Standard #: MAFS.912.G-MG.1.3

This document was generated on CPALMS - www.cpalms.org

Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios). ★

Grade: 912

Cluster: Apply geometric concepts in modeling situations. (Geometry - Major Cluster) -
Clusters should not be sorted from Major to Supporting and then taught in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

Date Adopted or Revised: 02/14

Content Complexity Rating: Level 3: Strategic Thinking & Complex Reasoning - More Information

Date of Last Rating: 02/14

Status: State Board Approved

Assessed: Yes

TEST ITEM SPECIFICATIONS

Item Type(s): This benchmark may be assessed using: EE item(s)

N/A
Assessment Limits :
Items may require the student to use knowledge of other Geometry standards.

Items that use volume should not also assess G-GMD.1.3 or GMG.1.1.

Calculator :
Neutral

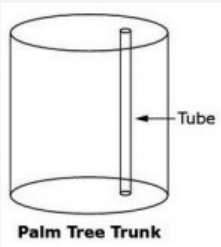
Clarification :
Students will apply geometric methods to solve design problems.
Stimulus Attributes :
Items must be set in a real-world context.
Response Attributes :
Items may require the student to interpret the results of a solution within the context of the modeling situation.

Items may require the student to apply the basic modeling cycle.

Items may require the student to use or choose the correct unit of measure

SAMPLE TEST ITEMS (1)

Test Item #: Sample Item 1
Question:
The trunk of a palm tree has cylindrical tubes that carry water. Each tube is 0.0003 meters wide. One of the tubes in a palm tree trunk is shown.



A. Using the diagram as a model, approximately how many tubes could fit in a palm tree trunk with a diameter of 0.5 meters?

B. The tubes in a palm tree are between 20 to 21 meters long. What is the approximate volume, in cubic meters, of one tube?

Difficulty: N/A
Type: EE: Equation Editor

Related Courses

Course Number	Course Title
1200400:	Intensive Mathematics (Specifically in versions: 2014 - 2015, 2015 and beyond (current))
1206300:	Informal Geometry (Specifically in versions: 2014 - 2015, 2015 and beyond (current))
1206310:	Geometry (Specifically in versions: 2014 - 2015, 2015 and beyond (current))
1206320:	Geometry Honors (Specifically in versions: 2014 - 2015, 2015 and beyond (current))
7912060:	Access Informal Geometry (Specifically in versions: 2014 - 2015 (course terminated))
7912070:	Access Liberal Arts Mathematics (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 - 2019, 2019 and beyond (current))
1206315:	Geometry for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 and beyond (current))
1207300:	Liberal Arts Mathematics 1 (Specifically in versions: 2014 - 2015, 2015 and beyond (current))
7912065:	Access Geometry (Specifically in versions: 2015 and beyond (current))

Related Access Points

Access Point

Access Points Number	Access Points Title
MAFS.912.G-MG.1.AP.3a:	Apply the formula of geometric figures to solve design problems (e.g., designing an object or structure to satisfy physical restraints or minimize cost).

Related Resources

Model Eliciting Activity (MEA) STEM Lesson

Name	Description
3D MEA: Carrying Cargo Challenge:	Students will be engaged in a hands-on activity to test the efficiency of various cargo boat designs. In testing, students will collect data using 3D-printed boat models and determine which design is superior in terms of total cargo mass. Students will explore scientific approaches, engineering design, and mathematical applications, namely developing a procedure to select a boat while meeting several constraints. In part 2 of the activity, students will have the opportunity to design their own boat prototype.

