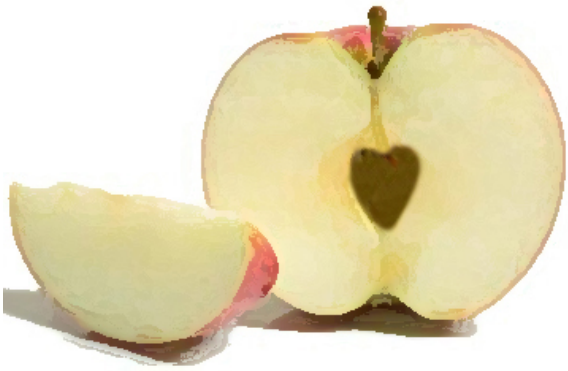


Getting to the Core

Volume

Fifth Grade

Table of Contents
5th Grade Math
Volume

Santa Ana Unified School District Common Core Unit Planner-Mathematics

Unit Title:	Volume	
Grade Level/Course:	5th Grade	**Time Frame:** 9 Days
Big Idea (Enduring Understandings):	Objects can be measured and compared by their attributes.	
Essential Questions:	• What is volume? • How are area and volume alike and different? • How do you measure volume? • Why is volume represented with cubic units? • Does volume change when you change the measurement material? Why or why not? • How can you find the volume of cubes and rectangular prisms? • Why is it important to know how to measure volume?	

Instructional Activities: Activities/Tasks

Purpose: Engage students, spark curiosity, "hook" and necessitate

PRE-ASSESSMENT

INTRO LESSONS:

Preparing the Learner A

Preparing the Learner B

Math Talk with JiJI

Purpose: Sequence problems, building activities, to develop specific concepts, designed to scaffold and deepen conceptual understanding

CONCEPT LESSONS: 1, 2 and 3

Provide the students with hands on experiences which build on one another to deepen their conceptual understanding of volume. Volume is the measure of a finite amount of 3-D space.

FORMATIVE ASSESSMENT LESSONS are throughout the unit, visible through student discussions, projects and math journals. Students will be able to solve real world problems

ROBUST AND DIFFERENTIATION LESSONS are available to challenge the accelerated learner and deepen their conceptual understanding

Each lesson has resources in the appendix for students that require additional support

Purpose: attend to precision, students will have multiple opportunities to figure out the volume of rectangular prisms by drawing nets, building rectangular prisms, packing them with unit cubes, and comparing them.

Purpose: Students will develop a deeper conceptual understanding of the volume of rectangular prisms while making the connection to the formula: LWH

SUMMATIVE ASSESSMENT LESSON 4 Post Assessment – Students will demonstrate their understanding of volume of rectangular prisms by answering the questions, giving a detailed explanation of the strategies they used

Designing for Opportunities for Standards for Mathematical Practice happen at the Unit Level
From: Bill McCallum, Ph.D., University of Arizon

<table>
<tr><td>21st Century Skills:</td><td colspan="2">Learning and Innovation:
☒ Critical Thinking & Problem Solving ☒ Communication & Collaboration ☒ Creativity & Innovation
Information, Media and Technology:
☒ Online Tools ☐ Software ☒ Hardware</td></tr>
<tr><td>Essential Academic Language:</td><td>Tier II:
Variable
Unknown
Strategies
Solution
Viable
Critique
Area
Attributes
Length
Width
Height
Measure
Volume
Bed
Estimate
Base</td><td>Tier III:
Algebraic
Equations
Square units
Cubic units, Unit cubes
Rectangular prism
Nets
Prisms</td></tr>
<tr><td colspan="2">What pre-assessment will be given?
PreAssessment Test</td><td>How will pre-assessment guide instruction?
Students missing 2 or more questions will benefit from all the activities in unit. Student missing less than 2 will develop a deeper conceptual understanding of volume. Accelerated learning activities are included in each.</td></tr>
</table>

Standards	Assessment of Standards (include formative and summative)	
Common Core Learning Standards Taught and Assessed (*include one or more standards for one or more of the areas below. Please write out the complete text for the standard(s) you include.)*	**What assessment(s) will be utilized for this unit?** *(include the types of both **f**ormative assessments (**F**) that will be used throughout the unit to inform your instruction and the summative assessments (**S**) that will demonstrate student mastery of the standards.)*	**What does the assessment tell us?**
Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition. 3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units. 4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. 5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. b. Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.	F: Reflective journal of their new learning and understanding F: Visual representation of area, volume, rectangular prisms F: Performance Task: 1-3 S: Performance Task: Culminating Task 4A-4B S: End of Unit Assessment **Other Evidence:** Teacher observation	Ongoing evidence of students' understanding of the concepts presented Diagnostic information for intervention or acceleration Student comprehension of unit concepts and the big idea: Objects can be measured and compared by their attributes

Opportunities for listening, speaking, reading, writing, and thinking (*Cite Literacy Standards (as applicable):* 3. Use knowledge of language and its conventions when writing, speaking, reading or listening 6. Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships(e.g., however, although, nevertheless, similarly, moreover, in addition) 1.Engage effectively in a range of collaborative discussions (one –on-one, in groups , and teacher-led with diverse partners on grade 5 topics and text b. Follow agreed upon rules for discussions and carry out assigned roles c. Pose the respond to specific question by making comments that contribute to the discussion and elaborate on the remarks of others. d. Review the key ideas expressed and draw conclusions in the light of information and knowledge gained from the discussion 4. Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.	F: Teacher evaluation of student use of appropriate mathematical academic language during partner, small group, and class discussions S: Use of accurate mathematical terms and appropriate relationship language in culminating written explanation of strategies used to solve problem. Teacher evaluation of student speaking and listening: F: Ask and answer questions in pairs and small groups during lessons F: Work collaboratively to solve complex problems while treating each out with respect. F: Participation in presentation of solutions for group work. S: Write the sequence of strategies used to solve the culminating activity	Do students use the appropriate academic language when speaking in class discussions and presentations and when writing in their math journals? When talking about mathematic in pairs, do students follow protocol/rules/ routines for collaborative discussions? Can students plan and deliver an informative presentation with appropriately detailed sequencing? Do all students participate in the thinking, conversation and final project? Do they all follow the rules and guidelines for collaboration?

Standards of Mathematical Practice:	(*Check all that apply*) ☒ 1. Make sense of problems and persevere in solving them. ☒ 2. Reason abstractly and quantitatively. ☒ 3. Construct viable arguments and critique the reasoning of others. ☒ 4. Model with mathematics. ☒ 5. Use appropriate tools strategically. ☒ 6. Attend to precision. ☒ 7. Look for and make use of structure. ☒ 8. Look for and express regularity in repeated reasoning.	**Opportunities for Observable Data** *(How will students demonstrate these Mathematical Practices?)* • Students will create models of rectangular prisms, figuring out volume by physically packing prisms with cubes to figure out the volume. • Students will answer questions during Math Talk warm up demonstrating understanding • Students will explain strategies to their partner, group, and eventually in writing. • Post assessment
Resources/ Materials:	**Text(s) Titles:** **Mathematical Tools: centimeter cubes, linking cubes, rulers, centimeter graph paper** **Media/Technology:** • **ST Math – Volume Fill and Volume Select** **Supplementary Materials: tape, crayons or colored pencils, glue sticks**	
Interdisciplinary Connections:	**Optional Close Read Activity: Cite several interdisciplinary or cross-content connections made in this unit of study (i.e. literature, science, social studies, art, etc.)** The article "**Cool Jobs – Math as Entertainment: Magic, movies and metal: How mathematics adds dazzle to the visual world"** is included for students to do a close read. Also, websites are included for students to do further research on how math is all around us. Websites make connections to how Native Americans measured as well as others throughout history, while exposing students to real life problems.	

Differentiated Instruction:	**Based on desired student outcomes, what instructional variation will be used to address the needs of English Learners by language proficiency level?** • Use of sentence frames (appropriate for language level) to facilitate academic language and conversations. Use of visual organizers to assist processing mathematical ideas • Explicitly teach key academic vocabulary • Use of manipulatives to facilitate conceptual understanding • Flexible grouping to support language acquisition and target instruction • Use collaboration to promote socio-cultural learning • Opportunities for verbal rehearsal of concepts	**Based on desired student outcomes, what instructional variation will be used to address the needs of students with special needs, including gifted and talented?** **Special Needs-** • Appendix to provide additional resources which include pre-lesson to help prepare students for new lesson • Opportunities for verbal rehearsal of concepts • Use of visual organizers in organizing and evaluating evidence • Change size of manipulatives (smaller cube to fill up, larger cubes to use a fillers) • Explicitly teach key academic vocabulary **GATE (Depth & Complexity)** • Rules • Patterns • Language of the Discipline • Unanswered Question • Real World Application

VOLUME UNIT OVERVIEW

Big Idea: Objects can be measured and compared by their attributes.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
	Prepare the Learner A PreAssessment	**Prepare the Learner B**	**Lesson 1**	**Lesson 2**		**Lesson 3**	**Lesson 4**	**Unit Reflection Summative Assessment**
Content Objectives	**Math Talk** *Students will solve problems mentally using multiple strategies.*	**Area** *Students will measure area by counting square units Students will define attribute.*	**Volume** *Students will measure the volume of rectangular prisms by packing them with cubic units.*	**Area/Volume** *Students will make a conjecture about how to find volume without cubes (standing robot).*		**Volume** *Students will find the volume of rectangular prisms. (truck)*	**Volume** *Students will calculate the approximate volume of their classroom using linking cubes. (classroom)*	**Volume** *Students will find the volume of rectangular prisms.*
Language Objectives	**Define** *Students will use precise mathematical language to share different strategies and approaches.*	**Describe** *Students will describe their robots by their attributes.*	**Define** *Students will define volume.*	**Compare & Contrast** *Students will compare and contrast volume.*		**Sequence** *Students will sequence the steps they followed to build their prisms and their strategies to solve problems.*	**Cause/Effect** *Students will justify their strategy.*	**Cause/Effect** *Students will identify reasons why understanding volume is important.*

Thinking Maps	Defining Map	Defining Map	Defining Map	Compare & Contrast		Sequencing Map	Cause & Effect Map	Cause & Effect Map
Linguistic Frames/Stems	The first step I took in solving the problem was to ___ because _____. I decided that my solution was reasonable because _____. The strategy that would work the best would be ____ because it _____.	Our robot _____. One attribute of _____ is that_____. In addition, it has _____. It has a total area of _____ square units.	Volume is _____.	Area and volume both _____. Like area, volume also _____. Area_____. However, volume_____.		First, _____. To begin with, _____. The next step, _____. Finally, _____.	I _____, because ____. I _____ so that _____. I_____ in order to ____.	Now that I understand volume, I can _____. Understanding volume is important because_____. In the future, I will need to _____. For this reason, _____.
Essential Questions			• What is volume?	• How are area and volume alike and different? • How do we measure volume?	• How do we measure volume? • How can you find the volume of cubes & rectangular prisms? • Why is volume represented with unit cubes?	• How do we measure volume? • How can you find the volume of cubes & rectangular prisms? • Why is volume represented with unit cubes? • Does the volume change with the measurement material? • Why is important to know how to measure volume?	• How do we measure volume? • How can you find the volume of cubes & rectangular prisms? • Why is volume represented with unit cubes? • Does the volume change with the measurement material? • Why is important to know how to measure volume?	• Why is important to know how to measure volume?

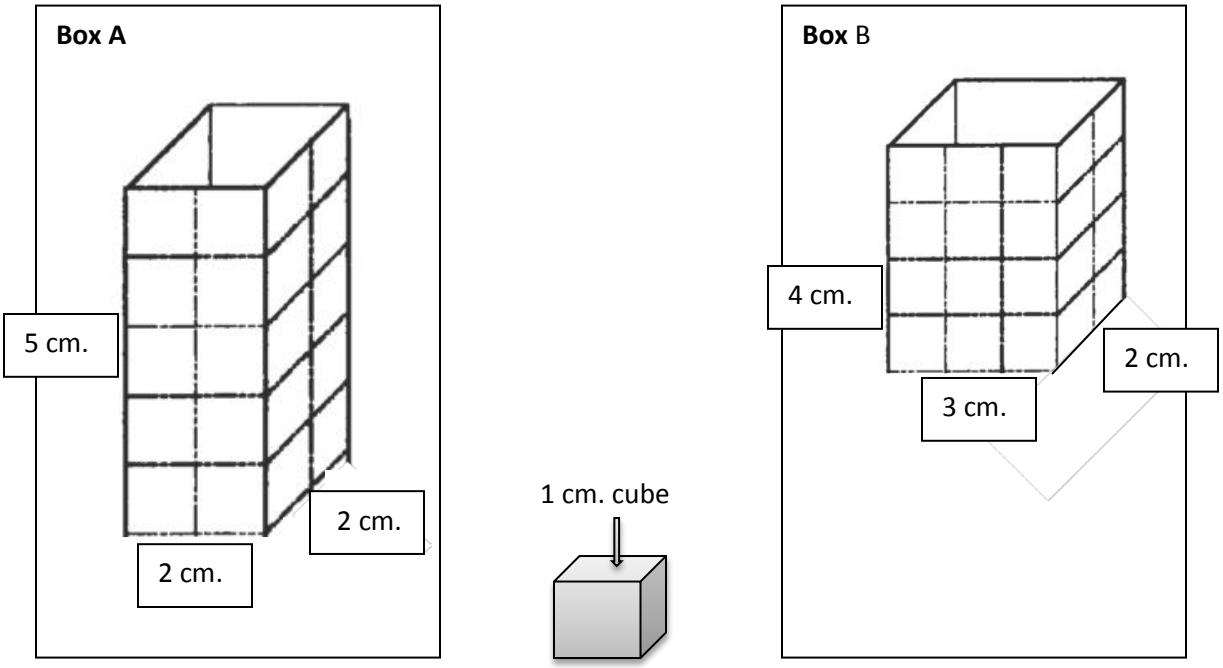
Name _____

Volume Pre-Assessment

How Many Cubes?

This problem gives an opportunity to explain your understanding of volume.

Erick fills Box A and Box B with centimeter cubes.



1. How many cubes can Erick fit into Box A? _____

Explain in detail how you solved this problem.

_____

_____

_____

2. What is the volume of Erick's Box B? _____

Show your calculations.

3. Which of the two boxes can hold more cubes? _____

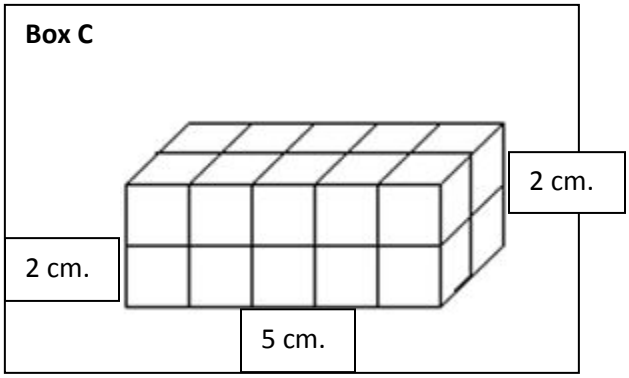
Explain your answer.

_____

_____

4. Here is another box. How many centimeter cubes can this box hold?

_____



List the measurements of a different box that holds the same number of cubes as Box C.

_____ cm long _____ cm wide _____ cm high

Adapted from Noyce Foundation

Volume Pre-Assessment Answer Key

How Many Cubes? ***Based on these, credit for specific aspects of performance could be assigned as follows***	
1. Gives correct answer: **20 cubes** Gives correct explanation such as: ***There are 4 cubes on each layer and 5 layers. 4 x 2 x 2 =***	**1 point** **1 point**
2. Gives correct answer: **24 cubes** Shows work such as: ***2 x 2 x 6 =***	**1 point** **1 point**
3. Gives correct answer: **Box A**	**1 point**
4. Gives correct answer: **20 cubes** Gives a correct answer such as: ***1 x 10 x 2 =*** ****Do not accept boxes with a 5 x 2 or 2 x 5 base.****	**1 point** **1 points**
TOTAL Points	**7 points**

Adapted from Noyce Foundation

Math Talk

Unit: **Lesson:** Preparing the Learner A	**Grade Level/Course:** 5th	**Duration: approximately 60 minutes**
Common Core and Content Standards	**5th Grade Operations and Algebraic Thinking** ***5.OA.1*** – Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. **Speaking and Listening** 4. Report on a topic or text, or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes: speak clearly at an understandable pace.	
Materials/ Resources/ Lesson Preparation	• Post the Big Idea & Essential Questions • Post Content & Language Objectives • Power Point • Math Talk Thought Process & Sharing Guide • Chart Paper • Markers	
Objectives	**Content:** Students will solve problems mentally using multiple strategies.	**Language:** Students will use precise mathematical language to share different strategies and approaches.
Depth of Knowledge Level	☐ **Level 1: Recall** ☐ **Level 2: Skill/Concept** ☒ **Level 3: Strategic Thinking** ☒ **Level 4: Extended Thinking**	
Standards for Mathematical Practice	☐ **1. Make sense of problems and persevere in solving them.** ☒ **2. Reason abstractly and quantitatively.** ☒ **3. Construct viable arguments and critique the reasoning of others.** ☐ **4. Model with mathematics.** ☐ **5. Use appropriate tools strategically** ☒ **6. Attend to precision.** ☒ **7. Look for and make use of structure.** ☐ **8. Look for and express regularity in repeated reasoning.**	
Common Core Instructional Shifts in Mathematics	☒ **Focus on the Standards** ☐ **Coherence within and across grade levels** ☒ **Rigor (Balance of conceptual understanding, procedural skill & fluency, and application of skills)**	

Academic Vocabulary (Tier II & Tier III)	KEY WORDS ESSENTIAL TO UNDERSTANDING	WORDS WORTH KNOWING
TEACHER PROVIDES SIMPLE EXPLANATION	Algebraic, Equation, Variable, Unknown, Strategies, Solutions, Viable, Critique	
STUDENTS FIGURE OUT THE MEANING		

Pre-teaching Considerations	Students have an understanding of how to solve for a missing variable in an algebraic equation.

Lesson Delivery Comprehension

Instructional Methods	**Check method(s) used in the lesson:** ☐ **Modeling** ☐ **Guided Practice** ☒ **Collaboration** ☒ **Independent Practice** ☐ **Guided Inquiry** ☒ **Reflection**
Lesson Opening	**Prior Knowledge, Context, and Motivation:** Algebra and Functions Associative Property

Lesson Continuum

Body of the Lesson: Activities/ Questioning / Tasks/ Strategies/ Technology/ Engagement

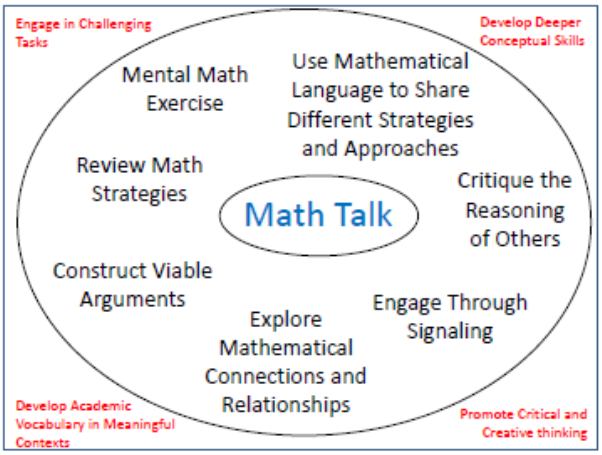
Lesson Overview

Always begin your lesson by reviewing the Big Idea and Essential Questions. Additionally, review in kid-friendly terms the content and language objectives. These should all be posted somewhere in your classroom.

