



Advanced Manufacturing & Prototyping Integrated to Unlock Potential

7TH GRADE MATH

Experimental Design

IT'S GAME TIME!

*Board Game
Piece Challenge*



Advanced Manufacturing & Prototyping Integrated to Unlock Potential

7th Grade Math Experimental Design (7EDM)

It's Game Time!

Board Game Piece Challenge

<p>Module Description</p>	<p>Students use different measuring tools to find the dimensions of a set of 3-D printed geometric solids to find the piece that best fits a set of requirements. Using the measurements and formulas for basic geometric solids, they will then be asked to calculate the values for area, surface area, and volume to compare the pieces in their group's set. They will present and/or write a letter that supports their decision for the game piece that best fits all design requirements from their set. During the module, they will investigate experimental design as they create a procedure to measure their pieces.</p>	
<p>Supported Georgia Standards of Excellence</p>	<p>MGSE7.G.4: <i>Given the formulas for the area and circumference of a circle, use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</i></p> <p>MGSE7.G.6: <i>Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</i></p>	
<p>Module Timeline</p>	<p>50-minute class periods: 6 days</p> <p>Day 1: Section 1 Day 2: Section 2 Day 3: Section 2 Day 4: Section 3 Day 5: Section 3 Day 6: Section 4</p>	<p>90 minute blocks: 3 days</p> <p>Day 1: Sections 1 & 2 Day 2: Sections 2 & 3 Day 3: Sections 3 & 4</p>
<p>Documents Included in the Download</p>	<p><u>Student Materials Folder</u></p> <ul style="list-style-type: none"> • Student Edition (<i>recommended to be printed double sided</i>) • Student Worksheet Packet (<i>recommended to be printed single sided</i>) <p><u>Teacher Materials Folder</u></p> <ul style="list-style-type: none"> • Materials List • Annotated Teacher's Edition • Teacher's Preparation Guide • Video 	

Section 1 – The Board Game Piece Design Challenge (50 minutes)

Section 1 provides students with a background of the Board Game Piece Challenge where GriffinCraft, a new game producer, has asked the students to become part of a game piece design team. In **Part 1.1**, students will view the **3D Game Piece** video used as a hook for the challenge. In the challenge, students are given design requirements of stability, size, image visibility, and cost. **Part 1.2** introduces students to the concept of a design solution which must meet certain design requirements or, at least most of the design requirements. In **Part 1.3**, students begin analyzing the design requirements and deciding on procedures used to test the pieces. In **Part 1.4**, the teacher conducts a lesson that provides students with the geometric formulas needed to solve the challenge.

Preparation

Materials	Student Pages
<ul style="list-style-type: none"> Video: <i>3D Game Piece</i> 	<ul style="list-style-type: none"> Design Requirement Student Sheet Geometric Formulas Student Sheet
Prep the Day Before: <ul style="list-style-type: none"> Review the section and challenge. Review video. Review class discussion questions. 	

Planning

GSE	<p>MGSE7.G.4: Given the formulas for the area and circumference of a circle, use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</p> <p>MGSE7.G.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</p>	
CCSS	<p>CCSS.MATH.CONTENT.7.G.B.4: Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</p> <p>CCSS.MATH.CONTENT.7.G.B.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</p>	
Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
<ul style="list-style-type: none"> Design solution Area Surface area Base 	<ul style="list-style-type: none"> What is a design solution? How do we determine the area of the base of a geometric figure? How do we determine the surface area of a geometric figure? 	<ul style="list-style-type: none"> Discussion Questions: Participation Design Requirement Student Sheet: Formative Geometric Formulas Student Sheet: Formative

Section 2 – Testing the Game Pieces (100 minutes)

For students to test the game pieces, they will need to calculate the area, surface area, and volume of each of the pieces. To do so, they must accurately measure their pieces with the measuring tool that their group has been assigned. Each group will receive either a ruler, a measuring tape, or a set of calipers. In **Part 2.1**, using their assigned measuring tool, students will measure and record their measurements on **Game Piece Student Sheet # 1**. In **Part 2.2**, students understand that a testing procedure is a series of steps used to determine if their piece meets the design requirements. The steps must be conducted accurately and consistently for their data to be accurate. Groups are now given all three measuring devices and students can determine the best tool to use for each figure. In **Part 2.3**, students develop a detailed set of procedures to measure the height of each game piece using the calipers. In **Part 2.4**, using the tool that was decided to be the best, students will re-measure each geometric dimension needed for their calculations and record it on **Game Piece Student Sheet # 2**. They will then compute the area, surface area, and volume of each game piece.