Lesson Plan

Name	Description
Building Graduation Caps:	In this lesson students will apply skills from the Geometry Domain to build graduation caps for themselves using heavyweight poster paper. They will also apply some basic mathematical skills to determine dimensions and to determine minimum cost. Some of the Geometric skills reinforced in *Building Graduation Caps: Cooperative Assignment* are finding area, applying the concept of similarity, and the application of the properties of parallelograms. Other skills also involved in this application are measuring, and statistical calculations, such as finding the mean and the range. In addition to the hands-on group project that takes place during the lesson, there is the *Prerequisite Skills Assessment: Area* that should be administered before the group activity and a home-learning activity. *Building Graduation Caps: Individual Assignment* is the home-learning assignment; it is designed to reinforced the skills learned in the group activity.
Concurrent Points Are Optimal:	Students will begin with a review of methods of construction of perpendicular bisectors and angle bisectors for the sides of triangles. Included in the review will be a careful discussion of the proofs that the constructions actually produce the lines that were intended. Next, students will investigate why the perpendicular bisectors and angle bisector are concurrent, that is, all three meet at a single meet. A more modern point of currency is the Fermat-Torricelli point (F-T). The students will construct (F-T) in GeoGebra and investigate limitations of its existence for various types of triangles. Then a set of scenarios will be provided, including some one-dimensional and two-dimensional situations. Students will use GeoGebra to develop conjectures regarding whether a point of concurrency provides the solution for the indicated situation, and which one. A physical model for the F-T will be indicated. The teacher may demonstrate this model but that requires three strings, three weights, and a base that has holes. A recommended base is a piece of pegboard (perhaps 2 feet by 3 feet), the weights could be fishing weights of about 3 oz., the string could be fishing line; placing flexible pieces of drinking straws in the holes will improve the performance. The combination of geometry theorems, dynamic geometry software, a variety of contexts, and a physical analog can provide a rich experience for students.

Interchangeable Wristwatch Band:	Students use measures and properties of rectangular prisms and cylinders to model and rank 3D printable designs of interchangeable wristwatch bands that satisfy physical constraints.
Modeling: Rolling Cups:	This lesson unit is intended to help you assess how well students are able to choose appropriate mathematics to solve a non-routine problem, generate useful data by systematically controlling variables and develop experimental and analytical models of a physical situation.
NASA Space Shuttle Mission Patches:	Students apply geometric measures and methods, art knowledge, contextual information, and utilize clear and coherent writing to analyze NASA space shuttle mission patches from both a mathematical design and visual arts perspective.
Olympic Snowboard Design:	This MEA requires students to design a custom snowboard for five Olympic athletes, taking into consideration how their height and weight affect the design elements of a snowboard. There are several factors that go into the design of a snowboard, and the students must use reasoning skills to determine which factors are more important and why, as well as what factors to eliminate or add based on the athlete's style and preferences. After the students have designed a board for each athlete, they will report their procedure and reasons for their decisions.
Poly Wants a Bridge!:	"Poly Wants a Bridge" is a model-eliciting activity that allows students to assist the city of Polygon City with selecting the most appropriate bridge to build. Teams of students are required to analyze properties of bridges, such as physical composition and span length in order to solve the problem.
Solving Quadratic Equations: Cutting Corners:	This lesson unit is intended to help you assess how well students are able to solve quadratics in one variable. In particular, the lesson will help you identify and help students who have the following difficulties; making sense of a real life situation and deciding on the math to apply to the problem, solving quadratic equations by taking square roots, completing the square, using the quadratic formula, and factoring, and interpreting results in the context of a real life situation.
The Grass is Always Greener:	The lesson introduces area of sectors of circles then uses the areas of circles and sectors to approximate area of 2-D figures. The lesson culminates in using the area of circles and sectors of circles as spray patterns in the design of a sprinkler system between a house and the perimeter of the yard (2-D figure).
The Seven Circles Water Fountain :	This lesson provides an opportunity for students to apply concepts related to circles, angles, area, and circumference to a design situation.
Turning Tires Model Eliciting Activity:	The Turning Tires MEA provides students with an engineering problem in which they must work as a team to design a procedure to select the best tire material for certain situations. The main focus of the MEA is applying geometric concepts through modeling.

3D Modeling

Name	Description
Carrying Cargo - 3D Boat Design and Modeling:	This MyStemKits.com model-eliciting activity (MEA) will help students tackle real-world problems as they balance constraints with finding the optimal design, all while overcoming unforeseen circumstances that may change the procedure students use to determine the best solution. In the end, students are challenged to design and test their own boats, using Tinkercad to model a 3D-printable boat.

Problem-Solving Task

Name	Description
Coins in a circular pattern:	Using a chart of diameters of different denominations of coins, students are asked to figure out how many coins fit around a central coin.
Ice Cream Cone:	In this task, students will provide a sketch of a paper ice cream cone wrapper, use the sketch to develop a formula for the surface area of the wrapper, and estimate the maximum number of wrappers that could be cut from a rectangular piece of paper.
Paper Clip:	In this task, a typographic grid system serves as the background for a standard paper clip. A metric measurement scale is drawn across the bottom of the grid and the paper clip extends in both directions slightly beyond the grid. Students are given the approximate length of the paper clip and determine the number of like paper clips made from a given length of wire.

