Unit 3: Chemical Reactions, Electromagnetic Spectrum, Waves

Content Area: **Science**
Course(s):
Time Period: **Trimester 2**
Length: **9-10 weeks**
Status: **Published**

Chemical Reactions, Electromagnetic Spectrum, Waves Summary

In this unit, students will explore chemical reactions, waves, and the electromagnetic spectrum through hands-on labs and NGSS-aligned investigations. They will identify and balance chemical reactions, observe evidence of chemical change, and classify reactions by type. Students will highlight the Law of Conservation of Mass and Matter through their exploration of Chemical Reactions. Students will also model and analyze mechanical and electromagnetic waves, examining properties like wavelength, frequency, and amplitude. Activities such as flame tests, spectroscopy, and the Slinky Lab help students connect abstract concepts to real-world phenomena. Throughout the unit, students will engage in scientific writing, data analysis, and a final project, building skills in communication, collaboration, and evidence-based reasoning. Students will also build foundational laboratory techniques and safety awareness.

Revision Date: July 2025

Essential Questions/Enduring Understanding

Essential Questions

How can we predict the outcome of chemical reactions, and why is this ability crucial for both scientific and real-world applications?

What is the fundamental relationship between energy and waves, and how does this connection explain the transfer of energy through different mediums?

Why is the law of conservation of matter a fundamental principle for all chemical reactions, and what methods do scientists use to ensure it is upheld?

In what ways do scientific models serve as powerful tools for visualizing and understanding complex, invisible phenomena like the structure of matter and the behavior of waves?

Enduring Understanding

An element's unique chemical properties are the fundamental factors that determine how it will interact with other substances and the types of chemical reactions it can undergo.

The essential characteristics of waves, such as their ability to transfer energy, are consistent and predictable

regardless of the medium they travel through.

The Law of Conservation of Matter is a fundamental principle in chemistry, stating that matter is neither created nor destroyed in a chemical reaction, but simply rearranged into new substances.

Objectives

Students will be skilled at identifying reactants, products, and the symbols used in chemical equations.
Students will be skilled at demonstrating how to write balanced chemical equations.
Students will be skilled at using coefficients and subscripts to show how mass is conserved during a chemical reaction.
Students will be skilled at classifying types of chemical reactions as synthesis, decomposition, single-displacement, or double-displacement.
Students will be skilled at comparing and contrasting exothermic and endothermic reactions.
Students will be skilled at describing the effects of catalysts and inhibitors and their role in chemical reactions.

Students will be skilled at determining the relationship between seismic waves and a reading on a seismograph.

Students will know what causes waves and how energy is transferred through them.

Students will know what the basic parts of a wave are.

Students will know the difference between reflection and refraction.

Students will know that the law of conservation of mass applies to all chemical reactions.

Students will know that chemical reactions involve the rearrangement of atoms to form new substances.

Learning Plan

1. **Discuss and practice science lab safety procedures**
   Students will learn and demonstrate proper lab safety practices, including how to use goggles, handle chemicals responsibly, respond to accidents, and follow classroom safety rules to ensure a safe learning environment.

2. **Explore how waves interact with other objects. Interactivity: Making Waves**
   Students will use the online textbook to complete a virtual simulation to analyze how waves interact

with items in their path and how they interact with other waves.

3. **Conduct a flame test**
   Students will burn different metal salts and observe the color of the flame to identify the metal ions present based on emission spectra.

4. **Discuss the four types of reactions that can take place during an experiment**
   Students will learn about and analyze synthesis, decomposition, single replacement, and double replacement reactions through notes, examples, and class discussions.

5. **Balancing Chemical Compounds Gizmo**

   Students will use an online platform to balance equations and simulate chemical bonding on a molecular level.

6. **Identify the type of reaction taking place by examining a balanced equation**
   Students will study balanced chemical equations and determine the type of reaction based on patterns in the reactants and products.

7. **Identify if a reaction is endothermic or exothermic**
   Students will observe and analyze chemical reactions to determine if energy is absorbed (endothermic) or released (exothermic).

