Area

v3.0

Applied Mathematics | Curriculum Packet

Overview:

In this lesson, students will learn how to determine the area of square, rectangular, and circular three-dimensional objects. Then, students will work in teams to build a custom structure and determine its area.

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Learning Objectives & NGSS Alignment:

- Define area.
- Determine the area of square, rectangular, and circular three-dimensional objects.
- Build a custom structure and then determine its area.

Scientific/Engineering Practice - Using mathematics
Crosscutting Concept - Scale, proportion, and quantity

Activity Time:
120 Minutes

Targeted Grade Level:
3 - 5

Student Grouping:
Teams of 2

Additional Lesson Materials:
- Teacher Lesson Plan
- Student Engineering Workbook

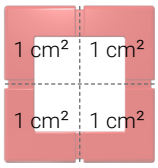
Kid Spark STEM Lab:
STEM Pathways

Note: *Two teams can share the engineering materials from one lab.*

Convergent Learning Activity:

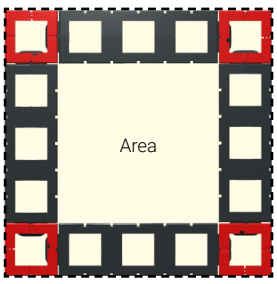
1. **What is Area?**

Area is the amount of two-dimensional space taken up by an object. Area is measured in square units of a fixed size, such as square inches (in²) or square centimeters (cm²). For this lesson, we will be using square centimeters (cm²) to determine the area of a square, rectangle, and circle. Each block represents an area of 4 cm².



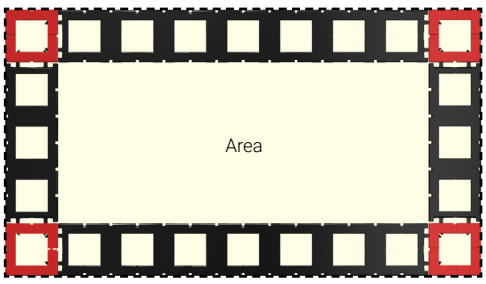
= **4 cm²**

Instructions: Assemble a square, rectangle, and circle as shown below.




4x
Half Beams

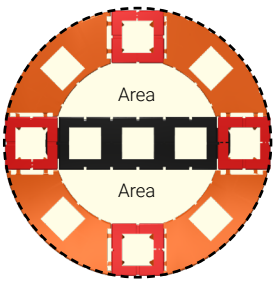

4x
Blocks




2x
Beams


2x
Half Beams


4x
Blocks




4x
Mini Curved
Beams


1x
Half Beam


4x
Blocks

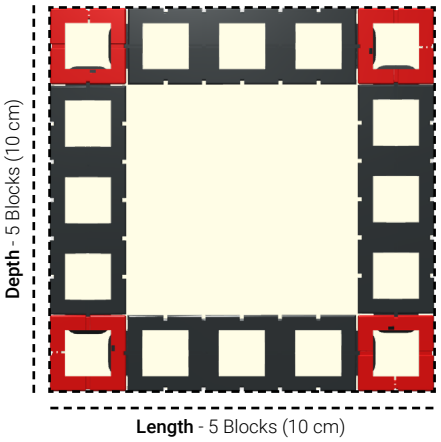
2. Determine the area of a square, rectangle, and circle.

Square

To determine the area of a square, multiply the length by the depth. This will determine the area in square centimeters (cm²).

