STEM Curriculum Planning Guide

This instructional design guide serves as the template for the design and development of STEM units of instruction at the Dayton Regional STEM Center in Dayton, Ohio. The guide is anchored to the *STEM Education Quality Framework* also developed at the Dayton Regional STEM Center.

STEM Unit Title	**Moving on Up**
Economic Cluster	Advanced Manufacturing & Materials Environmental Engineering
Targeted Grades	11-12
STEM Disciplines	Science Technology Engineering Mathematics
Non-STEM Disciplines	English Language Arts Social Studies

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Section I: STEM Unit Overview

Unit Overview

Teams of students will design and build a model for a transportation system in the Virunga Mountains. Student learning will focus on science (physics of simple machines), math (statistics and modeling), language arts (technical writing) and history (African people and mountain ranges) to solve this problem.

Essential Question

What is the most efficient way for people of the Virunga Mountains bordering Rwanda, Uganda and the Democratic Republic of the Congo (DRC) in Africa to transport people and goods over steep terrain?

Enduring Understanding

There are many different ways to move over rough terrain, but the factors that play a big role include the materials available, what is being moved, and the change in elevation. Each of these factors should be taken into account throughout the design and building process.

When designing a transportation system, research must be done on the geographical area and the technologies that are going to be used. This research is useful because geological information will dictate which materials are appropriate and which designs will prove to be the most effective.

Engineering Design Challenge

Members of a village in Uganda have trouble moving goods, materials, and themselves across the rough terrain and the mountainous area. Currently, people of all ages, even some handicapped, are moving heavy loads without any type of assistance. A request has been made for your engineering design team to design a transportation system prototype for carrying people, goods, and materials from one area to another, without the use of electricity. It is necessary that your team present your prototype in the form of a brief presentation explaining the design process and effectiveness of your scaled prototype of the transportation device.

Time and Activity Overview

Day	Time Allotment	Actvities
1	50 minutes	unit introduction & problem introduction & pretest
2	50 minutes	research Virunga Mountain range and people
3	50 minutes	pulleys, gears and levers research
4	50 minutes	design process facilitation
5	50 minutes	brainstorming & Google sketch introduction
6	50 minutes	Google sketches & design selection
7	50 minutes	build prototype
8	50 minutes	create brief presentation
9	50 minutes	finish building and test

10	50 minutes	student presentations
11	50 minutes	finish presentations and post test

Pre-requisite Knowledge & Skill

Students need to be able to apply basic algebra skills and math conversions.
Students need to apply angle geometry.
Students need to be able to conduct effective Internet investigations.
Students should be able to understand and apply the concept of scale for proportional reasoning.
Students should have basic knowledge of Google SketchUp.
Students should be able to create electronic presentations.

Academic Content Standards

Add Standard	Mathematics	Ohio
Grade/Conceptual Category	8-9	
Domain	ALGEBRA	
Cluster	Creating Equations	
Standards	Create equations in 1 variable.	

Add Standard	Mathematics	Ohio
Grade/Conceptual Category	9-12	
Domain	STATISTICS	
Cluster	Make Inferences & Justify Conclusions	
Standards	Decide if a model is consistent with results. Evaluate reports based on data.	

Add Standard	English Language Arts	Ohio
Grade	11-12	
Strand	Speaking & Listening	
Topic	Presentation of Knowledge and Ideas	
Standard	Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks	

Add Standard	English Language Arts	Ohio
Add Standard	English Language Arts	Ohio
Grade	11-12	
Strand	Reading Standards for Literacy in Science and Technical Subjects 6–12	
Topic	Key Ideas and Details	
Standard	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	

Add Standard	English Language Arts	Ohio
Grade	11-12	
Strand	Reading Standards for Literacy in Science and Technical Subjects 6–12	
Topic	Craft and Structure	
Standard	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 11–12 texts and topics. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.	

Add Standard	English Language Arts	Ohio
Grade	11-12	
Strand	Reading Standards for Literacy in Science and Technical Subjects 6–12	
Topic	Integration of Knowledge and Ideas	
Standard	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	

Add Standard	English Language Arts	Ohio
Add Standard	English Language Arts	Ohio
Grade	11-12	
Strand	Writing Standards for Literacy in History/Social Studies, Science and Technical Subjects 6–12	
Topic	Text Types and Purposes	
Standard	1. Write arguments focused on discipline-specific content. a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).	

