interactive notebook
Use of a scribe
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Ability to type all assignments
Follow a routine/schedule
Teach time management and organizational skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Daily check-in with case manager or special education teacher
Adjusted assignment timelines
Visual daily schedule



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book or open-note tests
Read test and directions to student
Provide study guides prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Pace long-term projects
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Allow outlining, instead of writing for an essay or major project
Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator for math tests
Film or video supplements in place of reading text
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Pass/no pass option

Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS FOR STUDENTS:

- Breaks between tasks
- Cue expected behavior
- Daily feedback to student
- Have contingency plans
- Use de-escalating strategies
- Use positive reinforcement
- Use proximity/touch control
- Use peer supports and mentoring
- Model expected behavior by adults
- Have parent sign homework
- Set and post class rules
- Chart progress and maintain data



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

Accommodations and Modifications for ESL Students

- Give tests orally
- Give instructions/directions in writing and orally
- Assign a peer tutor, same language or English speaking
- Allow use of bilingual/translation dictionary
- Provide summaries of text or study guides of particular chapters
- Allow errors in speaking
- Allow errors in writing
- Accept writing in first language
- Highlight key vocabulary
- Reduce amount of work required
- Assess comprehension through demonstration or other alternative means (gestures, drawings)
- Rephrase questions, directions, and explanations
- Reduce multiple choices on assessments
- Provide study guides and/ or outlines
- Shorten reading assignments
- Allow extended time for test/project completion
- Use of audio books
- Use of graphic organizers
- Use reduced text, so that print is not dense
- Use visuals/pictures throughout lesson/unit/assignment
- Adapt homework to reflect language proficiency/home support
- Adapt homework to reflect home support
- Provide hands-on activities and explanations
- Allow extended time to answer questions, and permit drawing, as an explanation
- Use of translation dictionaries to locate words in the native language
- Use anecdotal records and portfolio of work as forms of assessment
- Use story retellings to assess comprehension

What Does the Gifted and Talented Experience Look Like? *Springfield Public Schools*

Mission Statement

The Gifted and Talented Program of the Springfield Public Schools aims to provide a meaningful and rigorous education that instills the value of lifelong learning and empowers all students to reach their full potential and become self-fulfilled creative leaders in accordance with the comprehensive standards of our state. We accomplish this by offering challenging, real-world experiences in a student-centered environment.

We recognize that students come from diverse socioeconomic, cultural, and ethnic backgrounds, and the mission of the gifted and talented program is to provide opportunities for students to explore their intellectual, creative, and artistic gifts and talents within the classroom and with beyond-the-classroom experiences. It is essential to provide diverse, appropriate, and ongoing learning experiences and environments that incorporate students' academic, psychological, and social needs. Our responsibility is to provide students with educational alternatives that teach, challenge, and expand their knowledge, while simultaneously stressing the development of independent and self-directed learners who continuously generate questions, analyze, synthesize, and evaluate information and ideas.

New Jersey Administrative Code 6A:8-3.1 defines students who are gifted and talented as those students who possess or demonstrate high levels of ability in one or more content areas when compared to their chronological peers in the local district and who require modification of their educational program if they are to achieve in accordance with their capabilities.

Goals:

To support our mission, we have established the following goals to guide our work:

- To infuse into the general education program a broad range of activities for high-level learning that will challenge all students to perform at advanced levels, and provide extended opportunities, resources, and support in particular areas where student interest or talent is demonstrated.
- To provide a continuum of gifted education services that will strengthen the total school program, offer enriching and challenging learning opportunities for all students, and provide specialized learning experiences
- To promote achievement of students' best potentials and increased ability.

Through a productive and collaborative relationship among the building principals, classroom teachers, and the Gifted and Talented teacher, our schools can create programming that will enhance the learning experience for every student and serve the unique and specialized needs of students currently demonstrating gifted behaviors.

Elements of the Schoolwide Enrichment Model, W.I.N (What I Need), differentiated instruction, advanced classes, or individual programs into a student's regular instruction program are integral to this overarching framework for gifted education in the Springfield School District.

