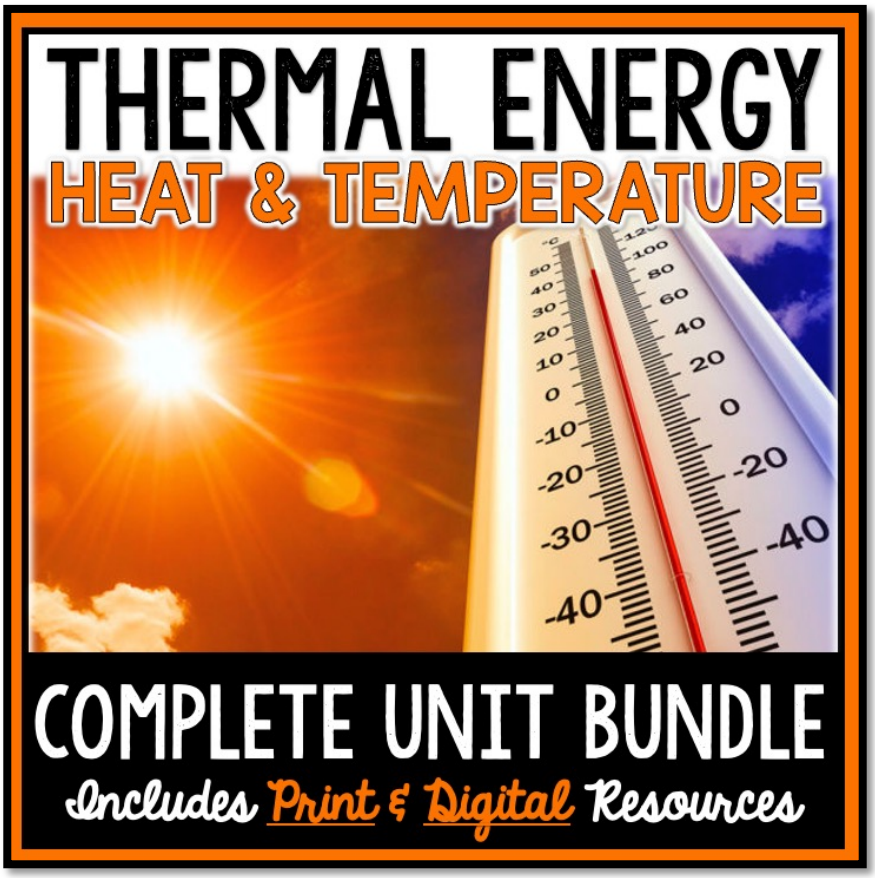
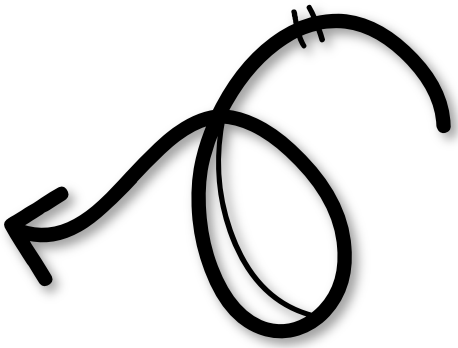
Save Time, Save Energy with this COMPLETE unit.



Everything you need to teach a comprehensive heat, temperature, and thermal energy unit!

Topics Included in this bundle:

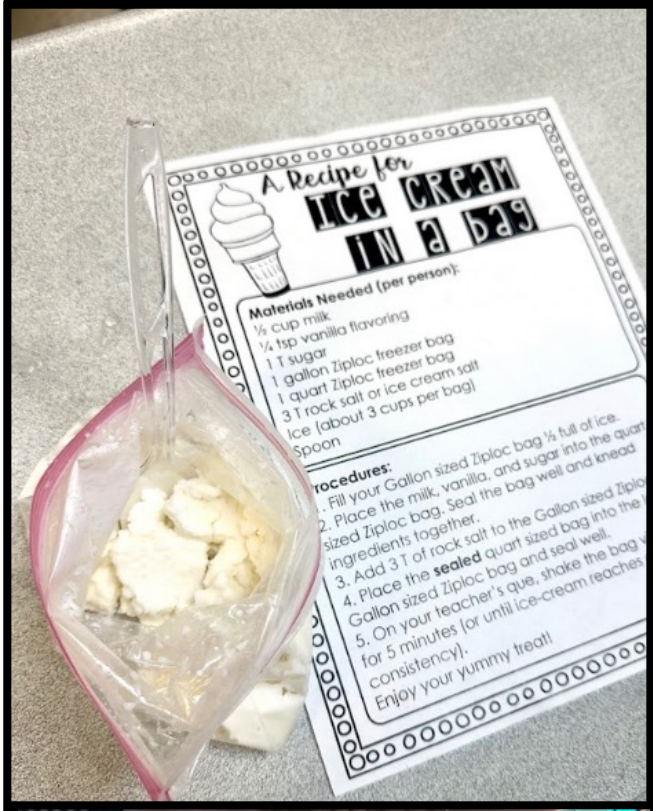
- ❑ KINETIC THEORY OF MATTER & PARTICLE MOTION
- ❑ TEMPERATURE AND AVERAGE KINETIC ENERGY
- ❑ HEAT ENERGY AND THERMAL ENERGY
- ❑ QUALITATIVE VS. QUANTITATIVE TEMPERATURE MEASUREMENTS
- ❑ THERMOMETERS AND THERMAL EXPANSION
- ❑ HEAT TRANSFER AND THERMAL EQUILIBRIUM
- ❑ CONDUCTION, CONVECTION, AND RADIATION
- ❑ CONDUCTORS AND INSULATORS
- ❑ SPECIFIC HEAT AND HEAT CAPACITY
- ❑ FACTORS AFFECTING HEAT CAPACITY
- ❑ SPECIFIC HEAT COMPARISONS
- ❑ SPECIFIC HEAT CALCULATIONS USING $Q = MC\Delta T$
- ❑ IDENTIFYING UNKNOWN METALS USING SPECIFIC HEAT
- ❑ REAL-WORLD APPLICATIONS OF THERMAL ENERGY TRANSFER

