Rigorous Curriculum Design

Unit Planning Organizer

Subject:	Course 1			Grade:	6
Unit Number:	4	Unit Name:	Energy		
Unit Length	Days: 30 days + 5 buffer days		Mins/Day: 1 class period		
Unit Synopsis	"How can energy be transferred from one object or system to another". Students need to understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, come to know the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy.				

	NGSS	Science and Engineering Practice(s)
Priority Performance Expectations	**MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*** [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] **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.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] **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.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]	**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ▪ Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. ▪ Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5)
		Disciplinary Core Ideas

		PS3.A: Definitions of Energy ▪ Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) **PS3.B: Conservation of Energy and Energy Transfer** ▪ When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) ▪ The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) ▪ Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) **ETS1.A: Defining and Delimiting an Engineering Problem** ▪ The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. *(secondary to MS-PS3-3)* **ETS1.B: Developing Possible Solutions** ▪ A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. *(secondary to MS-PS3-3)*
Crosscutting Concepts	**Scale, Proportion, and Quantity** ▪ Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-4) **Energy and Matter** ▪ Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5) ▪ The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)	

	NGSS	Math CCSS	Literacy CCSS
Supporting Performance Expectations	Students who demonstrate understanding can: MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. 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.	**MP.2** Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-4),(MS-PS3-5) **6.RP.A.1** Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),(MS-PS3-5) **7.RP.A.2** Recognize and represent proportional relationships between quantities. (MS-PS3-1),(MS-PS3-5) **8.F.A.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1),(MS-PS3-5) **6.SP.B.5** Summarize numerical data sets in relation to their context. (MS-PS3-4)	**RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-PS3-1),(MS-PS3-5) **RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3),(MS-PS3-4) **WHST.6-8.1** Write arguments focused on discipline content. (MS-PS3-5) **WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS3-3),(MS-PS3-4) **SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS3-2)

	NG ELD Standards	Literacy / Science / History / Other
Interdisciplinary Connections	**Interpretive 6** Reading closely literary and informational texts and viewing multimedia to determine how meaning is conveyed explicitly and implicitly through language. **Productive 10** Writing literary and informational texts to present, describe, and explain ideas and information, using appropriate technology.	**Key Ideas and Details** CCSS.ELA-Literacy.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. **Craft and Structure** CCSS.ELA-Literacy.RST.6-8.4 Determine the meaning of symbols, key terms, and other

		domain-specific words and phrases as they are used in a specific scientific or technical context relevant to*grades 6–8 texts and topics*. CCSS.ELA-Literacy.RST.6-8.5 Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic. CCSS.ELA-Literacy.RST.6-8.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text. **Integration of Knowledge and Ideas** CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). CCSS.ELA-Literacy.RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. **Range of Reading and Level of Text Complexity** CCSS.ELA-Literacy.RST.6-8.10 By the end of grade 8, read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.

Unwrapped Priority Performance Expectations

PE: MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.			
Skills	Concepts	Bloom's	DOK (Rigor Matrix)	Language Demand
Apply	Scientific principles	Create	Level 4	
To Design	A device that either minimizes or maximizes thermal energy transfer.			
To Construct	A device that either minimizes or maximizes thermal energy transfer.			
To Test	A device that either minimizes or maximizes thermal energy transfer.			

PE: 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.			
Skills	Concepts	Bloom's	DOK (Rigor Matrix)	Language Demand
Plan	An investigation.	Evaluate	Level 3	
To Determine	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.			

PE: 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.			
Skills	Concepts	Bloom's	DOK (Rigor Matrix)	Language Demand
Construct, Use, & Present	Arguments	Analyze	Level 3	
To Support	The claim that when the kinetic energy of an object changes, energy is transferred to or from the object.			

Learning Progressions of Skills and Concepts

PE: PS 3-3		
Previous Courses	Current Course	Next Courses
4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide. [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]	**MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*** [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]	HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.* [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] [Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.]

PE: PS 3-4		
Previous Courses	**Current Course**	**Next Courses**
4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]	**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.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]	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). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.]

PE: PS 3-5		
Previous Courses	**Current Course**	**Next Courses**
N/A	**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.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]	HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other, including an explanation of how the change in energy of the objects is related to the change in energy of the field.] [Assessment Boundary: Assessment is limited to systems containing two objects.]

<table>
<tr><th>Big Idea(s)</th><th>Corresponding Essential Question(s)</th></tr>
<tr><td>PS3-3 Thermal energy is transferred at different rates through different materials.

PS3-4 Energy transfer is related to type of matter and mass. Kinetic energy can be measured by temperature.

PS3-5 When an objects moves or changes temperature, energy is transferred between the objects.</td><td>PS3-3 How can you affect the transfer of thermal energy?

PS3-4 What factors determine how energy is transferred? How can you measure kinetic energy?

