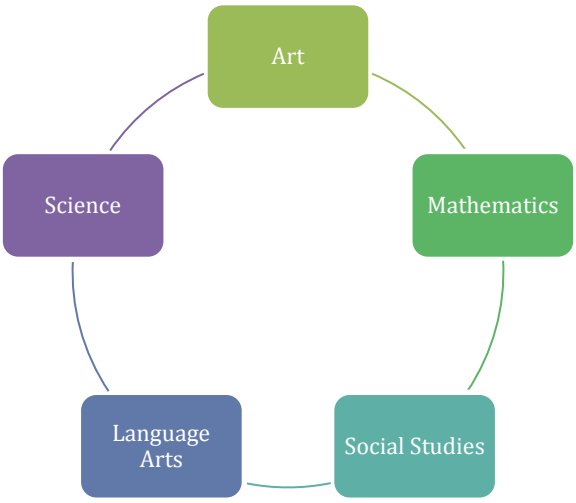
STEM School Chattanooga
9th Grade PBL
Unit Plan Template

Unit 3: Transportation



Learning Target Topics

Art I: Examine materials, technologies, processes, and terminology used in visual art and integrate visual art ideas, issues, and themes.

Algebra I: Summarize, represent, and interpret data on two categorical and quantitative variables; Reason quantitatively and use units to solve Problems.

Geometry: Apply geometric concepts in modeling situations; Visualize relationships between two-dimensional and three-dimensional objects.

English I: Write arguments to support claims; Gather, evaluate, and cite information from research sources; Demonstrate command of standard English grammar, spelling, capitalization, and punctuation in writing.

Physical World Concepts: Analyze and apply Newton's three laws of motion; Investigate kinematics and dynamics; Investigate and apply Archimedes's, Pascal's and Bernoulli's principles.

World History: Research historical information; Write arguments to support a claim.

Grade Level	9th Grade	Unit Length	3 Weeks
Unit Overview	The Unit 3 PBL on transportation will introduce students to the essential concepts underlying the principles of movement and conservation of energy. Along with the study of motion, students will apply geometric concepts related to triangle congruence and algebraic problem solving to collaboratively design and build a toothpick model of a bridge. Students will also conduct a bungee egg drop lab to test Newton's Laws and acceleration due to gravity and interpret the results of the quantitative data. Students will then present their design process, final design, and functionality of the bridge.		
Unit Essential Issue	• Strand: Transportation		
Culminating Events	For the Unit 3 PBL, the students will work collaboratively in groups of three. Student teams will research and design a toothpick bridge. They will then write an Engineering Design Report and build a model of their design. Student groups will also conduct a bungee egg drop lab experiment to observe the effects of Newton's Laws and acceleration due to gravity. **Egg Drop Lab Day - November 6th** Students will conduct a bungee egg drop lab and create a scatter plot, line of best fit, and equation based on data collected using an Egg Drop Lab Report. The following items will be turned in as part of the lab: • Bungee Egg Drop Lab Report **Bridge Test Assessment – Week of November 16th** The culminating event for this PBL is a lab day where students will test the efficiency of their bridge determined by the amount of weight it will hold. The following items will be turned in as part of the assessment: • Engineering Design Report		

- Argumentative Writing Essay on the Bridge Design Choice
- Toothpick Bridge Model
- Two Dimensional Plan of Bridge

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 Eggdrop Lab Report and toothpick bridge model and EDR.
- Physical World Concepts: Safety of bridge based on Newton's Laws of Motion, speed limit, path of objects falling from bridge, and movement of river below in the Engineer Design Report.
- English I: Argumentative format, structure, and the correct use of standard English in the research-based argumentative writing essay supporting their chosen bridge type.
- Art: Form and balance in the model and aesthetics in the 3D bridge design plan.
- World History: Research, citation, and use of analysis in Historical content in the research-based argumentative writing essay supporting their chosen bridge type.

Common Assessment

STEM School Chattanooga

STEM PBL Rubric

PBL Unit: _____
Student: _____
Date: _____

	Advanced	Proficient	Needs Improvement
Math Components: **Algebra I**	• Based on the tested efficiency of their bridge design, students can assess their model, explain, and justify changes they would make to make their bridge more efficient. • Using a graphing calculator, students will create a line of best fit for the lab data and will explain what a line of regression is.	• Using the efficiency equation E= L ÷ M, students can identify what each variable represents and can solve for the variables E, L and M. • Students can create a scatter plot using data from bungee drop lab and, using graph paper and pencil, will estimate a line of best fit.	
Math Components: **Geometry**	• Students will follow the engineer design process and, within the engineering design report, will analyze the efficiency of their bridge design and explain how they would redesign it to be more functional.	• Student can design and build a model of a bridge using principles of triangle congruence, parallel lines, and transversals as a basis of their design.	
Science Components: **Physical World Concepts**	• Students can explain the motion of projectiles falling from the bridge using vector components and addition, providing the angle, velocity, and position of the projectile at any given point or time.	• Students can explain why the bridge will withstand vehicular traffic using all 3 of Newton's Laws of Motion. • Students will set a speed limit based on momentum. • Students can mathematically explain, using horizontal and vertical forces, the path of projectiles falling from the bridge or jump tower. • Students can explain the relationship of the bridge and river using at least one fluid dynamic principle.	
Language Arts Components: **English I**	• Students can analyze and evaluate the research found concerning the bridge design to develop a strong, clear argument supporting their decision. • Students can evaluate and select evidence from sources that most effectively supports their argument for both their claims and counterclaim.	• Students can use proper argumentative writing structure in the 2-3 argumentative paragraph essay supporting the type of bridge design chosen. • Students include at least 2 supporting points for the claim and 1 for the counterclaim in their argumentative essay.	