Add Standard	English Language Arts	Ohio
Grade	11-12	
Strand	Writing Standards for Literacy in History/Social Studies, Science and Technical Subjects 6–12	
Topic	Production and Distribution of Writing	
Standard	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.	

Add Standard	English Language Arts	Ohio

Add Standard	English Language Arts	Ohio
Grade	11-12	
Strand	Writing Standards for Literacy in History/Social Studies, Science and Technical Subjects 6–12	
Topic	Research to Build and Present Knowledge	
Standard	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively;	

Add Standard	Social Studies	Ohio
Grade	High School	
Theme	Contemporary World Issues	
Strand (pk-8 only)		
Topic	History	
Content Standard	Sustainability issues are interpreted and treated differently by people viewing them from various political, economic and cultural perspectives.	

Add Standard	Social Studies	Ohio

Add Standard	Social Studies	Ohio
Grade	High School	
Theme	Contemporary World Issues	
Strand (pk-8 only)		
Topic	History	
Content Standard	Decisions about human activities made by individuals and societies have implications for both current and future generations, including intended and unintended consequences.	

Add Standard	Social Studies	Ohio
Grade	High School	
Theme	Contemporary World Issues	
Strand (pk-8 only)		
Topic	History	
Content Standard	Stainability issues are interpreted and treated differently by people viewing them from various political, economic and cultural perspectives.	

Add Standard	Science	Ohio
Grade		
Theme		
Topic		
Content Standard		

Add Standard	Science	Ohio

Add Standard	Science	Ohio
Strand	Physical Science	
Course Content	Energy	
Content Elaboration	Work and Power Work can be calculated for situations in which the force and the displacement are at angles to one another using the equation W = F x(cos) where W is the work, F is the force, x is the displacement, and is the angle between the	

Add Standard	Science	Ohio
Strand	Physical Science	
Course Content	Forces and Motion	
Content Elaboration	Use and apply the laws of motion to analyze, describe and predict the effects of forces on the motions of objects mathematically. Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., a car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight).	

Add Standard	Fine Arts	Ohio
Grade		
Subject		
Standard		
Benchmark		
Indicator		

Add Standard	**Technology**	
Grade	12	

Add Standard	**Technology**	
Standard	3: Technology for Productivity Applications Students learn the operations of technology through the usage of technology and productivity tools. Students use	
Benchmark	A: Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.	
Indicator	1 Research and create technology systems, resources and services to solve technical problems.	

Add Standard	**Technology**	
Grade	12	
Standard	4: Technology and Communication Applications Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.	
Benchmark	C: Identify communication needs, select appropriate communication tools and design collaborative interactive projects and activities to communicate with others, incorporating emerging technologies.	
Indicator	2. Use all available online communication capabilities to make inquiries, do research and disseminate results.	

Add Standard	**Technology**	
Grade	11-12	
Standard	5: Technology and Information Literacy Students engage in information literacy strategies, use the Internet, technology tools and resources, and apply information-management skills to answer questions and expand knowledge.	
Benchmark	D: Evaluate choices of electronic resources and determine their strengths and limitations.	
Indicator	Grade 11 1. Modify a search through the use of different keywords and other techniques specific to an electronic resource (e.g., online database, Web- based index) Grade 12	

Assessment Plan

What evidence will show that students have acquired the enduring understandings for this STEM unit?

Performance Task, Projects	moving goods and debris without electricity transportation system for people,
Quizzes, Tests, Academic Prompts	pre/post test exit slips
Other Evidence (e.g. observations, work samples, student artifacts, etc.)	individual design sketches team design sketches team presentation
Student Self- Assessment	reflections

Technology Integration

ADISC Technology Integration Model*

	Type of Integration	Application(s) in this STEM Unit
A	Technology tools and resources that support students and teachers in ***adjusting, adapting, or augmenting*** teaching and learning to meet the needs of individual learners or groups of learners.	Electronic White Board Microsoft PowerPoint (or other presentation software)
D	Technology tools and resources that support students and teachers in ***dealing effectively with data***, including data management, manipulation, and display.	Computers
I	Technology tools and resources that support students and teachers in conducting ***inquiry***, including the effective use of Internet research methods.	Internet Video
S	Technology tools and resources that support students and teachers in ***simulating*** real world phenomena including the modeling of physical, social, economic, and mathematical relationships.	Google SketchUp Excell AutoDesk Inventor (student edition)

C	Technology tools and resources that support students and teachers in ***communicating and collaborating*** including the effective use of multimedia tools and online collaboration.	PowerPoint other presentation software
	**The ADISC Model was developed by James Rowley PhD, Executive Director of the Institute for Technology-Enhanced Learning at the University of Dayton*	

Career Connections

Career Description

- Structural Engineers work with the analysis and design of structures which support or resist loads. These engineers work with the analysis and design of buildings and non-building structures such as machinery, medical equipment, and vehicles.