PS3-5 How does energy transfer between objects?</td></tr>
<tr><th colspan="2">Unit Vocabulary Words</th></tr>
<tr><th>Academic Cross-Curricular Vocabulary (Tier 2)</th><th>Content/Domain Specific Vocabulary (Tier 3)</th></tr>
<tr><td>Heat, Minimize, Maximize, Transfer</td><td>Thermal Energy
Heat Transfer
Kinetic Energy
Temperature
Conduction</td></tr>
<tr><th>Supporting Vocabulary (Tier 2)</th><th>Supporting Vocabulary (Tier 3)</th></tr>
<tr><td></td><td>Gas, Liquid, Solid, Matter,
Mass, Energy, Particles
Potential Energy</td></tr>
<tr><th colspan="2">Resources for Vocabulary Development (Strategies, Routines and Activities)</th></tr>
<tr><td colspan="2">• Instagram vocab activity
• Vocabulary Matchbooks/Frayer model/Looping
• Vocabulary Flashcards
• Vocabulary Flipbook/Foldable
• Vocabulary around the World
• Vocabulary Snowball Fight
• Vocabulary Examples/non-examples
• Vocabulary Matrix
• Vocabulary Web
• Vocabulary Focus Word Wall
• Mnemonics</td></tr>
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<table>
<tr><th colspan="2">21st Century Skills</th></tr>
<tr><td>☐ Creativity and Innovation
☐ Critical Thinking and Problem Solving
☐ Communication and Collaboration
☐ Flexibility and Adaptability
☐ Globally and Financially Literate
☐ Communicating and Collaborating</td><td>☐ Initiative and Self-Direction
☐ Social and Cross-Cultural Skills
☐ Productivity and Accountability
☐ Leadership and Responsibility
☐ ___________________________
☐ ___________________________</td></tr>
<tr><td colspan="2">Connections between 21st Century Skills, NGSS, and Unit Overview:</td></tr>
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Costa & Kallick, 2008

Unit Assessments	
Pre-Assessment	**Post-Assessment**
Please see www.alvordschools.org/cfa for the most current EADMS CFA ID numbers.	Please see www.alvordschools.org/cfa for the most current EADMS CFA ID numbers.
Scoring Guides and Answer Keys	

Assessment Differentiation			
Students with Disabilities	***Accommodations*** Reference IEP to ensure appropriate testing environment ***Modifications***	English Language Learners	Emerging Expanding

Engaging Scenario Overview (Situation, challenge, role, audience, product or performance)	
Description:	Suggested Length of Time Days:

	Mins/Day:

Engaging Learning Experiences Synopsis of Authentic Performance Tasks		
Authentic Performance Tasks	Description	Suggested Length of Time
APT Hyperlink	Science_grade_Unit_4_APT.docx	
Task 1:	Problem Solving: SEP:	Days: Mins/Day:
Task 2:	Problem Solving: SEP:	Days: Mins/Day:
Task 3:	Problem Solving: SEP:	Days: Mins/Day:
Task 4:	Problem Solving: SEP:	Days: Mins/Day:

Authentic Performance Task 1

Name:		Suggested Length	Days: Mins/Day:

Performance Expectations / Standards Addressed	Priority Standards	
	NGSS	Science and Engineering Practice(s)
		Disciplinary Core Idea(s)

				Crosscutting Concept(s)	
	Supporting Standards				
	NGSS	CCSS Math	CCSS ELA	NG ELD	
Teaching and Learning Progression				Bloom's	DOK
				Scoring Rubric	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
		Expanding	
	Modifications	Bridging	

Authentic Performance Task 2

Name:		Suggested Length	Days: Mins/Day:

Performance Expectations / Standards Addressed	Priority Standards			
	NGSS		Science and Engineering Practice(s)	
			Disciplinary Core Idea(s)	
			Crosscutting Concept(s)	
	Supporting Standards			
	NGSS	CCSS Math	CCSS ELA	NG ELD

Teaching and Learning Progression		Bloom's	DOK
		Scoring Rubric	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
		Expanding	
	Modifications		
		Bridging	

Authentic Performance Task 3

Name:		Suggested Length	Days: Mins/Day:

Performance Expectations / Standards Addressed	Priority Standards			
	NGSS		Science and Engineering Practice(s)	
			Disciplinary Core Idea(s)	
			Crosscutting Concept(s)	
	Supporting Standards			
	NGSS	CCSS Math	CCSS ELA	NG ELD

Teaching and Learning Progression		Bloom's	DOK

		Scoring Rubric	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
		Expanding	
	Modifications		
		Bridging	

Authentic Performance Task 4

Name:		Suggested Length	Days: Mins/Day:

Performance Expectations / Standards Addressed	Priority Standards			
	NGSS		Science and Engineering Practice(s)	
			Disciplinary Core Idea(s)	
			Crosscutting Concept(s)	
	Supporting Standards			
	NGSS	CCSS Math	CCSS ELA	NG ELD

Teaching and Learning Progression		Bloom's	DOK
		Scoring Rubric	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations ***Modifications***	Emerging Expanding Bridging	

Engaging Scenario

Detailed Description (situation, challenge, role, audience, product or performance)			
Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations ***Modifications***	Emerging Expanding Bridging	
Scoring Guide:			

Feedback to Curriculum Team Reflect on the teaching and learning process within this unit of study. What were some successes and challenges that might be helpful when refining this unit of study?		
	Successes	Challenges
Student Perspective		
Teacher Perspective		