Unit 2: Energy's Effect on Matter

Standard(s):

8.1.5 Develop a model that uses **computational thinking** to illustrate cause and effect relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. Emphasize molecular-level models of solids, liquids, and gases to show how adding or removing heat energy can result in phase changes, and focus on calculating the density of a substance's state. (PS3.A)

8.1.7 Design, construct, and test a device that can affect the rate of a phase change. Compare and identify the best characteristics of competing devices and modify them based on **data analysis** to improve the device to better meet the criteria for success. (PS1.A, PS3.A, ETS1.A, ETS1.B, ETS1.C).

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Students use fundamental tools in science to compute relationships and interpret results. **Designing Solutions to Problems** Students design solutions to problems using observations that are consistent with current evidence and scientific principles.	**PS1.A Structure and Properties of Matter** **PS3.A Definitions of Energy**	**Cause and Effect** Students investigate and explain causal relationships in order to make tests and predictions.

Overarching Concepts from Framework:

Within matter, atoms and their constituents are constantly in motion. The arrangement and motion of atoms vary in characteristic ways depending on the substance and its current state (e.g., solid, liquid).

Thermal energy is the random motion of particles (whether vibrations in solid matter or molecules or free motion in a gas), this energy is distributed among all the particles in a system through collisions and interactions at a distance.

Preceding Grade Bands:	Target Grade Bands:	Following Grade Bands:
● Matter can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means.	● 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	● All the different manifestations of energy can be modeled as either motions of particles or energy stored in fields.

● The faster an object is moving, the more energy it possesses.	contact with each other; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and vibrate in position, but do not change relative locations. ● The changes of state that occur with variation in temperature ~~or pressure~~ can be described and predicted using these models of matter. ● Temperature is a measure of the average kinetic energy in particles of matter.	

Proficiency Scale:

4 **Advanced**	3 **Proficient**	2 **Approaching Proficiency**	1 **Beginning Proficiency**
I can: **Use computational thinking** to accurately illustrate cause and effect relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. AND **Design** a device, based on valid evidence and accepted scientific thinking, that affects the rate of a phase change. AND Use valid evidence and accepted scientific reasoning to critique other designs.	**I can:** **Use computational thinking** to accurately illustrate cause and effect relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. AND **Design** a device, based on valid evidence and accepted scientific thinking, that affects the rate of a phase change.	**I can:** **Use computational thinking** to illustrate cause and effect relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. AND **Design** a device, based on evidence and scientific reasoning, that affects the rate of a phase change.	**I can:** **Use computational thinking** to illustrate how heat energy affects matter. AND **Design** a device that affects the rate of a phase change.

Anchoring Phenomenon:

Can crush- A can with a little boiling water in it will crush when flipped upside down into ice water.

Essential Question:

How does heat energy affect matter?

Learning Goals:

Students will be able to. . .

- 2A: Develop a model that illustrates the relationship between particle motion, temperature, states of matter and be able to calculate the density of a substance's state.
- 2B: Design a device that can affect the rate of a phase change.

	Learning Opportunities	Formative Assessments
Engage	Activity 1 Unit 2 Phenomenon Pop Can A can with a little boiling water in it will crush when flipped upside down into ice water. Paper Student assignment Can Crush Model	Unit 2 Notebook document contains all activities described. ● Student models (collect) ● Student discussions ● Student questions
Learning Goal: 2A: Develop a model that illustrates the relationship between particle motion, temperature, states of matter and be able to calculate the density of a substance's state.		
Explore	The goal of these activities is for students to collect evidence they can use to answer the question: **What is the relationship between particle motion, temperature, density and state of matter?** Students do NOT need to complete all activities; 1-2 should suffice. **Activity 2 Phases Digital Simulation** PhET Simulations - Phases of Matter - Change the temperature and watch for patterns in what happens to the molecules. Change the phases and watch what happens to the molecules. Reading about why ice floats.	● Student answers to questions ● Student Discussions ● Exit Tickets
Explain	**Activity 3 Phase change Stations** - students go to different stations around the room where they observe a phase change happening. They describe what is happening to the molecules in each situation.	Use students worksheets to determine if they are understanding the concepts
Explore	**Activity 4 Exploring Density with Lava Lamps:** make observations and explain why the ice floats where it does in different liquids Activity ?(optional) Exploring density with ice and liquids	

	This activity has the students observing 4 different situations with water ice alcohol and oil and identifies density this is an alternative instead of doing activity 4 but they cover the same idea. **Activity 5 Will it float? Calculating density of phases**: practice mathematically finding the density of various substances in all three phases.	
Explain	**Activity** 6 revisiting the Unit Phenomenon: Pop Cans Students revise their explanation of what happened in the pop cans.	• Revised Models • CER Paragraph • Student Discussions • Demonstrate a skill • Student answers to Questions • Exit Tickets • Phases of Matter Exit Ticket • Density Learning Ticket • Learning Goal 2B Assessment • Quiz 2A level 1& 2 • Quiz 2A level 3 • Quiz 2A level 4

Learning Goal: 2B: Design a device that can affect the rate of a phase change.		
Elaborate	Activity 7 Frozen (Let it go!): students design a device to keep a popsicle frozen for 3 hours.	• Engineering Assessment 2B
Evaluate	Possible Assessment (Needs revision) https://docs.google.com/document/d/1LoiugaGMZkKCEXlbkfWmZk4nj5D5eg4t40SWLRVrrpU/edit?usp=sharing Add to the summative a piece where students need to reflect on their design and have the opportunity to critique another design.	