- Mechanical Engineering applies the ideas of physics and materials science for the analysis and design of mechanical systems. Mechanical engineers design and build engines, power plants, structures and vehicles both large and small.

- Chemical/Materials Engineering applies the physical and chemical properties of materials and substances to analyze and design new materials for structures and systems. Chemical and material engineers can be split into two broad subgroups including 1) design, manufacture, and operation of plants and machinery in industrial chemical and related processes; and 2) development of new or adapted substances for products ranging from foods and beverages to cosmetics to cleaners to pharmaceutical ingredients, among many other products.

- Environmental Geochemical Sciences/Engineering applies the physical sciences (e.g. chemistry, physics, geology) and life sciences (e.g. biology, biochemistry) to environmental problems and issues. Environmental geochemical scientists and engineers apply scientific research and engineering principles to modern day environmental problems around the globe.

Section II: STEM Lesson Plan

Title of Lesson

Day 1 We Have a Problem

Time Required

50 minutes

Materials

Appendix A: Pre/Post Test (1 per student)
Appendix B: Pre-Test Answer Key (1 per teacher)
Appendix C: Cornell Note Sheet (1 per student)
Appendix D: Engineering Roles (1 per team)
Resource - PowerPoint Presentation (included on website as a downloadable resource)
Video: "Introducing Virunga National Par (DR Congo):
:http://www.youtube.com/watch?v=zYDgAJv55B4 (3m41s)
Projection System

Objectives

Students will demonstrate prior knowledge of the subject mater in this lesson.

Students will be able to identify a problem within the Mt. Gahinga region.

Students will be able to make decisions about human activities made by societies that have implications for both current and future generations, including intended and unintended consequences.

Instructional Process

1. Administer Pre-Test
2. Divide students in teams of 4, and distribute Engineering Roles to each team. Assign an engineering role or have the students choose their role.
3. introduce the lesson by giving the PowerPoint presentation and showing the Video of the region, introduce students to the African region and the problem which the people face in transporting goods up the 11400 feet of Mt. Gahinga.
4. Give students Cornell Note Sheet and have them write questions generated through class discussion about the region. Then, instruct them to take notes and answer the questions throughout the presentation and the video.
5. Have students discuss the problem with their teams to clarify the goal of the project.
6. Present the following as an exit slip: "in your own words, summarize the problem which faces the people in the Virunga Mountain range."

Differentiation

Differentiation can be achieved through team selection based on learning modalities and strengths.
Questioning is differentiated using Cornell note sheet.

Assessments

Cornell note record sheet of information from presentation
Exit Slip Answers
Pre Test Results

Section II: STEM Lesson Plan

Title of Lesson	**Day 2 Where is the Virunga Mountain Range?**
Time Required	50 minutes
Materials	Computer and Internet Access (1 per student) Appendix E: Region Guided Internet Research (1 per student) Appendix F: Region Guided Internet Research - Sample Answers (1 per teacher)

Objectives	Students will conduct research to gain an understanding of the Virunga Mountain range in Africa and the people living in the area. Students will develop sufficient background knowledge so they can proceed with the project. Students will prepare for discussion, having read and researched material being studied in order to stimulate a thoughtful, well reasoned exchange of ideas.
Instructional Process	1. Instruct students to use the Internet to research the Virunga Mountain range in Africa and the people living in the area. 2. Have students begin individual research Region Guided Internet Research.
Differentiation	Differentiation can be achieved through team selection based on learning modalities and strengths. Modify research documents.
Assessments	Region Guided Internet Research

