

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

Pre-Lesson Preparation:

1. Prepare enough lesson materials for each team. (Curriculum Packets, Student Engineering Workbooks)
2. Using Kid Spark engineering materials, assemble a square, rectangle, and circle. *Curriculum Packet - Page 1*
3. Make sure to review how to determine the area of a square, rectangle, and circle. *Curriculum Packet - Pages 1 - 4*
4. Prepare an example solution for the design and engineering challenge. *Curriculum Packet - Page 5*

Convergent Learning Activity:

1. Introduce students to the concept of area. *Note: Students should fill out lesson information in their Student Engineering Workbooks as they work through the lesson.*

Area is the amount of two-dimensional space taken up by an object. Pick up an object and place it on a table. Discuss how the amount of two-dimensional space (length and depth) the object takes up is referred to as its area.

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. Have each student pick up a block and explore how each block represents an area of 4 cm². *Curriculum Packet - Page 1*

Activity Time:

120 Minutes

Note: This lesson can easily be taught over the course of two class periods.

Period 1 - Convergent Learning Activity

Period 2 - Divergent Learning Activity

Targeted Grade Level:

3 - 5

Student Grouping:

Teams of 2

Additional Lesson Materials:

- Curriculum Packet
- Student Engineering Workbook

Kid Spark STEM Lab:

STEM Pathways

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

2. Instruct each team to assemble a square, rectangle, and circle using the engineering materials in the lab. *Curriculum Packet - Page 1*
3. Work with students to determine the area of the square, rectangle, and circle. *Curriculum Packet - Pages 2 - 4*

Note: Work with students to determine the total area of each object, then challenge teams to determine the inner area of each object and record their answers in the Student Engineering Workbook.

Divergent Learning Activity:

1. Review the Design & Engineering Challenge with teams. *Curriculum Packet - Page 5*
2. *Instruct teams to use the Kid Spark Design & Engineering Process to develop a solution to the challenge. Curriculum Packet - Page 5, Student Engineering Workbook - Page 2*

Challenge tips & information:

- *Two teams will share the engineering materials from one Kid Spark STEM Lab.*
- *House floor plans should only be a single layer in height.*
- *Consider asking students to sketch out their designs on paper before trying to build them.*
- *If teams get done early, challenge them to determine the overall area of the structure (exterior measurements).*
- *Set a time limit on how long students have to complete their design.*
- *In some instances, you may want to limit the number of engineering materials students have access to out of the STEM Lab. (Example: Instruct students to pull out X number of engineering materials before the start of the lesson.)*

Lesson Closure:

1. Project presentations - Instruct each team to share the design they created with the rest of the class. Be specific with what information you want students to share. (Example: Teams are required to share how each member contributed, the area of the large and small rooms, etc.)
2. Lab cleanup - After teams have finished their presentations, instruct them to disassemble their designs and pack all engineering materials back into the labs correctly.
3. Lesson reflection - If time permits, do a quick recap/review of the lesson.

Assessment/Evaluation:

- A. Student Engineering Workbook (10 Points)
- B. Design & Engineering Challenge (20 Points)

Team Members:

1. _____ 2. _____

Total Points

Workbook: /10 pts

Challenge: /20 pts

What is Area?

Fill in the blanks in the statement below.

1. **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).

Assemble a Square, Rectangle, and Circle

Place a check in each box as each step is completed.

2. Assemble a **square** using Kid Spark engineering materials.
3. Assemble a **rectangle** using Kid Spark engineering materials.
4. Assemble a **circle** using Kid Spark engineering materials.

Determine the area of Squares, Rectangles, and Circles

Fill out the correct information in the spaces provided.

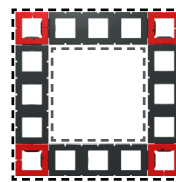
 5. **Area** of entire **square**: **100** cm²

 6. **Area** of interior **square**: **36** cm²

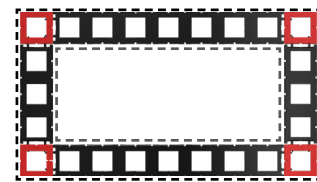
 7. **Area** of entire **rectangle**: **180** cm²

 8. **Area** of interior **rectangle**: **84** cm²

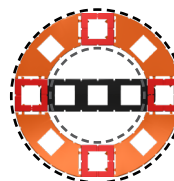
 9. **Area** of entire **circle**: **78.5** cm²

 10. **Area** of interior **circle**: **28.26** cm²


Square



Rectangle



Circle

Design & Engineering Challenge

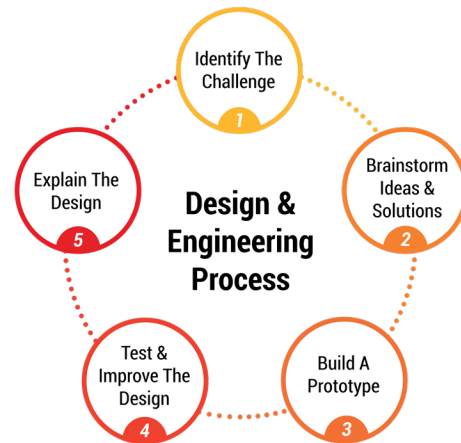
Follow each step in the Design & Engineering Process to develop a solution to the challenge. Place a check in each box as each step is completed. Fill in the blanks when necessary.

1. Identify The Challenge

Challenge: Design and engineer a simple, single-layer floor plan for a storage building.

2. Brainstorm Ideas & Solutions

- Discuss design ideas.
- Consider building components.
- Sketch out design ideas on paper.
- Choose the best design.



3. Build A Prototype

Use Kid Spark engineering materials to build a prototype.

4. Test & Improve The Design

- Look for opportunities to improve the design. (Is it practical, proportional, etc..)
- Review challenge specifications/criteria and grading rubric.

5. Explain The Design

- Determine the specifications of the design that was created. *Student Engineering Workbook - Page 3*
- Discuss the following items with your team and be prepared to share with the rest of the class.

- a. How did the team arrive at the final design solution? Discuss how each step in the Design & Engineering Process was used to develop the design.
- b. Is the design realistic and well-proportioned? Is the large room big enough to store a maintenance vehicle? Is there enough room to walk around the vehicle when it's inside the building?
- c. How did each team member contribute towards the overall design? Do you feel like everyone had an equal opportunity to contribute in the creative process?
- d. Is the team prepared to share detailed specifications of the design to others?

Design Specifications

Use the space provided to determine the area of the large and small rooms in the storage building.

Large Room





Total area of large room: Total cm²

Small Room

Total area of small room: Total 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	<input type="checkbox"/> Meets all specifications	<input type="checkbox"/> Meets most specifications	<input type="checkbox"/> Meets some specifications	<input type="checkbox"/> Does not meet specifications
Team Collaboration	<input type="checkbox"/> Every member of team contributed	<input type="checkbox"/> Most members of team contributed	<input type="checkbox"/> Some members of team contributed	<input type="checkbox"/> Team did not work together
Design Quality/ Aesthetics	<input type="checkbox"/> Great design/ aesthetics	<input type="checkbox"/> Good design/ aesthetics	<input type="checkbox"/> Average design/ aesthetics	<input type="checkbox"/> Poor design/ aesthetics
Presentation	<input type="checkbox"/> Great presentation/ well-explained	<input type="checkbox"/> Good presentation/ well-explained	<input type="checkbox"/> Poor presentation/ explanation	<input type="checkbox"/> No presentation/ explanation
Points	<u> Column Total </u>	<u> Column Total </u>	<u> Column Total </u>	<u> Column Total </u>
Total Points				<u> Total Points </u> /20