Volume

v3.0

Applied Mathematics | Teacher Lesson Plan

Overview:

In this lesson, students will learn how to determine the volume of rectangular prisms and cylinders. Then, students will work in teams to build a custom structure and determine its volume.

Click here **to explore the entire Kid Spark Curriculum Library.**

Learning Objectives & NGSS Alignment:

- Define volume.
- Determine the volume of rectangular prisms and cylinders.
- Build a custom structure and then determine its volume.

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 rectangular prism and a cylinder. *Curriculum Packet - Page 1*
3. Make sure to review how to determine the volume of rectangular prisms and cylinders. *Curriculum Packet - Pages 1 - 4*
4. Prepare an example solution for the Design & Engineering Challenge. *Curriculum Packet - Page 5*

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.*

Convergent Learning Activity:

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

Volume is the amount of three-dimensionsal space an object occupies. Pick up an object and place it on a table. Discuss how the amount of three-dimensional space (length, depth, and height) an object occupies is referred to as its volume.

Volume is measured in cubic units of a fixed size, such as cubic inches (in^3) or cubic centimeters (cm^3). For this lesson, we will be using cubic centimeters (cm^3) to determine the volume of rectangular prisms and cylinders. Each block represents a volume of 8 cubic centimeters (8 cm^3). Have each student pick up a block and explore how it represents a volume of 8 cm^3. *Curriculum Packet - Page 1*

2. Instruct each team to assemble a rectangular prism and a cylinder using the engineering materials in the lab. *Curriculum Packet - Page 1*

3. Work with students to determine the volume of the rectangular prism and the cylinder. *Curriculum Packet - Pages 2 - 4, Student Engineering Workbook - Page 1*

   Note: Work with students to determine the total volume of each object, then challenge teams to determine the interior volume 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.*
   - *Encourage students to keep their designs simple. Remind them that they are going to have to determine the interior volume of the design.*
   - *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 volume of the entire 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 volume of each end of the pool, 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. *Note: Each lab includes an Inventory and Organization Guide on the top lid to help students pack engineering materials back correctly.*

3. Lesson reflection - If time permits, do a quick recap/review of the lesson.

Assessment/Evaluation:

A. Student Engineering Workbook (7 Points)

B. Design & Engineering Challenge (20 Points)

Volume

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Applied Mathematics | Student Engineering Workbook

Team Members:

1. _____ 2. _____

Total Points	
Workbook:	/7 pts
Challenge:	/20 pts

What is Volume?

Fill in the blanks in the statement below.

1. Volume is the amount of three-dimensional space an object occupies. Volume is measured in cubic units of a fixed size, such as cubic inches (in^3) or cubic centimeters (cm^3).

Assemble a Rectangular Prism and a Cylinder

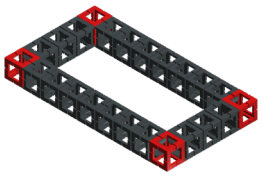
Place a check in each box as each step is completed.

2. [X] Assemble a **rectangular prism** using Kid Spark engineering materials.
3. [X] Assemble a **cylinder** using Kid Spark engineering materials.

Determine the Volume of Rectangular Prisms and Cylinders

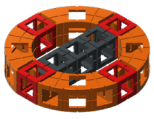
Fill out the correct information in the spaces provided.

4. **Volume** of entire **rectangular prism**: 360 cm^3
5. **Volume** of interior **rectangular prism**: 168 cm^3



Rectangular Prism

6. **Volume** of entire **cylinder**: 157 cm^3
7. **Volume** of interior **cylinder**: 56.52 cm^3



Cylinder

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

   [X] Challenge: **Design and engineer a structure for a new swimming pool.**

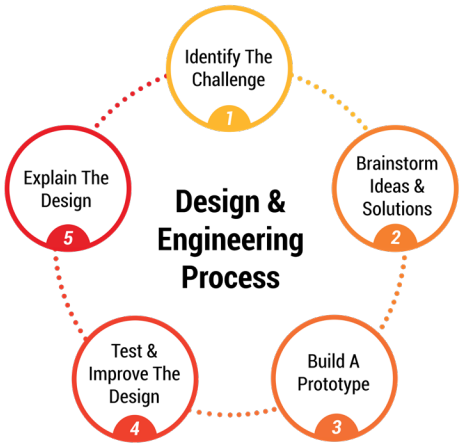
2. Brainstorm Ideas & Solutions

   [X] Discuss design ideas.

   [X] Consider building components.

   [X] Sketch out design ideas on paper.

   [X] Choose the best design.



3. Build A Prototype

   [X] Use Kid Spark engineering materials to build a prototype.

4. Test & Improve The Design

   [X] Look for opportunities to improve the design. (Is it practical, proportional, etc..)

   [X] Review challenge specifications/criteria and grading rubric.

5. Explain The Design

   [X] Determine the specifications of the design that was created. *Student Engineering Workbook - Page 3*

   [X] 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? Which end of the pool has a larger volume? Why did the team decide to configure the design of the pool in this way?

   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 total interior volume of the swimming pool.

Shallow End

Interior volume: ____Total____ cm^3

Deep End

Interior volume: ____Total____ cm^3

Total Interior Volume

Interior volume: ____Total____ cm^3

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	Column Total	Column Total	Column Total	Column Total
Total Points				Total Points ____ /20