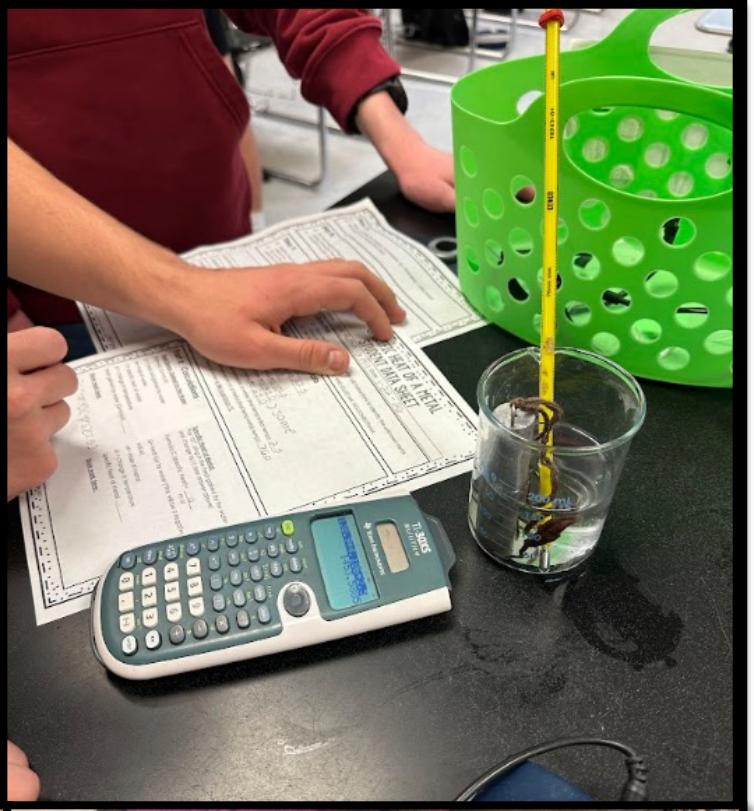


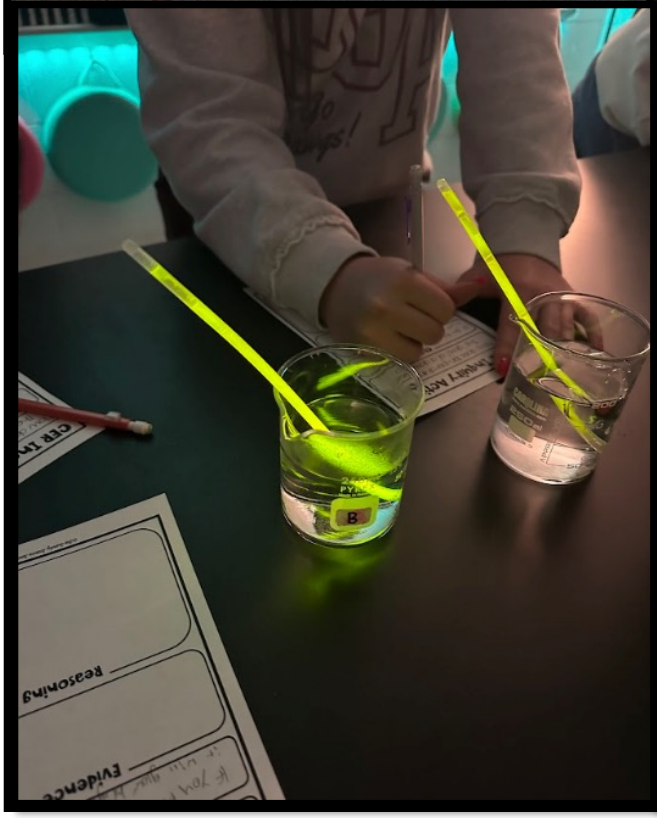
PRINT & DIGITAL OPTIONS INCLUDED

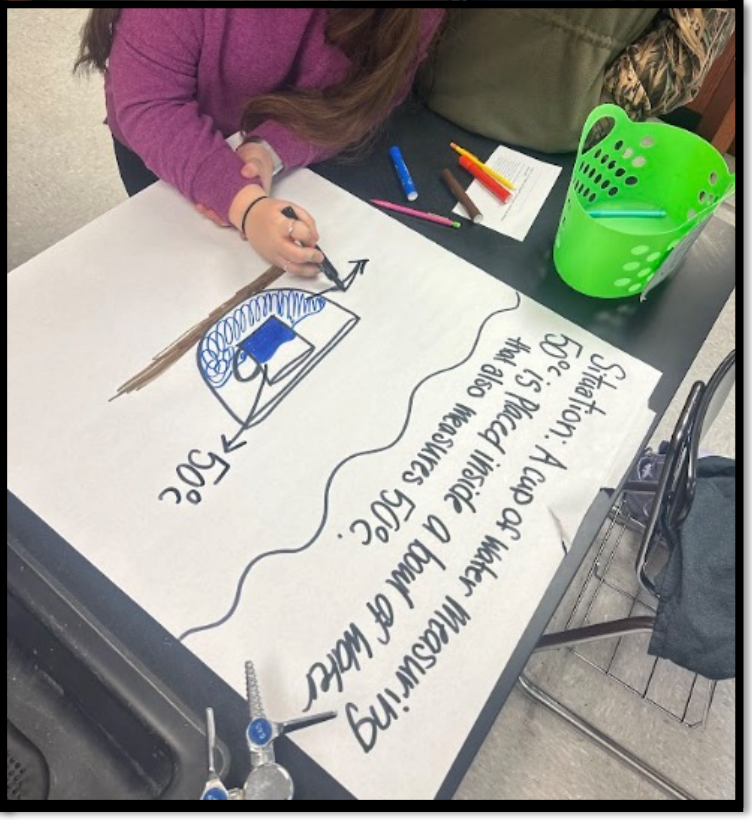


ENGAGING ACTIVITIES

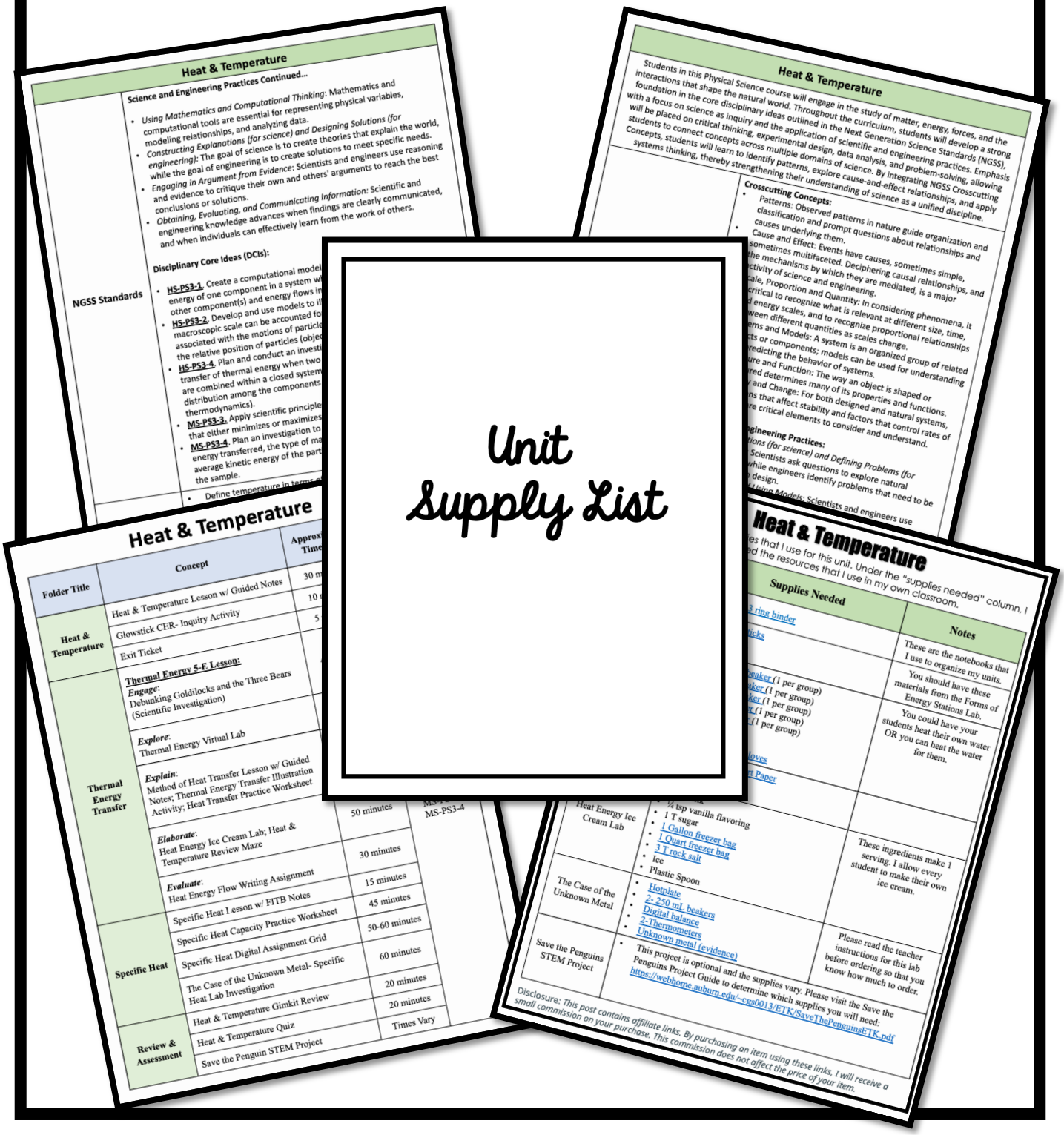








INCLUDES NGSS ALIGNMENT, LEARNING TARGETS, UNIT OUTLINE, SUPPLY LIST, AND TOPIC (EDITABLE) LESSON PLANS



EDITABLE LESSONS



CER INQUIRY ACTIVITY

- At your lab station, you will find
  - 2 beakers
  - 2 glow sticks
- Place warm water into one beaker and cold water in the other.
- Break the glow sticks, simultaneously, and add one to the beaker of warm water and the other to the beaker of cold water.
- Allow glowsticks to sit in the water for 2-3 minutes.
- Your teacher will then turn off the light, and you will write a CER for your observation.



HEAT & TEMPERATURE

List 5 different temperature readings that we use in everyday life.

-Body temperature
-Air temperature
-Cooking temperature
-Referring to something as HOT or COLD

HEAT & TEMPERATURE

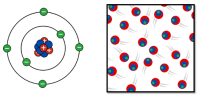
- What is temperature?
  - A measure of the average **kinetic** energy of **all** the particles within an object.

Ex. If I start waving my hands, I am increasing my kinetic energy. As a result, my body temperature will increase.