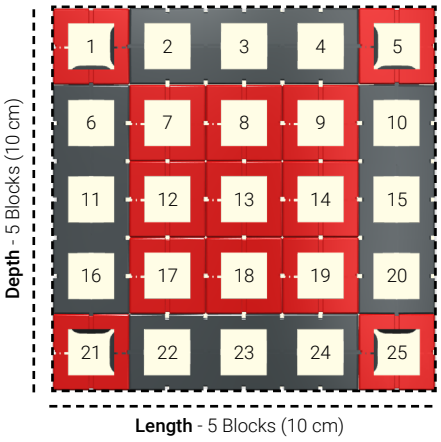
Part A - Determine the area

The square has a length of 10 cm (5 blocks) and a depth of 10 cm (5 blocks). Multiply 10 cm x 10 cm to get **a total area of 100 cm².**



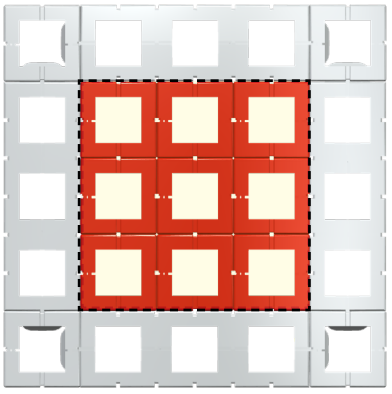
Part B - Check your math

Instructions: Fill the interior of the square with extra red blocks as shown. Count the number of blocks that make up the entire square object. In this example, there should be a total of 25 block units (5 x 5 = 25). Since each block unit represents 4 square centimeters, multiply 25 x 4 to get a **total area of 100 cm².**



Part C - Determine the area

Instructions: Work with your team to determine the area of the interior square represented by the extra red blocks that were used in Part B.

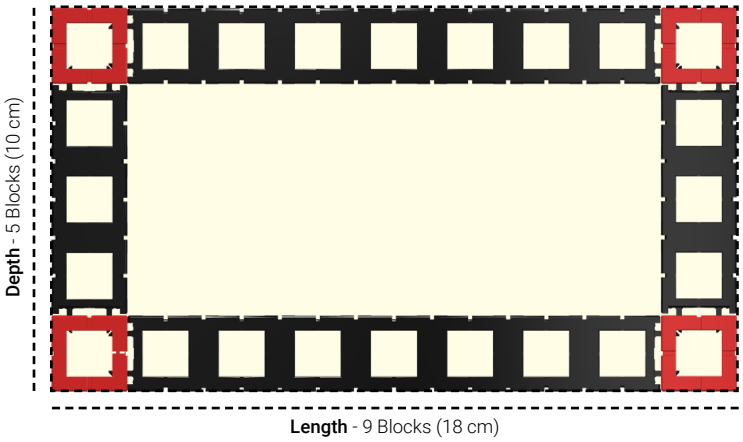


Rectangle

To determine the area of a rectangle, multiply the length by the depth in centimeters. This will determine the area in square centimeters (cm²).

Part A - Determine the area

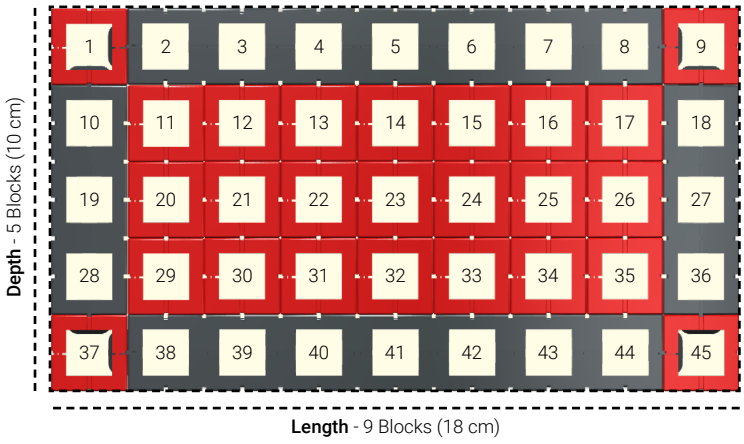
The rectangle has a length of 18 cm (9 blocks) and a depth of 10 cm (5 blocks). Multiply 18 cm x 10 cm to get **a total area of 180 cm².**



