Unit 2: Why do we use gasoline for energy?

Content Area: **Science**
Course(s):
Time Period: **MP2**
Length: **45 days**
Status: **Published**

NJSLS - Science

9-12.HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.
9-12.HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
9-12.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
9-12.HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
9-12.HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
9-12.HS-PS1-4	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
9-12.HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

Science and Engineering Practices

Developing and Using Models

Develop a model based on evidence to illustrate the relationships between systems or between system components. (HS-PS1-4), (HS-LS2-5), (HS-ESS2-6)

Analyzing and Interpreting Data

Analyze data using computational models to make valid and reliable scientific claims. (HS-ESS3-5)

Planning and Carrying Out Investigations

Plan and conduct an invasion 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, me), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking

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

Use a computational representation of phenomena or design soluons to describe and/or support claims and/or explanations. (HS-ESS3-6)

Obtaining, Evaluating, and Communicating Information

Communicate scientific ideas (e.g. about phenomena and 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-ESS1-3)

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter

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 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)

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-PS1-7)

PS2.B: Types of Interactions

Aracon 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) L

S2.B: Cycles of Matter and Energy Transfer in Ecosystems

Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)

PS3.D: Energy in Chemical Processes and Everyday Life

The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (secondary to HS-LS2-5)

ESS2.D: Weather and Climate

Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6)

Changes in the atmosphere due to human acvity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6)

ESS3.D: Global Climate Change

Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)

Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

Crosscutting Concepts

Patterns

Different paerns 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-PS1-3)

Energy and Matter

The total amount of energy and matter in closed systems is conserved. (HS-PS1-7), (HS-ESS2-6)

Changes in 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)

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) Scale, Proportion, and Quantity

The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1)

Systems and System Models

Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS2-5)

When investing or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Stability and Change

Change and rates of change can be quantified and modeled over very short or very long periods. Some system changes are irreversible. (HS-ESS3-3), (HS-ESS3-5)

Scientific Invesgations Use a Variety of Methods

Science investors use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5)

New technologies advance scientific knowledge. (HS-ESS3-5)

Scientific Knowledge Based on Empirical Evidence

Science knowledge is based on empirical evidence. (HS-ESS3-5)

Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS3-5)

Rationale and Transfer Goals

This unit focuses on developing an understanding of how the properties of an element determine the way its atoms will react with other atoms. Students will develop models, use mathematical representations, and analyze data to explore the law of conservation of mass and the role of energy in chemical bonds and reactions. Students will apply this understanding to real-world examples of chemical reactions including the role of photosynthesis and cellular respiration in atmospheric carbon cycling. Students will then move to understanding systems of the Earth and the impact of human acvity on those systems.

Enduring Understandings

- The Law of Conservation of Mass: In an isolated system mass is neither created nor destroyed by chemical reactions or physical transformations. [Anchor]
- A chemical bond is the physical phenomenon of chemical substances being held together by a racon of atoms to each other through sharing, as well as exchanging of electrons or electrostatic forces. [Anchor]
- When a chemical reaction occurs, molecular bonds are broken and other bonds are formed to make different molecules. Energy is always required to break a bond.
- The abundance of liquid water on the Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics.
- Water contains an extensive network of hydrogen bonds resulting in a high heat capacity and a high heat of vaporization. [Anchor]
- All forms of energy production have associated economic, social, environmental, and geopolitical costs and risks as well as benefits.

Essential Questions

- How do the properties of an element determine the way its atoms will react with other atoms?
- What is the role of energy in a chemical bond?
- What is the role of energy in a chemical reaction?
- How does carbon cycle through the ocean, atmosphere, soil, and biosphere?
- How are humans impacting the relationships among Earth systems?

Content - What will students know?

- The Law of Conservation of Mass: In an isolated system mass is neither created nor destroyed by chemical reactions or physical transformations.
- The strength of forces between particles (ions atoms, molecules, and networked materials)
- Develop a model to identify and describe the bonds formed and broken in a chemical reaction and the role of energy in a chemical reaction including the energy transfer between system and surroundings as well as the change of potential energy to kinetic energy.
- The cycling of carbon in the hydrosphere, atmosphere, geosphere, and biosphere as well as the role of photosynthesis and cellular respiration in this process.
- The current science behind climate change and the human impact on the systems of the Earth and predictions for the future.

Skills - What will students be able to do?

- Students will be able to state, explain, and demonstrate the law of conservation of mass as well as understand the meaning of reactant and product.
- Provide evidence that indicates that some intermolecular racons are stronger than others and how

properties of a substance (like melting point, boiling point, and volatility) can be used to make inferences about the strength of forces between particles.
- Describe the net change in energy within a system that results from broken bonds during a chemical reaction and calculate bond energies.
- Explain the exchange of carbon between organisms and the environment through photosynthesis and cellular respiration, as well as the cycling of carbon from one sphere to another.
- Analyze and interpret data showing the evidence of global

Activities - How will we teach the content and skills?

- Calculate the mass of the product formed in a chemical reaction given the mass of reactants and determine quakes of reactants and products of a chemical reaction in terms of atoms, moles, and mass. [Link]
- Students will complete an acvity titled “Interactions Between Particles.” [Link]
- Students will create and interpret energy level diagrams as well as analyze graphs of relative energies of reactants and products showing energy is conserved.
- Students will view a short documentary [Link] as well as complete a literacy acvity on carbon cycling via photosynthesis and cellular respiration. [Link]
- Students will read an article from the American Chemical Society titled “Global Climate Change.” [Link] Additionally students will analyze images and data from NASA. [Link]

Evidence/Assessments - How will we know what students have learned?

- **Assessments can be reviewed for each course in this folder.**

- Students will complete a laboratory activity titled “Achieving a photosynthesis balance.” [Link] This acvity will introduce the chemical reaction that is photosynthesis as well as the student's understanding of the law of conservation mass.
- Students will take an assessment of the role of energy in chemical bonds and chemical reactions.
- Students will take an assessment on the role of photosynthesis and cellular respiration in carbon cycling as well as climate change and human impact on the Earth.
- Chemistry Unit 2 Benchmark

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• In a chemical reaction mass and energy are conserved and energy is essential to understanding chemical	• Potential energy stored in molecules is converted to chemical energy and kinetic energy.	• Students will complete a self-guided POGIL acvity on types of energy. • Students will read an

bonds and chemical reactions. • Photosynthesis and cellular respiration are an essential part of the cycling of carbon in the hydrosphere, atmosphere, geosphere, and biosphere. • Human acvity has an impact on the systems of the Earth and climate change	• Photosynthesis is a process used by plants and other organisms to convert light energy into chemical energy that can later be released to fuel the organisms' activities. Cellular respiration breaks down a product of photosynthesis (sugar) into ATP. • Global warming is the rising average temperature of Earth's climate system.	article reviewing the concepts of photosynthesis and cellular respiration. [Link] • Students will complete the acvity "Finding Chemistry Connections in Climate Change." [Link] Students will be able to

Key Resources

Dynamic Periodic Table [Link]

POGIL: Process-Oriented Guided Inquiry Learning [Link]

PhET Simulations [Link]

American Association of Chemistry Teachers [Link]

Career Readiness, Life Literacies, & Key Skills

9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
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 (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
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 (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).
9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).

9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).
9.4.12.IML.6	Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).

Interdisciplinary Connections/Companion Standards

