05: Thermal Physics

Content Area: **Science**
Course(s): **Physics**
Time Period: **March**
Length: **15 days**
Status: **Published**

Unit Overview:

This unit is designed to give studetns an overview of the fundimental ideas associated with Thermal Energy and the motion of microscopic particles. They will learn about the history and development of the most common temperature scales, and the difference between heat and temperature.

Enduring Understandings:

- Energy conservation includes heat
- Heat is a measure of the energy added to the molecules of a substance
- Kelvin is the best unit of measure for temperature based on molecular motion.
- Objects can change size based on temperature and pressure
- Temperature is a measure of the average kinetic energy of the molecules that make up a substance.
- There are three types of heat transfer: conduction, convection, and radiation.

Essential Questions:

- How are the terms heat and temperature different from each other?
- How can the macroscopic properties of an object be determined from the motion of its molecules?

Standards/Indicators/Student Learning Objectives (SLOs):

- SWBAT calculate the heat gained or lost by a substance in a closed system
- SWBAT calculate the length or volume expansion of a substance as its temperature changes
- SWBAT convert between Kelvin, Celsius, and Fahrenheit temperature scales.
- SWBAT create and use heating and cooling curves to make predictions about a substance as it undergoes temperature changes.
- SWBAT define heat and calculate the heat of a substance.
- SWBAT define power and the rate of heat gain or loss, and calculate that rate for a variety of unique situations.
- SWBAT Define temperature and relate an object's temperature to the motion of its particles
- SWBAT identify and differentiate between the three types of heat transfer.
- SWBAT identify the changes in a fluid that occur as its temperature changes using the Ideal Gas Equation.

- SWBAT show that when one variable is held constant, the ideal gas equation becomes either Charles' Law, Gay-Lussac's Law or Boyle's Law
- SWBAT verify that heat is energy and therefore it is conserved.

9-12.HS-ETS1-4.4.1	Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales.
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-ETS1-4.ETS1.B.1	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
9-12.HS-PS3-4	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
9-12.HS-PS2-3.2.1	Systems can be designed to cause a desired effect.
9-12.HS-PS2-1.2.1	students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
9-12.HS-PS1-1.2.1	Use a model to predict the relationships between systems or between components of a system.
9-12.HS-PS1-4.2.1	Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS3-2.2.1	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS2-5.3.1	Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
9-12.HS-PS2-2.4.1	When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.
9-12.HS-PS3-1.4.1	Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
9-12.HS-PS2-3.6.1	Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
9-12.HS-PS2-6.8.1	Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
9-12.HS-PS3-2.PS3.A.2	At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
9-12.HS-PS3-3.PS3.D.1	Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.
9-12.HS-PS4-4.PS4.B.1	When light or longer wavelength electromagnetic radiation is absorbed in matter, it is

	generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.
9-12.HS-PS2-3.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Lesson Titles:

- Energy Conservation with Heat
- Expansion of Gases, Ideal Gas Law and its variations.
- Heat and Phase Changes
- Temperature, Temperature Scales and Expansion
- Three types of heat transfer and power.

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

LA.RH.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem.
LA.RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
LA.RST.11-12.10	By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.
LA.WHST.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
LA.WHST.11-12.1.B	Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
LA.WHST.11-12.1.C	Use transitions (e.g., words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.11-12.2.E	Provide a concluding paragraph or section that supports the argument presented.
LA.WHST.11-12.10	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Instructional Strategies/Learning Activities and Levels of Blooms/DOK:

- Notes on Heat Transfer Rates
- Classwork: Energy Conservation Problems. A series of problems dealing with energy conservation with answer found here
- Classwork: Heat Problems. A series of problems on heat that were given out in class....to see the answers
- Classwork: Heat, Temperature and Expansion Problems. Problems to review the ideas of the last few days and to serve as a preparation for the week's quiz.
- Homework: Expansion Issues. A series of problems dealing with the expansion of objects based on temperature.
- Homework: Temperature Questions. A series of questions on a google doc to make sure you can do the things we learned about dealing with temperature.
- Lab Activity: Bridge Expansion Activity. In this activity you will be calculating the size of the expansion joints needed on different bridges
- Lab Activity: Gas Expansion Lab. This activity will let you examine the factors that affect the volume of a gas.
- Lab Activity: Heat Transfer Lab. This activity will let you test how quickly heat passes through different containers.
- Lab Activity: Temperature Scale Lab. In this activity you will graph temperatures on the three main temperature scales and use your graphs to develop conversion equations.
- Notes on Energy Conservation including Heat
- Notes on Gases and Expansion
- Notes on Heat and Phases of Matter
- Notes on Temperature and Expansion
- Ownwork: Gas Law Problems. Some math problems involving gases changing temperature, pressure and volume.
- Ownwork: Heat Transfer Problems. These problems will let you practice working with the equation for the conduction of heat through materials.
- Ownwork: Temperature and Expansion Problems. This set of problems will deal with temperature conversions and expansion of materials.
- Quiz Review Academic: Temperature and Expansion. (Answer Key)

Modifications

- Tutoring During Delsea 1

ELL Modifications:

- Focus on domain specific vocabulary and key words
- Offer sources for specific topics in primary language (Youtube web resources)
- Repeat, reword and clarify
- Digital Translators
- Use real objects when possible

IEP & 504 Modifications:

- Formula sheets and example problems to use on assessments
- Modeling and showing various examples
- Scaffolding notes
- Students will be able to use calculators and/or other math tools

G&T Modifications:

- Extra labs to do outside the classroom
- Provide links to extension videos or other media
- Increase the level of problems and challenge problems

At Risk Modifications

- Utilize Delsea One to complete assignments, try supplemental material or to modify classroom behaviors
- Reach out to parents

Formative Assessment:

- Quiz 5.1 Temperature scales and Thermal Energy
- Quiz 5.2 Conservation of Energy, Heat and Thermal Equilibrium

Summative Assessment:

- Lab Assessment: Temperature Scales, Thermal Energy, Heat and Thermal Equilibrium
- Unit 5 Exam: Thermal Physics

Alternative Assessments:

Performance tasks

Project-based assignments
Problem-based assignments
Presentations
Reflective pieces
Concept maps
Case-based scenarios
Portfolios

Benchmark Assessments:

Skills-based assessment
Reading response
Writing prompt
Lab practical

Resources & Materials:

- Cell Phone Apps for Video Editing
- Chromebooks
- https://sites.google.com/site/delseaphysics1/Home
- Lab Pro Modules and appropriate sensors
- Meter Sticks/metric rules
- Timing Devices

Technology:

- Chromebook
- Class Website
- Ed Puzzle
- Google Classroom
- Google Suite
- Graphical Analysis Program
- Lab Pro Modules and Sensors
- Other
- Promethean Board

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.D.CS1	Advocate and practice safe, legal, and responsible use of information and technology.
TECH.8.1.12.D.CS2	Demonstrate personal responsibility for lifelong learning.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.C.4	Explain and identify interdependent systems and their functions.
TECH.8.2.12.C.CS3	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.CS1	Computational thinking and computer programming as tools used in design and engineering.