Unit 4 - Phase Change

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **Full Year**
Status: **Published**

Unit Overview

Students investigate phase change at the macroscale and molecular scale (scale, proportion, and quantity) by using physical and digital models and hands-on experiences in order to construct explanations about how energy transfer and molecular attraction determine whether a substance will change phase (energy and matter).

Enduring Understandings

The transfer of energy can be tracked as energy flows through a designed or natural system.
Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Macroscopic patterns are related to the nature of microscopic and atomic-level structure.

Essential Questions

How can the appearance of a substance change without it becoming a different substance?
How does the appearance of a substance change with it changes phase?
What happens to the molecules of a substance when it changes phase?
What causes molecules' freedom of movement to change?
Why can transferring energy into our out of a substance change molecules' freedom of movement?
Why does an energy transfer not always result in a phase change?
How does molecular attraction affect whether or not a phase change will occur?

Learning Objectives

By the end of this unit, students will know:
A solid holds its shape and does not take the shape of its container.
A gas has no visible shape and fills its container.
A liquid flows and can take the shape of its container.
A solid keeps its shape because its molecules only move in place, not around each other.
A liquid can flow because its molecules move around, not away from each other.
A gas does not have a visible shape because gas molecules can move away from each other.
A phase change is when the molecules that make up a substance experience a change to their freedom of movement. This phase change involves a macroscale change in appearance.
A change that can be observed at the macroscale can be explained by a change at the molecular scale, which

cannot be observed with the naked eye.
When energy is transferred to or from a substance, it can change the molecules' freedom of movement.
Temperature is a measure of the average kinetic energy of the molecules of a substance.
Transferring energy to a substance increases the kinetic energy of that substance's molecules. Transferring energy from a substance decreases the kinetic energy of that substance's molecules.
Whether or not a phase change occurs is determined by the interaction between the kinetic energy of the molecules and the attraction pulling the molecules together.
The molecular attraction of a substance never changes.
A phase change occurs when the kinetic energy increases enough to overcome the attraction between molecules.
A phase change occurs when the kinetic energy decreases enough so that the attraction between molecules pulls them together.
Different substances can have either weaker or stronger molecular attraction.
By the end of this unit, students will be able to:
Analyze the movement of molecules during each of the phase changes
Engage in hands-on investigations of evaporation and condensation
Visually represent understanding of possible phase changes using the modeling tool
Investigate how adding or removing energy can affect molecules' freedom of movement
Use the simulation and hands on observations to investigate why some substances do not change phase as easily as others.
Use text and physical models to compare with what was changed in the Sim to explain differences between substances.
Science Innovators Scrapbook Project. (Lessons satisfy the following legislative requirements: DEI, LGBTQIA+ & People w/ Disabilities, AAPI, Climate Change, and Amistad.

Standards: Content

SCI.MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures.
SCI.MS-PS1-4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
SCI.MS-PS3-1	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
SCI.MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
SCI.MS-PS3-4	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Standards: Interdisciplinary

Assessment Evidence

Formative	Teacher observations, Class discussions, Lab Activities, Key concepts and vocabulary quizzes, Warm Ups, Open Ended Responses, Modeling, Simulations, Innovators Monthly Research
Summative	In correlation with the NJSLS, students must demonstrate the following as summative assessments: -MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. -MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. -MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. -MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. Other summative assessments will include but are not limited to: projects, summative tests, lab skills demonstrations, vocabulary quizzes, and designs for Science Fair projects.
Alternative & Benchmark	Alternative assessments as required by student IEP/504/I&RS- Read to the student and chart oral responses. Word banks, sentence frames, oral responses, graphic organizers, observations, orally administered assessments, and anecdotal notes. Benchmark – LinkIt Benchmark Assessment, Teacher Generated Assessments
Assessment Evidence Resource	

Instructional Resources

Smartboard, Computers, Websites and digital interactives/models, Multi-media presentations, Video Streaming, Amplify Digital Curriculum, Generation Genius, BrainPop, Microsoft 365, Primary and Secondary Source Documents, Lab Materials as needed, Amplify Readings, Labs, Simulations

Instructional Resource List

Curricular Mandates

Below are the curricular requirements as defined in NJ Administrative Code and Statute

X	Amistad	X	Diversity, Equity, and Inclusion
X	Holocaust	X	LGBT and Disabilities (Grades 6-12)
X	Climate Change	X	Asian American & Pacific Islander

Social Emotional Learning (SEL) Competencies

NJ Social and Emotional Learning Competencies & Sub-Competencies

	Self-Awareness	X	Relationship Skills
X	Responsible Decision-Making	X	Social Awareness
X	Self-Management		

21st Century Skills & Themes

X	Global and Cultural Awareness	X	Technology Literacy		Planning and Budgeting
X	Creativity and Innovation		Financial Institutions		Risk Management and Insurance
X	Information and Media Literacy		Digital Citizenship		Economic and Government Influences
X	Critical Thinking and Problem Solving		Credit Profile		Career Awareness and Planning
	Civic Financial Responsibility		Financial Psychology		