TASK 4 Volume and Surface Area

Objectives

You will be able to

- Find the volume of rectangular prisms with fractional lengths.

How can we use mathematics to design a playground that is both fun and safe?

Evaluation and Feedback

To evaluate your work, you will

- Complete a check for understanding about volume of a cube.
- Complete your playground.
- Review the playground checklist from Learning Task 1 and make sure your playground is complete.
- Present your playground.

Task 4: Volume and Surface Area

As a group:

- Using cubes, build rectangular prisms and determine the volume and surface area.
- Determine the volume of ground cover needed in your playground.
- Finalize your playground.
- Present your playground and justify why our playground is fun and safe.

Vocabulary

- centimeter cube
- cube
- cubic unit
- depth
- fractional length
- greatest
- least
- rectangular prism
- volume

Connect to the Culminating Project

- Select the type of ground cover for your playground and determine the volume needed.

LESSON 1

SAFETY AND VOLUME

WARM-UP

Safety Reference Information

Review this safety reference information and then answer the questions that follow.

Safety Reference Information

Six years of school injury data (from a northwest Washington state school cooperative) show that the top five causes of injury on playgrounds are as follows:

Falls from equipment	25%
Athletic participation (in a game)	17%
Slip, trip, or fall	16%
Struck against object	13%
Struck by object	11%
All others	18%

In almost half of the playground injuries, equipment was involved. The types of equipment most frequently involved in school playground injuries are as follows:

Bars	29%
Balls, bats, racquets (tetherballs, baseball bats)	23%
Composite structures (like Big Toys)	14%
Climbing appartatus	10%
Non-play equipment (such as poles and posts)	8%
Swings (including tire swings)	7%
Slides	5%
Other play equipment	3%
Tires and tire climbes	1%

The most severe playground claims involve falls from equipment and being hit with balls.

(*Source*: http://web3.esd112.org/docs/insurance-programs/playgrdgdln1200.pdf)

1. What is the most common cause of injuries while at a playground?
2. How can you reduce the injuries or the severity of an injury if someone were to fall in your playground?
3. What types of materials have you seen under play structures at playgrounds?
4. Which types of material do you think work best?
5. How could you know how much of those materials to use?

PROJECT ACTIVITY

Dimension Connections

Use the centimeter cubes at your table to build different cubes and rectangular prisms. Record data about the dimensions of your figures. Label appropriate units. Record observations and patterns you notice in your data. An example is provided in the first row of the table. **Do not take the figures apart after you build them.**

Figure	Length	Width	Height	Volume	Surface Area
1 cube	1 cm	1 cm	1 cm	1 cm^3	6 cm^2
2					
3					
4					
5					
6					
7					
8					
9					
10					

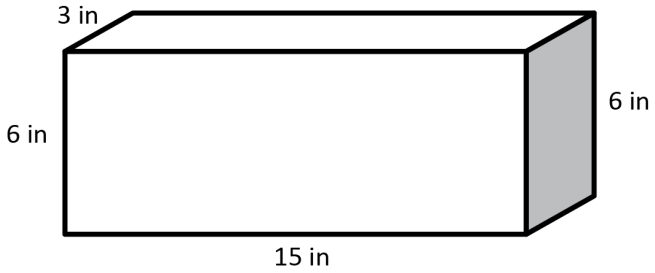
Observations

LESSON 2
GROUND COVER

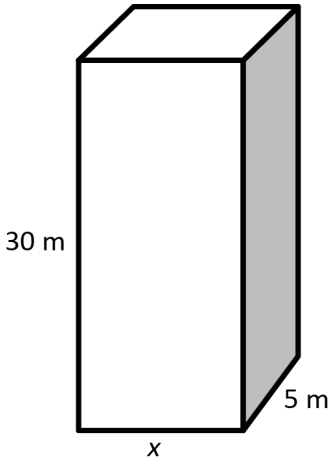
WARM-UP

Volume

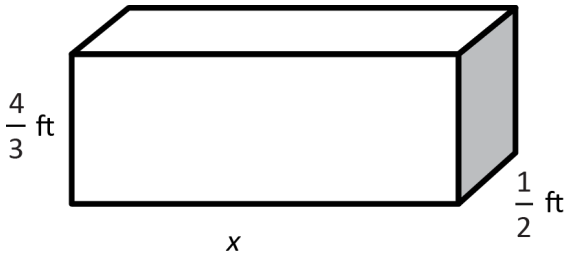
What is the volume of the rectangular prism below?



The volume of the rectangular prism below is 1,500 m^3. What is the missing width?



The volume of the rectangular prism below is $\frac{4}{3}$ ft^3. What is the missing length?



PROJECT ACTIVITY

Safety Reports

Playground Safety: Applicable Standards, Guidelines and Protective Surfacing

Read the following:

Playground Protective Surfacing Guidelines

Playgrounds should not be installed or operated without protective surfacing of some type. Concrete, asphalt or other hard surfaces should never be directly under playground equipment. Grass, dirt and compacted clay are not considered protective surfacing.

Pea gravel, sand, shredded/recycled rubber mulch, wood mulch and wood chips along with material (including unitary surfaces) tested to ASTM F1292 standards are appropriate playground surface materials.