Math Talk Rationale

Math talk is a daily ritual done with the entire class in order to develop conceptual understanding and efficiency with numbers, operations, and other mathematics. The first math talk will take 30 minutes because the students will be taught the routine. After that, it should take no more than 10 minutes per day and will be used as a precursor to the lesson of the day.

Purpose of Math Talks



Differentiated Instruction:

English Learners:

Possible Sentence Frames:

"Since ____ is given in the problem, I determined that I need to find out what ___ is."

"The first step I took in solving the problem was to ___, because _____."

"I decided that my solution was reasonable because _____."

"The strategy that would work the best would be ____ because it _____."

	Teacher Directions Display the first slide of the power point and explain each bullet point to the students. • **Mental Math** Explain to students that they will solve the math problem in their head without talking to anyone else. ***"Today we will be solving math problems in our head."*** • **Engagement Through Signaling** Have students place a fist on their chest. Explain to students that they will show you, not tell you, that they solved the math problem in their head by holding a thumb up on their chest. ***"Once you have found a way to solve the problem and have an answer, hold up your thumb on your chest."*** If several students in the class have found an answer and are holding one thumb up, tell them to continue to try and solve the problem using a different strategy (**Note:** The goal is for every child to be able to come up with at least one strategy to solve the problem. Students who need to be more challenged will try to come up with other strategies to solve the problem) ***"Once you have found another strategy to solve the problem or solution to the problem you will hold up another finger on your chest. Continue to challenge yourself until I tell you to stop."*** Allow enough time for every student to have at least one solution. ***"Those of you still working on a solution to the problem continue to do so."*** Only give the students between 3 to 5 minutes. If there are students who haven't found a solution, tell them it's okay. <u>The goal is for them to begin thinking about the process.</u> When it's time to share out, they can contribute what they were thinking. They will be learning from their peers as they listen to other students share out the strategies they used. • **Review Math Strategies** Explain to students that they will be solving math problems with math topics they have already seen. Therefore, **"Math Talk will be a review".** • **Explore Mathematical Connections & Relationships** Explain to students that they will solve the math problem by using math strategies they already know. They will determine in their heads the best way that they can solve the problem. ***"You will be solving the math problem by using your own strategies and knowledge about math. Use what works for you. The goal is for us to learn different strategies (approaches, paths) to solve the***	**Students Who Need Additional Support:** See Appendix for additional resources. **Accelerated Learners:** Expect students to show they have multiple strategies with ach problem.

problem and share them with each other. This way we can have more mathematical tools in our toolbox to help us improve out mathematical reasoning."

- **Construct Viable Arguments and Critique the Reasoning of Others**

Explain to students that after they solve the math problem in their head they will have the opportunity to share their strategies and solutions with the rest of the class. In order to do so they will need to be very clear about their understanding of the problem, how they began to solve the problem, and the specific steps they took to arrive at a solution. As they respectfully listen to each other's strategies and solutions, they need to be able to restate what their fellow classmate stated. If their classmate has made a mistake, then they have to wait, raise their hand, and once they have been called upon, cordially explain to their classmate their mistake. Everything must be supported with clear mathematical reasoning.

- **Use Mathematical Language to Share Different Strategies and Approaches**

Explain to students that they will need to include mathematical language in their explanation. For example: **"*Since I know that x is a variable that represents a number, and the problem is an equation, I figured out that I needed to solve for the variable x."***

After you are finished explaining the purpose of Math Talk and the routine:

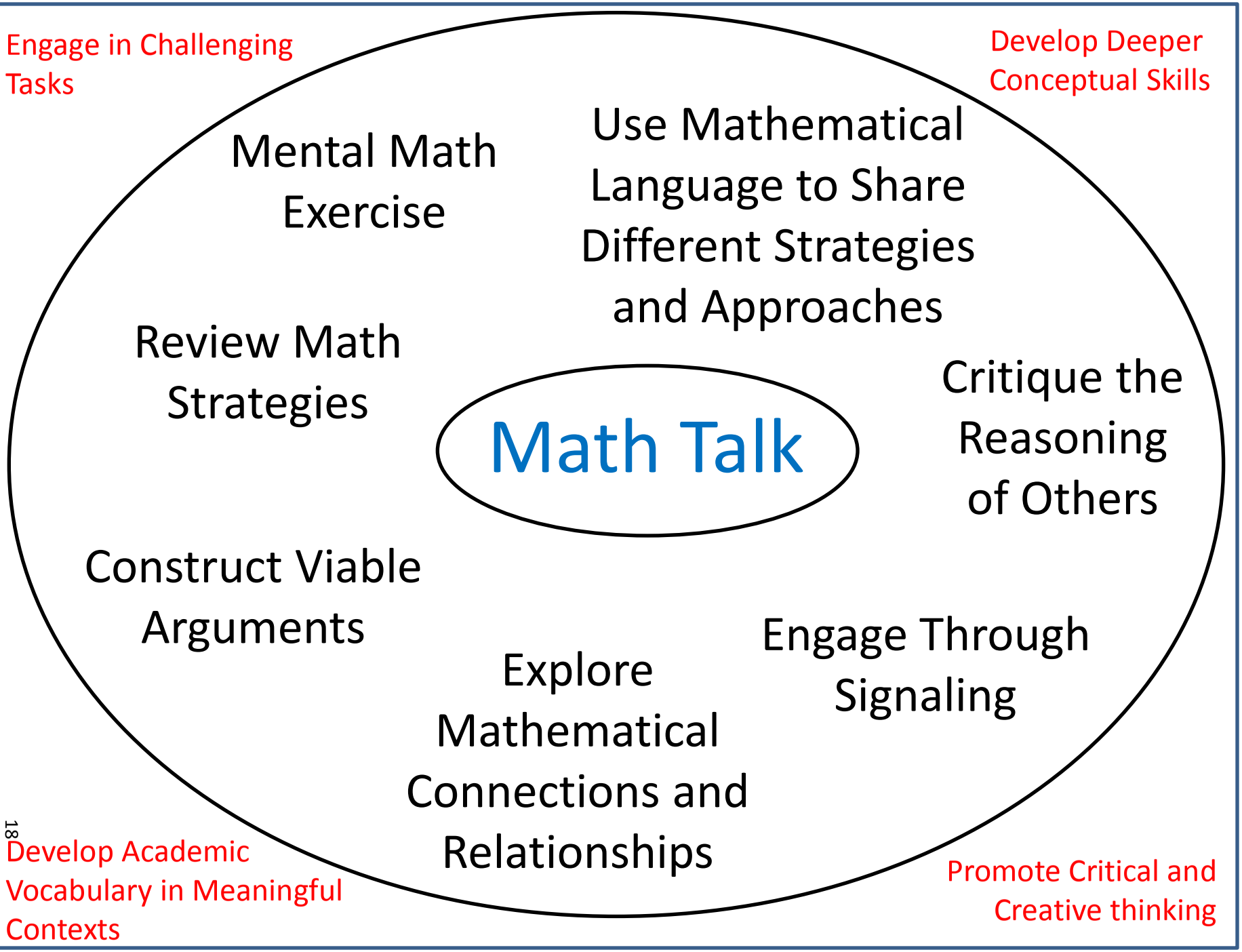
Teacher Model
Using Think Aloud, model how you would solve a math problem mentally. For example: 25+18 is the same as 25+20-2

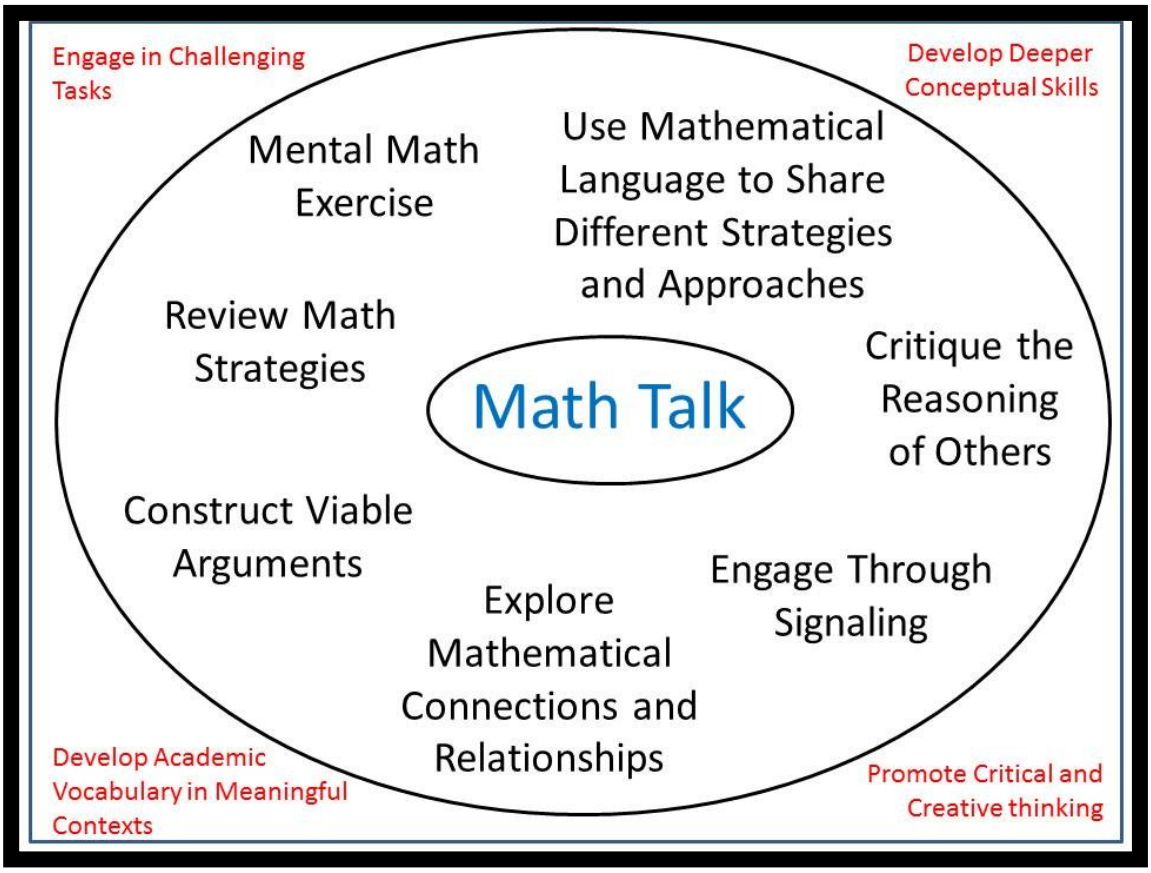
Independent Student Work
Hand out student sheet
Display the word problem on the second slide and read it aloud
Go on to the third slide and display the question to the math problem

- Guide them through the questions they will think about in their head
- Once they have found a solution to the problem they will hold up a thumb up on their chest
- They will continue to try and solve the problem using a different strategy (**Note:** The goal is for every child to be able to come up with at least one strategy to solve the problem. Students who need to be more challenged will try to come up with other strategies to

	solve the problem) • They will show that they found a different strategy by displaying another finger for each additional strategy. • Allow enough time for every student to have at least one solution • Once everyone has their thumb up and a few students have found more than one strategy, give them the opportunity to share and discuss their answers in a small group or in pairs • Display a list of questions to help guide and facilitate the discussion of student answers **Guiding Questions for the 1st problem: x + y + 12 = 22** 1. What information is given in the problem? 2. How did you decide what the problem was asking you to find? (What was unknown?) 3. What was the first step you took to solve the problem? 4. How does this strategy work in other situations? 5. How did you know your solution was reasonable? 6. Did you try a method that did not work? Why didn't it work? Would it ever work? Why or why not? 7. What would be a more efficient strategy? Select students to share out their strategies and answers to the problem • On chart paper, write out their first step, second step, and so on until the student arrives at their answer • Ask the students to raise their hand if they used a different strategy to solve the problem • Ask the following question: **"*How is the strategy you used like or different from another student's?*"** • Document their steps • Ask students if they found different solutions to the problem • Ask them: **"*How would it help to create a diagram, graph, or table in order to record the different possible solutions to the problem?*"** • Students might come up with a T-chart where they can display the different possible solutions for x and y.	

	Go on to the next slide for the 2nd problem. Read it aloud. Go on to the next slide and display the question. Repeat the math talk procedure of guiding the students through the math talk process. Remind them to work out the problem in their head and show you that they solved the problem through signaling. **Guiding Questions for the 2nd problem: 8 + y + x = 20** 1. What do you know that is not stated in the problem? 2. What ideas that you have learned before were useful in solving this problem? 3. What was the first step you took to solve the problem? 4. How did you know your solution was reasonable? 5. Did you try a method that did not work? 6. Why didn't it work? Would it ever work? Why or why not? 7. What would be a more efficient strategy? 8. How would it help to create a table? **Closure: Writing- Two-Minute Write (Please see Appendix)** In the math journals, students will answer these: • *What did you learn from Math Talk ?* • *How did it help you think about the math you can do?* • *How did listening to other students' strategies help you think about how you can do math differently?* **Procedural Practice:** To tie in conceptual understanding with computational fluency, have students find the unknowns in their journals. • **K** x 5 = 100 • 5 x **W** = 65 • **P** x **M** = 200	
Lesson Reflection		
Teacher Reflection Evidenced by Student Learning/ Outcomes		


Engage in Challenging Tasks
Develop Deeper Conceptual Skills
Mental Math Exercise
Use Mathematical Language to Share Different Strategies and Approaches
Review Math Strategies
Math Talk
Critique the Reasoning of Others
Construct Viable Arguments
Engage Through Signaling
Explore Mathematical Connections and Relationships
Develop Academic Vocabulary in Meaningful Contexts
Promote Critical and Creative thinking



Math Talk

Real Life Scenario

A teacher wanted to know the ages of Susan and Juan. She knew that Ricky was 12 years old. What are the ages of Susan and Juan if the total age of the 3 students is 22?

$$x + y + 12 = 22$$

Math Talk

What are the ages of Susan and Juan if the total age of the 3 students is 22?

$$x + y + 12 = 22$$

In your head think:

- What are some strategies you might try?
- What do the variables (x and y) used in the problem represent?
- Are there other solutions to the problem?

Algebraic Thinking

Math Talk

Real Life Scenario

A student wanted to know how many blue and red marbles were in the bag. He already knew that there were 8 purple marbles. How many blue and red marbles are there if the total number of marbles in the bag is 20?

$$8 + y + x = 20$$

Math Talk

How many blue and red marbles are there if the total number of marbles in the bag is 20?

$$8 + y + x = 20$$

In your head think:

- What are some strategies you might try?
- What do the variables (x and y) used in the problem represent?
- Are there other solutions to the problem?

Algebraic Thinking

Math Talk

$$8 + y + x = 20$$

In your head think:

- What do you notice is different about this problem from the previous problem?
- What are some new strategies you might try?
- Are there other solutions to the problem?

Algebraic Thinking

Math Talk Thought Process and Sharing Guide

Problem-Solving Thought Process Guiding Questions	Discussion/Sharing/Sentence Frames
What information is given in the problem?	The information given in the problem is _____.
How did you decide what the problem was asking you to find? What was unknown?	Since _____ is given in the problem, I determined that I need to find out what _____ is.
What was the first step you took to solve the problem?	The first step I took in solving the problem was to _____, because _____.
What did you do next?	The next step I took was to_____.
How did you know your solution was reasonable?	I decided that my solution was reasonable because _____.
Is there another strategy you can use to solve the problem?	Another strategy that I can use to solve the problem is _____.
Which strategy would work the best?	The strategy that would work the best would be _____ because it _____.
Did you try a method that did not work? Why didn't it work? Would it ever work? Why or why not?	I did try a method that didn't work. It didn't work because _____. It could work if _____.

2-D Robot

Unit: Prepare the Learner B	Grade Level/Course: 5th	Duration: approximately 60 minutes
Common Core and Content Standards	***5.MD.3*** – Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid which can be packed without gaps or overlaps using *n* cubic units is said to have a volume of *n* cubic units. ***5.MD. 5*** - Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume..	
Materials/ Resources/ Lesson Preparation	• Post the Big Idea & Essential Questions • Post Content & Language Objectives • Math Talk PowerPoint • Graph paper (cm.) • 4 different colors of pencils/crayons • *2-D Robot Puzzle Worksheet* • (Optional) Math Journal • ***Homework***: 2-D Robot Puzzle Homework	
Objectives	**Content:** Students will measure the area by counting square units.	**Language:** Students will describe their robots by their attributes.
Depth of Knowledge Level	☒ **Level 1: Recall** ☒ **Level 2: Skill/Concept** ☐ **Level 3: Strategic Thinking** ☐ **Level 4: Extended Thinking**	
Standards for Mathematical Practice	☒ **1. Make sense of problems and persevere in solving them.** ☐ **2. Reason abstractly and quantitatively.** ☐ **3. Construct viable arguments and critique the reasoning of others.** ☒ **4. Model with mathematics.** ☐ **5. Use appropriate tools strategically** ☒ **6. Attend to precision.** ☐ **7. Look for and make use of structure.** ☐ **8. Look for and express regularity in repeated reasoning.**	
Common Core Instructional Shifts in Mathematics	☐ **Focus on the Standards** ☒ **Coherence within and across grade levels** ☒ **Rigor (Balance of conceptual understanding, procedural skill & fluency, and application of skills)**	

Academic Vocabulary (Tier II & Tier III)		KEY WORDS ESSENTIAL TO UNDERSTANDING	WORDS WORTH KNOWING
	TEACHER PROVIDES SIMPLE EXPLANATION	Area Square units Attributes	Dimension/dimensional
	STUDENTS FIGURE OUT THE MEANING	Length Width	
Pre-teaching Considerations		This lesson addresses area because students need to be able to differentiate between the area and volume. Area is an attribute of plane two-dimensional figures, whereas volume is an attribute of solid three-dimensional figures.	

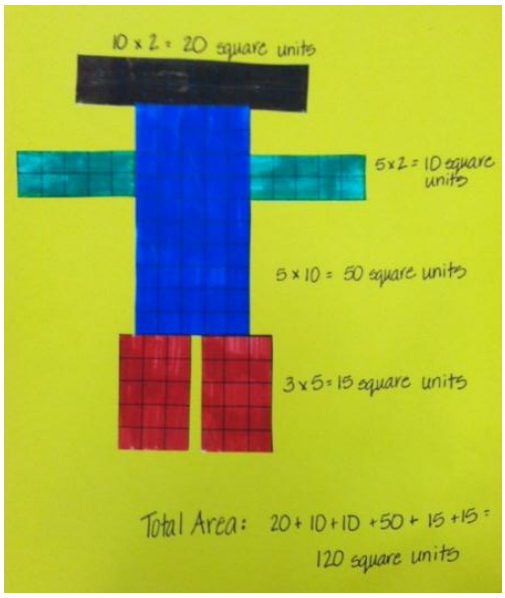
Lesson Delivery

Instructional Methods	**Check method(s) used in the lesson:** ☐ **Modeling** ☐ **Guided Practice** ☒ **Collaboration** ☐ **Independent Practice** ☒ **Guided Inquiry** ☐ **Reflection**	
Lesson Opening	Always begin your lesson by reviewing the Big Idea and Essential Questions. Additionally, review in kid-friendly terms the content and language objectives. These should all be posted somewhere in your classroom. **Prior Knowledge, Context, and Motivation:** ***"Today you're going to create your own two-dimensional robots based on my dimensions, but before we do that we are going to practice creating our robot pieces. Area is measured in square units because of the two dimensions of length and width being multiplied. On your graph paper, quickly draw a rectangle with an area of 12 square units." Provide students with an opportunity to share how they did this being sure that all possibilities are discussed (12X1, 4X3, 6X2). With your partner, think and talk about what information you need to create your robot."*** • *Possible student responses:* o *What is the robot's area?* o *How do I divide up my robot to total that area?* o *How many parts will my robot need?*	
Body of the Lesson: Activities/ Questioning / Tasks/ Strategies/ Technology/ Engagement	**<u>Lesson Overview</u>** **Warm-up:** Math Talk PowerPoint **Teacher Directions** 1. Place the Directions for the robot on the document camera: • The robot is two-dimensional; • All the parts of the robot are squares and rectangles; • One leg has a total area of 15 square units, the robot has two legs; • Each arm has an area of 10 square units; • The total area of the robot is 120 square units; • Make the body and the head with the remaining	**Differentiated Instruction:** **English Learners:** Our robot_____. One attribute of ____ is that ____. In addition it has ____. It has a total area of ____square units.