Perspectives Video: Professional/Enthusiast

Name	Description
Design Process for a Science Museum Exhibit:	Go behind the scenes and learn about science museum exhibits, design constraints, and engineering workflow! Produced with funding from the Florida Division of Cultural Affairs.
Geometry and Surveying :	A surveyor describes the the surveying profession and the mathematical background needed to be successful.
Mathematically Optimizing 3D Printing:	Did you know that altering computer code can increase 3D printing efficiency? Check it out!
NASA Space Flight Hardware Geometry:	If you want to take things to space, you have to have a place to put them. Just make sure they fit before you send them up.
Scale and Proportion for Bird Photography:	Mathematics plays a role in what we perceive as beautiful! Learn more about it while you learn about bird photography! Produced with funding from the Florida Division of Cultural Affairs.
Using Geometry and Computers to make Art with CNC Machining:	See and see far into the future of arts and manufacturing as a technician explains computer numerically controlled (CNC) machining bit by bit.

Formative Assessment

Name	Description
Land for the Twins:	Students are asked to solve a design problem in which a triangular tract of land is to be partitioned into two regions of equal area.
Softball Complex:	Students are asked to solve a design problem in which a softball complex is to be located on a given tract of land subject to a set of specifications.
The Duplex:	Students are asked to solve a design problem in which the length of wall used in a rectangular floor plan is minimized.
The Sprinters' Race:	Students are given a grid with three points (vertices of a right triangle) representing the starting locations of three sprinters in a race and are asked to determine the center of the finish circle, which is equidistant from each sprinter.

Video/Audio/Animation

Name	Description
MIT BLOSSOMS - Using Geometry to Design Simple Machines:	This video is meant to be a fun, hands-on session that gets students to think hard about how machines work. It teaches them the connection between the geometry that they study and the kinematics that engineers use -- explaining that kinematics is simply geometry in motion.

Assessment

Name	Description
Sample 2 - High School Geometry State Interim Assessment:	This is a State Interim Assessment for 9th-12th grade.
Sample 4 - High School Geometry State Interim Assessment:	This is a State Interim Assessment for 9th-12th grades.

Perspectives Video: Expert

Name	Description
The Geometry of DNA Replication:	A discussion of the applications of Knot Theory, replication of DNA, enzymes, and fluid dynamics.

Student Resources

Name	Description
Coins in a circular pattern:	Using a chart of diameters of different denominations of coins, students are asked to figure out how many coins fit around a central coin.
Ice Cream Cone:	In this task, students will provide a sketch of a paper ice cream cone wrapper, use the sketch to develop a formula for the surface area of the wrapper, and estimate the maximum number of wrappers that could be cut from a rectangular piece of paper.
Paper Clip:	In this task, a typographic grid system serves as the background for a standard paper clip. A metric measurement scale is drawn across the bottom of the grid and the paper clip extends in both directions slightly beyond the grid. Students are given the approximate length of the paper clip and determine the number of like paper clips made from a given length of wire.
Using Geometry and Computers to make Art with CNC Machining:	See and see far into the future of arts and manufacturing as a technician explains computer numerically controlled (CNC) machining bit by bit.

Parent Resources

Name	Description
Coins in a circular pattern:	Using a chart of diameters of different denominations of coins, students are asked to figure out how many coins fit around a central coin.
Ice Cream Cone:	In this task, students will provide a sketch of a paper ice cream cone wrapper, use the sketch to develop a formula for the surface area of the wrapper, and estimate the maximum number of wrappers that could be cut from a rectangular piece of paper.
Paper Clip:	In this task, a typographic grid system serves as the background for a standard paper clip. A metric measurement scale is drawn across the bottom of the grid and the paper clip extends in both directions slightly beyond the grid. Students are given the approximate length of the paper clip and determine the number of like paper clips made from a given length of wire.
Using Geometry and Computers to make Art with CNC Machining:	See and see far into the future of arts and manufacturing as a technician explains computer numerically controlled (CNC) machining bit by bit.