Section II: STEM Lesson Plan

Title of Lesson	**Day 3 Simple Machines Research**
Time Required	50 minutes
Materials	Computer and Internet (1 per student) Appendix G: Simple Machines Guided Research (1 per student) Appendix H: Forces and Friction Guided Internet Research (1 per student) Appendix I: Simple Machines and Forces and Friction Guided Internet Research - Sample Answers (1 per teacher)
Objectives	Students will conduct research to gain an understanding of different types of simple machines, including pulleys, wedges, screws, levers, wheels and axles, and inclined planes. Students will conduct research on frictional forces and how they effect static and kinetic bodies. Students will demonstrate their knowledge of forces by showing explicitly how different forces effect a mass. Students will develop sufficient background knowledge so they can proceed with the project. Students will prepare for discussion, having read and researched material being studied in order to stimulate a thoughtful, well reasoned exchange of ideas.
Instructional Process	1. Have the students use the Internet to research simple machines and find all six different types. 2. Have the students use the Internet to research frictional forces and their effects on bodies.
Differentiation	Modify research materials from an Internet based research to a text based research. Assign a student a specific number of machines to complete.
Assessments	Research results (Appendix: Day 3 - A - Internet Search Document)

Section II: STEM Lesson Plan

Title of Lesson

Day 4 The Engineering Design Challenge

Time Required

50 minutes

Materials

Appendix J: The Engineering Design Process
Appendix K: Engineering Design Challenge and Guide
Students Day 2 and Day 3 research results

Objectives

Students will acquire an understanding of the engineering design process and use it to identify a problem, research the problem and begin development of possible solutions.

Instructional Process

1. Hand out Copies of The Engineering Design Process Diagram and Engineering Design Challenge and Guide to the teams and have an open discussion about the 8 step process.
2. Discuss the essential questions and Prototype Requirements
3. Using steps 1-3 of the engineering design process have the teams begin identifying the problem and develop possible solutions.
4. Give the students exit slip reflection: "In your own words, summarize the problem and your team's possible solutions ideas."

Differentiation

After working to individually identify the problem, use a think-pair-share strategy to clarify the problem with all students.

Assessments

Exit Slip

Section II: STEM Lesson Plan

Title of Lesson

Day 5 Brainstorm and Google Sketch Introduction

Time Required

50 minutes

Materials

Resource - Presentation
Appendix K: Engineering Design Challenge and Guide
Appendix L: Google SketchUp - Shortcut Sheet
Appendix M: Decision Analysis Matrix
Appendix N: Teachers Aid to the Decision Analysis Matrix
Brainstorming Supplies - depending on chosen method - sticky notes, posters, graph paper
Stimuli baskets - Examples of stimuli: rubber bands, spin tops, rubber letters, balls, toys, straws, any small imaginable item

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Objectives

Students will brainstorm solutions to the engineering task individually and as a team.

Instructional Process

1. Have the students continue with a discussion of the engineering design process diagram, students will be concentrating on step 3. (There is an optional section in the Resource - Presentation)
2. Facilitate a brainstorming session with students, providing 3 min. for individual design brainstorms and criteria to include, (make sure students have a variety of stimuli available), provide 5 - 10 min. for discussion of individual criteria with team.
3. Provide 3 more minutes for students to create a design sketch (individual drawings); provide 5-10 min. for team discussion of individual designs.
4. Use Teacher's Aid to the Decision Analysis Matrix to explain and discuss the use of a Decision Analysis Matrix. Explain that teams will use the matrix as a tool to help them choose a team design based on an individual design plan scoring process.
5. Give the students an exit slip: “What part of the brainstorming process does your team need more time with and why?” - The purpose of this question is to get students to reflect on the brainstorming process and where their team is in that process. It will also provide the teacher with information on how involved the teams are in working together to achieve the common goal.

Differentiation

Provide more obvious stimulus to help guide student thoughts and creativity.

Assessments

Google Sketch: Drawing
Exit Slip Answers

Section II: STEM Lesson Plan

Title of Lesson

Day 6 Design Process Facilitation

Time Required

50 minutes

Materials

Appendix K: Engineering Design Challenge and Guide
Appendix M: Decision Analysis Matrix
Computer Lab with Google SketchUp Installed

Objectives

Students will be able to learn the operations of technology through the use of technology and productivity tools.
Students will be able to create 3-4 specific designs on Google SketchUp.
Students will be able to select a design using the Design Matrix.

Instructional Process

1. Finish design of prototype.
2. Have the students continue with a discussion of the engineering design process diagram, students will be concentrating on steps 4.
3. Using the Decision Analysis Matrix, have the teams select their design to build. (Reinforce that safety and any required criteria should be ranked 10).
4. Instruct each team to create a Google SketchUp of their team's chosen design plan. They may also sketch the team design if time is limited.
5. Give students an exit slip: "Rate your knowledge and use of Google SketchUp (1-5) and state why. What was positive about your groups Design Matrix discussion?"