		• Students can use MLA format with sources and parenthetical citations correctly without errors. • Students can write the report free of errors in grammar, capitalization, spelling, and punctuation.	• Students can use MLA documentation to cite their sources and research in their writing. • Students can write the report with few errors in grammar, capitalization, spelling, and punctuation.	
	Social Studies Components: **World History**	• Accurately and effectively presents important details from reading materials to develop argument or claim. • Presents thorough and detailed information to effectively support and develop the focus, controlling idea, or claim. • Integrates relevant and accurate disciplinary content with thorough explanations that demonstrate in-depth understanding.	• Accurately presents details from reading materials relevant to the purpose of the prompt to develop argument or claim. • Presents appropriate and sufficient details to support and develop the focus, controlling idea, or claim. • Accurately presents disciplinary content relevant to the prompt with sufficient explanations that demonstrate understanding.	
	Art Components: **Art I**	• The design must include intricate details that enhance the aesthetics of the design.	• Models will be assessed on their use of form. • The model must be free-standing and visually balanced.	
	Minimum Requirement Components: **Must be included to be graded**	Algebra 1: • Each variable in the efficiency equation must be defined. In the scatter plot, the independent and dependent variables must be defined. • The Scatter plot must be completed on graph paper. Geometry: • A two-dimensional design of the graph must be completed on graph paper. English I: • Students must turn in a copy of the Bridge Design Argumentative Essay to the English I assignment in Edmodo by attaching the link from their Unit 3 PBL Google Drive folder. • Argumentative essay must be in MLA format, including a Works Cited page. PWC: • All three of Newton's Laws must be stated and related to the bridge's worthiness. • Speed limit must include calculation and rationale for choosing the numbers used. • Path of projectile must use vertical and horizontal motion equations. • Fluid dynamic principle chosen must be stated and related to the bridge/river relationship. Art: • For the advanced portion: Must include a 2 dimensional drawing that is included in the Engineer Design Report. World History: • Must have at least two primary and/or secondary sources.		
Unit Learning Targets	Algebra 1: • I can summarize, represent, and interpret data on two categorical and quantitative variables. • I can reason quantitatively and use units to solve problems. Geometry: • I can apply geometric concepts in modeling situations. • I can visualize relationships between two-dimensional and three-dimensional objects. PWC: • I can use Newton's Laws to describe the relationships of objects in motion. • I can use mechanics to measure, calculate, describe, and represent the motion and energy of an object. • I can use Archimedes's, Bernoulli's, and Pascal's principles to describe the behavior of fluids. English I: • I can write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. • I can gather information from multiple sources, assessing the usefulness of each source and integrating information into the text successfully, avoiding plagiarism and following a standard format (MLA) for citation. • I can demonstrate command of the conventions of Standard English grammar and usage when writing			

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or speaking.
• I can demonstrate command of the conventions of Standard English capitalization, punctuation, and spelling when writing or speaking.
Art:
• I can examine the correlation of material, technologies, processes, and terminology used in visual art with those used in other disciplines.
• I can integrate ideas, issues, and themes in visual art and other disciplines to design a visual representation of a model.
World History:
• I can write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
• I can gather information from multiple sources, assessing the usefulness of each source and integrating information into the text successfully, avoiding plagiarism and following a standard format for citation.
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<tr><td>Vocabulary</td><td>
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<tr><td>Math: Algebra I</td><td>1. Literal equation
2. Formula
3. Line of best Fit
4. Line of Regression
5. Correlation</td></tr>
<tr><td>Math: Geometry</td><td>1. Efficiency
2. Tension
3. Compression
4. Congruence
5. Similarity</td></tr>
<tr><td>Science: Physical World Concepts</td><td>1. Vector
2. Velocity
3. Acceleration
4. Impulse
5. Momentum
6. Inertia
7. Projectile</td></tr>
<tr><td>Language Arts: English I</td><td>1. Argumentative
2. Claim
3. Counterclaim
4. Refutation</td></tr>
<tr><td>Social Studies: World History</td><td>1. Analysis
2. Literary Support
3. Logical Fallacies
4. Disciplinary Content</td></tr>
<tr><td>Art: Art I</td><td>1. Aesthetic
2. Form
3. Freestanding
4. Balance</td></tr>
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