

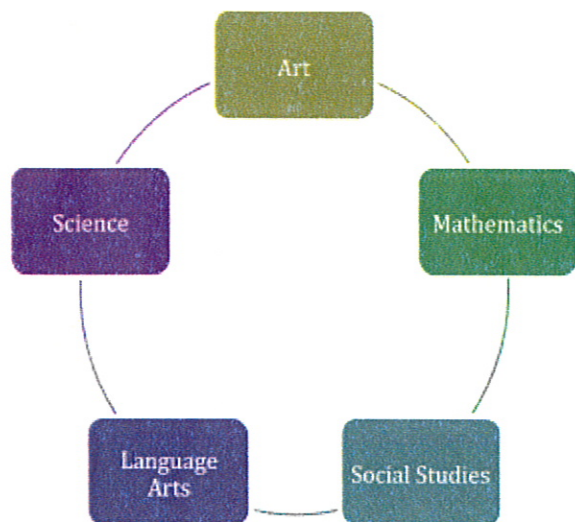
STEM School Chattanooga

9th Grade PBL

Unit Plan Template

Unit 2: Energy

Learning Target Topics



Art I: Examine material, technologies, processes, and terminology used in visual art; Integrate visual art ideas, issues, and themes

Algebra I: Rearrange formulas to highlight a quantity of interest

Geometry: Prove theorems and theories in modeling situations

English I: Write explanatory texts to convey information clearly; Demonstrate command of grammar, usage, spelling, capitalization, and punctuation in writing; Present information clearly and appropriately for the task and audience

Physical World Concepts: Describe the relationships among temperature, heat and internal energy; Convert between temperature scales; Use the First Law of Thermodynamics

World History: Identify key steps in a text's description of a process; Determine the meaning of words and phrases used in a text; Write informative/explanatory texts; Draw evidence from informational texts


Grade Level	9 th Grade	Unit Length	3 Weeks
Unit Overview	The Unit 2 PBL on Energy will introduce students to the essential concepts underlying the principles of movement and conservation of energy. Along with the study of thermodynamics, students will apply logic, deductive reasoning, and algebraic problem solving to collaboratively design and build a model of a Carnot Engine. Students will also apply these principles in a writing about an invention from the Renaissance time period. The group will then present their design process, final design, and functionality of the Carnot Engine in a PBL presentation and through their written Engineering Design Report. Finally, students will create a personal Digital Portfolio for their work, including a written reflection of the Unit 2 PBL.		
Unit Essential Issue	Strand: <i>Energy</i>		
Culminating Events	<p>For the Unit 2 PBL, the students will work collaboratively in groups of 4. Student teams will research and design a Carnot Engine. Students will also write an essay about an invention from the Renaissance time period and its connection to thermodynamics. They will then write an Engineering Design Report and build a model of their design, presenting their final design and prototype to the 9th grade class and team. Individually, students will create a Digital Portfolio with a written reflection of the Unit 2 PBL.</p> <p>Presentations – Week of October 6-7</p> <p>The culminating event for this PBL is a presentation where students will present their findings about the functionality of the Carnot Engine and also share their final engine design plan and model. The following items will be turned in as part of the presentation:</p> <ul style="list-style-type: none"> • Carnot Engine Design Plan • Renaissance Invention Essay 		

- Engineering Design Report
- Carnot Engine Model
- Academic Digital Portfolio (Individual)

The following items will be assessed by the appropriate content area teacher:

- Math (Algebra I and Geometry): Correct use of the mathematical learning targets included in the lab report and embedded in the presentation.
- Physical World Concepts: Functionality of the Carnot Engine model; content, reasoning, design process and record keeping of the Engineering Design Report.
- English I: Format, structure, and content of the Academic Digital Portfolio and PBL Reflection.
- Art: Written Art Critique of the Carnot Engine designs
- World History: Written essay about an invention from the Renaissance time period.

