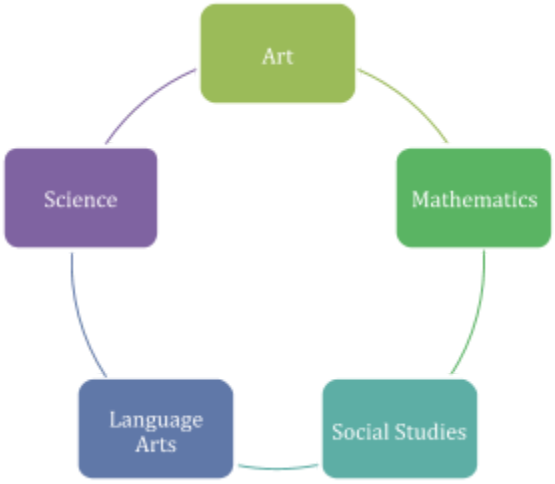
STEM School Chattanooga
9th Grade PBL
Unit Plan Template

Unit 1: Dynamics



Learning Target Topics

Art I: Plan and produce a work combining technologies, media, and processes of visual art with those of another discipline.

Algebra I: Solve quadratic equations in one variable.
Geometry: Apply geometric concepts in modeling situations;

English I: Create/write narratives to develop experiences; Use digital media to enhance understanding and interest; Adapt speech to concept or task.

Physical World Concepts: Investigate and analyze the kinematics and dynamics of projectile motion in a gravitational field..

World History: Research historical information; Write an expository report to explain the history of the chosen method.

Grade Level	9th Grade	Unit Length	6 Weeks
Unit Overview	The Unit 1 PBL on dynamics will introduce students to the essential concepts underlying the principles of 2 dimensional dynamics in a gravitational field. Along with the study of dynamics, students will construct either a medieval catapult, ball free throw, or custom launching device and use qualitative data to analyze the two dimensional motion of a projectile in Earth's gravitational field. Students will use digital fabrication in the final designs and document their process using video documentaries. Students will then demonstrate their design process, final design, and functionality of the launching device in a Catapult Challenge Competition.		
Unit Essential Issue	• Strand: Dynamics		
Culminating Events	For the Unit 1 PBL, the students will work collaboratively in groups of 3-4. Student teams will research and design a catapult launching device. They will then sketch and build various models of their design, using digital fabrication for the models. Student groups will demonstrate the launching device in a Catapult Challenge Competition to obtain and analyze data for a projectile. Students will also create video documentaries, including weekly prototype videos, documenting the fabrication process, testing, and final design reflection. **Catapult Challenge Competition -** The culminating event for this PBL is a Catapult Challenge Competition demonstrating the constructed launching devices. The catapult launch must be able to clear a barrier and hit a distance target with accuracy. The following items will be turned in as part of the assessment: • Video Documentaries on the Catapult Design, Fabrication Process, and Reflection • Catapult Launching Device and Prototypes • Written expository report explaining the history of the team's choice of design • PWC Catapult Analysis Worksheet • Algebra AD - graphed either on paper or digitally		

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

- Algebra I/Geometry: Correct use of the mathematical learning targets in the design and launch of the catapult in the Catapult Analysis Worksheet.
- Physical World Concepts: The research and analysis of the physics of the machines and projectiles in the Catapult Analysis Worksheet.
- English I: Use of the Weekly Prototype Videos and Final Documentary to document the building process, testing, and final design of the launching device.
- Art: Form and balance in the model and aesthetics in the launching device design plan.
- World History: Research, citation, and use of analysis of historical content in the research-based expository writing showing the history of their chosen launching device type.

Common Assessment

STEM School Chattanooga

STEM PBL Rubric

PBL Unit: _____
Student: _____
Date: _____

	Advanced	Proficient	Needs Improvement
Math Components: **Algebra I**	• Students will predict the angles for release point that is optimal to achieve a launch covering the longest distance. • Prediction must be graphed and supported using mathematical evidence and terminology.	• Students will create data tables for 4 different catapult launch angles, recording time and distance for each. • Students will use technology to graph each launch and use data to determine maximum height and initial velocity.	
Math Components: **Geometry**	• Student can alter the scale of an existing catapult or trebuchet design. • Completed design using TinkerCad.	• Student can design to scale a catapult which satisfies specified physical constraints. • Completed design using TinkerCad.	
Science Components: **Physical World Concepts**	• Students will quantitatively predict the effects on their machine in a different gravitational field in the advanced portion of the worksheet. • Students will suggest improvements to their machine that would increase their range and discuss the effects those improvements would have on the variables in both dimensions.	• Students will create a catapult suitable for launching a payload. • Students will build the machine base using no automated parts or kits. • Complete PWC Catapult Analysis of kinematics and gravity in 2 dimensions. • A written description of the displacement, velocity and acceleration of the projectiles in both X and Y dimension. • Students will qualitatively predict the motion of their machine in a different gravitational field.	
Language Arts Components: **English I**	• Video includes an analysis of the designs through reflections of results, adaptations, and predictions for the next prototype design. • Videos will include personal interviews from team member(s) about roles, struggles, and/or successes. • Videos are personalized and engaging, including analysis of learning through the processes.	• Students will document the design and construction process, from first to final design, in the Weekly Prototype and Final Documentary Videos. • Students will include testing, results, and next steps in the weekly prototype clips. • Students will use speech and domain-specific vocabulary in	

			the videos that is appropriate to the task and purpose.	
	Social Studies Components: **World History**	• Accurately and effectively presents important details from reading materials to develop thesis 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 thesis 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**	• Model must perform task effectively. • Two or more different digital fabrication elements. • Analyze the process of building the model as you use the fabrication processes in the documentary video.	• Final model will be assessed on their use of form. • Final model must be free-standing and visually balanced. • Final model must have one element of digital fabrication.	
	Minimum Requirement Components: **Must be included to be graded**	Algebra: • Tables correctly labeled and graphs created using graphing technology Geometry: • A two-dimensional orthographic design of the graph must be completed using TinkerCad. English I: • Weekly Prototype Video Clips must be completed each week and added to FlipGrid BEFORE advancing to the next prototype step. • Prototype and documentary videos must include ORIGINAL still images or live video of your launching device and processes. • Videos should be no more than 5 minutes long. PWC: • Machine must fit the size requirements mentioned in the pacing guide. Art: • Model must be sturdy and well put together within the size standards. World History: • Expository essay should be a minimum of 1.5 pages long. • Must have at least one primary and/or secondary sources.		
Unit Learning Targets	Algebra 1: • I can interpret complicated expressions by viewing one or more parts as a single entity. • I can interpret parts of an expression such as factors, coefficients and terms.. Geometry: • I can apply geometric concepts in modeling situations. • I can visualize relationships between two-dimensional and three-dimensional objects. PWC: • I can use kinematics in 2 dimensions to analyze motion. • I can discuss possible differences in motion due to differences in the gravitational field. English I:			

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I can create/write narratives to develop real or imagined experiences or events using effective techniques, well-chosen details, and well-structured event sequences.
I can make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Art:

I can plan and produce a work combining technologies, media, and processes of visual art with those of another discipline.
I can synthesize the use of expanded media, techniques, and processes to create a model form in a specific medium.
I can analyze and employ different types of media, techniques, and processes used to create various art forms .

World History:

I can write an expository paper 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. Quadratic Equation
2. Vertex
3. Parabola
4. Projectile</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. Displacement
3. Velocity (initial and final)
4. Acceleration
5. Acceleration due to gravity
6. Projectile</td></tr>
<tr><td>Language Arts: English I</td><td>1. Documentary
2. Prototype
3. Predictions</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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