Preparation

Materials	Student Pages
<ul style="list-style-type: none"> Sets of Game Pieces (1 set per group) Sets of Stickers (1 set per group) Measurement tools (differing among the groups) 	<ul style="list-style-type: none"> Game Piece Student Sheet # 1 Testing Procedure Student Sheet Game Piece Student Sheet # 2
Prep the Day Before: <ul style="list-style-type: none"> Review the section and challenge. Review class discussion questions. 	

Planning

GSE	<p>MGSE7.G.4: Given the formulas for the area and circumference of a circle, use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</p> <p>MGSE7.G.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</p>	
CCSS	<p>CCSS.MATH.CONTENT.7.G.B.4: Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</p> <p>CCSS.MATH.CONTENT.7.G.B.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</p>	
Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
<ul style="list-style-type: none"> Accurate Consistent 	<ul style="list-style-type: none"> How can we develop a testing procedure that will result in accurate and consistent data? 	<ul style="list-style-type: none"> Discussion Questions: Participation Game Piece Student Sheet # 1: Formative Testing Procedure Student Sheet: Formative Game Piece Student Sheet # 2: Formative

Section 3 –Testing the Design Requirements (100 minutes)

Now students have all the measurements and formulas needed to test whether their game pieces meet the design requirements. They can use both physical tests and mathematical computations to make their determinations. They will record all their data on their **Requirement Testing Student Sheet**. Students will also learn to use the stability inequality test. Pieces fail this stability test if the perimeter/circumference of the base of the figure is less than the height of the figure.

Preparation

Materials	Student Pages
<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Requirement Testing Student Sheet
Prep the Day Before: <ul style="list-style-type: none"> Review the section and challenge. Review class discussion questions. 	

Planning

GSE	<p><i>MGSE.7.G.4: Given the formulas for the area and circumference of a circle, use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</i></p> <p><i>MGSE.7.G.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</i></p>	
CCSS	<p><i>CCSS.MATH.CONTENT.7.G.B.4: Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</i></p> <p><i>CCSS.MATH.CONTENT.7.G.B.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</i></p>	
Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
<ul style="list-style-type: none"> Area Surface area Volume Stability inequality 	<ul style="list-style-type: none"> How do we determine the area and surface area of a geometric figure? How do we determine the volume of a geometric figure? How do we determine if a figure fails the stability inequality test? 	<ul style="list-style-type: none"> Discussion Questions: Participation Requirement Testing Student Sheet: Formative

Section 4 – Communicate Your Results (40 minutes)

Students will write a letter or make a presentation to share their design solution with the design team using the *Sharing Your Findings Student Sheet*. They will, not only present their solution, but also include statements about the tests that they performed and their results as compared to the pieces that were not selected. They should fully explain their recommendation and give justification using their data.

Preparation

Materials	Student Pages
<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Sharing Your Findings Student Sheet
Prep the Day Before: <ul style="list-style-type: none"> Review the section and challenge. 	

Planning

GSE	<p><i>MGSE7.G.4: Given the formulas for the area and circumference of a circle, use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</i></p> <p><i>MGSE7.G.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</i></p>	
CCSS	<p><i>CCSS.MATH.CONTENT.7.G.B.4: Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</i></p> <p><i>CCSS.MATH.CONTENT.7.G.B.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</i></p>	
Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
<ul style="list-style-type: none"> Design solution 	<ul style="list-style-type: none"> How can we determine and accurately justify design solutions? 	<ul style="list-style-type: none"> Class Discussion Question: Participation Sharing Your Findings Student Sheet: Summative

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

This curriculum is produced by Advanced Manufacturing & Prototyping Integrated to Unlock Potential (AMP-IT-UP) supported by National Science Foundation Award #1238089 through Georgia Institute of Technology's Center for Education Integrating Science, Mathematics, and Computing (CEISMC).

For more information about AMP-IT-UP
and to download our curriculum,
please visit our website at www.ampitup.gatech.edu.



Copyright © Georgia Institute of Technology All Rights Reserved 2017