Common
Assessment

	STEM PBL Rubric			PBL Unit: _____ Student: _____ Date: _____ -
		Advanced	Proficient	Needs Improvement
	Math Components: Algebra I	<ul style="list-style-type: none"> • Based on the First Law of Thermodynamics, students can explain how solving an equation in math is similar to the change in energy to the universe. • Students can create a scenario for a word problem relating to the equation $Q = M \cdot C \cdot \Delta T$. The problem must include a solution with a detailed explanation of each step of the process. 	<ul style="list-style-type: none"> • Using the equation $Q = M \cdot C \cdot \Delta T$, students can identify what each variable represents, and can solve for each variable: Q, M, C and T. • Students can create and solve a multistep equation, which includes variables on both sides of the equation. Each step in the process must be shown. 	
	Math Components: Geometry	<ul style="list-style-type: none"> • Using a diagram and paragraph, students can elaborate on how the Law of Syllogism in math relates to the Law of Zeroth in science. • Students can analyze the truth value of the four conditional statements and can draw a conclusion about the validity of their hypothesis regarding the Carnot Engine. 	<ul style="list-style-type: none"> • Students can write two truth statements about the Zeroth Law and then devise a third truth statement. • Students can identify and write the four conditional statements for the idea that a machine that functions momentarily is a Carnot Engine. 	
	Science Components: Physical World Concepts	<ul style="list-style-type: none"> • Students can design and craft an original Carnot Engine and justify its design and functionality using all four laws of thermodynamics. • Students can apply the four laws of thermodynamics to analyze the functionality of their Carnot Engine in terms of heat leaks. 	<ul style="list-style-type: none"> • Students can craft a Carnot Engine using the principles of the First and Second laws of Thermodynamics. • Students can explain the failure of their machine in terms of friction and heat. 	
	Language Arts Components: English I	<ul style="list-style-type: none"> • Students analyze their strengths and weaknesses during the PBL process in the Self-Reflection, including suggestions for future collaborative work. 	<ul style="list-style-type: none"> • Students can create an Academic Digital Portfolio using the format from the Digital Portfolio template. • The Academic Digital Portfolio contains the required sections 	

		<ul style="list-style-type: none"> • The Academic Digital Portfolio is creative and personalized for the individual student's interests and future goals, and it includes artifacts from individual class unit projects as well as PBLs. • Students can write the PBL Reflection free of errors in grammar and usage. • Students can write the PBL Reflection free of errors in capitalization, spelling, and punctuation. • Presentation is well organized and detailed, and presenters use effective public speaking techniques to present the design. 	<ul style="list-style-type: none"> and includes content from the Units 1 and 2 PBL tasks. • Students can write the Unit 2 PBL Self-Reflection with few errors in grammar and usage. • Students can write the PBL Self-Reflection with few errors in capitalization, spelling, and punctuation. • Presentation is appropriate for the audience and task, and presenters use appropriate eye contact and volume. 	
	Social Studies Components: World History	<ul style="list-style-type: none"> • Writing will also show benefits or flaws in the invention with respect to thermodynamics. • Writing also contains the student's evaluation of the invention's impact. • Students make judgments on invention's worth due to later events. • Writing contains an introduction and thesis statement that is supported by the body of their writing. • Research is supported by MLA citation and is used in the student's evaluation or judgment. 	<ul style="list-style-type: none"> • Writing will identify and explain the law of thermodynamics in the invention. • Writing creates a historical guide for the invention that includes: need, creation, and utilization. • Student identifies connections to later events that were affected by invention. • The writing contains flow and builds upon previous information. • Research is properly cited in MLA format. 	
	Art Components: Art I	<ul style="list-style-type: none"> • A complete critique of the final Carnot Engine design that analyzes the trials and errors as well as suggestions for a revised version. 	<ul style="list-style-type: none"> • The critique must cover the four steps of criticism. It should have at least one description of a design improvement prior to submission. 	
	Minimum Requirement Components: Must be included to be graded	<p>Engineering Design Reports must include the following sections:</p> <ul style="list-style-type: none"> • Title Page • Summary • Design Problem and Objectives • Detailed Design Documentation • Gantt Chart • Ethical Consideration • Safety • Acknowledgements (must be in MLA format) <p>English I:</p> <ul style="list-style-type: none"> • Academic Digital Portfolio must be created using Google Sites. • Unit 2 PBL Self-Reflection must be at least 2 paragraphs long and be a part of the Academic Digital Portfolio. <p>Math:</p> <ul style="list-style-type: none"> • Algebra I: <ul style="list-style-type: none"> ○ Each variable in equations must be defined. All steps in the solution must be shown. • Geometry: <ul style="list-style-type: none"> ○ Each conditional statement must be written in the correct format and relate to the Carnot Engine. • Math portion needs to be addressed in the Engineering Design Report. 		