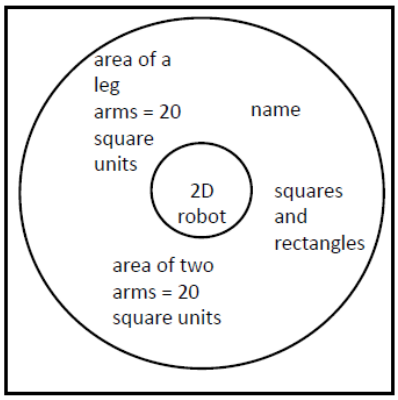
Lesson Continuum

area.

2. Using a pencil, students draw their robot on their graph paper (this makes a rough draft).
3. With a partner share your plan. The partner should verify that the robot's total area is 120 square units. Teacher calls on a few students to share out their plan.
4. Students draw their robot using different colors to show the area of each part of the robot in square units.
   Example:



5. Complete the table. (see Student Page 2-D Robot #1)
6. In pairs, students will describe their robots by their attributes.



Our robot is named Solaris. This amazing Robot is made of only squares and rectangles. One attribute of Solaris is that he has two arms that have a combined area of 20 square units. In addition, he has one leg with an area of 15 units. His head and his body combined have 70 square units. He has a Total area of 120 square units.

Our robot _____.
One attribute of _____ is that _____.
In addition, he has _____.
He has a total area of _____ square units.

Closure: Writing - Two-Minute Write (Please see Appendix)

In the math journals, students will answer this question:

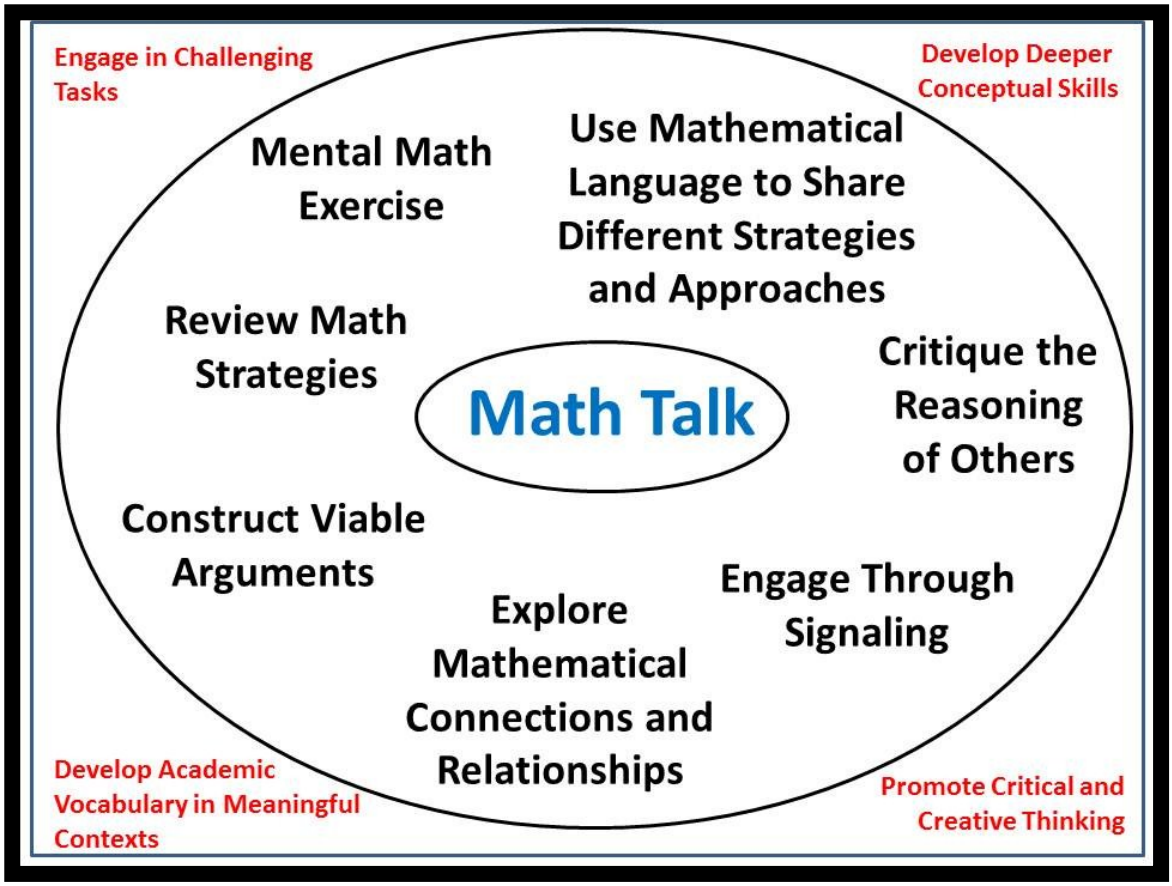
- *How is area measured?*

Special Needs:
Students can number each box as they count the square units.
Make available a multiplication table to aid in figuring the dimension.
(Ex. 15 square units = 5 x 3)

See Appendix for additional resources.

Accelerated Learners:
Make a different robot using the same area but with different dimensions for the body parts.

	Procedural Practice: To tie in conceptual understanding with computational fluency, have students find the unknowns in their journals. • **K** x 8 unit = 72 unit^2 • 6 cm x **W** = 120 cm^2 • **P** x **M** = 20 in^2	
Lesson Reflection		
Teacher Reflection Evidenced by Student Learning/ Outcomes		



Math Talk

Real Life Scenario

Miguel has a rock collection of 30 rocks. Most of his collection consists of igneous rocks. There are 15 igneous rocks. The rest are metamorphic and sedimentary rocks. What could the possible number of metamorphic and sedimentary rocks be?

$$x + 15 + y = 30$$

Math Talk

What could the possible number of metamorphic and sedimentary rocks be?

$$x + 15 + y = 30$$

In your head think:

- What are some strategies you might try?
- What do the variables (x and y) used in the problem represent?
- Is there more than one solution to the problem?

Algebraic Thinking and Measurement

Name _____

2-D Robot Puzzle Student Worksheet PTL-B

1) On graph paper, draw a robot based on the following description:

   The robot is two dimensional;

   all the parts of the robot are squares or rectangles;

   one leg has a total area of 15 square units;

   the robot has two legs;

   each arm has an area of 10 square units;

   the total area of the robot is 120 square units;

   draw the body and the head from the remaining square units.

2) Use different colors to show the area of each part of the robot.

3) Complete the following table:

Part of the Robot	Length	Width	Area
		Total Area	_____

Ideas taken from Robot Project by S. Mercer, M. Brambila, and E. Carrigg.

HOMEWORK

Name _____

2-D Robot Puzzle: PTL-B

On graph paper, draw a robot based on the following description:

The robot is two dimensional;

all the parts of the robot are squares or rectangles;

it has a total area of 60 square units;

the area of the body is 24 square units;

the robot has two legs and two arms;

one arm has an area of 6 square units;

both legs have the same area;

the head has an area ten more than one arm;

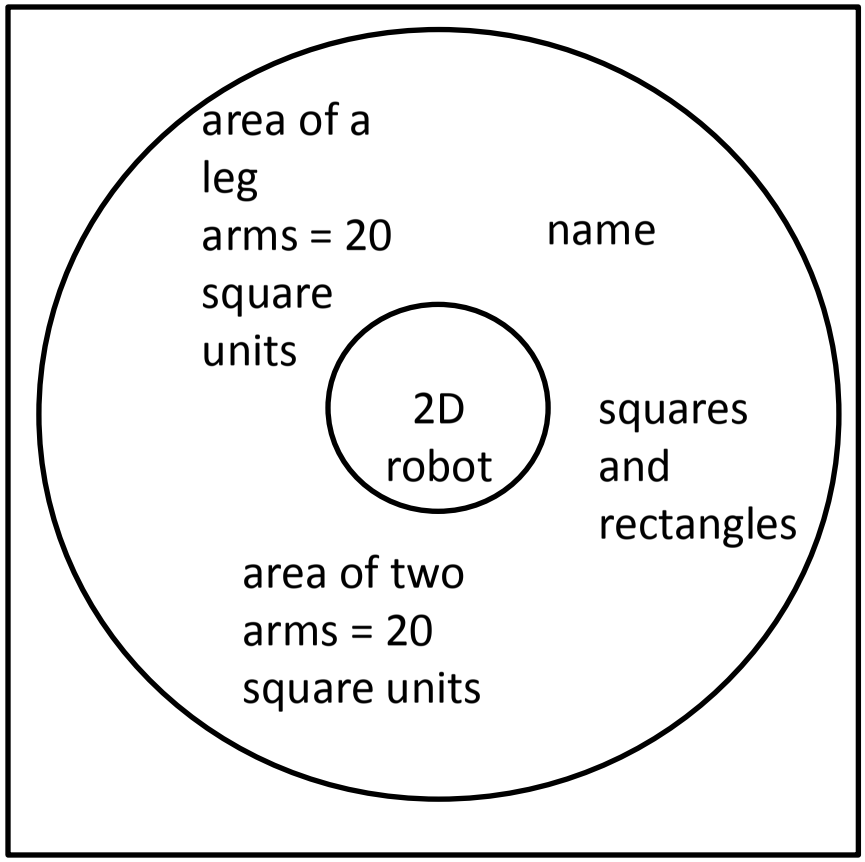
2) Use different colors to show the area of each part of the robot.

3) Complete the following table:

Part of the Robot	Length	Width	Area
		Total Area	_____

Thinking Map for *Prepare the Learner B*

Teacher Sample



Our robot is named Solaris. This amazing Robot is made of only squares and rectangles. One attribute of Solaris is that he has two arms that have a combined area of 20 square units. In addition, he has one leg with an area of 15 units. His head and his body combined have 70 square units. He has a Total area of 120 square units.

Our robot _____.
One attribute of _____ is that _____.
In addition, he has _____.
He has a total area of _____ square units.

3-D Robot

Unit: Lesson 1	Grade Level/Course: 5th	Duration: approximately 60 minutes

Common Core and Content Standards	***5.MD.3*** – Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid which can be packed without gaps or overlaps using *n* cubic units is said to have a volume of *n* cubic units. ***5.MD.5*** – Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.
Materials/ Resources/ Lesson Preparation	• Post the Big Idea & Essential Questions • Post Content & Language Objectives • Math Talk PowerPoint • 2D robot from previous lesson • Student Practice Net Sheet • Student Robot Net Sheet • Robot Recording Sheet • Crayons/markers • Scissors • (Optional) Math Journal • Cm. cubes (200 per group/1,000 per class) • Tape (1 per group) • Glue (1 per group) • 1 full sheet of construction paper (1 per group) • ***Homework***: Lesson 1

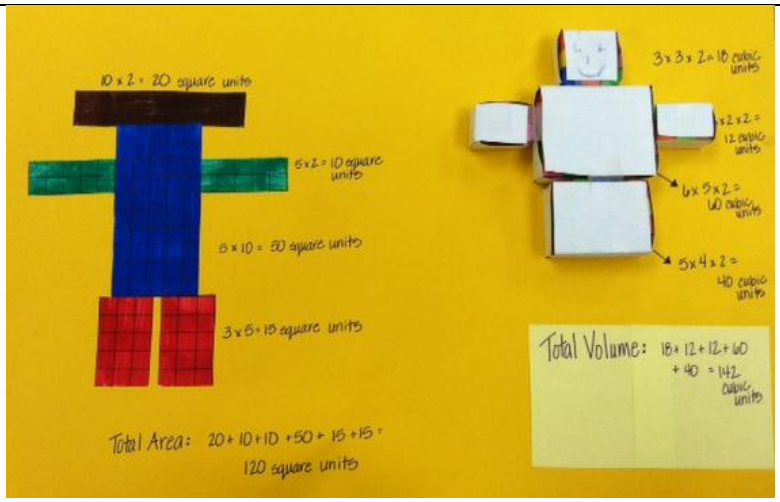
Objectives	**Content:** Students will measure the volume of rectangular prisms by packing them with cubic units.	**Language:** Students will compare and contrast area and volume in speaking and in writing.

Depth of Knowledge Level	☐ **Level 1: Recall** ☒ **Level 2: Skill/Concept** ☐ **Level 3: Strategic Thinking** ☐ **Level 4: Extended Thinking**
Standards for Mathematical Practice	☐ **1. Make sense of problems and persevere in solving them.** ☐ **2. Reason abstractly and quantitatively.** ☐ **3. Construct viable arguments and critique the reasoning of others.** ☒ **4. Model with mathematics.** ☐ **5. Use appropriate tools strategically** ☐ **6. Attend to precision.**

		☒ **7. Look for and make use of structure.** ☐ **8. Look for and express regularity in repeated reasoning.**	
Common Core Instructional Shifts in Mathematics		☐ **Focus on the Standards** ☐ **Coherence within and across grade levels** ☒ **Rigor (Balance of conceptual understanding, procedural skill & fluency, and application of skills)**	
Academic Vocabulary (Tier II & Tier III)	**TEACHER PROVIDES SIMPLE EXPLANATION**	**KEY WORDS ESSENTIAL TO UNDERSTANDING**	**WORDS WORTH KNOWING**
		Cubic units or unit cubes Square units or unit squares	Rectangular prism
	STUDENTS FIGURE OUT THE MEANING	Volume Area	Height Measure
Pre-teaching Considerations			
Lesson Delivery			
Instructional Methods		**Check method(s) used in the lesson:** ☐ **Modeling** ☐ **Guided Practice** ☒ **Collaboration** ☐ **Independent Practice** ☒ **Guided Inquiry** ☐ **Reflection**	
Lesson Opening		Always begin your lesson by reviewing the Big Idea and Essential Questions. Additionally, review in kid-friendly terms the content and language objectives. These should all be posted somewhere in your classroom. **Prior Knowledge, Context, and Motivation:** *"Whereas we created two dimensional, flat robots yesterday, today we're going to create three-dimensional, solid robots."*	
Body of the Lesson: Activities/ Questioning / Tasks/ Strategies/ Technology/		**<u>Lesson Overview</u>** **Warm-up:** Math Talk PowerPoint **Teacher Directions** Directions: • Pass out the Student Practice Net Sheets (one per group). One student will cut the paper into fourths so that each	**Differentiated Instruction:** **English Learners:** Volume is _____.

Lesson Continuum

Engagement	person in the group has a net. • Using the Student Practice Net Sheet model how to create a prism from a net with your students. • Students need to be precise when cutting and taping. There should not be any overlap or any gaps. • Have the students predict how many cubes can be packed into the prism. • Teacher will ask – "What can we do to pack the prism with cubes?' (Students should be able to tell that the top piece (face) should be cut off.) • Model how to cut the prism into an 'open box'. • Teacher packs the rectangular prism with cm cubes and notes that the prism = 18 cubes • Pass out the Student Robot Net Sheet. • Students will work in groups of four to create a robot. Given the specific nets, each student will create a prism from a net. • Distribute the Robot Recording Sheet. • Students find how many cubes are needed to pack each robot part with centimeter cubes. Students will record their data for the head, body, arms, and leg on the Robot Recording Sheet. • Each group will determine the total number of cubes (total volume) that fill their robot. • Students need to select **ONE** 2D robot from yesterday's lesson. Glue this robot to one side of the construction paper leaving at least 2 inches of paper on the bottom. • Students will glue their 3D robot next to their 2D robot. 	**Students Who Need Additional Support:** • Compare and contrast 'friendlier' (less cognitively demanding) items before area and volume • See Appendix for additional resources. **Accelerated Learners:** • Students will create their own nets by using their own dimensions.



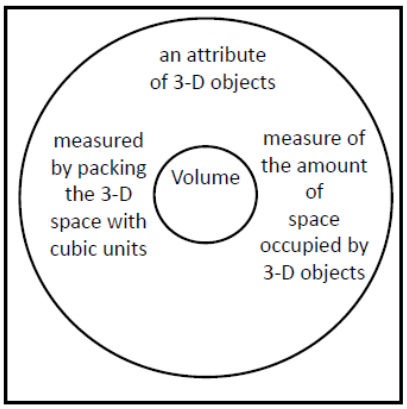
<u>VOLUME DISCUSSION</u>: ****Lead the discussion with the goal that students will discover the following about volume. This is also the time to take their mathematical ideas and attach the mathematical concepts with the academic language to these ideas. Please see the table below.****

Teacher poses the following questions to the class. Using Numbered Heads ***(see Appendix)*** *have students share out responses.*

Teacher Questioning	Possible Student Responses	Academic Rephrasing
What do you notice about the 3-D robot?	*"The robots pop out."*	***(Prisms are three dimensional.)***
What patterns do you notice?	"The prism is made up of equal layers**."**	***(Volume is related to operations of multiplication and addition.)***
We used cubes to measure something. What do you think the cubes measured?	"The cubes measured the inside of the robot."	***(Prisms have 'insides' which take up space. That space is called volume. One way volume can be measured is by packing the prism with cubes just like we did today.)***

What is the relationship between the size of the prism and the number of cubes it will hold?	*"The bigger the prism, the more cubes we needed."*	***(Volume increases as the size of the prism increases. In our study of volume, we'll call these cubes cubic units or unit cubes.)***

CLOSURE:



Volume is the measure of the amount of space occupied by 3-D objects. My 3-D robot takes up space. That 3-D space can be measured by packing it with cubic units.

Volume is _____.