Increased Kinetic Energy = Temperature Increase

HEAT & TEMPERATURE

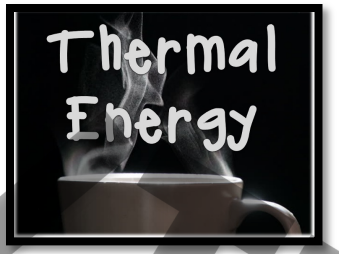
- The universe is made up of **matter** and **energy**.
- Matter is made up of tiny particles called **atoms**.
- These particles are always in **motion** (*Kinetic Theory*).
- **Energy** causes the particles to always be in motion.
- If there is no energy, there is no **motion**!



HEAT & TEMPERATURE

- To measure temperature, we use a **thermometer**.
- If we do not know the exact temperature of something, we use **qualitative** measures like *hot* or *cold*.
- In the lab, it's best to use **quantitative** data for temperature readings. (ex. -5°F)





Heat

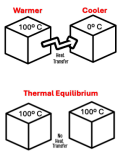
- **Heat** is the flow of thermal energy from one object to another.
- Heat transfer is the movement of **thermal energy** between objects that are **different temperatures**.





Heat

- Heat energy always moves from the **higher** temperature object to the **lower** temperature object.
- Heat transfer stops when thermal **equilibrium** is achieved.
- Heat is not transferred between two objects that are the **same** temperature.



Heat Energy Transfers

- Thermal energy transfers happen all around us.
- Thermal energy can be transferred in 3 ways:
  - Conduction
  - Convection
  - Radiation



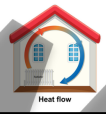
Conductors & Insulators

- **Conductor**
  - Any material through which energy can be **easily** transferred
  - Ex. metals
  - Gases are poor conductors because their particles are too spread out.
- **Insulator**
  - Any material through which energy **cannot** be easily transferred.
  - Ex. Rubber, wood, some fabrics, some liquids



Convection

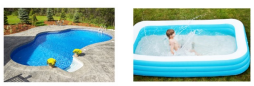
- Convection is the transfer of energy through **liquids** and **gases**.
- The particles of the fluid moves from one location to another carrying their energy along with them.
  - Example: Heat leaves a coffee cup as steam rises.
  - Example: Warm air moves from a heater through the air within a room.





The heat capacity of an object depends on both its **mass** and **chemical composition**.

An object with a **larger** mass, will have a **larger** heat capacity than an object with a smaller mass.

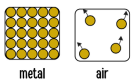


If a swimming pool and small blow-up pool were subjected to the same input of heat energy, the small pool would rise in temperature more quickly than the larger swimming pool.

