SUCCESS ACADEMY EDUCATION INSTITUTE

Physical Science:

Unit 2

Solids and Liquids and Gases, Oh My!: Introduction

Purpose: The Why, What, and How of This Unit

Essential Question: How can we make ice cream without putting the ingredients into the freezer?

Unit Storyline Synopsis: Why does a candy bar look solid but melt in your hands? Why doesn't the ocean freeze in the winter? In this unit, scholars will study the chemistry of phase changes as they grapple with a tricky task: making ice cream!

Why This Unit? Although scholars may recall studying a similar topic in elementary school, this unit will ask them to explore melting, boiling, and other phase changes in greater depth. This understanding of phase changes will provide scholars with the language to accurately describe and predict phenomena they encounter in daily life. In addition, this unit builds scholars' modeling skills through opportunities to represent experimental data graphically.

In the second half of seventh grade, expectations for scholar work increase. The content in this unit is, as such, more challenging than the material in previous units. This "step up" in rigor is intentional and designed to prepare scholars for Grade 8 science.

What Is the Bottom Line?

Big Idea 1: Molecular motion is always present in solids, liquids, and gases.

- Each state of matter has unique properties; solids and liquids have a definite volume, whereas gases do not, and only solids have a definite shape.
- Adding or removing thermal energy can affect particle motion and spacing, temperature, and the state of a substance.
- Gas molecules have the greatest average speed and the most kinetic energy, whereas solid molecules can only vibrate in place and have the least amount of kinetic energy.

Big Idea 2: Matter exists in several distinct forms, and phase changes are influenced by many factors.

- Matter can exist in many different forms known as states of matter, and that matter can transition between states during phase changes.
- Intermolecular forces and environmental conditions can affect the time or temperature at which a phase change occurs.

How do Next Generation Science Standards practices and crosscutting concepts support mastery of the Big Ideas? Science and Engineering Practices highlighted in this unit:

- **Developing and Using Models**
    - Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
    - Develop and/or use a model to predict and/or describe phenomena.
- **Constructing Explanations and Designing Solutions**
    - Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) 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.
    - Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.

Crosscutting Concepts highlighted in this unit:

- **Energy and Matter**
    - Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion).
    - Within a natural system, the transfer of energy drives the motion and/or cycling of matter.

- **Stability and Change**
    - Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.
    - Small changes in one part of a system might cause large changes in another part.

Safety

Plan carefully for safety in all lessons. The top safety risks in this unit include:

- In Lessons 1 and 9, scholars use ice cream ingredients, which contain dairy and other common allergens. Be conscious of the allergies your scholars have whenever using food products in the classroom. If scholars have severe allergies to any of the ice cream ingredients needed for Lessons 1 and 9, you will need to find an alternative. Scholars who cannot eat ice cream may be able to substitute with a partially frozen or unfrozen freeze pop in place of the milk/cream/sugar mixture. Ensure that these replacement freeze pops do not contain additional allergens. Ensure that scholars wear proper personal protective equipment (PPE) as indicated in the lesson.
- In Lessons 3, 4, and 6, scholars will use a hot plate. Set up hot plate stations around your room and ensure scholars are aware of how to work with hot materials safely to avoid accidentally burning themselves, as well as what to do should they burn themselves. All materials should be handled with oven mitts at the hot plate station as there is no way to see whether materials are too hot to touch. Ensure that scholars wear proper PPE as indicated in the lesson. Ensure hot plates are turned off at the end of each section. Check glassware for chips or cracks before placing on a hot plate as the heat can cause the glass to shatter if already damaged.
- In Lesson 4, scholars use chocolate. Be conscious of the allergies your scholars have whenever using food products in the classroom. If scholars have severe allergies to the chocolate needed for Lesson 4, you will need to find an alternative. Ensure that scholars wear proper PPE as indicated in the lesson.
- Lesson 8 uses acetone. Review all safety information and the Safety Data Sheet for **acetone** to ensure proper safety precautions are taken before conducting this lesson. Ensure that scholars wear proper PPE as indicated in the lesson.

Important Note: These lesson plans highlight some of the safety risks you should be aware of while teaching these lessons. These safety suggestions are not meant to take the place of a formal science safety training. Please be sure to follow all safety rules from your district, as well as all local, state and federal science safety guidelines.

Unit Storyline

Engage: Exciting news: All the ingredients to make ice cream are right here in the science lab! The catch is that there are no directions, and there's no space in the freezer. After struggling to find a solution, scholars will investigate the Essential Question: How can we make ice cream without putting the ingredients into the freezer?

- **Lesson 1: Ice Cream, Anyone?** Scholars return from break to a pleasant surprise: All the ingredients necessary to make ice cream are right there waiting for them in the science lab!

The catch is, there's no freezerâ€" and the ice is already starting to melt! Scholars embark on a unit-long journey to gather needed information and conquer this challenge.

Explore: Before designing a solution to freeze the ice cream, scholars must understand why it didn't freeze in the first place. Scholars explore the behavior of molecules during phase changes.

- **Lesson 2: Molecular Dances.** Scholars take a whirl to model molecules as states of matter and during phase changes!
- **Lesson 3: Achieving Balance.** What happens when cold ice cream ingredients meet much colder ice? Why don't they just freeze? Scholars explore substances of various temperatures to find out how they interact.

Explain: With a newly developed understanding of molecular movement, scholars are ready to explore phase changes in more depth. There must be *some* way to get those ingredients to reach their freezing points!

- **Lesson 4: Total Meltdown.** Scholars measure the temperature of substances as they undergo phase changes to learn more about what is happening at the molecular level.
- **Lesson 5: Graphing Phase Changes.** Scholars graph their data from Lesson 4 and study the graphs to learn more about what happens to a substance as thermal energy is added or removed.
- **Lesson 6: A Pinch of Salt.** Why do people salt the water when they cook pasta? Scholars explore this common kitchen tip to help them understand howâ€" and whyâ€" we would want to manipulate the freezing or boiling point of a substance.
- **Lesson 7: Can You Freeze the Ocean?** In the last investigation, scholars learned that different substances have different boiling points. Does the same rule apply to freezing points, too? If so, can scholars use that information to their advantage?

Elaborate: Scholars apply understandings of phase change to explain the reason substances have unique freezing points.

- **Lesson 8: Why Do Boiling, Melting, and Freezing Points Vary?** Scholars know that different substances have different boiling/melting points ... but they don't know why. Scholars investigate to learn!

Evaluate: Scholars have studied hard and earned a second chance to make ice cream! Armed with their new understanding, scholars attempt the ice cream challenge again.

- **Lesson 9: Ice Cream Party, Take Two.** The final challenge has arrived! Scholars have another chance to successfully create ice cream. This time, they can apply their understanding from the unit to help them!

Extra Resources

In addition to the resources linked throughout the guide, use the following materials to help you prepare to launch this unit with scholars:

- **Printable Exit Tickets**
- **Printable Lab Notebook**