8. **Discuss and distinguish between covalent and ionic bonding**
   Students will compare covalent and ionic bonds by examining how electrons are shared or transferred between atoms, and learn how bonding affects compound properties.

9. **Bonding Lab: Students will predict and investigate the type of bond holding together a variety of chemicals**
   Students will test and observe physical properties (like solubility, conductivity, and melting point) of substances to determine whether they are ionically or covalently bonded.

10. **Write a well-written lab report**
    Students will practice recording observations, procedures, data analysis, and conclusions in a clear and organized lab report format using scientific language.

11. **Define and discuss the distinguishing properties of acids and bases, including household examples, common uses and effects on the body**
    Students will compare properties of acids and bases, identify common examples found at home, and discuss how these substances interact with the human body.

12. **Examine pH measurement by discussing the effectiveness of pH paper, how pH paper works and practice measuring solutions with pH paper**
    Students will learn how pH paper indicates acidity or basicity, then test and record the pH of various substances in the lab.

13. **Discuss the causes and effects of acid rain. Examine before and after photos of a variety of structures deteriorated by acid rain**
    Students will learn how acid rain forms, observe real-life damage it causes to buildings and nature, and connect this to environmental chemistry concepts.

14. **Discuss the digestive system and the essential roles that acids and bases play in food digestion**
    Students will explore the role of acids (like stomach acid) and bases in the human digestive process

through visuals, discussions, and guided activities.

15. **Introduce the Lewis dot structure for drawing elements and the Octet rule**
    Students will draw Lewis dot diagrams to represent valence electrons and apply the Octet Rule to predict how atoms bond.

16. **Discuss how to write and name the chemical formulas for molecular compounds**
    Students will practice writing and naming molecular compounds using element symbols and numeric prefixes based on the number of atoms present.

17. **Define and discuss how chemical properties determine if an acid/base is strong or weak**
    Students will analyze the strength of acids and bases by learning how completely they dissociate in water and examining related chemical properties.

18. **Explore how waves interact with other objects Interactivity: Making Waves**
19. Students will use the online textbook to complete a virtual simulation

Advanced

1. **Define and discuss neutralization and how salts form**
   Students will explore how acids and bases react to form water and a salt in neutralization reactions and identify real-life examples of this process.
2. **Discuss how to use oxidation numbers to find subscripts for these compounds**
   Students will use oxidation numbers to determine how elements combine in chemical formulas, ensuring balanced charges.

Lab Safety will be reviewed before all Lab Activities

Assessment

Science courses are designed to promote skill attainment. Student progression and pace through which they proceed through the performance tasks is based on their affinity for and ability to reach skill attainment. The teacher will determine formative and summative skill attainment; alternative assessments will be incorporated for each student based on their strengths and challenges.

Formative Assessments:

Worksheets

Exit Tickets

Class Discussion

Quizzes

Gizmos

Check for Understandings

***Some Suggested Options**:*

Reaction Types

Balancing Reactions

pH and Acid/Base

Color wheel

visable light

Infrared/x-rays/ultra violet

Wave types

Wave properties

Summative Assessment:

Quizzes

***Some Suggested Options**:*

Reaction Types

Balancing Reactions

pH and Acid/Base

Color wheel

visable light

Infrared/x-rays/ultra violet

Wave types

Wave properties

Unit Tests

***Some Suggested Options**:*

Chemical Reactions and Balancing Equations

Electromagnetic Spectrum

Waves

Bench Marks:

Formal Lab Reports/Lab Write-ups

Lab Work

***Some Suggested Options**:*

Where's the Evidence?

