

Advanced Manufacturing & Prototyping Integrated to Unlock Potential

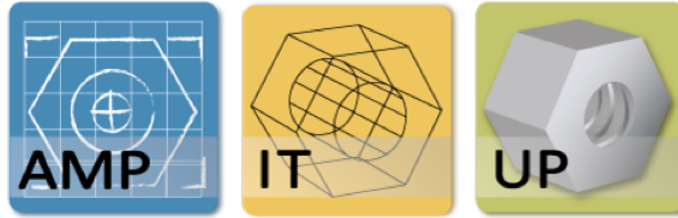
EXPRESSIONS AND EQUATIONS

Data-Driven Decision Making

POWER PAYOFF

Power Finance Challenge

Teacher Preparatory Guide



Advanced Manufacturing & Prototyping Integrated to Unlock Potential

8th Grade Math Data-Driven Decision Making (8DMM)

"Power Payoff"

Power Finance Challenge

<p>Module Description</p>	<p>Students use previous solar thermal power plant simulation data in conjunction with other cost attribute data (i.e. insulation material cost, material transportation cost, worker pay, budget...) for different global locations. Students reason quantitatively using a system of linear equations to decide on insulation material and thickness for their location. The module covers basic GSE concepts in linear systems of equations.</p>	
<p>Related Mathematics Georgia Standards of Excellence</p>	<p><i>MGSE8.EE.8 Analyze and solve pairs of simultaneous linear equations (systems of linear equations).</i></p> <p><i>MGSE8.EE.8c Solve real-world and mathematical problems leading to two linear equations in two variables.</i></p>	
<p>Module Timeline</p>	<p>50-minute class periods: 5 days</p> <p>Day 1: Section 1 Day 2: Section 1,2 Day 3: Section 2 Day 4: Section 3 Day 5: Section 3</p>	<p>90 minute blocks: 3 days</p> <p>Day 1: Sections 1, 2 Day 2: Sections 2, 3 Day 3: Section 3</p>
<p>Documents Included in the Download</p>	<p><u>Student Materials Folder</u></p> <ul style="list-style-type: none"> • Student Edition (recommended to be printed double sided) • Student Worksheet Packet (recommended to be printed double sided) <p><u>Teacher Materials Folder</u></p> <ul style="list-style-type: none"> • Materials List • Annotated Teacher’s Edition • Teacher’s Edition 	

Section 1 – Financing the Solar-Thermal Power Plant (70 minutes)

The focus of Section 1 is to provide students with a background of the Power Finance Challenge. The students will act as a team of engineers that have been hired to make recommendations about which insulation materials to use when building the power plant. Throughout the module, students will analyze data to determine which type of insulation should be used on the pipes of the power plant and how thick the insulation should be. Their final decision will be based off of startup cost, amount of time it takes to break even, and how much profit can be made.

Students are also introduced to key terms they will need to be able to understand throughout the challenge including: Expenses, Revenue, Profit, and Break-Even Point. Students are then provided a brief overview of the simulation, as well as the financial statement spreadsheet, that will be utilized to determine the decision making factors. After students use the financial statement spreadsheet they are asked to graph the expenses versus the revenue.

Preparation

Materials	Student Pages
<ul style="list-style-type: none"> Solville Financial Statement spreadsheet Red colored pencils Black colored pencils 	<ul style="list-style-type: none"> Financial Planning Sheet #1 Break-even Graph student sheet
<p>Prep the Day Before: Review the section and challenge. Complete section one for self to determine any sections that students may need additional support completing.</p>	

Planning

GSE	<p>MGSE8.EE.8 Analyze and solve pairs of simultaneous linear equations (systems of linear equations).</p> <p>MGSE8.EE.8c Solve real-world and mathematical problems leading to two linear equations in two variables</p>
CCSSM	<p>HSA.REI.C.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.</p> <p>HSA.REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.</p>

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
<ul style="list-style-type: none"> Trade-offs Expenses (start-up, yearly operating, cumulative) Revenue (gross yearly, net yearly, cumulative) Break-even point Slope Slope intercept equation Y-intercept Equation of the lines 	<p>Why are trade-offs an important decision for businesses to consider when planning financial decisions?</p> <p>Why is the break-even point an important point for business decisions?</p> <p>What information can you determine when you graph a system of equation? Why is this helpful? Why is it not helpful?</p>	<ul style="list-style-type: none"> Discussion Questions: <ul style="list-style-type: none"> Participation Student Financial Planning Sheet #1: Formative Break-Even Graph Sheet: Formative