CPSC's Handbook Publication 325 Guide to Loose Fill Groundcover Depth

Minimum Compressed Loose Fill Groundcover

Inches of Loose Fill Material		Protects to Fall Height *(feet)*
6*	Shredded/recycled rubber	10
9	Sand	4
9	Pea Gravel	5
9	Wood Mulch	7
9	Wood Chips	10

*Shredded/recycled rubber loose-fill surfacing does not compress in the same manner as other loose-fill materials. However, care should be taken to maintain a constant depth as displacement may still occur.

Loose-fill materials will compress at least 25% over time due to use and weathering. This must be considered when planning the playground. For example, if the playground will require 9" of wood chips, then the initial fill level should be 12".

(*Source*: Playground Safety: Applicable Standards, Guidelines and Protective Surfacing)

Safety Report

Use the table below to **show how** you determined how much ground cover your playground will need. Because your playground is brand new, you will need to add extra ground cover. 25% of your ground cover will compress over time. **Remember to label all units of measurement!**

Name of Playground Item	Fall Height	Type of Ground Cover Needed	Area of Use Zone	Depth of Ground Cover Needed (Remember: $\frac{1}{4}$ of it will compress)	Total Amount of Ground Cover Needed for This Item

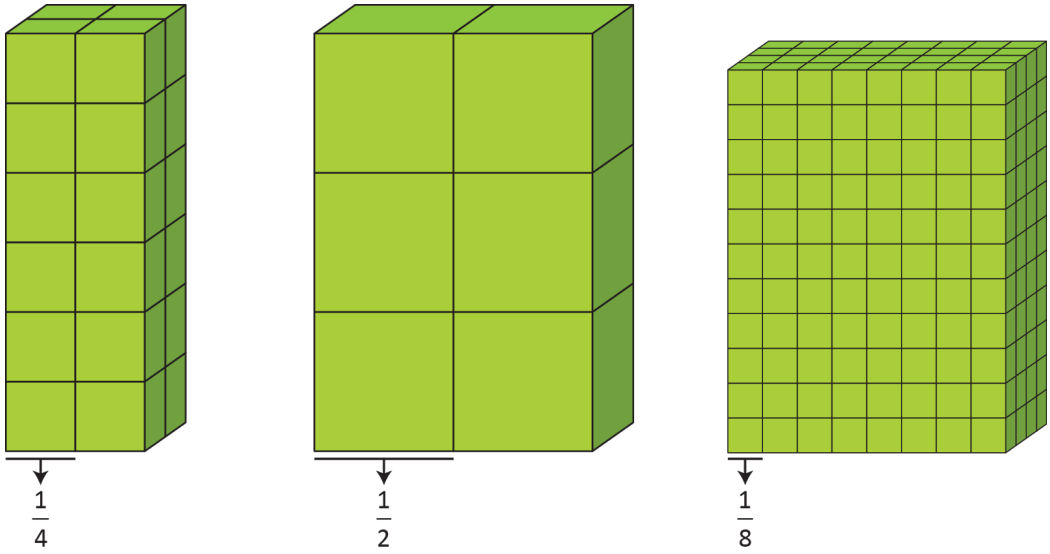
LESSON 3

SAFETY REPORTS

WARM-UP

Volume Word Problem

Put these rectangular prisms in order from the least to greatest volume. Justify your answer.



PROJECT ACTIVITY

Safety Reports (continue working)

Continue to work on your safety report from the last lesson and on any other unfinished work.

LESSON 4

TRAVELERS AND TELLERS

WARM-UP

Volume Word Problem

For his playground, Alex built a tree house in the shape of a cube. Each of the cube's edges are $3\frac{1}{4}$ meters long. He wants to store all of his cube-shaped boxes in the tree house while the rest of the playground is being built. All of the boxes have edges of $\frac{1}{4}$ meter. If he fills the whole tree house, how many boxes could he fit inside?

PROJECT ACTIVITY

Travelers and Tellers

Your playground team will divide in half.

- Half of the team (the Travelers) will interview other teams about their project.
- The other half (the Tellers) will explain their project to the visiting Travelers and answer any questions.

Travelers: Rotate through the other playground teams as your teacher directs. Then go back to your team and share at least one thing you learned from the other teams.

Tellers: Briefly present your project to the Travelers and answer questions. When the Travelers have rejoined you, share at least one thing that you learned from the Travelers who visited your team.

Revise

Make any necessary revisions to your playground based on the Travelers and Tellers activity, and finalize any outstanding information needed for your playground.

CHECK FOR UNDERSTANDING

Test your knowledge of volumes of figures using the the Check for Understanding • Volume and Fractions.

CULMINATING PROJECT

PLAYGROUNDS

PROJECT ACTIVITY

Work on Culminating Project

- Finish your work on the Playgrounds Culminating Project. Make sure you have completed all the items on the Playgrounds Culminating Project checklist and assessed your project using the rubric (both the checklist and rubric are from Learning Task 1, Lesson 1).

GROUP PREVIEW

Work with your group to test your knowledge of area, volume, surface area, and the coordinate plane.

INDIVIDUAL PERFORMANCE TASK

Test your knowledge of area, volume, surface area, and the coordinate plane.