6.2 Thermal Energy

Content Area: **Science**
Course(s):
Time Period: **Marking Period 1**
Length: **6 weeks**
Status: **Published**

Course Pacing Guide

Unit	MP/Trimester	Weeks
Intro to MS Science and Light	1	5
Thermal Energy	1	8
Weather and Climate	2	9
Plate Tectonics	2, 3	6
Natural Hazards	3, 4	6
Cells and Systems	4	8

Unit Overview

Students are presented with an anchoring phenomenon that certain beverages containers are better at keeping drinks cold, while other containers perform poorly at doing this. As students investigate the design features of more and less effective beverage containers, they are challenged to create their own container that can perform as good as, or better, than the expensive double-wall containers sold at stores. Students are also prompted to consider how designers used highly conductive materials and transparent materials in a way that made those materials more insulative.

Enduring Understandings

- 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 contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- Temperature is the average kinetic energy of the molecules
- When molecules collide, the particles with more energy transfer energy to molecules with less energy
- Double-walled designs of certain containers minimize thermal energy transfer by creating an insulating vacuum between the two walls
- Reflective surface materials can reflect radiation

Essential Questions

- Why does the temperature of the liquid in some cup systems change more than in others?
- What cup features seem most important for keeping a drink cold?
- How are the cup features that keep things cold the same or different for keeping things hot?
- How does a lid affect what happens to the liquid in the cup?
- Where does the water on the outside of the cold cup system come from?
- How can we explain the effect of a lid on what happens to the liquid in the cup over time?
- If matter cannot enter or exit a closed system, how does a liquid in the system change temperature?
- How does a cup's surface affect how light warms up a liquid inside a cup?
- How does the temperature of a liquid on one side of a cup wall affect the temperature of a liquid on the other side of the wall?
- What is the difference between a hot and a cold liquid?
- Why do particles move more in hot liquids?
- How does the motion of particles compare ina. sample of matter at a given temperature?
- How could the motion of particles on one side of a solid wall affect the motion of particles on the other side of that wall?
- Does our evidence support that cold is leaving the system or that heat is entering the system?
- How do certain design features slow down the transfer of energy into a cup?
- How can we design a cup system to slow energy transfer into the liquid inside it?
- How can we improve our first design to slow energy transfer into the cup system even more?

New Jersey Student Learning Standards (No CCS)

SCI.MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
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-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

Interdisciplinary Connections

MA.6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
LA.W.6.1	Write arguments to support claims with clear reasons and relevant evidence.

Technology Standards

TECH.8.2.8.A.1	Research a product that was designed for a specific demand and identify how the product has changed to meet new demands (i.e., telephone for communication - smart phone for mobility needs).

21st Century Themes/Careers

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.

Instructional Strategies & Learning Activities

- Anchoring Phenomenon - Temperature data investigation
- Designing initial models
- Creating a Driving Question Board to track questions for unit
- Food coloring investigation
- Particle Motion Simulation
- Particle collision games
- Planning and carrying out investigations: Testing Cups (data on varying water temperature inside cup over time)
- Planning and carrying out investigations: Testing Lids (data on varying water temperature inside cup over time; data on mass changes in closed/open systems)
- Examination of materials using SEM images and observations
- Planning and carrying out investigations: Temperature data when changing the states of matter outside the cup
- Planning and carrying out investigations: Temperature changes in transparent and reflective cups
- Design Challenge and Gallery Walks

Differentiated Instruction

Examples may include:

- Curriculum Mapping
- Inquiry/Problem-Based Learning
- Learning preferences integration (visual, auditory, kinesthetic)
- Sentence & Discussion Stems
- Tiered Learning Targets
- Meaningful Student Voice & Choice
- Relationship-Building & Team-Building
- Self-Directed Learning
- Mastery Learning (feedback toward goal)

- Grouping
- Rubrics
- Learning Menus
- Jigsaws
- Flipped Classroom
- Assessment Design & Backwards Planning

Formative Assessments

Include, but are not limited to:

- Student science notebooks
- Scientist Circle discussions
- Exit Tickets/Google Form reflections
- Time Lapse model
- Evolution of Water Bottle reading and comprehension questions

Summative Assessment

- Final Cup Design, with Group Presentation and Individual Reflection of Design Process
- Final CER (scientific explanation)

Benchmark Assessments

- Fall/Winter LinkIt Assessments

Resources & Technology

- Storyline and lessons adapted from OpenSciEd Thermal Energy Unit
- Simulations and digital representations of particle movement

BOE Approved Texts

N/A

Closure

Individual classes and lessons will end with a closure activity that reinforces what students figured out during class, and helps navigate toward next steps.
Closure activities may include:

- Scientists' Circle
- Post-it reflection
- Google form exit ticket
- Group performance reflection
- Science notebook jot

ELL

- Alternate Responses
- Advance Notes
- Extended Time
- Teacher Modeling
- Simplified Written and Verbal Instructions
- Frequent Breaks
- Google Translate

Special Education

Accomodations will be made in accordance with students' IEPs. The following list provides examples:

- Shorten assignments to focus on mastery of key concepts.
- Substitute alternatives for written assignments (clay models, posters, panoramas, collections, etc.)
- Keep workspaces clear of unrelated materials.
- Provide a computer for written work.
- Seat the student close to the teacher or a positive role model.
- Provide an unobstructed view of the chalkboard, teacher, movie screen, etc.
- Keep extra supplies of classroom materials (pencils, books) on hand.
- Maintain adequate space between desks.
- Give directions in small steps and in as few words as possible.
- Number and sequence the steps in a task.
- Have student repeat the directions for a task.

- Provide visual aids.
- Go over directions orally.
- Allow the student to complete an independent project as an alternative test.
- Show a model of the end product of directions (e.g., a completed math problem or finished quiz).
- Stand near the student when giving directions or presenting a lesson.
- Mark the correct answers rather than the incorrect ones.
- Use a pass-fail or an alternative grading system when the student is assessed on his or her own growth.

504

Examples of accommodations in 504 plans include but are not limited to:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits

At Risk

Examples may include:

- Have student restate information
- Provision of notes or outlines
- Concrete examples
- Assistance in maintaining uncluttered space
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
- Peer or scribe note-taking
- Use of manipulatives
- Follow a routine/schedule
- Teach time management skills
- Verbal and visual cues regarding directions and staying on task
- Adjusted assignment timelines
- Visual daily schedule
- Immediate feedback
- Work-in-progress check
- Pace long-term projects
- Film or video supplements in place of reading text
- Cue/model expected behavior
- Use de-escalating strategies

- Use peer supports and mentoring
- Have parent sign homework/behavior chart
- Chart progress and maintain data

Gifted and Talented

Examples may include:

- Offer choice
- Speak to Student Interests
- Allow G/T students to work together
- Tiered learning
- Focus on effort and practice
- Encourage risk taking