Closure: Writing - Two-Minute Write (Please see Appendix)

In the math journals, students will answer the essential question:

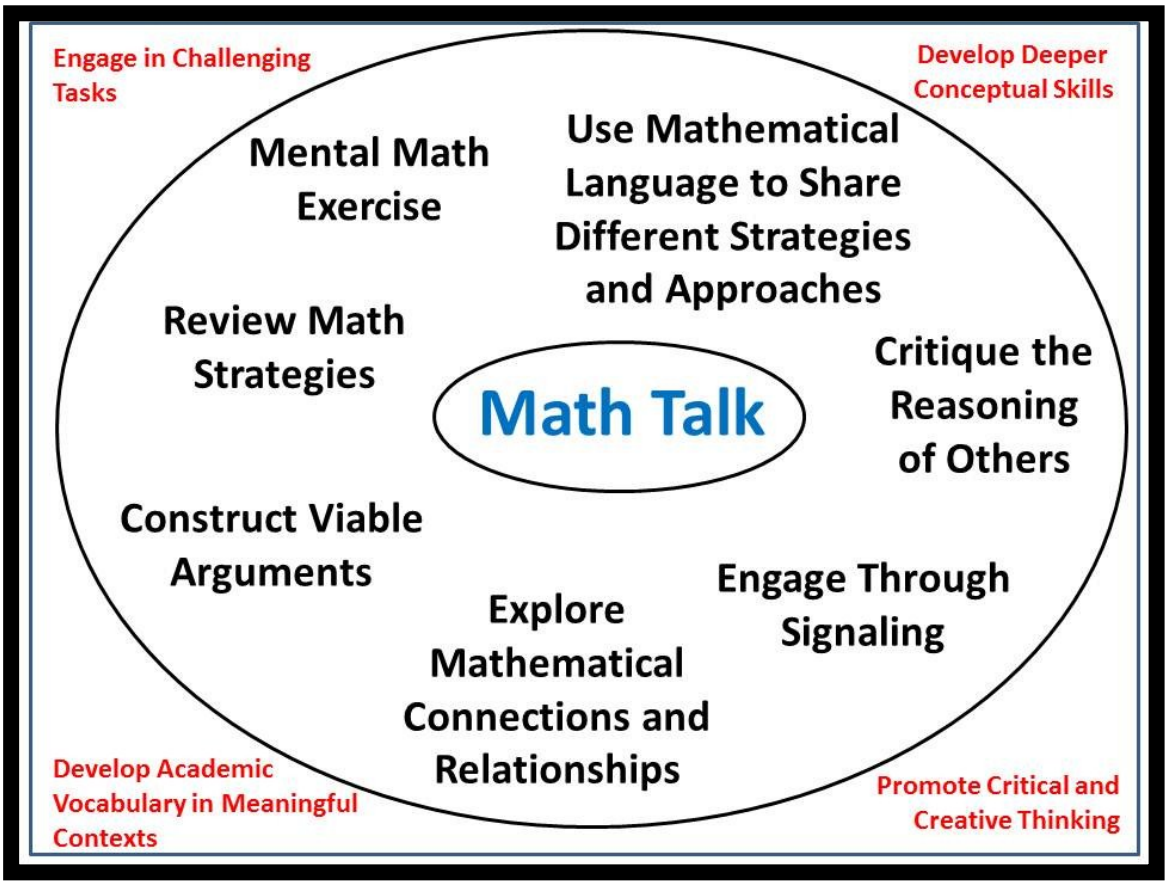
- *What is volume?*

Procedural Practice: To tie in conceptual understanding with computational fluency, have students find the unknowns in their journals.

- **K** x 6 unit x 6 unit = 72 unit^3
- 5 cm x 2 cm x **W** = 120 cm^3
- 4 ft x **P** x 8 ft = 160 ft^3

Lesson Reflection

Teacher Reflection Evidenced by Student Learning/ Outcomes	



Math Talk

Real Life Scenario

Jonathan's dad told him that he could grow a garden in his backyard. However he could only take up 24 square feet of space. What could the possible length and width of Jonathan's garden be?

Area = 24 square feet

Math Talk

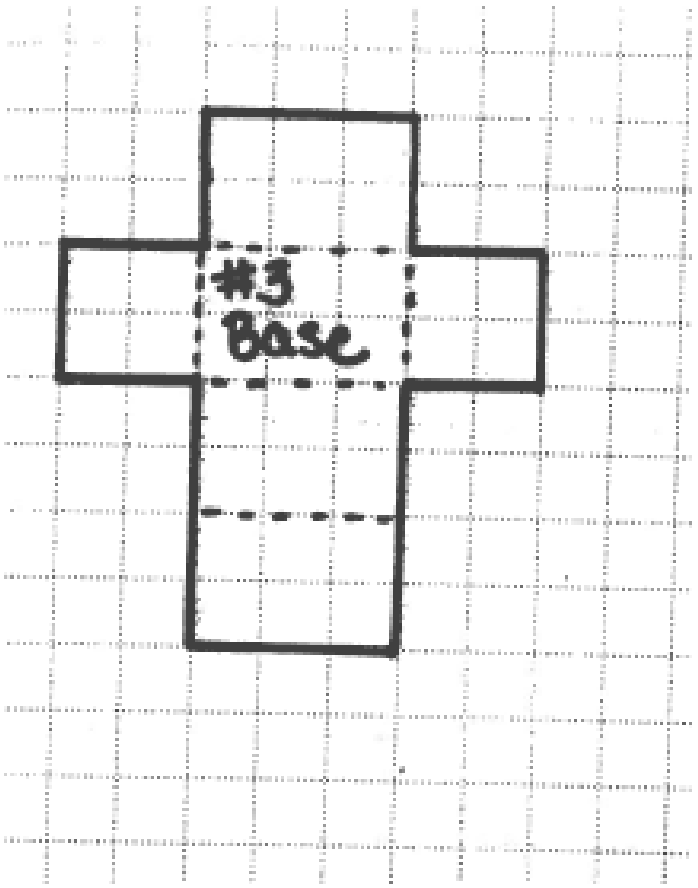
What could the possible length and width of Jonathan's garden be?

Area = 24 square feet

In your head think:

- What are some strategies you might try?
- What do the variables (length and width) used in the problem represent?
- Is there more than one solution to the problem?

Algebraic Thinking and Measurement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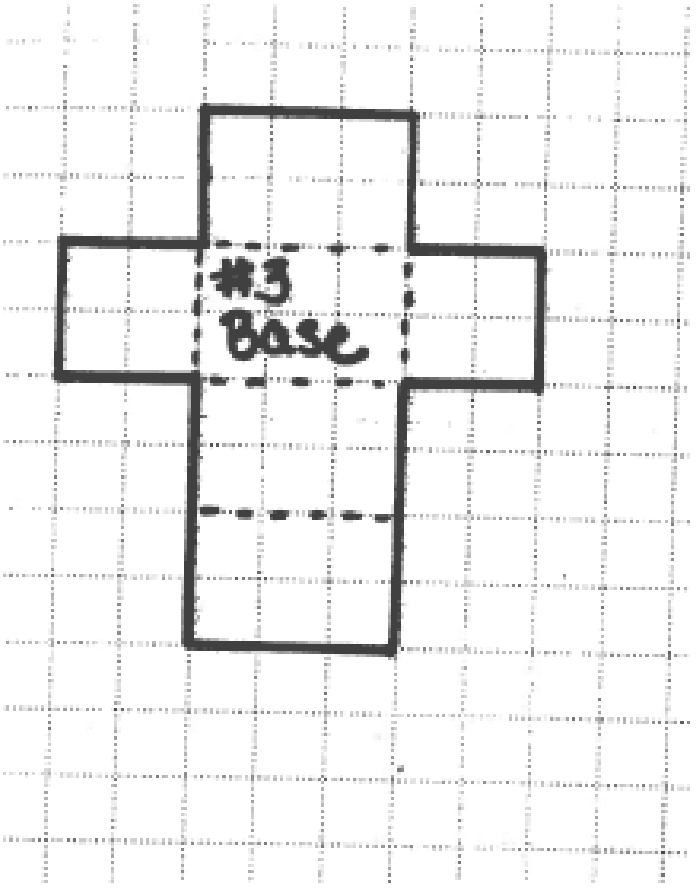
Base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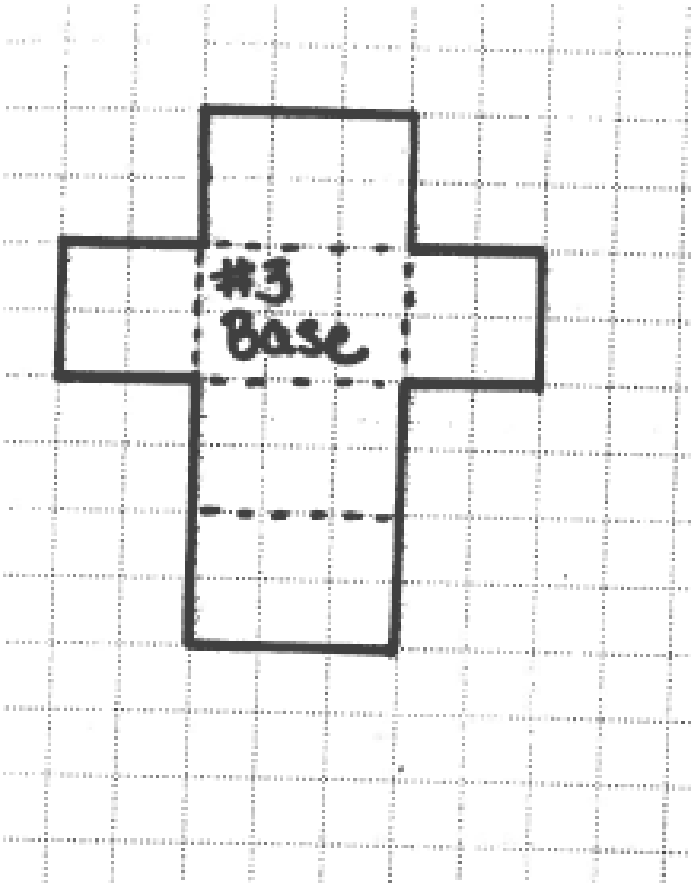
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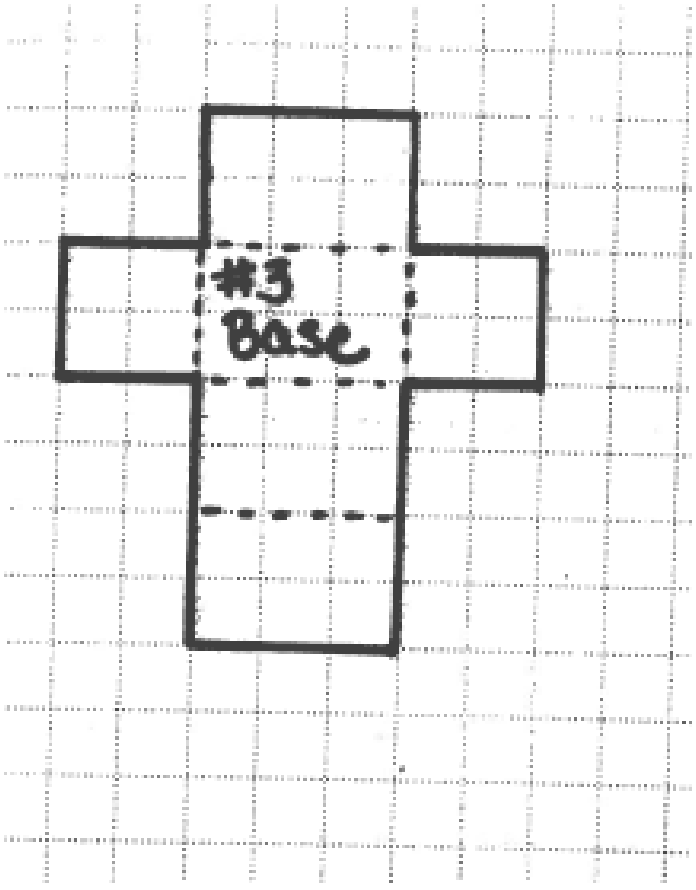
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Base

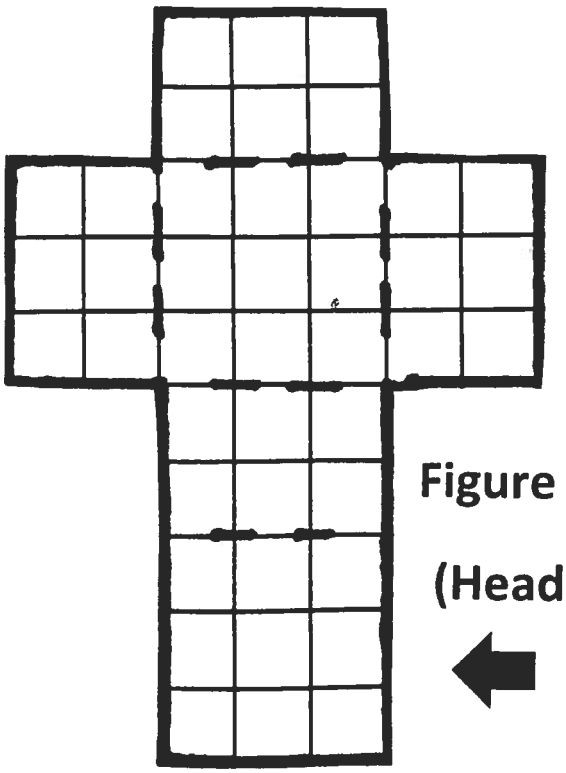


Figure A

(Head)

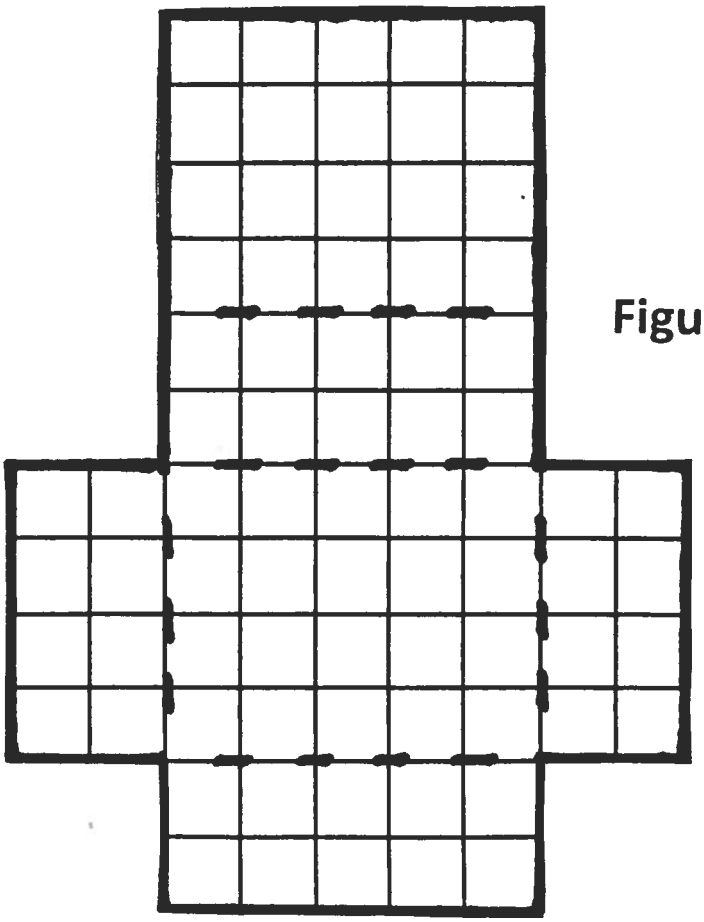


Figure D

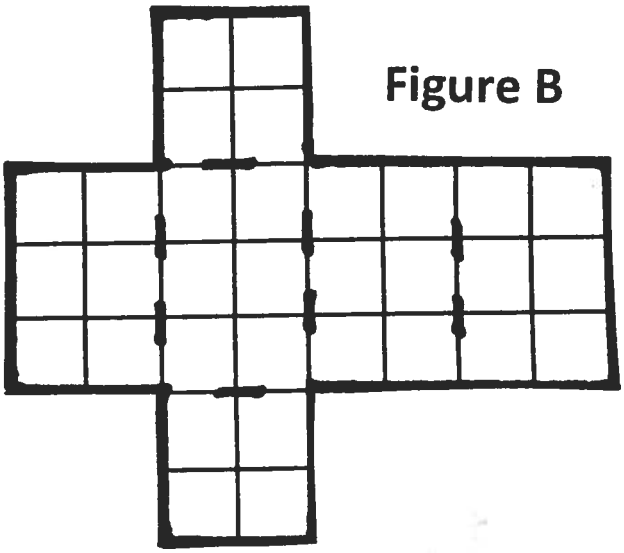


Figure B

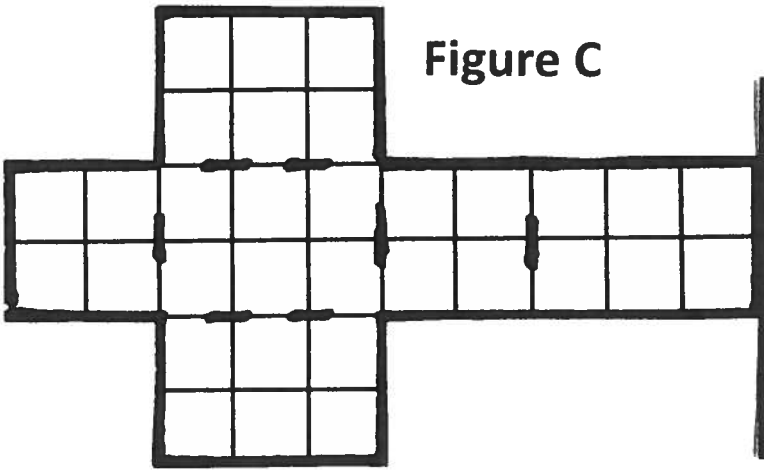


Figure C

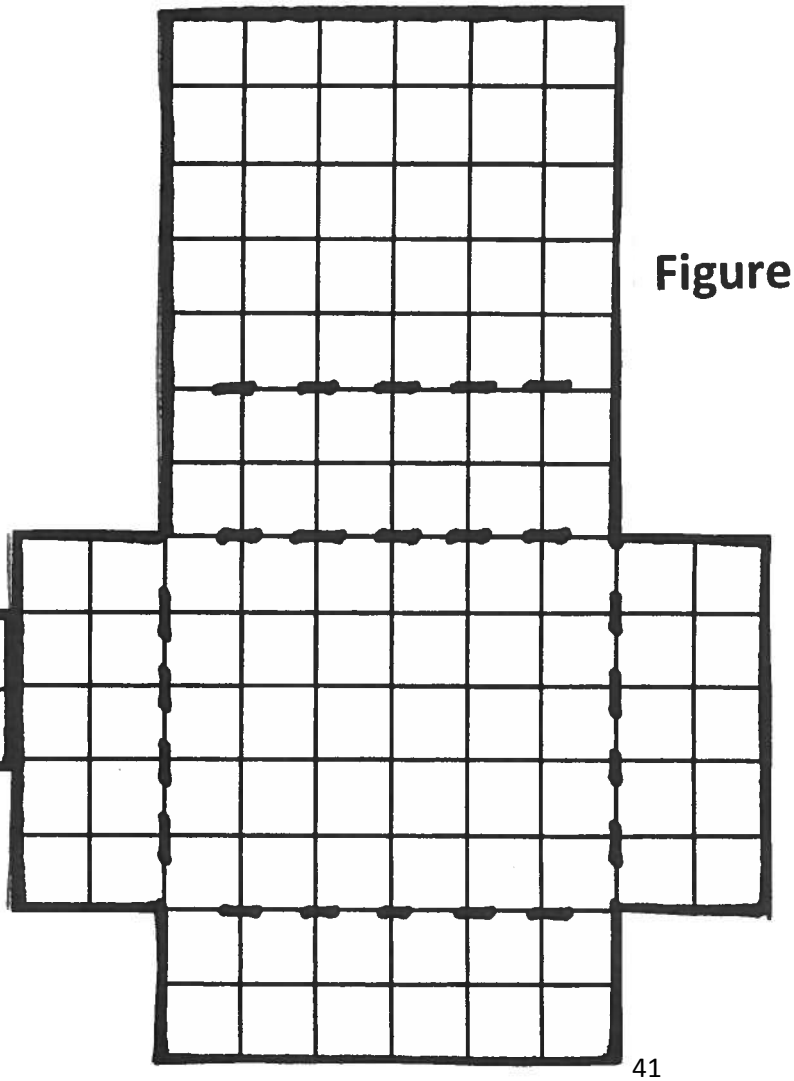


Figure E

Name _____

Robot Recording Sheet

Complete the following table:

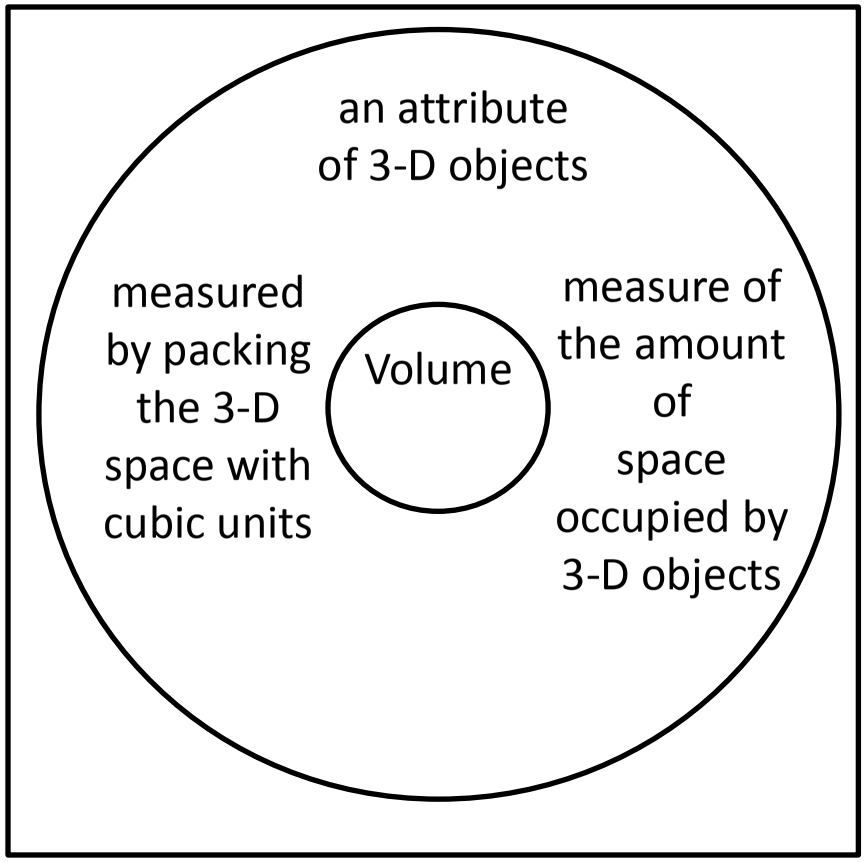
Part of the Robot	Dimensions of the Base length x width	Height	Volume (number of cubic units)

_____

Total Volume

Thinking Map for Lesson 1

Teacher Sample



Volume is the measure of the amount of space occupied by 3-D objects. My 3-D robot takes up space. That 3-D space can be measured by packing it with cubic units.

