Unit 3 - Thermal Energy

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

Unit Overview

In their role as student thermal scientists, students work with the principal of Riverdale School, a fictional school, in order to help choose a new heater system. The principal is considering two proposed systems, both of which would use water to heat the school. However, these systems differ in important ways. How these two systems works serves as the anchor phenomenon for this unit and the explanations students make allow them to make a recommendation to the principal. The water heater system uses a small amount of warmer water to heat the school. The groundwater system uses a large amount of slightly cooler water to heat the school. Throughout the unit, students are called upon to analyze the differences between these two systems at the molecular scale and to explain how and why they will heat the school. To do so, students make use of the Thermal Energy Simulation, which provides evidence about the molecular nature of temperature and its relationship to kinetic energy.

Enduring Understandings

How Thermal energy is transferred.

Essential Questions

Why do things change temperature?
How is something different when it is warmer or colder?
Why do molecules change speed?
Why does the transfer of energy between two things stop?
What determines how much total kinetic energy something has?
What determines how much something will change temperature?

Learning Objectives

Investigate the movement of food coloring in warm and cool water.
Investigate molecular movement and temperature in the Sim.
Create visual models showing the difference between a substance when it is warmer and cooler.
Observe a video of an investigation in which a container of warm water heats the air around it, and they explore one thing warming another in the Sim.
Model energy transfer using tokens in a physical model.
Investigate energy transfer with different volumes of water.
Test energy transfer using objects of different sizes in the Sim.
Make a final model explaining energy transfer and write an explanation of which heating system is better for

the school and why.
By the end of this unit, students will know:
Things are made of molecules (or other types of atom groups).
When a thing gets hotter, its molecules are moving faster and have more kinetic energy.
When a thing gets colder, its molecules are moving slower and have less kinetic energy.
Temperature is a measure of the average speed (kinetic energy) of the molecules of a thing.
When two things are in contact, their molecules collide, and kinetic energy transfers from the faster moving molecules to the slower moving molecules.
Energy isn't created or destroyed. Therefore, as energy transfers, it increases in one part of the system as it decreases in another part of the system. The total energy of a system doesn't change.
The molecules of a system will transfer energy until the system reaches a stable state known as equilibrium, in which all of the molecules are moving at about the same speed.
For things at the same temperature, the thing with more molecules has more total kinetic energy (thermal energy) than the thing with fewer molecules.
At equilibrium, the average kinetic energy (temperature) of the molecules in a system is the total kinetic energy (thermal energy) divided by the number of molecules in a system.
When a thing gains or loses energy, the energy gained or lost is divided among all the molecules of a thing.
Science Innovators Scrapbook Project. (Lessons satisfy the following legislative requirements: DEI, LGBTQIA+ & People w/ Disabilities, AAPI, Climate Change, and Amistad. Innovators of the Week Assignment.docx

Standards: Content

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.
MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
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.
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.

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-PS3-3. Apply scientific principles to design, construct, and test a device that either

	minimizes or maximizes thermal energy transfer. 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. 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-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. 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

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		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		