Part B - Check your math

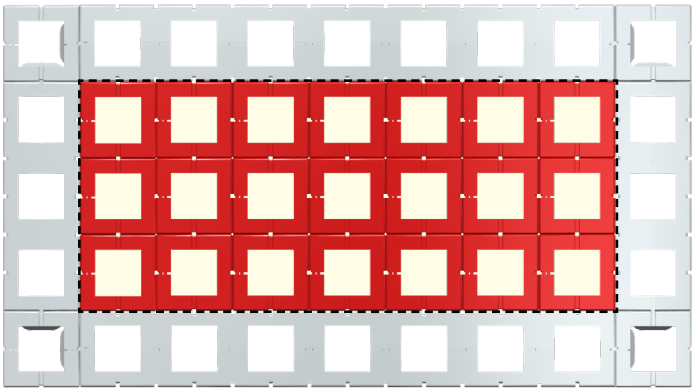
Instructions: Fill the interior of the rectangle with extra red blocks as shown. Count the number of blocks that make up the entire rectangular object. In this example, there should be a total of 45 block units (9 x 5 = 45). Since each block unit represents 4 square centimeters, multiply 45 x 4 to get **a total area of 180 cm².**

Note: *For this step, you may have to share extra red blocks with the other team that is using the same lab.*



Part C - Determine the area

Instructions: Work with your team to determine the area of the interior rectangle represented by the extra red blocks that were used in Part B.



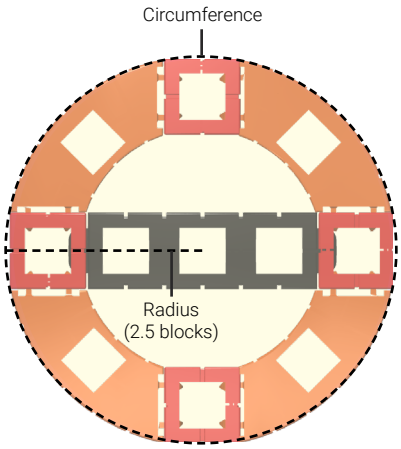
Circle

The area of a circle is the space inside the circle's circumference. To determine the area of a circle, the following formula can be used:

Area = $\pi \times r^2$ ($\pi = 3.14$, r = radius)

Part A - Determine the area

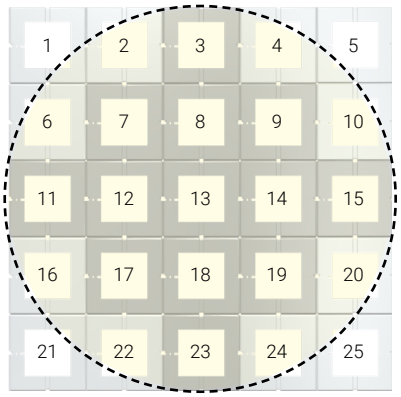
The circle has a radius of 5 cm (2.5 blocks). Multiply 3.14 x (5 x 5) to get **a total area of 78.5 cm².**



Part B - Check your math

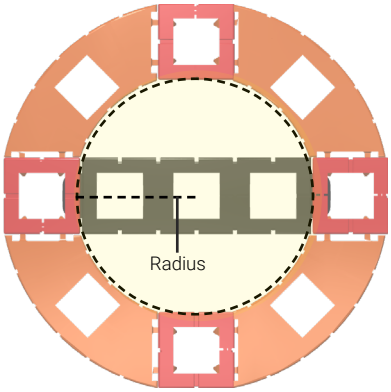
Even though we can't physically fill the entire circle with extra blocks, we can still try to visualize how many blocks are used to completely fill the circle.

In the illustration to the right, a total of 25 blocks are used to fill the circle. Of the 25 blocks, 13 are full blocks, while the additional 12 are only partial blocks. If you were to try and combine the 12 partial blocks to make full blocks, you would end up with approximately 7 more full blocks. This would bring the total to approximately 20 full blocks needed to fill the circle. Since each block represents 4 square centimeters, multiply 20 x 4 to get **a total area of 80 cm².** This is very close to the total area of 78.5 cm² that was determined in Part A.