Volume is _____.

VOLUME HOMEWORK

Practice making prisms using these nets.

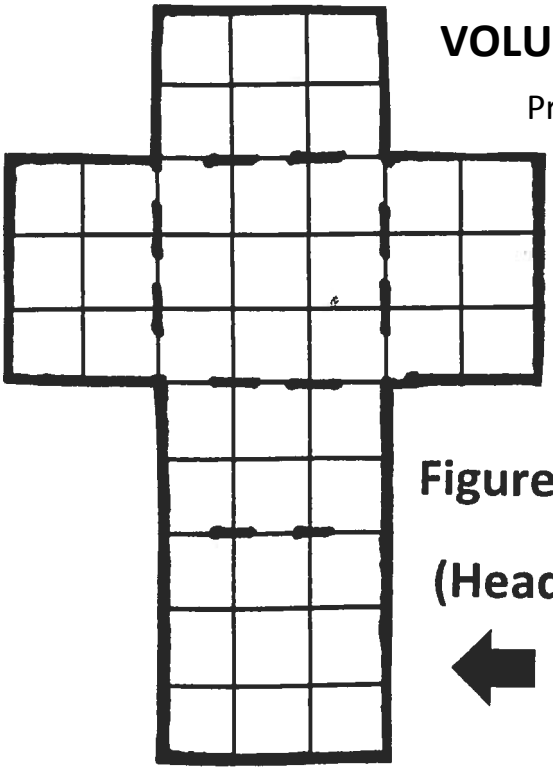


Figure A

(Head)

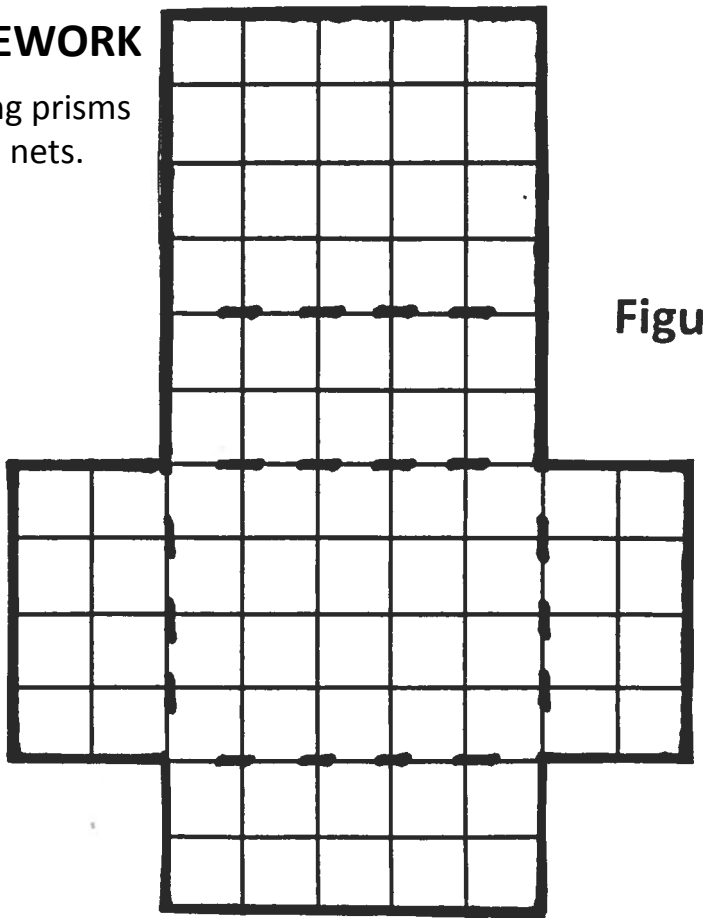


Figure D

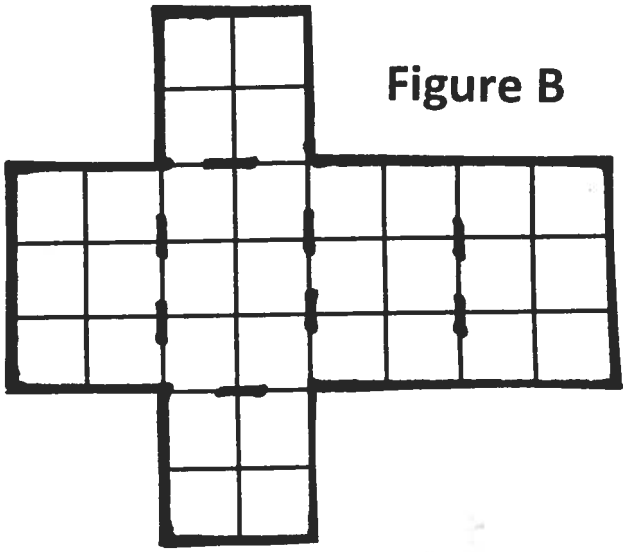


Figure B

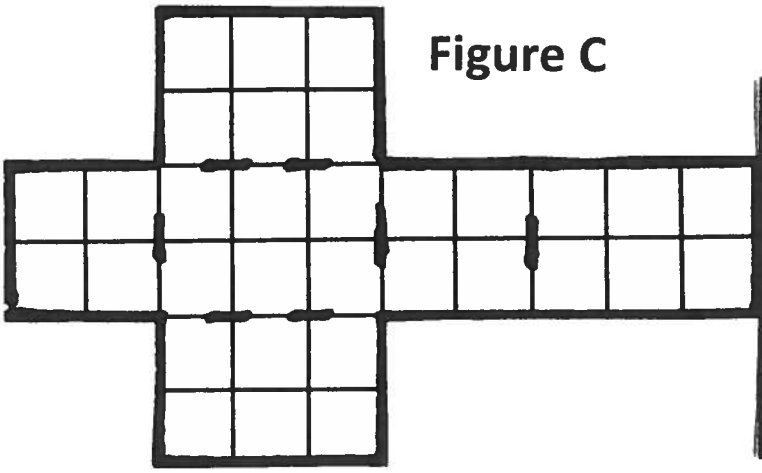


Figure C

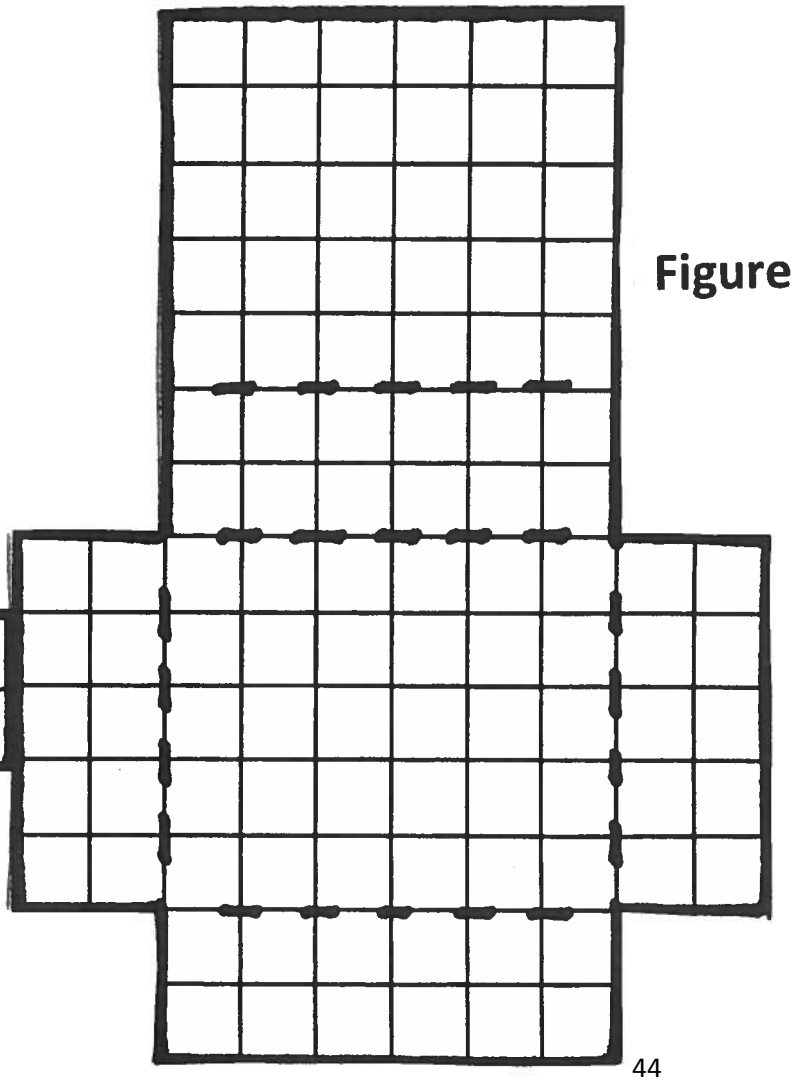
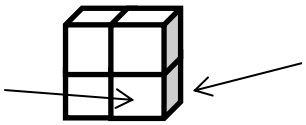


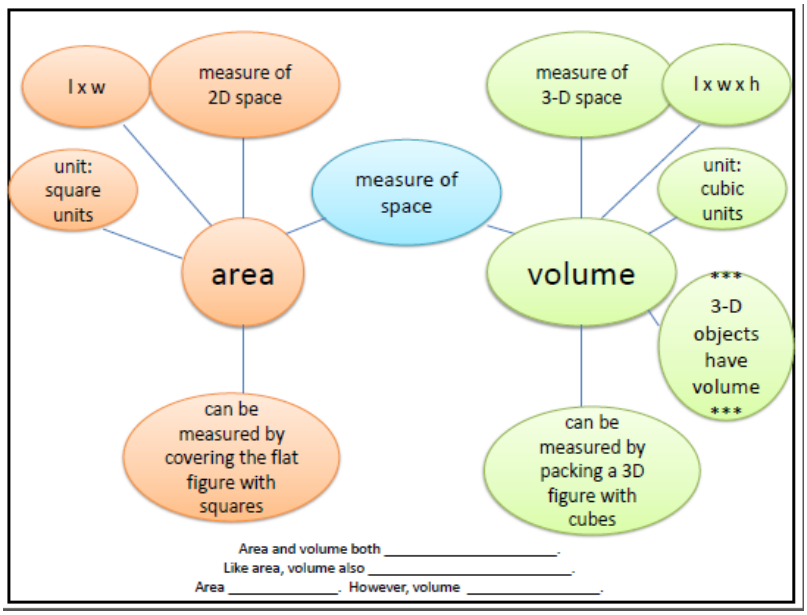
Figure E

Standing Robot

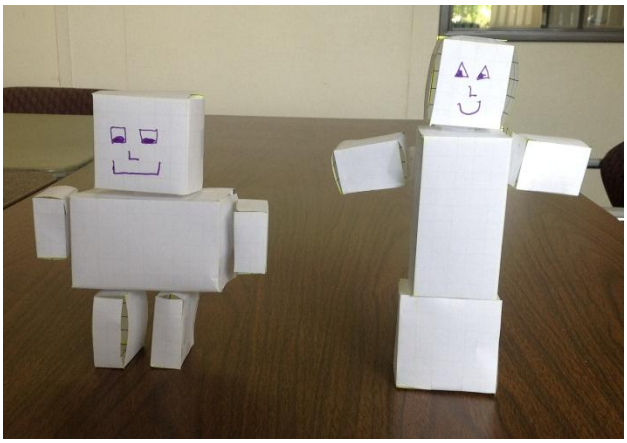
<table>
<tr><td>Unit:
Lesson 2</td><td>Grade Level/Course:
5th</td><td colspan="2">Duration: approximately 120 minutes (over 2 days)</td></tr>
<tr><td>Common Core and Content Standards</td><td colspan="3">5.MD.3 – Recognize volume as an attribute of solid figures and understand concepts of volume measurement.
a. A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.
b. A solid which can be packed without gaps or overlaps using n cubic units is said to have a volume of n cubic units.
5.MD.5 – Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.</td></tr>
<tr><td>Materials/ Resources/ Lesson Preparation</td><td colspan="3">• Post the Big Idea & Essential Questions
• Post Content & Language Objectives
• Math Talk PowerPoint
• Video: “How to Make a Net” (Provided by CLAS teachers)
• (Optional) Math Journal
• 1 cm. graph paper per student
• Blank sheet of paper for Compare & Contrast/Double Bubble Map
• Scissors
• cm. cubes (approximately 12 per student)
• Die (1 per group)
• Standing Robot Recording Sheet (1 per group)
• Tape (1 per group)
• Homework: Volume Lesson 2</td></tr>
<tr><td>Objectives</td><td colspan="2">Content:
Students will determine the volume of multiple prisms.
Students will make a conjecture about how to find volume of a rectangular prism without using cubes.</td><td>Language:
Students will compare and contrast area and volume in speaking and writing.</td></tr>
<tr><td>Depth of Knowledge Level</td><td colspan="3">☐ Level 1: Recall ☒ Level 2: Skill/Concept
☒ Level 3: Strategic Thinking ☒ Level 4: Extended Thinking</td></tr>
<tr><td>Standards for Mathematical Practice</td><td colspan="3">☒ 1. Make sense of problems and persevere in solving them.
☐ 2. Reason abstractly and quantitatively.
☐ 3. Construct viable arguments and critique the reasoning of others.
☒ 4. Model with mathematics.
☐ 5. Use appropriate tools strategically
☐ 6. Attend to precision.</td></tr>
</table>

		☒ **7. Look for and make use of structure.** ☐ **8. Look for and express regularity in repeated reasoning.**	
Common Core Instructional Shifts in Mathematics		☒ **Focus on the Standards** ☐ **Coherence within and across grade levels** ☒ **Rigor (Balance of conceptual understanding, procedural skill & fluency, and application of skills)**	
Academic Vocabulary (Tier II & Tier III)	**TEACHER PROVIDES SIMPLE EXPLANATION**	**KEY WORDS ESSENTIAL TO UNDERSTANDING**	**WORDS WORTH KNOWING**
		Cubic units or unit cubes Square units or unit squares	
	STUDENTS FIGURE OUT THE MEANING	Volume Area	
Pre-teaching Considerations		**<u>Math Talk:</u>** This addresses an area of difficulty for fifth grade students is understanding that **<u>more than 1 square</u>** in a diagram/picture might represent the same cube. Students need to be asked questions to help them see that cubes may have 1, 2, 3, or 0 faces shown in a diagram/picture (see Pre-Assessment). This ability to be fluent between diagrams/pictures and physical models is a critical foundation for the mathematics they will be learning in middle grades and for understanding and applying geometrical formulas.  *These 2 squares (faces) represent the same cube.* **<u>Lesson:</u>** Students will need to know how to make their own 'nets' for their rectangular prisms. A short video is provided as a part of this lesson which models how to create nets from a given set of dimensions. ***(Video will be provided by CLAS teacher.)***	
Lesson Delivery			
Instructional Methods		**Check method(s) used in the lesson:** ☐ **Modeling** ☐ **Guided Practice** ☒ **Collaboration** ☐ **Independent Practice** ☒ **Guided Inquiry** ☒ **Reflection**	

Lesson Continuum

Lesson Opening	Always begin your lesson by reviewing the Big Idea and Essential Questions. Additionally, review in kid-friendly terms the content and language objectives. These should all be posted somewhere in your classroom. **Prior Knowledge, Context, and Motivation:** ***"Today we're going to create three-dimensional robots to explore the concept of volume."***	
Body of the Lesson: Activities/ Questioning /Tasks/ Strategies/ Technology/ Engagement	**<u>Review of Lesson 1</u>** • **<u>VOLUME & AREA</u>**: Pass out the blank sheet of paper. Have the students compare and contrast area and volume using both their 2D & 3D robots (please see example) by creating a Compare & Contrast/Double Bubble Map. Students will orally rehearse one comparing and one contrasting statement.  • **<u>Speaking and Listening:</u>** • **<u>Stroll, Pair, Share (Please see Appendix)</u>**: Students will share their rehearsed comparing and contrasting sentences with others. **<u>Lesson Overview</u>** **Warm-up:** Math Talk PowerPoint **Teacher Directions** • Optional: You may show the demonstration video of "How to Create Nets." • In groups of four, students will create a 'standing robot'. • Pass out the Standing Robot Recording Sheet and one die. • Each group member will roll a die three times to find the dimensions of a robot part. The number 1 will represent 10. • Record the dimensions on the Standing Robot Recording Sheet.	**Differentiated Instruction:** **English Learners:** • Provide leveled sentence starters for comparing and contrasting. *"Area and volume both _____."* *"Like area, volume also _____."* *Area _____, but volume _____."* **Students Who Need Additional Support:** See Appendix for additional resources. **Accelerated Learners:** Once volume is determined, students will create a robot with half its volume.

- Then students will determine which set of dimensions will be assigned to each robot part. For example: 5x5x4 = head, 2x2x3 = arm (They will need to make two.)
- Students will draw the nets on their graph paper and then cut them out.
- Students will then create rectangular prisms from their nets.
- Students will calculate the volume of each rectangular prism. This is student exploration – some will use the algorithm while others will need to "pack" their cube.
- Students will tape their rectangular prisms together to create 1 group robot.
- Students will calculate the TOTAL volume of the ENTIRE robot and record it on their Standing Robot Recording Sheet.



