

Advanced Manufacturing & Prototyping Integrated to Unlock Potential

7TH GRADE MATH

Experimental Design

IT'S GAME TIME!

Board Game Piece Challenge

Spring 2018

7EDM



Advanced Manufacturing & Prototyping Integrated to Unlock Potential

7th Grade Math Experimental Design (7EDM)

It's Game Time!

Board Game Piece Challenge

Module Description	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.					
Supported	MGSE7.G.4: Given the formulas for the area	a and circumference of a circle, use them to				
Georgia Standards of	solve problems; give an informal derivation	of the relationship between the				
Excellence	circumference and area of a circle.					
	MGSE7.G.6: Solve real-world and mathema	tical problems involving area, volume and				
	surface area of two- and three-dimensional	l objects composed of triangles,				
	quadrilaterals, polygons, cubes, and right p	risms.				
Module Timeline	50-minute class periods:	90 minute blocks:				
	6 days	3 days				
	Day 1: Section 1	Day 1: Sections 1 & 2				
	Day 2: Section 2	Day 2: Sections 2 & 3				
	Day 3: Section 2	Day 3: Sections 3 & 4				
	Day 4: Section 3					
	Day 5: Section 3					
	Day 6: Section 4					
Documents	Student Materials Folder					
Included in the Download	• Student Edition (recommended to be printed double sided)					
	• Student Worksheet Packet (recommended to be printed single sided)					
		Taaabar Matariala Faldar				
	Teacher Materials Folder					
	Teacher Materials Folder					
	 <u>Teacher Materials Folder</u> Materials List Annotated Teacher's Edition 					
	 <u>Teacher Materials Folder</u> Materials List Annotated Teacher's Edition Teacher's Preparation Guida 					
	 <u>Teacher Materials Folder</u> Materials List Annotated Teacher's Edition Teacher's Preparation Guide Video 					

5E Stage	Student Activities	Teacher Activities
	How will students engage actively in the three	How will the teacher facilitate and monitor student
	dimensions throughout the lesson?	learning throughout the lesson?
How does the lesson capture student	 Students are introduced to the challenge (determine the best design for a new game piece) 	 Guide students through text to check for understanding.
interest, activate prior knowledge, and	(1.1)	
connect to a complex question, global		
issue, or real-world problem?		
Explore	• Students will read from the test to familiarize	 Divide students into groups of 3- 4.
develop a common base of experiences	 Students are given the A-part sticker set and the 	 Facilitate a class discussion about the information required to make a good decision
by actively investigating the phenomenon	single sticker that make up the visibility	 Facilitate reading and monitor group
or problem?	requirement. (1.1)	discussions while students explore the
	Students analyze each design requirement	requirements.
	individually and answer questions on their Design	
Evolain	Requirement Student Sneet. (1.3)	Capilitate class discussion where groups share
How does the lesson allow students to	 Inrough a class discussion, groups will share some of their idea for each requirement. (1.3) 	 Facilitate class discussion where groups share their ideas for each requirement
develop, share, critique, and revise their	 Students will complete their Geometric Formulas 	 Allow time for student groups to discuss the
explanations before connecting to	Student Sheet needed to solve the challenge. (1.4)	geometric formulas needed to complete the
scientific explanations and terminology?		challenge.
Elaborate	• Students complete their Geometric Formulas	Conduct a lesson on the geometric formulas
How does the lesson allow students to	Student Sheet needed to solve the challenge. (1.4)	needed to complete the challenge.
the three dimensions through	 Based on requirement testing results, student measure and record the required measurements 	 Monitor groups as the measure with their assigned measuring tools. Check for accuracy
opportunities to apply knowledge, skills,	needed to calculate area, surface area, and volume	 Facilitate a class discussion where students
and abilities in new experiences?	of game pieces on Game Piece Data Student Sheet	discuss their group's measuring tool.
	# 1 . (2.1)	• Have groups share their testing procedures.
	 Students discuss whether the measuring tool that the in groups in this the sector of durated difficult to 	Monitor groups as they work through their
	their group was initially assigned was difficult to	calculations. Check for accuracy.
	geometric figures. (2.1)	Monitor groups as they work through their Requirement Testing Student Sheet
	• Students develop a testing procedure. (2,2, 2.3)	 Ensure students provide a written explanation
	• Students accurately measure the figures and	including statements about the tests that they
	calculate the area, surface area, and volume. (2.4)	performed to determine their design solution.
	Students perform both physical tests and use	
	mathematical computations to determine if their game pieces meet the requirements (3)	
	 Students provide a written explanation including 	
	statements about the tests that they performed to	
	determine their design solution. (4)	
Evaluate	Formative:	
How does the lesson—through both	 Ongoing questioning and discussion (all sections) Design Requirement Student Short (1.2) 	
throughout the lesson and a summative	 Design Requirement Student Sheet (1.3) Geometric Formulas Student Sheet (1.4) 	
assessment that might coincide with the	 Game Piece Student Sheet # 1/2.1) 	
elaborate phase—make visible students'	• Testing Procedure Student Sheet (2.2, 2.3)	
thinking and their ability to use practices	• Game Piece Student Sheet # 2 (2.4)	
with core ideas and crosscutting concepts	• Requirement Testing Student Sheet (3)	
to make sense of phenomena and/or to design solutions?	Summative:	
นธราธาา รังในเป็นระ	 Sharing Your Findings Student Sheet (4) 	

	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	4.1
Engage										
Explore										
Explain										
Elaborate										
Evaluate										

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
• Video: 3D Game Piece	 Design Requirement Student Sheet
	Geometric Formulas Student Sheet
Prep the Day Before:	
• Review the section and challenge.	

- Review video.
- Review class discussion questions.

GSE	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. 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.				
CCSS	CCSS 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. 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.				
Key Terms and Concepts Essential Questions Assessment and Grading Opportunities Opportunities					
Кеу Те	rms and Concepts	Essential Questions	Assessment and Grading Opportunities		

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 much 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**, student 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 need 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
• Sets of Game Pieces (1 set per group)	Game Piece Student Sheet # 1
• Sets of Stickers (1 set per group)	 Testing Procedure Student Sheet
 Measurement tools (differing among the groups) 	Game Piece Student Sheet # 2
Prep the Day Before:	
• Review the section and challenge.	
Review class discussion questions.	

GSE	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. 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.				
CCSS	 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. 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. 				
Key Terms and Concepts Essential Questions As			Assessment and Grading Opportunities		
AccurateConsistent		• How can we develop a testing procedure that will result in accurate and consistent data?	 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 that the height of the figure.

Preparation

Materials	Student Pages
• N/A	Requirement Testing Student Sheet
Prep the Day Before:	
 Review the section and challenge. 	
Review class discussion questions	

GSE	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. 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.				
CCSS	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. 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.				
Key Terms and Concepts Essential Ouestions Assessment and Grading					
Key Terms and C	Concepts	Essential Questions	Assessment and Grading		

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
• N/A	 Sharing Your Findings Student Sheet
Prep the Day Before:	
 Review the section and challenge. 	

GSE	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. 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.				
CCSS	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. 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.				
Key Terms and Concepts		Essential Questions	Assessment and Grading Opportunities		
• Design solution		 How can we determine and accurately justify design solutions? 	 Class Discussion Question: Participation Sharing Your Findings Student Sheet: Summative 		

Georgia L 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