Section 2 – Plant Design Investigation (70 minutes)

In order for students to understand the true break-even point accurately, students should solve for the break-even point using a system of equations. Student are asked to solve for the break-even point for 5cm of Adobe using a system of equations. **(NOTE: The challenge allows for the teacher to use any method that is preferential for the teacher. You may also choose to jump out of the lesson for a day or two to go more in-depth with system of equations, or to provide a more complete lesson.)**

Section 2.2 students determine which of the plant designs are actually workable in this challenge. The plant must be able to power 120,000 homes, which all insulations materials are unable to do. **(NOTE: If You completed the Solar Energy Unit, a previous AMP-IT-UP challenge, your students should already know this information and you may skip this section of the challenge. You may want to remind your students of the materials the thickness through a discussion, or a slide projected on your board.)** Students then complete Financial Planning Sheet #2, by determining the gross yearly revenue and net yearly revenue for each plant design that is deemed appropriate.

After students complete which can provide power to sell, they will be instructed to calculate their break-even points. This should be completed using system of equations. The teacher should assign students/groups to complete one of the appropriate designs. It is appropriate for multiple groups to do the same design to ensure validity of data.

Preparation

Materials	Student Pages
<ul style="list-style-type: none"> Simulation (http://ampitup.gatech.edu/simulations) 	<ul style="list-style-type: none"> Financial Planning Sheet #1 Break-even System of Equation student sheet
Prep the Day Before: Determine a method that will be employed to divide students into groups Review the section to anticipate mathematical challenges that students might face	

Planning

GSE	MGSE8.EE.8 Analyze and solve pairs of simultaneous linear equations (systems of linear equations).	
	MGSE8.EE.8c Solve real-world and mathematical problems leading to two linear equations in two variables	
CCSSM	HSA.REI.C.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.	
	HSA.REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	
Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
<ul style="list-style-type: none"> System of equations 	<ul style="list-style-type: none"> How can a system of equation be best to determine how quickly a business will hit a break-even point? 	<ul style="list-style-type: none"> Discussion Questions: Participation Financial Planning Sheet #2: Formative

Section 3 – Making Decisions Based On Data (80 minutes)

During this section, students will gather the information about the insulation materials and thickness to make an informed recommendation about the power plant design. Students should consider: the size of the loan, the amount of time it takes to reach break-even, and finally the profit after break-even.

Students are introduced to the decision making matrix, which will be used to help guide their decisions. Students variables are pre-determined and they will work through coding the matrix to give them a visual representation of the data need to make their final recommendation. Students are provided direct instructions as to how to properly code the matrix in section 3.3.

Finally, students should use their decision matrix to make a recommendation to the Mayor of Solville. This should be written in a letter format, using correct grammar and complete sentences. The recommendation letter should consider the amount of loan requested, amount of time for break-even, as well as the profit impact. Students should utilize evidence and reasoning within their recommendation drawing from the matrix and prior knowledge and/or experiences.

Preparation

Materials	Student Pages
<ul style="list-style-type: none"> Colored Pencils 	<ul style="list-style-type: none"> Decision Making Matrix Financial Planning Sheet #2 Insulation Recommendation Sheet
<p>Prep the Day Before: Review the section to anticipate mathematical challenges that students might face</p>	

Planning

GSE	MGSE8.EE.8 Analyze and solve pairs of simultaneous linear equations (systems of linear equations). MGSE8.EE.8c Solve real-world and mathematical problems leading to two linear equations in two variables	
CCSSM	HSA.REI.C.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. HSA.REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	
Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
<ul style="list-style-type: none"> Decision Making Matrix 	<ul style="list-style-type: none"> How can a matrix help you to visualize multiple factors that need to be considered for a decision? 	<ul style="list-style-type: none"> Discussion Questions: Participation Decision Making Matrix: Formative Insulation Recommendation Sheet: Summative

**Georgia
Tech**  **Center for Education
Integrating Science,
Mathematics & Computing**

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