Specific heat is the amount of heat required to raise the temperature of 1 kg of a material by one degree (C).

1) specific heat of water = 4184 J / kg °C
2) specific heat of sand = 664 J / kg ° C

How do you think the specific heat of metal compares to the specific heat of air?



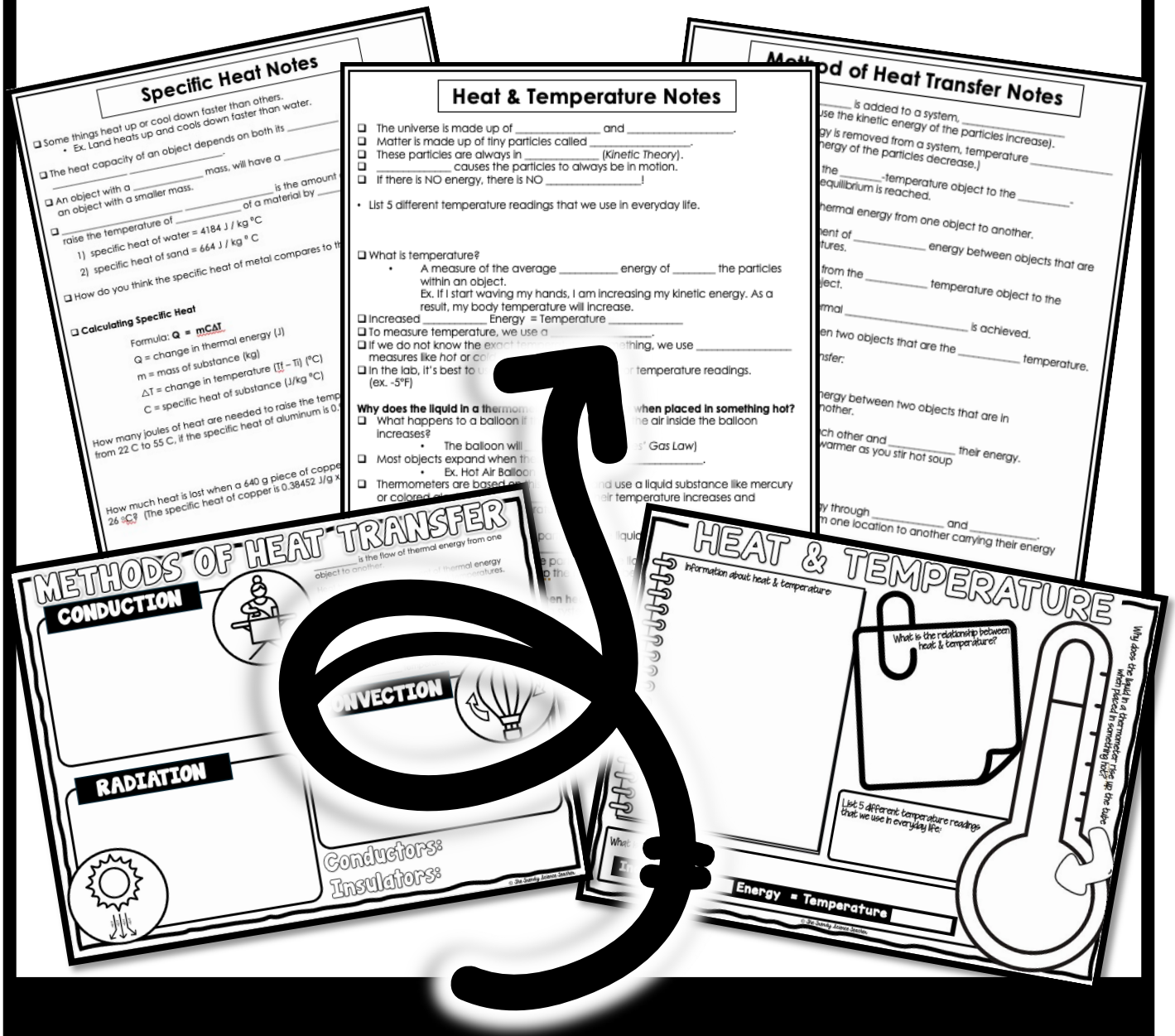
Calculating Specific Heat

$Q = mC\Delta T$

How many joules of heat are needed to raise the temperature of 10 g of aluminum from 22 C to 55 C if the specific heat of aluminum is 0.9 J/g °C?

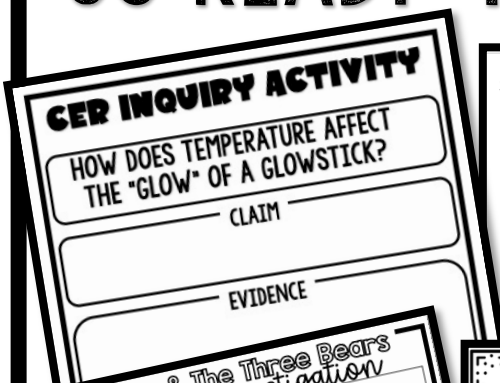
Each lesson is available in PowerPoint & Google Slides.