Reference Board Policy and Regulation 2464 – Gifted and Talented Pupils (M)

Early Childhood Center **Edward V. Walton**

Schoolwide Virtual Enrichment

All first and second grade students have access to the [Gifted and Talented Virtual Classroom](#). This virtual classroom is a space for students to complete various challenges and enrichment opportunities at their own pace. Students can receive feedback and additional adaptable resources to meet their individual learning needs. The virtual classroom design expands accessibility to enrichment resources and allows students to choose learning activities according to their unique interests and abilities. The purpose of the activities is to encourage problem-solving, develop critical thinking

skills, and expand curiosity and imagination. Activities are aligned to the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

The Gifted and Talented teacher serves as a resource to all teachers within Edward V. Walton School. Teachers seeking resources for their high-ability learners will receive additional support from the Gifted and Talented teacher in various ways. This support may include additional units of study, challenging resources, and student projects.

Elementary Schools **James Caldwell** **Thelma L. Sandmeier**

The goal is to engage small groups of students in intensive learning experiences through standards-based, rigorous, and relevant units of study that supplement, not supplant, the grade-level curriculum and support students' unique learning needs.

Enrichment Experience Grade 3

Beginning in third grade, the G&T teacher will cycle through all classrooms to work on problem-solving and enrichment tasks with students. Driven by assessment data, academic performance, student interest, and teacher observation, small groups of students will meet with the G&T teacher during W.I.N. (What I Need) periods throughout the week that the teacher is assigned to their classroom teacher. Groupings will be flexible and monitored to best meet each student's needs throughout the school year. Activities will include brain teasers, puzzles, strategic thinking, problem-solving, and STEM challenges.

Targeted Gifted and Talented Programing Grades 4-5

Students may become identified as Gifted and Talented in fourth grade. Students that are identified may receive support from the G&T Teacher for up to five periods (200 minutes) a week during W.I.N. (What I Need) periods. Identified students will meet to explore grade-level content while incorporating depth and complexity in a student-centered, problem-based environment. The Gifted and Talented Program aims to provide students with various advanced and challenging learning experiences across content areas to promote independent thinking skills, refine critical thinking and communication skills, cultivate joy in learning, and expand student interests through problem-solving. The instruction that students receive incorporates 21st Century Skills and advanced content that is challenging, hands-on, and relevant to the real world.

Strategies and Practices that Support Gifted and Talented Students

- Adjusted Pace of Lessons
- Inquiry-Based Instruction
- Higher-Order Thinking Activities
- Interest-Based Content
- Real World Problem Solving/Problem Based Learning
- Independent Study/Passion Projects
- Units of Study with Like-Minded Peers

Schoolwide Virtual Enrichment

All JCS and TLS students have access to grade level-specific [Gifted and Talented Virtual Classrooms](#). These virtual classrooms are a space for students to complete various challenges and enrichment opportunities at their own pace. Students are able to receive feedback and additional opportunities based on their needs. The virtual classrooms have expanded the accessibility of enrichment resources directly to the students and allows for students to choose opportunities according to their interests and abilities. The purpose of the activities is to encourage problem solving, develop critical thinking skills, and expand curiosity and imagination in conjunction with the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

In addition to classroom support, the Gifted and Talented teacher also serves as a resource to all teachers in the building. Teachers that are seeking resources for their high ability learners will receive additional support from the Gifted and Talented teacher in various ways. This may include additional units of study, challenging resources, student projects, and meeting with the G&T teacher as needed.

Additional Enrichment Opportunities

Across all grade levels 3-5, as recommended by the classroom teacher, students exhibiting a need for additional enrichment may have the opportunity to meet with the G&T teacher as the schedule allows. Groupings will be flexible and monitored to best meet the students' needs throughout the school year. Activities will include, brain teasers, puzzles, strategic thinking activities, problem-solving challenges, and STEM challenges. Students engage in an extended process of asking questions, using resources, and developing answers that lead to thinking about what and how they are learning. Students are held accountable for how they work and use their time by demonstrating their learning through products or presentations.

Students self-select to participate in individual and/or group projects based on interest and commitment. The classroom teacher and/or the enrichment teacher will help guide

and monitor student exploration of chosen topics, facilitating their learning with resources and teaching of needed skills.

Secondary Schools
Florence M. Gaudineer Middle School
Jonathan Dayton High School

Grades 6-12: Access to specific content programs with higher levels of academic challenges (i.e. Pre-Algebra, Accelerated Communication Arts, and Advanced Placement Classes)

Dual Credit Courses provide students the opportunity to obtain high school credit, and college credit, simultaneously through partnerships with several institutions.

Project Lead the Way (PLTW) students become builders of technology by engaging in real world activities. Students are empowered as design thinkers collaborating on real world projects.

Gifted and Talented Identification Criteria

The Springfield Schools Gifted and Talented Program recognizes that students require differentiated learning experiences beyond the core curriculum being taught because of their advanced abilities in one or more content areas. These students may also have other cognitive qualities such as curiosity, creativity, motivation, leadership, and passion that require modifications to their academic experience.

