

Lesson Plan Title	Countdown to Meltdown (Comparison Matrix, p. 53, <i>Beyond the Blueprint</i>)
Lesson Plan Created by	Mary Anne Butler, CSDE Educational Consultant for Secondary Science / M. Porter
Grade	9
Subject	Physical Science
Standards(s)	D 1. Describe the effects of adding energy to matter in terms of the motion of atom and molecules, and the resulting phase changes.
Time	45 minutes
Indicators/Objective(s)	Investigate and understand how temperature and heat are related but different.
Required Materials for Lesson / Technology	Sets of black aluminum and black polymer tiles Thermometers Ice
Initiation (prior knowledge; connections; vocabulary)	Key vocabulary: temperature, heat, thermal energy, joules, calories, kinetic energy, conduction, convection, radiation.
Learning Procedures	<p>Microlab (teams of three) to assess prior knowledge of heat and temperature with three series of three questions. Each student is given a number 1-3, and after two minutes to think in silence, chooses one question to respond to uninterrupted for one minute. Rotate which student starts each set.</p> <p>Set 1</p> <ul style="list-style-type: none"> • What is temperature? • How does kinetic energy relate to temperature? • What does temperature measure? <p>Set 2</p> <ul style="list-style-type: none"> • What is heat? • How is heat transferred? • How does heat transfer relate to climate change? <p>Set 3</p> <ul style="list-style-type: none"> • What is the difference between heat and temperature? • How are heat and temperature related? • What influences the thermal conductivity of a material? <p>Guided investigation with probing questions. Model use of comparison</p>

	matrix (<i>Beyond the Blueprint</i> , Section 7 p.53) to set up homework assignment.
Guided Practice	Teams follow teacher-guided tile investigation with own materials. What temperature are the tiles? Can you provide evidence? How do they feel to the touch? Why? What happens to an ice cube when placed on each tile? Why?
Instructional Strategies	Microlabs with scaffolded question sets, guided inquiry, questioning, written assessment of understanding.
Closure	Identify situations in daily life that demonstrate the understanding of the relation between heat and temperature.
Independent Practice	Microlabs and completion of the comparison matrix.
Assessment based on Objectives (informal, formal, formative, summative – essential question)	Formative assessment to provide feedback on misconceptions and new learning about heat and temperature (embedded formative assessment and written formative assessment via the comparison matrix).
Interventions (for struggling students)	Microlab questions have easy entry points in each set. Provide modified written question prompts for guided inquiry.
Enrichment (for gifted students)	Use Alison database to analyze heat flux in Arctic lakes and relate the conclusions to global climate change. Alaskan Lake Ice and Snow Observatory Network (ALISON) Project. http://www.gi.alaska.edu/alison/index.html
Connections to Other Subjects	Social studies/global climate change and energy issues.

Comparison Matrix

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
mass in kg $\times 10^{24}$	0.33	4.87	5.98	0.65	1900	570	87	100
diameter in km	4876	12,107	12,755	6,794	142,983	120,536	51,117	49,527
atmosphere	helium hydrogen	nitrogen carbon dioxide	nitrogen oxygen argon	carbon dioxide nitrogen argon	hydrogen helium methane	hydrogen helium methane	hydrogen helium methane	hydrogen helium methane

	temperature	heat
units of measurement	Kelvin (K), Celsius °C, Fahrenheit °F	Joules (J)
related vocabulary	kinetic energy, average, motion, matter, conversion	thermal energy, conduction, convection, radiation, temperature, joules
relationship to kinetic energy	measures the average kinetic motion of particles in a system	amount of thermal energy in a system depends on the kinetic and potential energies of the particles