	<div></div> <p>History:</p> <ul style="list-style-type: none"> • Writing must be typed, 12-point font, double spaced, with Times-New Roman or Arial. • Must contain MLA citation. • Must contain organization that separates ideas into paragraphs. <p>Art:</p> <ul style="list-style-type: none"> • The critique must follow the standard criticism format for art critiques. <p>Presentations must be:</p> <ul style="list-style-type: none"> • 3 to 5 minutes • All content information must be cited using MLA format. 						
Unit Learning Targets	<p>Algebra 1:</p> <ul style="list-style-type: none"> • I can rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. • I can create equations in one variable and use them to solve problems. <p>Geometry:</p> <ul style="list-style-type: none"> • I can prove geometric theorems. • I can apply geometric concepts in modeling situations. <p>PWC:</p> <ul style="list-style-type: none"> • I can describe the relationships among temperature, heat and internal energy. • I can convert between Celsius, Fahrenheit, and Kelvin scales. • I can use the First Law of Thermodynamics to describe changes in internal energy as they relate to heat transfer via conduction, convection, and radiation. <p>English I:</p> <ul style="list-style-type: none"> • I can write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through effective selection, organization, and analysis of content. • I can demonstrate command of the conventions of Standard English grammar and usage when writing or speaking. • I can demonstrate command of the conventions of Standard English capitalization, punctuation, and spelling when writing or speaking. • I can present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task. <p>Art:</p> <ul style="list-style-type: none"> • I can examine the correlation of material, technologies, processes, and terminology used in visual art with those used in other disciplines. <p>World History:</p> <ul style="list-style-type: none"> • I can identify key steps in a text's description of a process related to history/social studies. • I can determine the meaning of words and phrases as they are used in a text, including vocabulary specific to domains related to history/social studies. • I can write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • I can draw evidence from informational texts to support analysis, reflection, and research. 						
Vocabulary	<table border="1"> <tr> <td data-bbox="277 1587 716 1745">Math: Algebra I</td><td data-bbox="716 1587 1341 1745"> 1. Literal Equation 2. Formula 3. Identity 4. Accuracy 5. Precision </td></tr> <tr> <td data-bbox="277 1745 716 1913">Math: Geometry</td><td data-bbox="716 1745 1341 1913"> 1. Deductive Reasoning 2. Inductive Reasoning 3. Bi-Conditional Statement 4. Conjecture 5. Counter Example </td></tr> <tr> <td data-bbox="277 1913 716 1944">Science: Physical World Concepts</td><td data-bbox="716 1913 1341 1944">1. Thermodynamics</td></tr> </table>	Math: Algebra I	1. Literal Equation 2. Formula 3. Identity 4. Accuracy 5. Precision	Math: Geometry	1. Deductive Reasoning 2. Inductive Reasoning 3. Bi-Conditional Statement 4. Conjecture 5. Counter Example	Science: Physical World Concepts	1. Thermodynamics
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		2. Conduction 3. Convection 4. Radiation 5. Heat 6. Temperature	
	Language Arts: English I	1. Audience 2. Task 3. Purpose 4. Reflection 5. Artifacts	
	Social Studies: World History	1. Thermodynamics 2. Transition 3. Flow 4. Narrative 5. Expository	
	Art: Art I	1. Aesthetic 2. Form 3. Freestanding 4. Balance	