Testing pH

Making Waves

Slinky Lab

Laboratory Techniques

Alternative:

Long-Term Projects

Making a musical instrament

The Greenhouse Effect

Laboratory Practical

Materials

General lab equipment

General lab kits

General classroom supplies

Safety Equipment

- goggles, gloves, lab aprons, sinks, fire extinguisher, fire blanket, eye wash station, safety shower, fume hood, first aid kit, safety contract for students, tongs, hot plate

Elevate Science Physical Savvas Realize

Science Explorer Modules Physical Science Prentice Hall

Computer(s)

Smartboard

Access to Internet

Powerpoints

Relevant worksheets/notes

Relevant videos

Relevant virtual activities

Relevant interactive programs

Various Lab Chemicals

Cups

String

Rubberbands

Mirrors

Balloons

Felt

Corks

Pins

Battery

Copper Wire

Standards

P.1	Act as a responsible and contributing community members and employee.
P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
	Troubleshooting a problem is more effective when knowledge of the specific device along with a systematic process is used to identify the source of a problem.
	Multiple solutions often exist to solve a problem.

P.9	Work productively in teams while using cultural/global competence.
	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
	Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
	An essential aspect of problem solving is being able to self-reflect on why possible solutions for solving problems were or were not successful.
	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
	Advancements in computing technology can change individuals' behaviors. Society is faced with trade-offs due to the increasing globalization and automation that computing brings.
	Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.
	Data is represented in many formats. Software tools translate the low-level representation of bits into a form understandable by individuals. Data is organized and accessible based on the application used to store it.
	Digital technology and data can be leveraged by communities to address effects of climate change.
8.EE.C.8.a	Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
	Computer models can be used to simulate events, examine theories and inferences, or make predictions.
8.EE.C.8.b	Solve systems of two linear equations in two variables using the substitution method and estimate solutions by graphing the equations. Solve simple cases by inspection.
	Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
	Increases in the quantity of information available through electronic means have heightened the need to check sources for possible distortion, exaggeration, or misrepresentation.
	Digital tools make it possible to analyze and interpret data, including text, images, and sound. These tools allow for broad concepts and data to be more effectively communicated.
	Control structures are selected and combined in programs to solve more complex problems.
	The mode of information can convey a message to consumers or an audience.
	Sources of information are evaluated for accuracy and relevance when considering the use of information.
W.AW.8.1	Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence.
W.AW.8.1.A	Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
	Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
	In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.

	There are ethical and unethical uses of information and media.
W.AW.8.1.B	Support claim(s) with logical reasoning and relevant evidence, using relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
	The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.
	Engineering design is a systematic, creative, and iterative process used to address local and global problems. The process includes generating ideas, choosing the best solution, and making, testing, and redesigning models or prototypes.
	The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.
	The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.
W.IW.8.2	Write informative/explanatory texts (including the narration of historical events, scientific procedures/experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
W.IW.8.2.A	Introduce a topic clearly, previewing what is to follow; and organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.
W.IW.8.2.F	Provide a concluding statement or section (e.g., sentence, part of a paragraph, paragraph, or multiple paragraphs) that synthesizes the information or explanation presented.
	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
	Economic, political, social and cultural aspects of society drive development of new technological products, processes, and systems.
	Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
	Technology interacts with society, sometimes bringing about changes in a society’s economy, politics, and culture, and often leading to the creation of new needs and wants. New needs and wants may create strains on local economies and workforces. Improvements in technology are intended to make the completion of tasks easier, safer, and/or more efficient.
8.SP.A.2	Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit (e.g., line of best fit) by judging the closeness of the data points to the line.
8.SP.A.3	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
	Some chemical reactions release energy, others store energy.

	Resources need to be utilized wisely to have positive effects on the environment and society. Some technological decisions involve trade-offs between environmental and economic needs, while others have positive effects for both the economy and environment.
	A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
	Technological disparities have consequences for public health and prosperity.
MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
	A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
	Graphs and charts can be used to identify patterns in data.
MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
	A sound wave needs a medium through which it is transmitted.
	When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
	The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.
	A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
	However, because light can travel through space, it cannot be a matter wave, like sound or water waves.
	Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.

Suggested Strategies for Modifications

This link includes content specific accommodations and modifications for the populations listed below the link.

https://docs.google.com/spreadsheets/d/1-5KhjcdFRswaPUN1joj7W_KCoowH0TRTHF6kBkW_P_o/copy