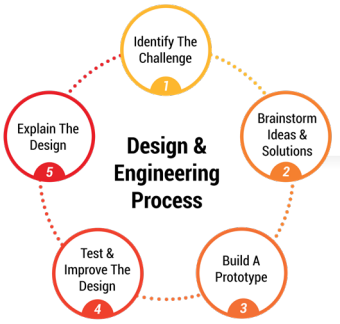


Part C - Determine the area

Instructions: Work with your team to determine the area of the interior circle represented in the illustration to the right.



Divergent Learning Activity:



Scenario:

A local business is looking to install a new building to store their maintenance vehicle and miscellaneous work equipment. The business is currently trying to determine an appropriate floor plan for the new storage building.

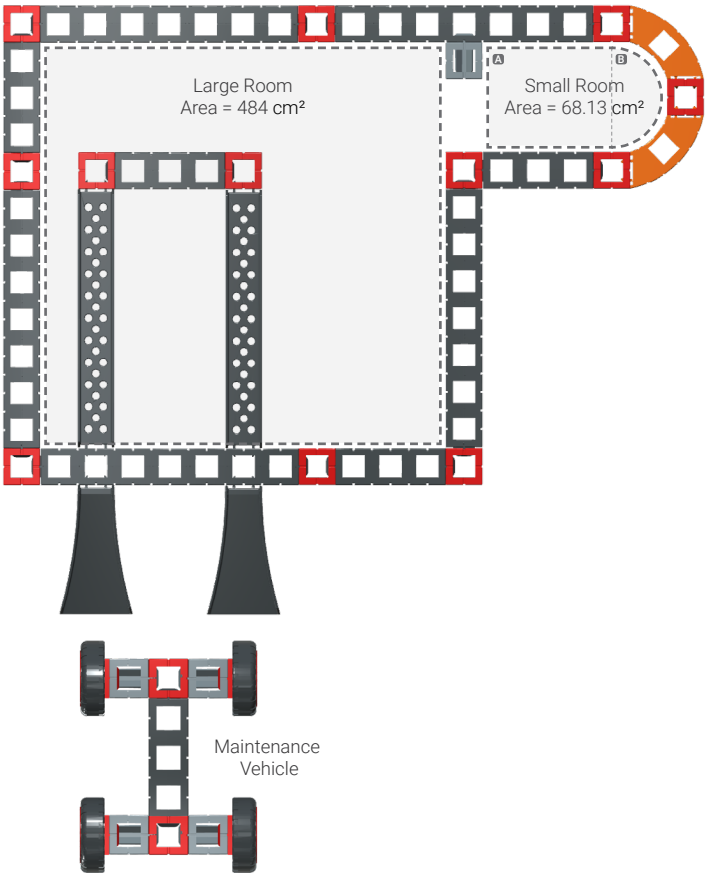
Design & Engineering Challenge:

Design and engineer a simple, single-layer floor plan for a storage building. (See example below)

Specifications/Criteria:

1. Teams can work in teams of two to complete this challenge. Teams should record their progress in their Student Engineering Workbooks.
2. Teams must work through each step of the Design & Engineering Process to design, prototype, and refine a custom floor plan for a storage building. Teams will present their designs to the class when they are finished.
3. The storage building should include two rooms: 1 large room capable of storing a maintenance vehicle, and 1 small room to store miscellaneous work equipment. The large room should not exceed 900 cm². The small room should not exceed 200 cm².
4. Teams must determine the interior area of each room in the storage building.

Example Solution:



Large Room

The large room in this example is a square.

