7th Grade Math Processes (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 Georgia Standards of Excellence	*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.*

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 Included in the Download	<u>Student Materials Folder</u> • Student Edition *(recommended to be printed double sided)* • Student Worksheet Packet *(recommended to be printed single sided)* <u>Teacher Materials Folder</u> • Materials List • Annotated Teacher's Edition • Teacher's Preparation Guide • Video

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

Planning

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 • Area • Surface area • Base	• 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?	• 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 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) - Sets of Stickers (1 set per group) - Measurement tools (differing among the groups)	- Game Piece Student Sheet # 1 - Testing Procedure Student Sheet - Game Piece Student Sheet # 2
Prep the Day Before: - Review the section and challenge. - Review class discussion questions.	

Planning

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
- Accurate - Consistent	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.

Planning

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
• Area • Surface area • Volume • Stability inequality	• 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?	• 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
• N/A	• Sharing Your Findings Student Sheet
Prep the Day Before:	
• Review the section and challenge.	

Planning

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**