EACH LESSON COMES WITH NOTES OPTIONS!



NOT A FAN OF DOODLE NOTES? NO PROBLEM! EDITABLE FITB NOTES ARE INCLUDED FOR EACH LESSON.

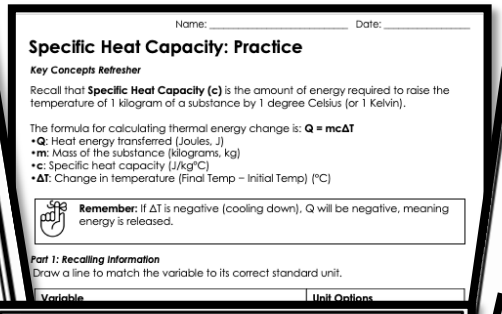
35 READY-TO-GO ASSIGNMENTS!


CER INQUIRY ACTIVITY

HOW DOES TEMPERATURE AFFECT THE "GLOW" OF A GLOWSTICK?

CLAIM

EVIDENCE


Name: _____ Date: _____

Specific Heat Capacity: Practice

Key Concepts Refresher

Recall that **Specific Heat Capacity (c)** is the amount of energy required to raise the temperature of 1 kilogram of a substance by 1 degree Celsius (or 1 Kelvin).

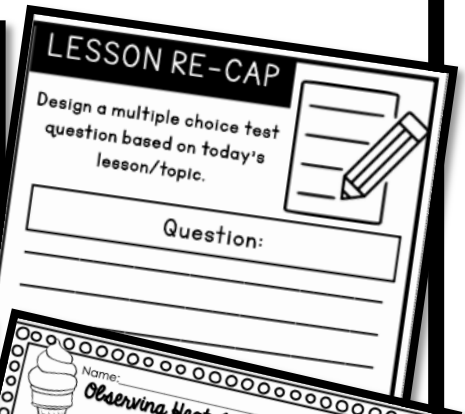
The formula for calculating thermal energy change is: **Q = mcΔT**
- **Q**: Heat energy transferred (Joules, J)
- **m**: Mass of the substance (kilograms, kg)
- **c**: Specific heat capacity (J/kg°C)
- **ΔT**: Change in temperature (Final Temp − Initial Temp) (°C)

Remember: If ΔT is negative (cooling down), Q will be negative, meaning energy is released.

Part 1: Recalling Information

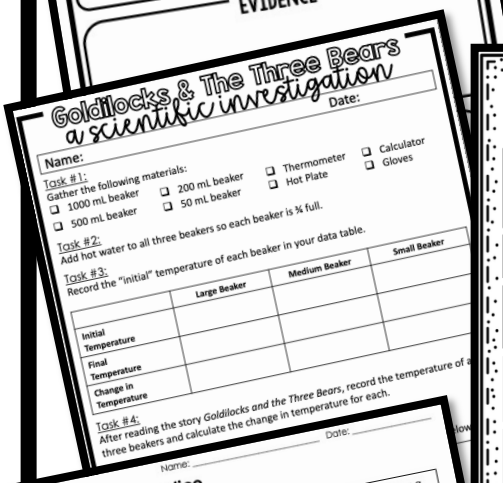
Draw a line to match the variable to its correct standard unit.

Variable	Unit Options


LESSON RE-CAP

Design a multiple choice test question based on today's lesson/topic.

Question:


Goldilocks & The Three Bears a scientific investigation

Name: Date:

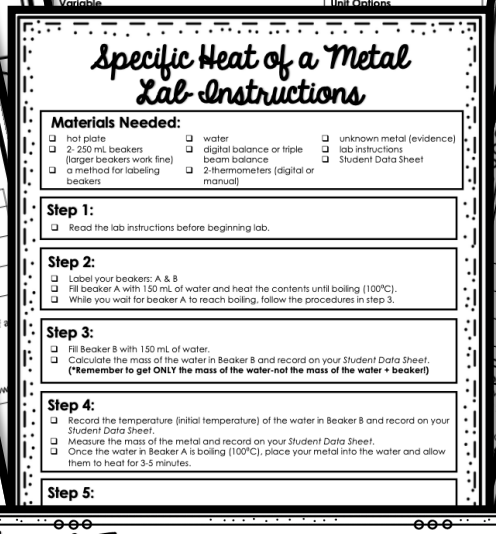
Task #1:
Gather the following materials:
- ☐ 1000 mL beaker
- ☐ 500 mL beaker
- ☐ 200 mL beaker
- ☐ 50 mL beaker
- ☐ Thermometer
- ☐ Hot Plate
- ☐ Calculator
- ☐ Gloves

Task #2:
Add hot water to all three beakers so each beaker is ¾ full.

Task #3:
Record the "initial" temperature of each beaker in your data table.