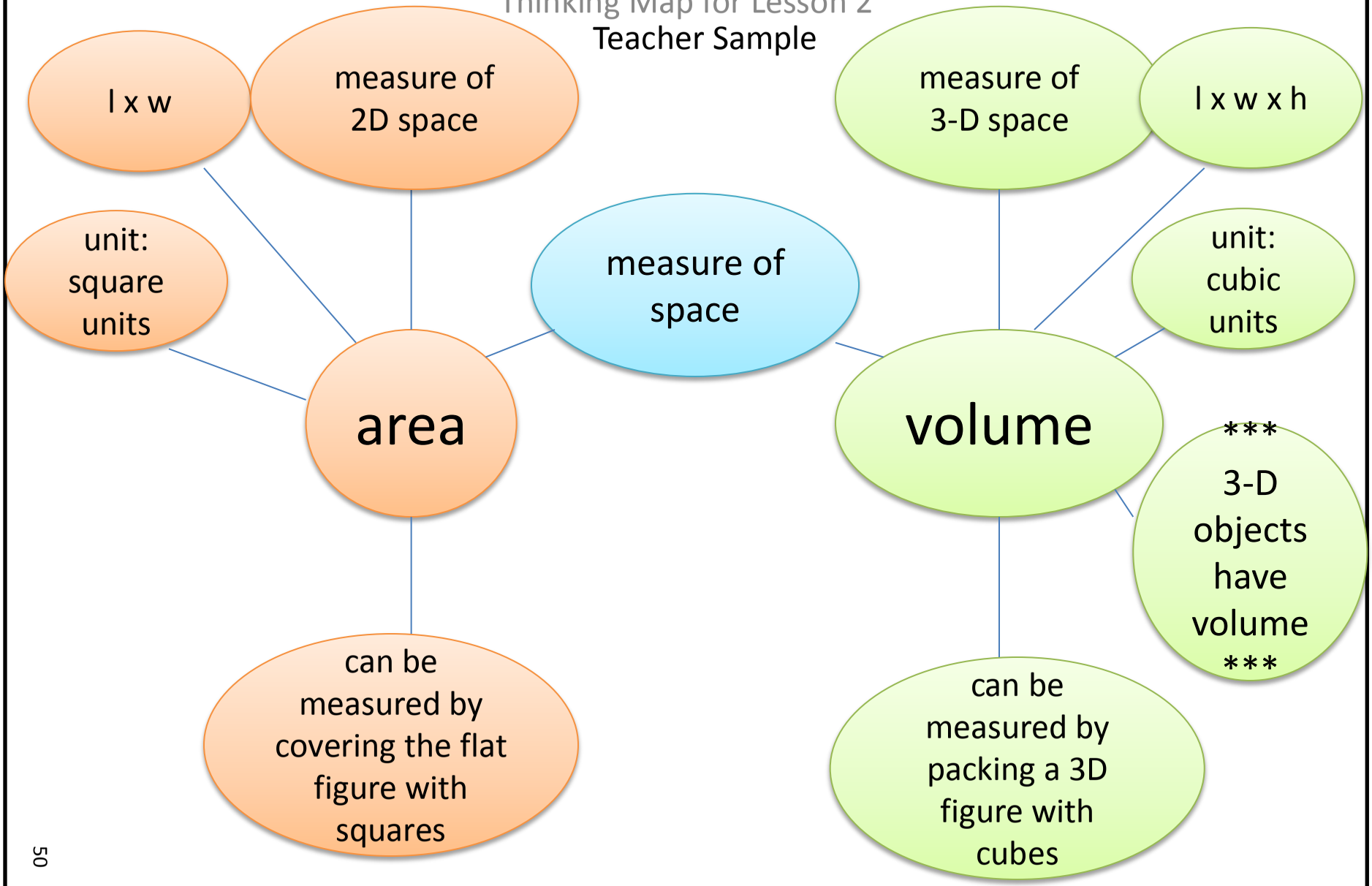
VOLUME DISCUSSION: *********Lead the discussion with the with the goal that students will discover the following about volume. This is also the time to take their mathematical ideas and attach the mathematical concepts with the academic language to these ideas. Please see the table below.****

Teacher Questioning	Possible Student Responses
How did we find the TOTAL volume of the ENTIRE robot? ***What were the strategies that your group used?*** ***What challenges did your group encounter?***	• *"We added up the volume of all the prisms that made up the robot."* • *Student responses will vary.*

	*****This is a good place to stop, if you are out of time.*** Distribute the net worksheet for Lesson 2 and have students cut out the net. Have students determine the volume by using some cubes (but not enough to fill the entire prism). Record the dimensions of the final net on the Standing Robot recording sheet from earlier. In groups, look at the numbers from the chart and make a conjecture/statement about how to find the volume of a rectangular prism without using cubes. **TEACHER NOTE:** Students need to discover that there is a pattern – volume is the area of the base X's the height. (Length X's Width X's Height). This is ESSENTIAL to the unit. **Closure: Writing - Two-Minute Write (Please see Appendix)** In the math journals, students will answer the essential questions: • *How are area and volume alike and different?* • *How do we measure volume?* **Practice:** To tie in conceptual understanding with computational fluency, have students find the unknowns in their journals. • **K** x **D** x 3 unit = 27 unit³ • 3 in x **Q** x **W** = 54 in³ • 5 cm x **P** x **S** = 100 cm³	
Lesson Reflection		
Teacher Reflection Evidenced by Student Learning/ Outcomes		

Thinking Map for Lesson 2

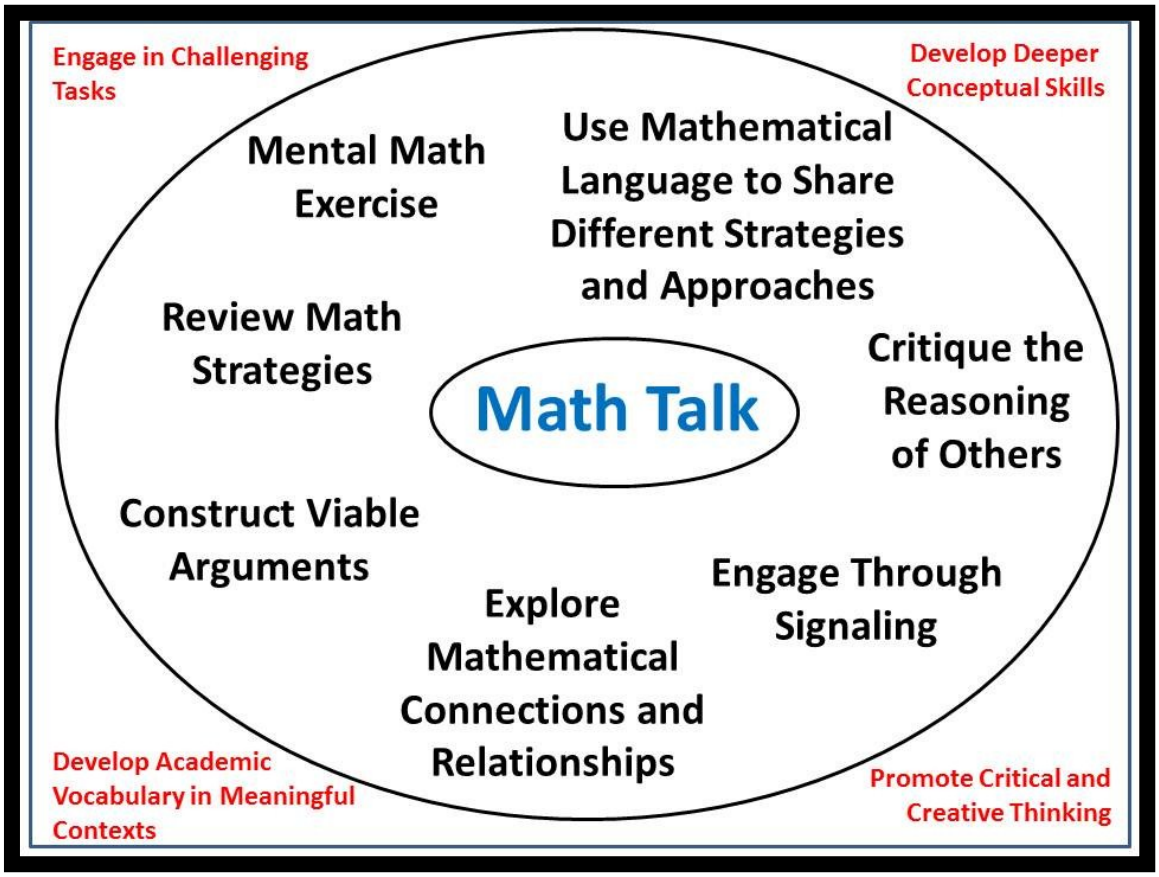
Teacher Sample

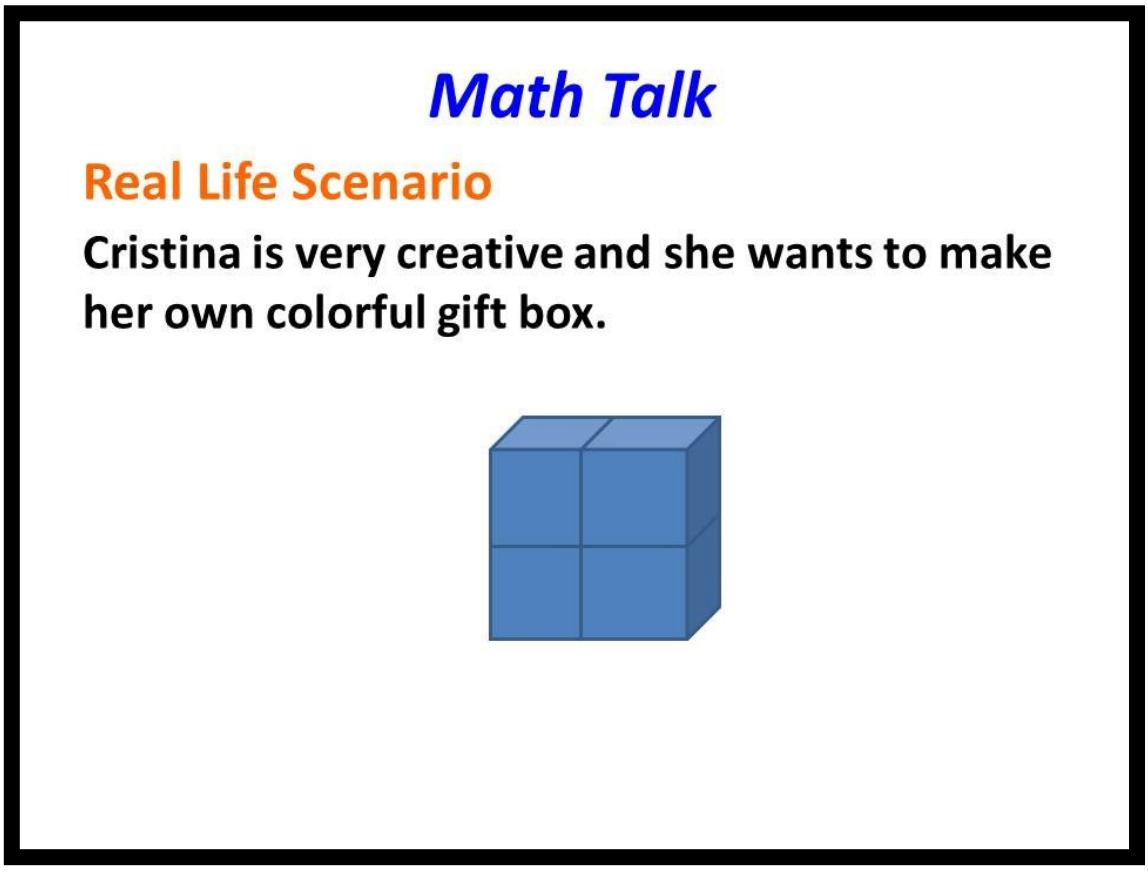


Area and volume both _____.

Like area, volume also _____.

Area _____. However, volume _____.

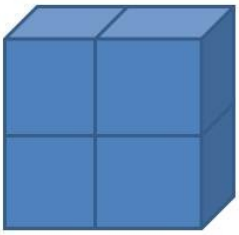

Engage in Challenging Tasks
Develop Deeper Conceptual Skills
Mental Math Exercise
Use Mathematical Language to Share Different Strategies and Approaches
Review Math Strategies
Math Talk
Critique the Reasoning of Others
Construct Viable Arguments
Engage Through Signaling
Explore Mathematical Connections and Relationships
Develop Academic Vocabulary in Meaningful Contexts
Promote Critical and Creative Thinking


Math Talk
Real Life Scenario
Cristina is very creative and she wants to make her own colorful gift box.

Math Talk

Real Life Scenario

She needs a box with a volume of 4 cubic units. She looked at this box and concluded that it has a volume of 16 cubic units.

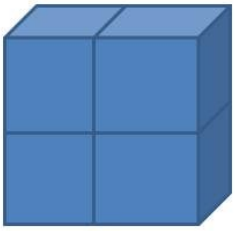


Cristina is clearly mistaken.
Analyze her mathematical error.

Math Talk

Real Life Scenario

She needs a box with a volume of 4 cubic units. She looked at this box and concluded that it has a volume of 16 cubic units.



In your head think:

- What are some strategies you might try?
- What do the numbers 4 and 16 represent?
- How do the numbers 4 and 16 differ?

Name _____

Standing Robot – Lesson 2

1) Roll a die three times to find the dimensions of each of your robot's body parts.
2) Create the nets based on these dimensions (one net for each body part).
3) Create the rectangular prisms from the nets.
4) Calculate the volume of each rectangular prism. Show evidence of your work.
5) Calculate the TOTAL volume of the ENTIRE robot. Show evidence of your work.
6) Tape your rectangular prisms together to create a robot. **Your robot must be able to stand upright.**

Robot Part	Dimensions of Base	Height	Volume
		Total Volume	_____

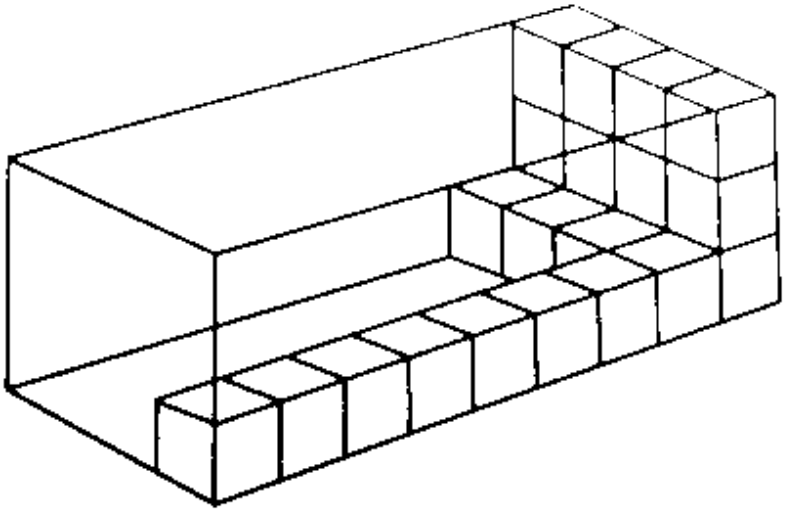
Looking at the numbers in the chart and thinking about your method to find volume for the last prism, make a conjecture about how to find the volume of a rectangular prism without using cm cubes.

How can you find the volume of a rectangular prism without using cm cubes?

HOMEWORK

Name _____

VOLUME – LESSON 2



Find the volume of this rectangular prism. Please show evidence of your work.

Explain your reasoning.

Pack Your Boxes!

<table>
<tr><td>Unit:
Lesson 3</td><td>Grade Level/Course:

5th</td><td colspan="2">Duration: approximately 60 minutes</td></tr>
<tr><td>Common Core and Content Standards</td><td colspan="3">5.MD.3 – Recognize volume as an attribute of solid figures and understand concepts of volume measurement.
a. A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.
b. A solid which can be packed without gaps or overlaps using n cubic units is said to have a volume of n cubic units.
5.MD.4 – Measure volumes by counting unit cubes, using cubic cm., cubic in., cubic ft., and improvised units.
5. MD.5 – Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.
a. Find the volume of a right rectangular prism with whole number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volume, e.g. to represent the associative property of multiplication.
b. Apply the formula V= L x W x H for rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.</td></tr>
<tr><td>Materials/ Resources/ Lesson Preparation</td><td colspan="3">• Post the Big Idea & Essential Questions
• Post Content & Language Objectives
• Math Talk PowerPoint
• ST Math (Ji-Ji) Connection to Math Talk
• ST Math Helpful Hints Bookmark
• Pack Your Boxes! Worksheet
• Graph paper
• Scissors
• Centimeter cubes
• Video: How to Build a Net
• (Optional) Math Journal
• Tape (1 per group)
• Homework: Lesson 3 Homework</td></tr>
<tr><td>Objectives</td><td colspan="2">Content:
Students will find the volume of rectangular prisms.</td><td>Language:
Students will sequence the steps they followed to build their prisms and their strategies to solve problems.</td></tr>
<tr><td>Depth of Knowledge Level</td><td colspan="2">☒ Level 1: Recall

☒ Level 3: Strategic Thinking</td><td>☒ Level 2: Skill/Concept

☒ Level 4: Extended Thinking</td></tr>
</table>

<table>
<tr><td colspan="2">Standards for Mathematical Practice</td><td colspan="2">☒ 1. Make sense of problems and persevere in solving them.
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☒ 3. Construct viable arguments and critique the reasoning of others.
☒ 4. Model with mathematics.
☒ 5. Use appropriate tools strategically.
☒ 6. Attend to precision.
☒ 7. Look for and make use of structure.
☒ 8. Look for and express regularity in repeated reasoning.</td></tr>
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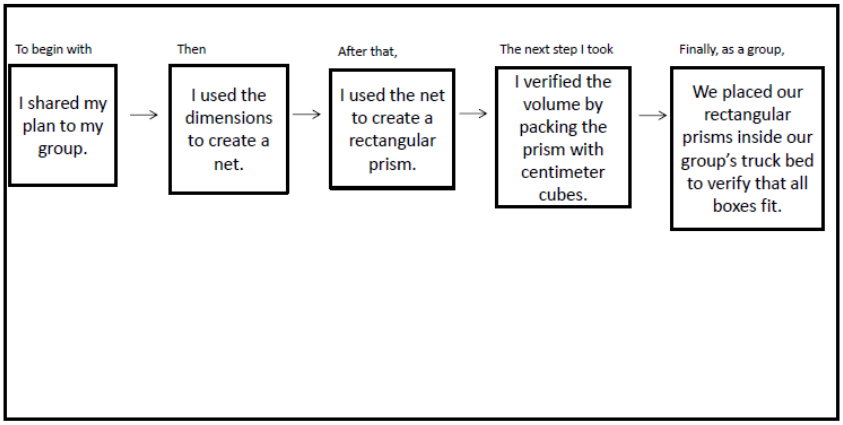
☐ Coherence within and across grade levels
☒ Rigor (Balance of conceptual understanding, procedural skill & fluency, and application of skills)</td></tr>
<tr><td rowspan="3">Academic Vocabulary (Tier II & Tier III)</td><td>TEACHER PROVIDES SIMPLE EXPLANATION</td><td>KEY WORDS ESSENTIAL TO UNDERSTANDING</td><td>WORDS WORTH KNOWING</td></tr>
<tr><td></td><td>Nets
Prism</td><td></td></tr>
<tr><td>STUDENTS FIGURE OUT THE MEANING</td><td>Bed of truck or truck bed</td><td></td></tr>
<tr><td colspan="2">Pre-teaching Considerations</td><td colspan="2"></td></tr>
<tr><td colspan="4">Lesson Delivery</td></tr>
<tr><td colspan="2">Instructional Methods</td><td colspan="2">Check method(s) used in the lesson:
☐ Modeling ☐ Guided Practice ☒ Collaboration
☒ Independent Practice ☒ Guided Inquiry ☒ Reflection</td></tr>
<tr><td colspan="2">Lesson Opening</td><td colspan="2">Always begin your lesson by reviewing the Big Idea and Essential Questions. Additionally, review in kid-friendly terms the content and language objectives. These should all be posted somewhere in your classroom.