Square
Length - 22 cm
Depth - 22 cm
22 cm x 22 cm = **484 cm²**

Total area of large room: 484 cm²

Small Room

To easily calculate the area of the small room, split the irregular shape into a rectangle and semi-circle. Calculate the area for each and then add the sums to determine the total area for the room. *Note - To determine the area for a semi-circle, simply determine the area for a full circle first, then divide by two.*

Rectangle (A)
Length - 9 cm
Depth - 6 cm
9 cm x 6 cm = **54 cm²**

Semi-Circle (B)
Radius - 3 cm
3.14 x (3 cm x 3 cm) = 28.26 cm²
28.26 cm² / 2 = **14.13 cm²**

Total area of small room:
54 cm² + 14.13 cm² = **68.13 cm²**

Challenge Evaluation

When teams have completed the Design & Engineering Challenge, it should be presented to the teacher and classmates for evaluation. Teams will be graded on the following criteria:

- **Specifications:** Does the design meet all specifications as stated in the design brief?
- **Team Collaboration:** How well did the team work together? Can each student describe how they contributed?
- **Design Quality/Aesthetics:** Is the design of high quality? Is it structurally strong, attractive, and well-proportioned?
- **Presentation:** How well did the team communicate all aspects of the design to others?

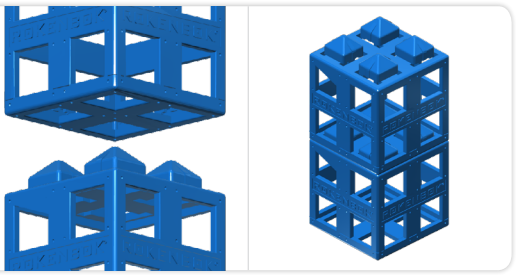
Grading Rubric	Advanced 5 Points	Proficient 4 Points	Partially Proficient 3 Points	Not Proficient 0 Points
Specifications	☐ Meets all specifications	☐ Meets most specifications	☐ Meets some specifications	☐ Does not meet specifications
Team Collaboration	☐ Every member of team contributed	☐ Most members of team contributed	☐ Some members of team contributed	☐ Team did not work together
Design Quality/ Aesthetics	☐ Great design/ aesthetics	☐ Good design/ aesthetics	☐ Average design/ aesthetics	☐ Poor design/ aesthetics
Presentation	☐ Great presentation/ well-explained	☐ Good presentation/ well-explained	☐ Poor presentation/ explanation	☐ No presentation/ explanation
Points	……	……	……	……
Total Points				…… /20

Building Basics

The following tips will be helpful when using Kid Spark engineering materials.

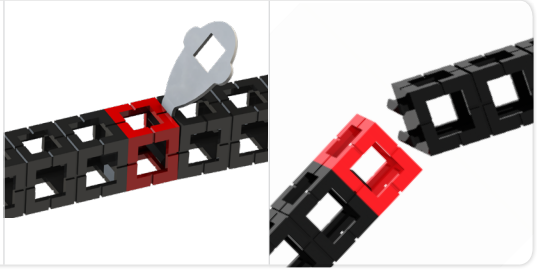
Connecting/Separating ROK Blocks:

ROK Blocks use a friction-fit, pyramid and opening system to connect. Simply press pyramids into openings to connect. To separate blocks, pull apart.



Connecting/Disconnect Smaller Engineering Materials:

Smaller engineering materials use a tab and opening system to connect. Angle one tab into the opening, and then snap into place. To disconnect, insert key into the engineered slot and twist.

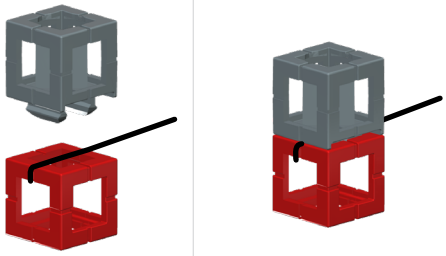


Snapping Across Openings:

Materials can be snapped directly into openings or across openings to provide structural support to a design. This will also allow certain designs to function correctly.

Attaching String:

In some instances, string may be needed in a design. Lay string across the opening and snap any component with tabs or pyramids into that opening. Be sure that the tabs are perpendicular to the string to create a tight fit.



Measuring:

The outside dimensions of a basic connector block are 2 cm on each edge. This means the length, depth, and height are each 2 cm. To determine the size of a project or build in centimeters, simply count the number of openings and multiply by two. Repeat this process for length, depth, and height.