	Large Beaker	Medium Beaker	Small Beaker
Initial Temperature			
Final Temperature			
Change in Temperature			

Task #4:
After reading the story *Goldilocks and the Three Bears*, record the temperature of


Specific Heat of a Metal Lab Instructions

Materials Needed:
- ☐ hot plate
- ☐ 2- 250 mL beakers (larger beakers work fine)
- ☐ a method for labeling beakers
- ☐ water
- ☐ digital balance or triple beam balance
- ☐ 2-thermometers (digital or manual)
- ☐ unknown metal (evidence)
- ☐ lab instructions
- ☐ Student Data Sheet

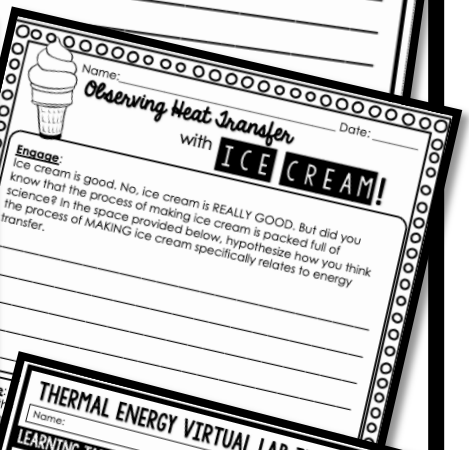
Step 1:
- ☐ Read the lab instructions before beginning lab.

Step 2:
- ☐ Label your beakers: A & B
- ☐ Fill beaker A with 150 mL of water and heat the contents until boiling (100°C).
- ☐ While you wait for beaker A to reach boiling, follow the procedures in step 3.

Step 3:
- ☐ Fill Beaker B with 150 mL of water.
- ☐ Calculate the mass of the water in Beaker B and record on your *Student Data Sheet*. **(*Remember to get ONLY the mass of the water-not the mass of the water + beaker!)**

Step 4:
- ☐ Record the temperature (initial temperature) of the water in Beaker B and record on your *Student Data Sheet*.
- ☐ Measure the mass of the metal and record on your *Student Data Sheet*.
- ☐ Once the water in Beaker A is boiling (100°C), place your metal into the water and allow them to heat for 3-5 minutes.

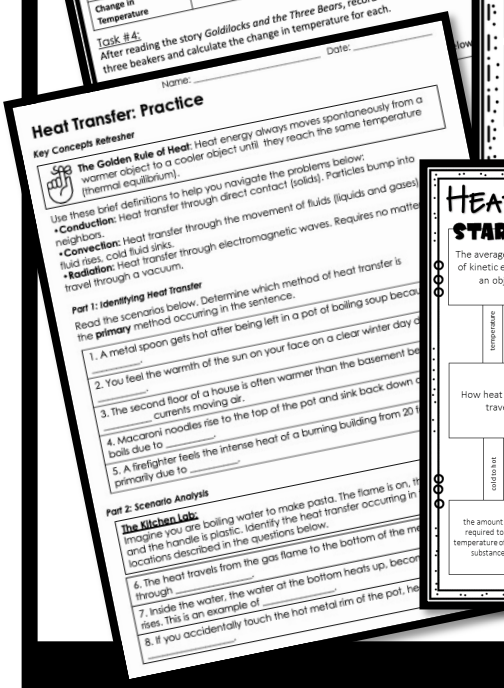
Step 5:


Name:

Observing Heat Transfer with ICE CREAM!

Date:

Engage:
Ice cream is good. No, ice cream is REALLY GOOD. But did you know that the process of making ice cream is packed full of science? In the space provided below, hypothesize how you think the process of MAKING ice cream specifically relates to energy transfer.


Heat Transfer: Practice

Name: Date:

Key Concepts Refresher

The Golden Rule of Heat: Heat energy always moves spontaneously from a warmer object to a cooler object until they reach the same temperature (thermal equilibrium).

Use these brief definitions to help you navigate the problems below:
- **Conduction:** Heat transfer through direct contact (solids). Particles bump into neighbors.
- **Convection:** Heat transfer through the movement of fluids (liquids and gases). fluid rises, cold fluid sinks.
- **Radiation:** Heat transfer through electromagnetic waves. Requires no matte travel through a vacuum.

Part 1: Identifying Heat Transfer

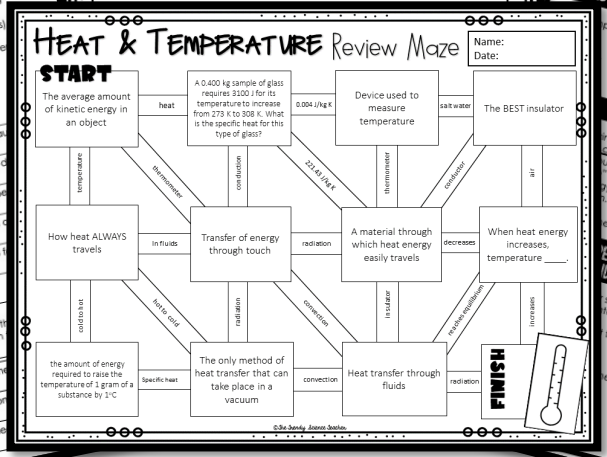
Read the scenarios below. Determine which method of heat transfer is the **primary** method occurring in the sentence.