Prior Knowledge, Context, and Motivation:
The teacher will explain to the students that they will use their prior knowledge of volume and apply it to solve a real world problem. This will require them to use a variety of problem solving strategies. The story is a real possibility with a problem to solve, which is the motivational hook.</td></tr>
</table>

Lesson Continuum

Body of the Lesson: Activities/ Questioning /Tasks/ Strategies/ Technology/ Engagement	**Lesson Overview** **Warm-up:** Math Talk PowerPoint Note: For the next 2 lessons you will be using ST Math as a whole group during Math Talk. Please see the Connection to Math Talk directions at the end of this lesson. Pass out the ST Math Helpful Hints bookmark. **Teacher Directions** 1. Pass out the Recording Sheet. 2. Explain to students they will be working in groups of four. ***"Read the problem "Pack Your Boxes!" quietly to yourself. Take a minute to think about how you would solve the problem."*** (Allow time for students to think.) ***"Share with your group and come up with a plan you can all agree on."*** (Allow approximately 10 min. before calling on groups to share.) *3.* Teacher will listen to group ideas and ask questions such as: ***"Can you give me an example? ", "Can anyone add to that?", "So, let me see if I understand…"*** *4.* Have a student from each group pick up the necessary materials. *5.* Tell students ***"Each of you will be responsible for building one of the boxes. If you have difficulty including the top of the box in your net, you may add it later."*** *6.* Have students share their ideas on how to build the boxes before they begin. Allow time for students to explore with drawing the nets. Be sure to circulate to all of the tables and offer hints to center the base of the boxes. **NOTE:** If you think most students need help, lead them through how to center the base of the box by demonstrating how to draw the rectangular prism (bed of the truck) on the graph paper. As a resource to the teacher: you may want to watch the video. *7.* Students will each build one box using the given dimensions. *8.* After students build their boxes they will need to fill them with cm. cubes to determine the volume. *9.* Record data on the Recording Sheet. *10.* Students will physically place their boxes in the bed of the truck. They will conclude after adding the volume of the three smaller boxes that the boxes will fit in the enclosed bed of the truck. 11. In their groups, students will discuss the solutions to the problems of the story. "My mom told me that the boxes have the same amount of space. I want to figure out if Mom is right." "Then Mom told me to check that our boxes will fit in the bed of Dad's truck." 12. As a group, students will sequence the steps they followed to build their prisms and their strategies to solve problems.	**Differentiated Instruction:** **English Learners:** First, _____. To begin with, _____. The next step, _____. Finally, _____. **Students Who Need Additional Support:** Students may use calculators to determine volume. See Appendix for additional resources. **Accelerated Learners:** Ask students if a 4^{th} box will fit and what would the dimensions of that box be. If your boxes were half the size of the originals, how many could you fit?



First, _____.
To begin with, _____.
The next step, _____.
Finally, _____.

Teacher note:

After students have determined that these boxes will fit pose the question, "If the volume of the boxes is less than the volume of the truck bed, will the boxes always fit?" Allow students to discuss with their group the scenarios when it would not work and explain why. Just because the volume is less than or the same as the truck bed doesn't mean the boxes will always fit. They need to consider the dimensions of the boxes.

Closure: Writing - Two-Minute Write (Please see Appendix)

In the math journals, students will answer the essential question:

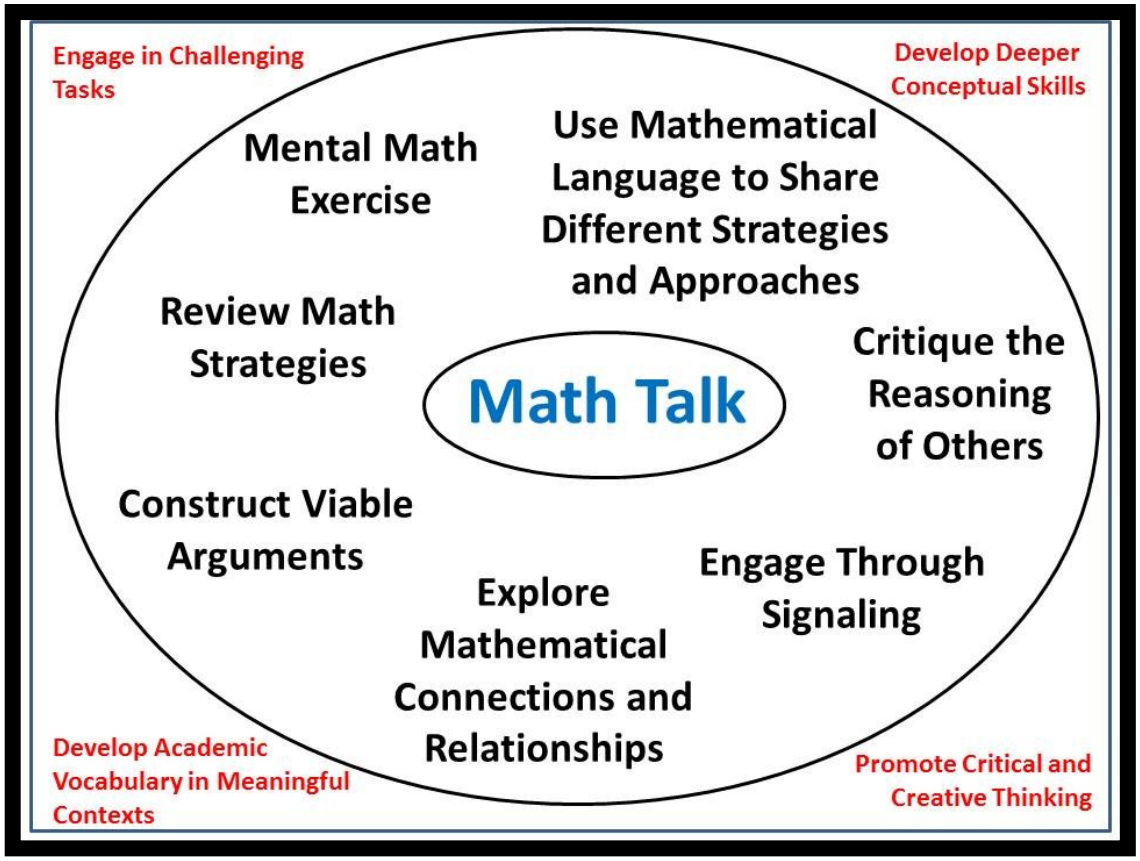
- *Why is it important to know how to measure volume?*

Procedural Practice: To tie in conceptual understanding with computational fluency, have students find the unknowns in their journals.

- **K** x **D** x 1 unit = 16 unit^3
- 23 cm x **Q** x **W** = 23 cm^3
- 4 in x **P** x **S** = 60 in^3

Lesson Reflection

Teacher Reflection Evidenced by Student Learning/ Outcomes	



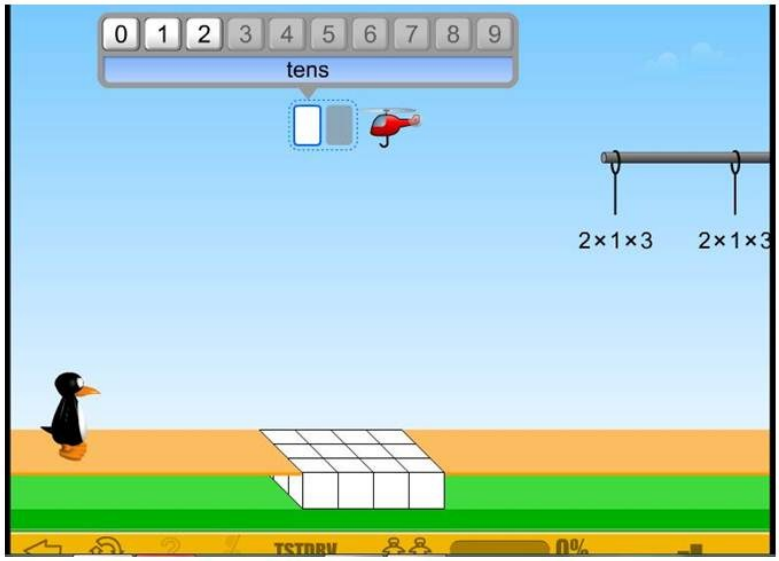
Math Talk

Even though you've had a lot of practice with Jiji, you haven't had an opportunity to reflect or to explain what is happening. Take your time to think about the questions posed. When you are ready to give an explanation about your strategy, put your thumb up. If you have more than one strategy, hold up another finger.

Jiji Time

Math Talk

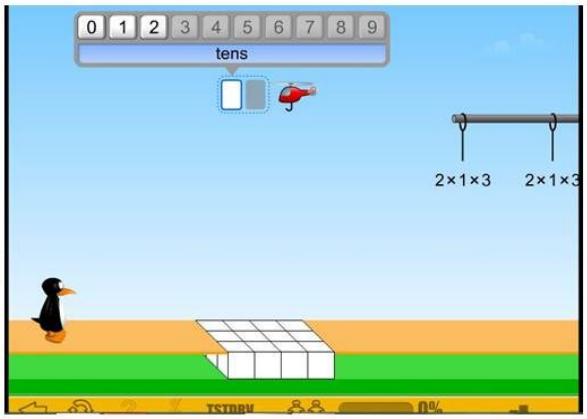
Take a close look.



Math Talk

In your head think:
What do you notice?
What else do you notice?
Is this like an activity that you have done before? How is it the same? How is it different?
What does Jiji need to do?
How might you begin?

Volume

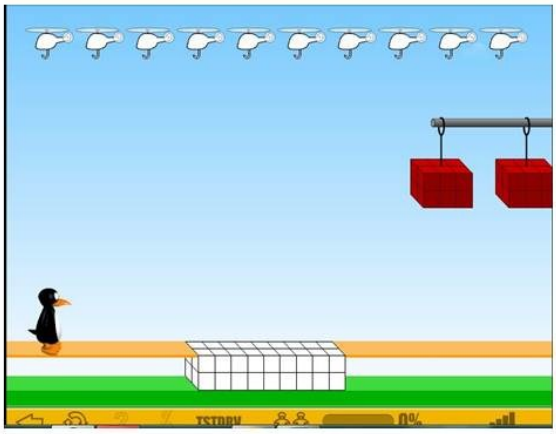


Math Talk

Time to Share Out!

Volume

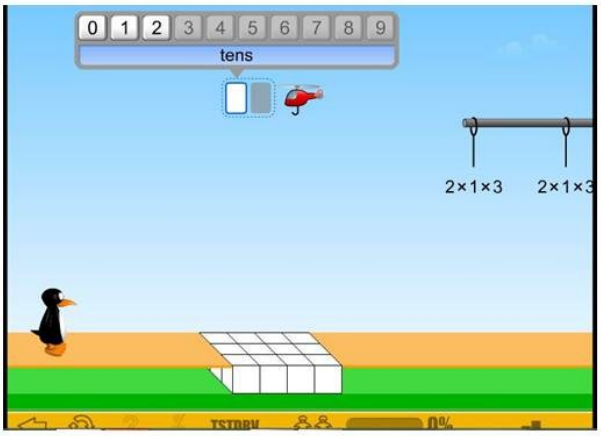
I noticed that _____.
Something else I noticed is _____.
This is like _____ that I did before because _____.
It's different from _____ because.
Jiji needs to _____ because _____.
I would begin by _____.



Math Talk

Volume

In your head think about the following *essential questions*:
How do you measure volume?
Why is volume represented with cubic units?



Time to Share Out!

Math Talk

Ready to try out your strategy?

St Math Teacher Login Link:
http://web.stmath.com/entrance/microtc.html#/ndl

ST Math (Ji Ji)

Connection to Math-Talk

Day 6 – Lesson 3: "Pack Your Boxes!"

NOTE: This Math Talk will be done whole group. Students will not be doing this individually on computers.

- **Follow the "script" on slides 2 – 6 of this lesson's Math Talk PowerPoint.**
- **When you reach the final slide, login in to ST Math as a teacher and display on the big screen.**
- **Follow the steps on the back of this page to be sure that you are opening up the correct game and level.**
- **For today you will be focusing on "Helicopter *LI* – Level 3"**
  - **NOTE: Make sure you do not confuse this with another game on the opening page that is just called, "Helicopter Volume."**
  - **NOTE: Your opening of the game may not look exactly the same, as it could start with a different problem than the one shown on the final slide on the back of this page.**
- **Discuss how the game is played, but do not provide students with strategies or solutions.**
- **Use the ST Math bookmark (each student should have one) to guide students through the process of how they may solve this problem.**
  - **NOTE: You may use your own judgment to select questions from the bookmark that are appropriate for your class.**
- **If you have enough time, you may move on to the next problem(s) in the same game and level and follow the same process.**

ST Math (Ji Ji)

Connection to Math-Talk

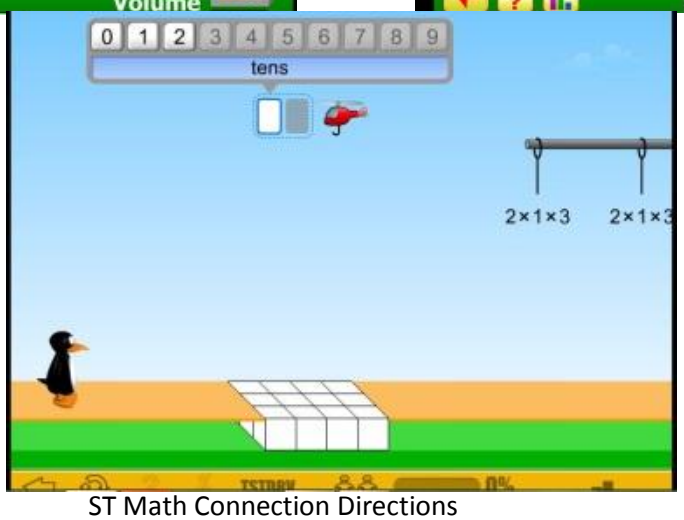
Day 6 – Lesson 3: "Pack Your Boxes!"

CLICK ON: Volume

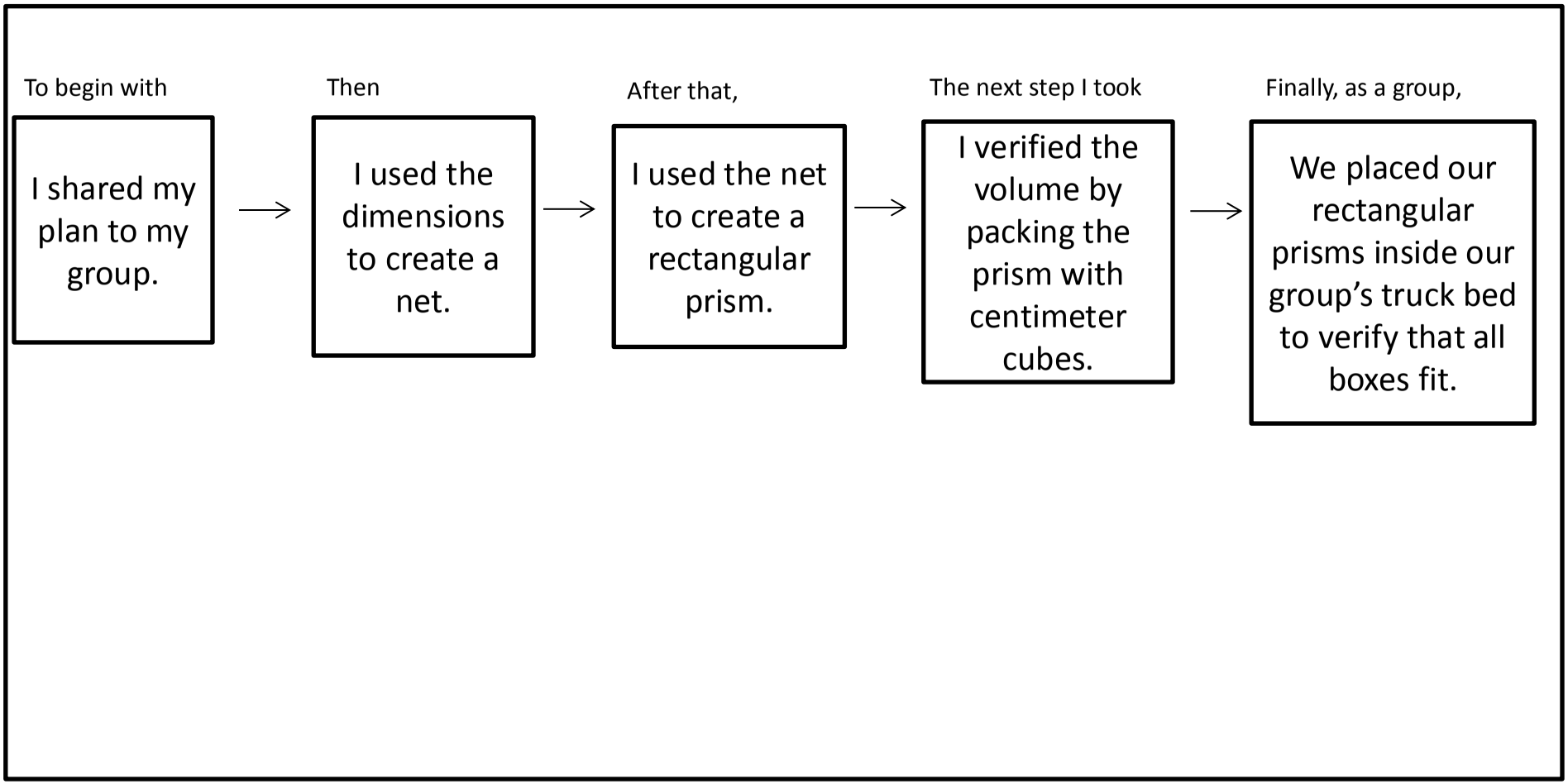
Volume

Helicopter Volume LI

Level 3

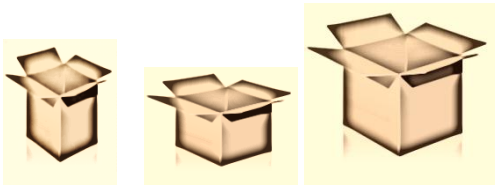


Thinking Map for Lesson 3
Teacher Sample



First, _____.
To begin with, _____.
The next step, _____.
Finally, _____.

"Pack Your Boxes!"