Differentiation

Students work together for completing the Google SketchUp drawing. The team facilitator will be responsible for making sure everyone shares their design ideas.

Assessments

Completed Group Design Matrix
Completed Google SketchUp
Exit Slip Answers

Section II: STEM Lesson Plan

Title of Lesson

Day 7 Building the Transport Prototype

Time Required

50 minutes

Materials

Appendix K: Engineering Design Challenge and Guide
Appendix O: Engineering Design Challenge Rubric (1 per student)

per Class:
One 3'x4'x5' Triangle for Inclined Plane (possibly built from wood, should be capable of holding teams designs)

Per Team:
1 Piece Foam (24 sq. in., 2 in. thick)
1 Piece Cardboard (24 sq. in.)
8 Model Car Wheels (or anything similar)
1 Bag Rubber Bands (variety of sizes)
15 Popsicle Sticks
1 Piece String (21 ft. long)
1 Box Paper Clips
2 Glue Sticks
1 Roll Duct Tape
1 Set K'NEX®, Gears and Wheels (or anything similar-divide available quantity of gears and/or wheels amongst teams)
Note: K'NEX® Gears and Wheels may be purchased in kits or individually from their website:
http://www.knex.com/Shop/site_search_portal.php?func=1&words=gears+and+wheels

Objectives

By constructing a transport prototype, students will be able to demonstrate ways in which frictional forces constrain the motion of objects.

Students will be able to use and apply the laws of motion to analyze, describe, and predict the effects of forces on the motions of objects mathematically.

Instructional Process

1. Give the teams the materials to construct their transport prototype.
2. Discuss the Prototype constraints: must carry 5lbs at a 36.87 degree incline with a 3 x4x5 foot triangular incline.
3. Give the students an exit slip: "What does your team have left to finish your prototype? How much time do you believe your team would need to finish the building of your prototype?"

Differentiation	Allow additional time to finish prototype.
Assessments	Informal observation of student collaboration Exit Slip

Section II: STEM Lesson Plan

Title of Lesson	**Day 8 Preparing the Presentation**
Time Required	50 minutes
Materials	Prototype available and ready to discuss. Access to a laptop or desktop computer (with access to PowerPoint or online collaborative presentation tool) Access to an overhead projector. Access to Internet. Appendix O: Engineering Design Challenge Rubric (1 per student) Appendix P: Presentation Rubric (1 per student)
Objectives	Students will discuss the strengths and weaknesses of their prototype. Students will analyze testing results, and then plan and create a presentation explaining the design process of their team's prototype and its effectiveness.
Instructional Process	1. Have the teams begin discussing their prototype and how well it meets the stated constraints. Students should complete the Engineering Design Challenge Rubric based on their anticipated performance. 2. Float around to observe each group's discussion. This is an opportunity for the instructor to ask some important questions to see how well each prototype meets the stated constraints. 3. Tell the students the last portion of class should be dedicated to planning and preparing for the presentation. 4. Make sure you stress to the students to be creative in their presentation medium selection. 5. Give the students an exit slip: "What are the strengths and weaknesses of your prototype and does your prototype meet the constraints?"
Differentiation	Students can use the Engineering Design Challenge Rubric to evaluate their product's strengths and weaknesses.
Assessments	Engineering Design Challenge Rubric (self assessment) Exit Slip

Section II: STEM Lesson Plan

Title of Lesson

Day 9 Finish Design Build and Test

Time Required

50 minutes

Materials

One 3'x-4'x5' Triangle (Inclined Plane) capable of holding the teams designs
Appendix O: Engineering Design Challenge Rubric (1 per student)
Appendix P: Presentation Rubric

Objectives

Students will be able to present a completed prototype of their team's design.

Students will be able to test the designs and prototypes their teams have put together.

Students will calculate the amount of work and power that their prototypes use. Students will decide if a model is consistent with results mathematically.

Instructional Process

1. Allow the students time to finish building their prototypes and put finishing touches on them.
2. Have the students test their prototypes. To do this they will:
   a. Make any attachments to the Inclined Plane that is necessary for their prototype to function, or prepare their prototype to take weight and begin its ascent to the top.
   b. Add the 5 lbs to their prototype in increments of 1 pound.
   c. Proceed with the testing.
3. Have the students calculate the amount of work their prototypes did during the testing.
4. Have the students calculate the amount of power their prototypes used.