Multiple Measures of Eligibility

Kindergarten through grade twelve identification process for gifted and talented students includes multiple measures. Multiple measures may include but are not limited to: achievement test scores; grades; student performance or products; intelligence testing; parent, student, and/or teacher recommendation; and other appropriate measures. The identification methodology is developmentally appropriate, non-discriminatory, and related to the programs and services offered by the Springfield School District. The identification procedures are reviewed annually.

According to N.J.A.C. 6A:8-3.1, all public school districts must have a board-approved gifted and talented identification process and provide services for identified students

enrolled in the grades of that school district. The regulations require that identification and services be made available to students in grades K-12.

When students are recommended for the Gifted and Talented Program there are multiple measures that are considered to determine if services are necessary and appropriate. The assessments used are as follows:

- *Cognitive Abilities Test (CogAT)*
- *Classroom Performance/Student Portfolios*
- *DRA2 Level*
- *iReady Diagnostic Scores*
- *Gifted Indicators Checklist*
- *Start Strong/NJSLA Assessment Data*

The N.J.A.C. requires that students be compared to their chronological peers in the local school district. The New Jersey Department of Education has not established state-level criteria for identifying students who are gifted, such as mandated tests or assessments, grade point averages, or IQ scores. Local school districts must use multiple measures to identify students.

Procedures

<https://www.straussesmay.com/seportal/Public/DistrictPolicy.aspx?policyid=2464&id=b8a33a9f505e4998a6db3fb8e1de778b>

Team meetings present the opportunity to review data and assess the educational needs of all students. Programs for gifted and talented students will be periodically evaluated for their continuing efficacy and adjusted accordingly. The parent of any student identified as gifted or talented shall be consulted regarding any program designed to address the student's particular needs.

NJDOE Fast Facts

<https://www.nj.gov/education/standards/gifted/>

<https://www.nj.gov/education/standards/gifted/legislation.shtml>

Gifted and talented student: The “[*Strengthening Gifted and Talented Education Act*](#)” defines a gifted and talented student as a “student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities.”

Twice-exceptional (2E) students: A twice-exceptional (2E) student is defined as “a student who is both gifted and a student with a disability. These students may also be

referred to as having dual exceptionalities or as being gifted with learning disabilities (GT/LD). This also applies to students who are gifted with ADHD or gifted with autism” (New Jersey Association for Gifted Children, www.nagc.org).

Instructional adaptation: An adjustment or modification to instruction enabling a student who is gifted and talented to participate in, benefit from, and demonstrate knowledge and application of the New Jersey Student Learning Standards in one or more content areas at the instructional level of the student, not just the student’s grade level.

Identifying gifted and talented students: The focus of identification is to provide programming and services in which students' specific learning needs and potential are appropriately addressed and met. In every New Jersey school district, there are students who require modifications to the general education curriculum if they are to achieve in accordance with their abilities. By identifying a student’s general intellectual ability, creativity, or specific academic area aptitudes, we are acknowledging that they need programming and services outside of the general education/grade level curriculum to advance their learning.

Supplemental Resources/Programming for Gifted Students

Edward V. Walton

- PETS Program – Primary Education Thinking Skills
- Group Solutions/Group Solutions 2 – Cooperative Logic Activities
- Lollipop Logic
- Beginning Thinking Skills
- AIMS Education Programming

James Caldwell and Thelma L. Sandmeier

Math/ELA

- Project M3: Mentoring Mathematical Minds
- Junior Great Books
- AIMS Education Programming
- Borenson Hands on Equations
- BizWorld
- Perplexors
- Advanced Math Explorations grade 3-5
- Challenging Units for Gifted Learners (ELA and Math)
- Creative Curriculum Extenders

- Differentiated Lessons & Projects
- Challenge Math Grades 4+
- Differentiating Instruction with Menus (All Content Areas)
- Jacob's Ladder
- Genius Hour/Passion Project
- Spatial Reasoning
- Logic Puzzles, Brain Games, Analogies

STEM

- Engineering is Elementary
- Engineer Throughout the Year
- PBS Design Squad
- DefinedSTEM
- Project Lead the Way (PLTW)

Enrichment Events

Experience for all students to be enriched through events related to the curricular or extracurricular activities. Examples include after school clubs, PTA-sponsored events, leadership opportunities, visual and performing arts, and community service opportunities.