1. A metal spoon gets hot after being left in a pot of boiling soup beca
2. You feel the warmth of the sun on your face on a clear winter day
3. The second floor of a house is often warmer than the basement be currents moving air.
4. Macaroni noodles rise to the top of the pot and sink back down a boils due to _____.
5. A firefighter feels the intense heat of a burning building from 20 f primarily due to _____.

Part 2: Scenario Analysis

The Kitchen Lab:
Imagine you are boiling water to make pasta. The flame is on, th and the handle is plastic. Identify the heat transfer occurring in locations described in the questions below.

6. The heat travels from the gas flame to the bottom of the m through _____.
7. Inside the water, the water at the bottom heats up, becau rises. This is an example of _____.
8. If you accidentally touch the hot metal rim of the pot, he _____.


Heat & Temperature Review Maze

Name:
Date:

START

The average amount of kinetic energy in an object

heat

A 0.400 kg sample of glass requires 3100 J for its temperature to increase from 273 K to 308 K. What is the specific heat for this type of glass?

0.004 J/kg·K

Device used to measure temperature

salt water

The BEST insulator

temperature

thermometer

conduction

221.43 J/kg·K

thermometer

insulator

air

How heat ALWAYS travels

in fluids

Transfer of energy through touch

radiation

A material through which heat energy easily travels

decreases

When heat energy increases, temperature ____.

cold to hot

hot to cold

radiation

convection

is a liquid

reaches equilibrium

increases

the amount of energy required to raise the temperature of 1 gram of a substance by 1°C

Specific heat

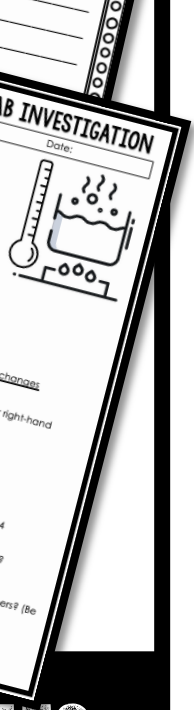
The only method of heat transfer that can take place in a vacuum

convection

Heat transfer through fluids

radiation

FINISH


THERMAL ENERGY VIRTUAL LAB INVESTIGATION

Name:

Date:

LEARNING TARGET

Explain how thermal energy is transferred between two objects.

PRE-LAB

perature:

ng website:
olorado.edu/en/simulations/energy-forms-and-changes

utton.

option.

y symbols" and "link heaters" boxes in the upper right-hand

e red "E" inside represents heat/thermal energy.

ELATIONSHIP D TEMPERATURE

so that there is one thermometer in each of the 4 er, and olive oil.

the comparative temperature of the containers?

e amount of heat/thermal energy in the containers? (Be

PRACTICE ASSIGNMENTS- ACTIVITIES- INQUIRY LEARNING- LABS- MAZES- REVIEW- ASSESSMENTS

Heat & Temperature Unit

Folder Title	Concept	Approximate Timeline	Standards Alignment
Heat & Temperature	Heat & Temperature Lesson w/ Guided Notes	30 minutes	HS-PS3-1 HS-PS3-2 HS-PS3-4 MS-PS3-3 MS-PS3-4
	Glowstick CER- Inquiry Activity	10 minutes	
	Exit Ticket	5 minutes	
Thermal Energy Transfer	**<u>Thermal Energy 5-E Lesson:</u>** ***Engage***: Debunking Goldilocks and the Three Bears (Scientific Investigation)	45 minutes	
	Explore: Thermal Energy Virtual Lab	45-60 minutes	
	Explain: Method of Heat Transfer Lesson w/ Guided Notes; Thermal Energy Transfer Illustration Activity; Heat Transfer Practice Worksheet	60-75 minutes	
	Elaborate: Heat Energy Ice Cream Lab; Heat & Temperature Review Maze	50 minutes	
	Evaluate: Heat Energy Flow Writing Assignment	30 minutes	
Specific Heat	Specific Heat Lesson w/ FITB Notes	15 minutes	
	Specific Heat Capacity Practice Worksheet	45 minutes	
	Specific Heat Digital Assignment Grid	50-60 minutes	
	The Case of the Unknown Metal- Specific Heat Lab Investigation	60 minutes	
Review & Assessment	Heat & Temperature Gimkit Review	20 minutes	
	Heat & Temperature Quiz	20 minutes	
	Save the Penguin STEM Project	Times Vary	

Access to a digital Google Drive full of virtual options!

PRINT & DIGITAL RESOURCES

Perfect for Distance Learning