Unit 7.1 Chemical Reactions and Matter

Content Area: **Science**
Course(s): **Science 7**
Time Period: **Marking Period 1**
Length: **MP 1**
Status: **Published**

Essential Questions

How can we make something new that was not there before?

- Lesson 1: What happens when a bath bomb is added to water (and what causes it to happen)?
- Lesson 2: Where is the gas coming from?
- Lesson 3: What's in a bath bomb that is producing the gas?
- Lesson 4: Which combinations of the substances in a bath bomb produce a gas?
- Lesson 5: What gas(es) could be coming from the bath bomb?
- Lesson 6: How can we explain another phenomenon where gas bubbles appear from combining different substances together?
- Lesson 7: How can we revise our model to represent the differences in the matter that goes into and comes out of the bath bomb system?
- Lesson 8: How can particles of a new substance be formed out of the particles of an old substance?
- Lesson 9: Does heating liquid water produce a new substance in the gas bubbles that appear?
- Lesson 10: When energy from a battery was added to water, were the gases produced made of the same particles as were produced from heating the water?
- Lesson 11: How do Dalton's models of the particles that change in a reaction compare to the ones we developed?
- Lesson 12: How can a new substance (a gas) be produced and the total mass of the closed system not change?
- Lesson 13: Why do different substances have different odors and how do we detect them?
- Lesson 14: What is happening to the Taj Mahal?

Big Ideas

Unit Summary and Storyline

Seventh grade chemistry students' conceptual understanding of chemical reactions for middle school science is foundational to much science learning. Understanding atomic level reactions is crucial for learning physical, life, earth, and space science. Even more importantly, they open up new windows of curiosity for students to see the world around them. By seventh grade, students are ready to take on the abstract nature of the interactions of atoms and molecules far too small to see.

To pique 7th grade students' curiosity and anchor the learning for the unit in the visible and concrete, students start with an experience of observing and analyzing a bath bomb as it fizzes and eventually disappears in the water. Their observations and questions about what is going on drive learning that digs into a series of related phenomena as students iterate and improve their models depicting what happens during chemical reactions for middle school science. By the end of the unit, students have a firm grasp on how to model simple molecules, know what to look for to determine if chemical reactions have occurred, and apply their knowledge to

chemical reactions to show how mass is conserved when atoms are rearranged.

This unit begins with an exploration of observing what happens when a store bought bath bomb is added to water. Students make observations of the bath bomb multiple times: 1) before adding it to water by passing it around the class, 2) right after the bath bomb has been added to water, and 3) after the bath bomb has been in the water for 10 minutes. They notice that when the bath bomb is added to water it immediately begins to behave differently—it bubbles (forming a gas), breaks apart (dissolves and reacts), changes the color of the water, and has an odor that wasn't as evident before adding to the water. After observing a store bought bath bomb as a class, each student is given one of four different homemade bath bomb samples to investigate before and after adding to water. These investigations lead to students having many questions about bath bombs and ideas for how to investigate what is causing the different bath bombs to behave the way they do.

Enduring Understandings

NGSS Performance Expectations

MS-PS1-1: Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.]
MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]
MS-PS1-5: Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]
The following PE will be developed over three OpenSciEd units;
OpenSciEd Unit 6.1: Why do we sometimes see different things when looking at the same object? (One-way Mirror Unit),
OpenSciEd Unit 7.1: How can we make something new that was not there before? (Bath Bombs Unit), and
OpenSciEd Unit 8.2: How can a sound make something move? (Sound Unit). This 7th grade unit will address only the chemical reactions that input the transmit signals to the brain through smell. The other units will address electromagnetic and mechanical inputs, as well as the connection to signals processing in the brain, resulting in immediate behaviors or memories.

MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment boundary: Assessment does not include mechanisms for transmission of this information]
MS-LS1.D: Information Processing: Each sense receptor responds to different inputs (electromagnetic,

mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

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).
Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
PS1.B: Chemical Reactions

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.
The total number of each type of atom is conserved, and thus the mass does not change.
LS1-D: Information Processing

Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

Crosscutting Concepts

While this 7th grade chemistry unit engages students in multiple CCCs across the lesson level performance expectations for all the lessons in the unit, there are three focal practices that this unit targets to help support students' development in a learning progression. These are: Patterns; Scale, Proportion, and Quantity; Energy and Matter.

Cross-Curricular Integration

Additional Mathematics and ELA integration can be found within each lesson plan.

Mathematics Integration

Density is a property that students measure, graph, and calculate from mass and volume data in Lesson 8. They will be using the following two math concepts in that lesson:

CCSS.MATH.CONTENT.7.RP.A.2.A Decide whether two quantities are in a proportional relationship, e.g.,

by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
CCSS.MATH.CONTENT.7.RP.A.2.B Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

Diversity Integration

Connect chemistry to real-world applications and social contexts
Illustrate relevant applications: Connect chemical reactions and matter concepts to real-world issues, particularly those that might be relevant to diverse communities. For example, discuss the chemistry of water purification in developing countries or the role of chemistry in addressing environmental justice issues.
Address the broader impacts of research: Explore how chemical discoveries have benefited or harmed different communities unequally, fostering critical thinking about the social responsibility of science.

Labs and Resources

Scientific Inquiry

Chemical Reactions & Energy

Objective:
Students will explore how chemical reactions can release or absorb energy. They will observe an exothermic and an endothermic reaction using common materials.

Reflection Questions:
What was the temperature change during the exothermic reaction? What does this tell you about the energy change?
How did the temperature change during the endothermic reaction? What does this indicate about energy absorption?
Assessment:
Students will complete a lab report including:
A summary of their observations.
Answers to reflection questions.
A conclusion explaining the energy changes in both reactions.

Science and Engineering Practices

While this 7th grade chemistry unit engages students in multiple SEPs across the lesson level performance expectations for all the lessons in the unit, there are three focal practices that this unit targets to support students' development in a learning progression across the 7th grade year for the SEPs. These are:

Constructing Explanations and Designing Solutions
Analyzing and Interpreting Data
Engaging in Argument from Evidence
In addition, there are two supporting practices that students will utilize over the course of the 7th grade chemistry unit. These practices are two that students have developed over the course of 6th grade in the OpenSciEd sequence and will be used as supporting practices in this unit:

Developing and Using Models
Planning and Carrying Out Investigations

Science and Society

Antoine Lavoisier: His experiments with combustion led to the discovery that oxygen is essential for this process and to the formulation of the law of conservation of mass, which states that matter is neither created nor destroyed in chemical reactions. He also played a crucial role in standardizing chemical nomenclature.

John Dalton: Dalton's atomic theory, proposed in the early 1800s, posited that all matter is composed of atoms, and that atoms of a given element are identical. His law of multiple proportions explains that when two elements form more than one compound, the different masses of one element that combine with a fixed mass of the other element are in a ratio of small whole numbers.

Amedeo Avogadro: In the early 19th century, Avogadro proposed that equal volumes of all gases, at the same temperature and pressure, contain the same number of molecules. This is known as Avogadro's law and is fundamental to understanding the behavior of gases.

Video

CSDT Technology Integration