Differentiation

Some students may only complete predetermined sections of the rubric as needed.

Assessments

Engineering Design Challenge Rubric

Section II: STEM Lesson Plan

Title of Lesson	**Days 9 and 10 Student Presentations**
Time Required	100 minutes (50 minutes per day)
Materials	Student team presentations Presentation computer & setup Appendix P: Presentation Rubric Appendix A: Pre/Post Test Appendix B: Pre-Test Answer Key
Objectives	Students will be able to present information, findings, and supporting evidence to convey a clear and distinct perspective, such that listeners can follow their line of reasoning. Students will be able to facilitate the classroom demonstrating their learning from the unit. Students will demonstrate an understanding of the unit investigated through completion of a post-test.
Instructional Process	1. Have the student teams present to the class their design and prototype presentations. 2. Administer Post-Test.
Differentiation	Students will participate at different levels based on team activities and assignments. Students may use different modes of presenting to achieve the goal. Assessment will be administered to students in regard to their learning modalities.
Assessments	Presentation Rubric Post-Test Results

Section III: Unit Resources

Materials and Resource Master List

Appendices
Computer with Internet Access and Projection Capabilities
Sticky Notes
Posters (1 per team)
Graph Paper
Brainstorming Stimuli Baskets of Random Manipulatives for Stimulating Creativity (1 per team-examples: rubber bands, spin tops, rubber letters, balls, toys, straws, any small imaginable item)
One 3'x4'x5' Triangle for Inclined Plane (possibly built from wood, should be capable of holding teams designs)

Suggested Materials Per Team (choose materials based on accessibility/availability for you):
1 Piece Foam (24 sq. in., 2 in. thick)
1 Piece Cardboard (24 sq. in.)
8 Model Car Wheels (or anything similar)
1 Bag Rubber Bands (variety of sizes)
15 Popsicle Sticks
1 Piece String (21 ft. long)
1 Box Paper Clips
2 Glue Sticks
1 Roll Duct Tape
1 Set K'NEX®, Gears and Wheels (or anything similar-divide available quantity of gears and/or wheels amongst teams)
Note: K'NEX® Gears and Wheels may be purchased in kits or individually from their website: http://www.knex.com/Shop/site_search_portal.php?func=1&words=gears+and+wheels


The Dayton Regional
STEM Center
Science, Technology, Engineering and Math

Key Vocabulary

Brainstorm -
A process to develop innovative plans or ideas.

Constraint -
the state of being checked, restricted, or compelled to avoid perform some action.

Prototype -
An original type, form, or instance serving as a basis or standard for later stages.

Design -
To conceive a plan out in the mind; to devise for specific function or end

Engineering Design -
A systematic, intelligent process in which designers generated, evaluated, and specify, designs, for devices or processes whose forms and functions achieve clients' objectives and users' needs while satisfying a specified set of constraints.

Force -
A push or a pull which causes acceleration on a body.

Form -
The shape and structure of something as distinguished from its material

Function-
the action for which a person or something is specially fitted or used or for which a thing exists; one of a group of related actions contributing to a larger action

Gear -
A wheel with attached levers.

Inclined Plane -
A flat surface set at an angle to another surface.

Lever -
A machine which uses a fulcrum to provide a mechanical advantage.

Objective -
Something toward which effort is directed; an aim or end of action

Pulley -
A wheel with a groove along its edge, where a rope or cable can be placed.

Scalar quantity -
A quantity which is fully described by only its magnitude.

Screw -
A shaft that has an inclined groove (threads) along its surface.

Simple Machine -
A basic device which can provide a mechanical advantage.

Terrain -
An area of land or ground

Transportation System -
a facility consisting of the means and equipment necessary for the movement of passengers or goods

Vector quantity -
A quantity which is fully described by both magnitude and directions.

Wedge -
A double-inclined plane that moves to exert a force along the lengths of the sides.

Wheel and Axle -

Technical Brief

Appendix Q: Technical Brief

Safety and Disposal

If students require drilling while manufacturing the prototype use general safety precautions to include eye protection. All materials used in this lab require no special disposal methods. Used materials can be simply placed in the waste basket.

References

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