Name:_____ **Date:**_____

Our family is going on vacation to Joshua Tree. Mom told us we will be gone for an entire week. She is giving us boxes to pack our things in. My sister got the largest box because she has more stuff. It is 3ft. long, 3ft. wide and 2ft. high. My brother's box is 2ft. long, 3ft. wide and 2ft. high. My box is 2ft. long, 2ft. wide and 3ft high. I'm not sure why I got the smallest box. My mom told me that the boxes have the same amount of space. I want to figure out if Mom is right. Then Mom told me to check that our boxes will fit in the bed of Dad's truck. The dimensions for the truck bed are 6ft. long, 5 ft. wide and 3 ft. high. Help me figure this out. Make the boxes using graph paper. Each centimeter will represent 1 foot to recreate the boxes and the bed of the truck.

Boxes' Volume

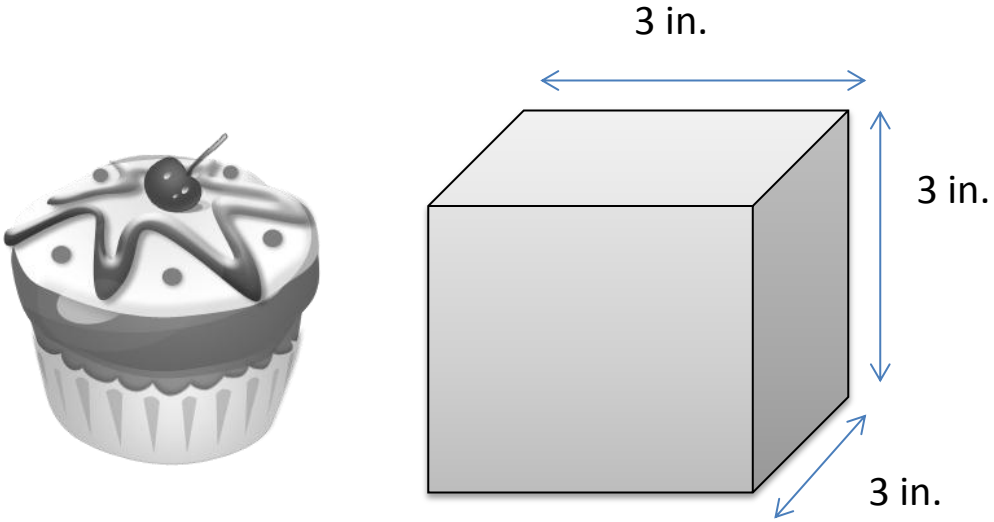
Box	Diagram	Length	Width	Height	Volume
Sister's					
Brother's					
Mine					
Total	X	X	X	X	

Box	Diagram	Length	Width	Height	Volume
Truck bed					

Name _____

Lesson 3 Homework

Maria works at a bakery. When she sells individual cupcakes, she packages each cupcake in a cube-shaped box. Each box measures 3 inches in length, width, and height.



Individual Cupcake Box

1. Maria wants to design a new box that holds 6 cupcakes. The new 6-pack cupcake box must
   - be a rectangular prism;
   - provide each cupcake with the same dimensions of space as an individual cupcake box provides; and
   - measure 3 inches in height

   Describe, in words, all the 6-pack box designs that will fit these conditions.

2. Create a model of your cupcake box. Draw the net onto the graph paper and cut it out to turn in with your homework.

Volume of a Classroom

Unit: **Lesson 4**	**Grade Level/Course:** **5th**	**Duration: approximately 60 minutes**
Common Core and Content Standards	***5.MD.3*** – Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid which can be packed without gaps or overlaps using *n* cubic units is said to have a volume of *n* cubic units. ***5.MD.4 –*** Measure volumes by counting unit cubes, using cubic cm., cubic in., cubic ft., and improvised units. **5. MD.5 –** Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. a. Find the volume of a right rectangular prism with whole number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volume, e.g. to represent the associative property of multiplication. b. Apply the formula V= L x W x H for rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.	
Materials/ Resources/ Lesson Preparation	• Post the Big Idea & Essential Questions • Post Content & Language Objectives • Math Talk PowerPoint • ST Math (Ji-Ji) Connection to Math Talk • ST Math Helpful Hints Bookmark • Group Materials: o Brainstorming Worksheet-Lesson 4/Volume of a Classroom Rubric o *Volume of a Classroom* Response Sheet o Linking cubes o Standard tools of measurement (For example: rulers, tape measures, chalk wheels, yard sticks, etc.) o Other various nonstandard measuring tools (For example: yarn, feet, etc.) o Boxes and containers of various sizes (For example: crayon, Kleenex, cereal, copy paper boxes) o Calculators • **Homework:** *Find the Fiction*	

<table>
<tr><td>Objectives</td><td>Content:
Students will calculate the approximate volume of their classroom using linking cubes.</td><td>Language:
Students will justify their strategy.</td></tr>
<tr><td>Depth of Knowledge Level</td><td colspan="2">☒ Level 1: Recall ☒ Level 2: Skill/Concept
☒ Level 3: Strategic Thinking ☒ Level 4: Extended Thinking</td></tr>
<tr><td>Standards for Mathematical Practice</td><td colspan="2">☒ 1. Make sense of problems and persevere in solving them.
☒ 2. Reason abstractly and quantitatively.
☒ 3. Construct viable arguments and critique the reasoning of others.
☒ 4. Model with mathematics.
☒ 5. Use appropriate tools strategically
☒ 6. Attend to precision.
☒ 7. Look for and make use of structure.
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<tr><td>Common Core Instructional Shifts in Mathematics</td><td colspan="2">☐ Focus on the Standards
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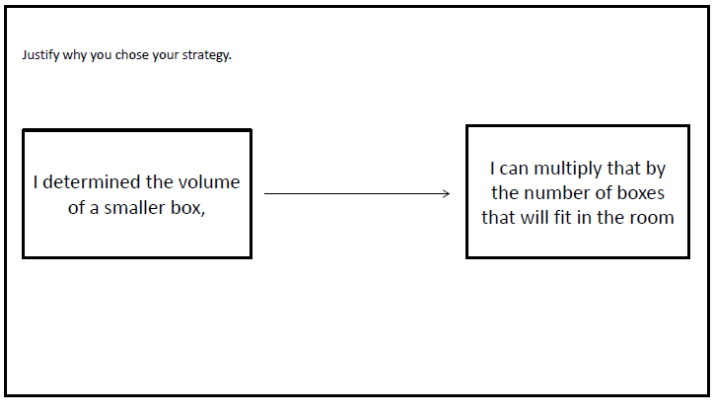
☒ Rigor (Balance of conceptual understanding, procedural skill & fluency, and application of skills)</td></tr>
<tr><td rowspan="3">Academic Vocabulary (Tier II & Tier III)</td><td>TEACHER PROVIDES SIMPLE EXPLANATION</td><td>KEY WORDS ESSENTIAL TO UNDERSTANDING</td><td>WORDS WORTH KNOWING</td></tr>
<tr><td>Cubic units
Square units or units squares</td><td></td></tr>
<tr><td>STUDENTS FIGURE OUT THE MEANING</td><td>Volume
Estimate</td><td></td></tr>
<tr><td>Pre-teaching Considerations</td><td colspan="2">Review Group Work Expectations/Rules
Estimation
IMPORTANT: Watch this Teacher Resource (without students) before teaching this lesson:
Video – “How Many Peas Fill this Classroom?”
https://www.teachingchannel.org/videos/teaching-volume</td></tr>
<tr><td colspan="3">Lesson Delivery</td></tr>
<tr><td>Instructional Methods</td><td colspan="2">Check method(s) used in the lesson:
☐ Modeling ☐ Guided Practice ☒ Collaboration
☒ Independent Practice ☐ Guided Inquiry ☐ Reflection</td></tr>
</table>

Lesson Opening	Always begin your lesson by reviewing the Big Idea and Essential Questions. Additionally, review in kid-friendly terms the content and language objectives. These should all be posted somewhere in your classroom. **Warm-up:** Math Talk PowerPoint NOTE: See additional ST Math directions following this lesson **Prior Knowledge, Context, and Motivation:** ***"In our previous lesson we determined if the children's boxes would fit in the bed of the truck, today we're going to determine how many linking cubes will fill our classroom."***	
Body of the Lesson: Activities/ Questioning / Tasks/ Strategies/ Technology/ Engagement	**<u>Lesson Overview</u>** **Warm-up:** Math Talk PowerPoint NOTE: See additional ST Math directions following this lesson **Teacher Directions** Whole Group • Explain to students that they will participate in a group activity using a variety of strategies to solve a problem. • Pass out the Brainstorming – Lesson 4 worksheet. • ***"I'm going to give you a scenario and I want you to think about it on your own for a few minute."*** • Scenario: ***"You're going to need to figure out how many linking cubes will fill this classroom. With that in mind, I want you to think how you would go about doing that. Come up with at least two different strategies about how you would determine the number of linking cubes it will take to fill this classroom."*** Allow time for students to think about it. Instruct students to write down their strategies on their Brainstorming – Lesson 4 worksheet. • ***"Now share your strategies with your partner."***  • Ask the students, ***"What information do you need to have to solve this problem?"*** • *Possible student responses:* *"We need the height, the length, and the width."*	**Differentiated Instruction:** **English Learners:** • Provide sentence starters • *We solved the problem by _____.* • *I agree with _____ because _____.* • *I respectfully disagree with _____ because _____.* **Students Who Need Additional Support:** See Appendix for additional resoruces. **Accelerated Learners:** Change the standard unit of measure into a nonstandard unit of measure such as chickpeas or beans.

Lesson Continuum

"We need the dimensions of the linking cube."

Teacher Questioning	Possible Student Responses
"What do you notice about the linking cubes?"	*"They are very small. There aren't that many. "* ***(It will take a large amount to fill the classroom.)***
"What challenges do you think you might face?"	"We don't have enough linking cubes to fill the room. The room is too big." ***(They won't be able to physically fill the room with linking cubes the way they were able to fill the rectangular prisms with cm. cubes in a prior lesson.)***

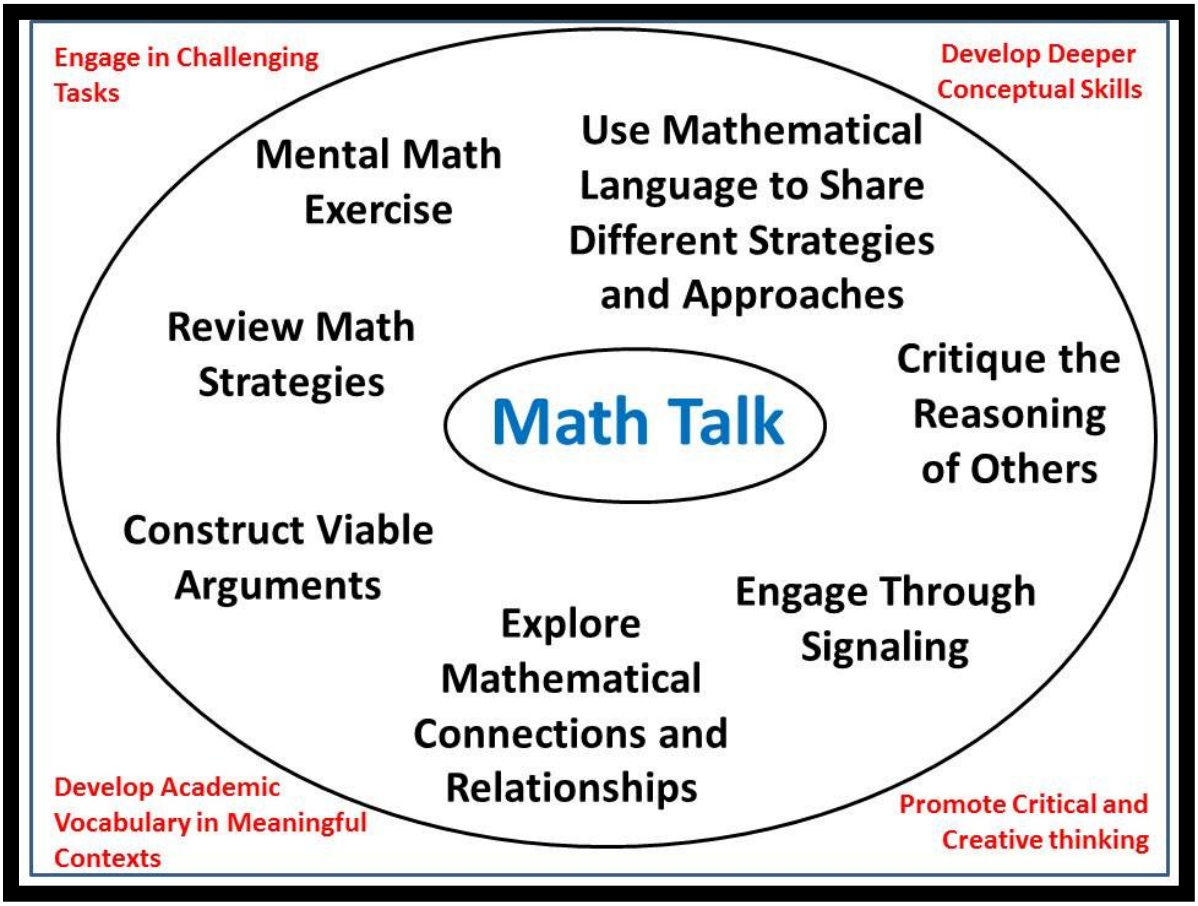
- Remind students to follow the rules of collaboration.
- Once they have come to this understanding, point out that they can use any materials that are available to them (standard measuring tools, or nonstandard tools, i.e. books, paper, yarn, shoes, feet).
- Have students get into groups of four to work on this task.
- Be sure to let the students know that they will only have a limited amount of linking cubes. Suggestion: Divide your linking cubes evenly amongst your groups.
- Have the students discuss the ideas they wrote down and decide as a group which strategy or combined strategies they will use to complete the task.
- Students will then complete the bottom half of the Brainstorming – Lesson 4 worksheet.
- Give them the Volume of a Classroom response sheet to record their strategies, steps, and reasoning.
- Allow the materials person from the group to gather the materials.
- Students may begin measuring using the strategy and tools they selected.

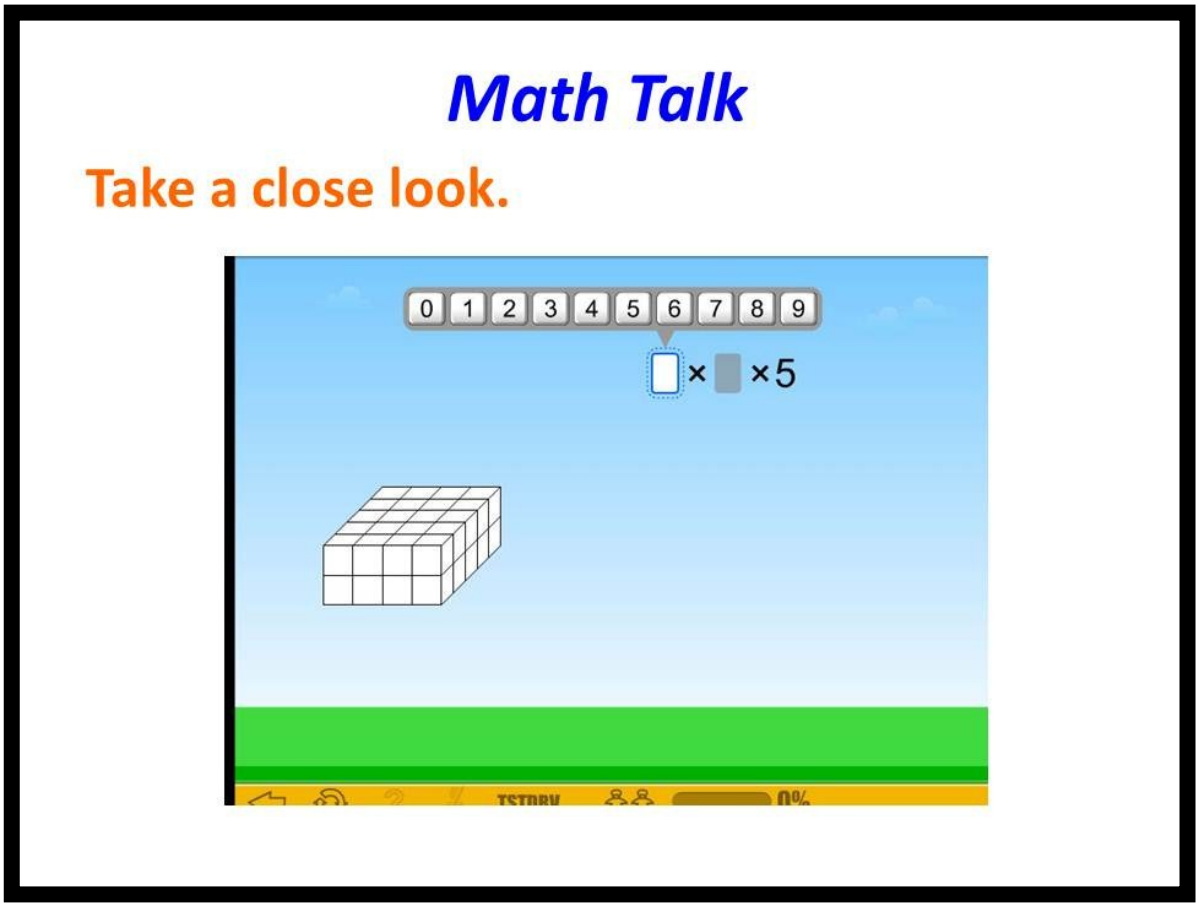
- Teacher continuously circulates the room to answer questions and support students' exploration.

Teacher Note:

The goal of this lesson is that students will make the connection to the algorithm. It is not important for them to find the actual answer. The process and the application of the algorithm is what is important.

	Closure: **Speaking and Listening Strategies** • **Lines of Communication (Please see Appendix)**: Students will share their findings of how to calculate the volume of a classroom. **Whole Group** ***Lead a discussion with the following questions:*** • ***Does volume change when you change the measurement material? Why or why not?*** • ***Why is it important to measure volume?*** • ***What were some of the skills and strategies you've learned throughout this unit about measuring volume that helped you solve this problem?*** • ***How can you apply what you've learned to other real life situations? What might those situations be?***	
Lesson Reflection		
Teacher Reflection Evidenced by Student Learning/ Outcomes		

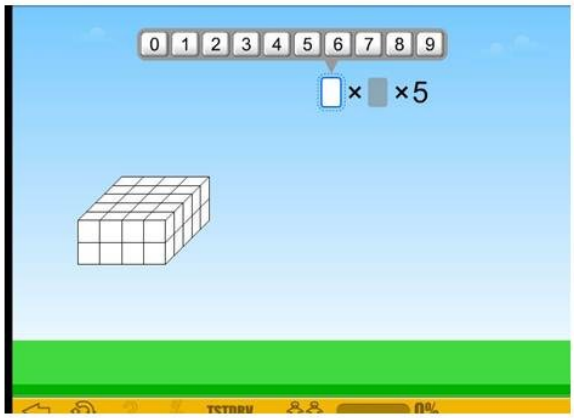

Engage in Challenging Tasks
Develop Deeper Conceptual Skills
Mental Math Exercise
Use Mathematical Language to Share Different Strategies and Approaches
Review Math Strategies
Math Talk
Critique the Reasoning of Others
Construct Viable Arguments
Engage Through Signaling
Explore Mathematical Connections and Relationships
Develop Academic Vocabulary in Meaningful Contexts
Promote Critical and Creative thinking


Math Talk
Take a close look.
0 1 2 3 4 5 6 7 8 9
× ×5

Math Talk

In your head think:
What do you notice?
What else do you notice?
Is this like an activity that you have done before? How is it the same? How is it different?
What does Jiji need to do?
How might you begin?

Volume



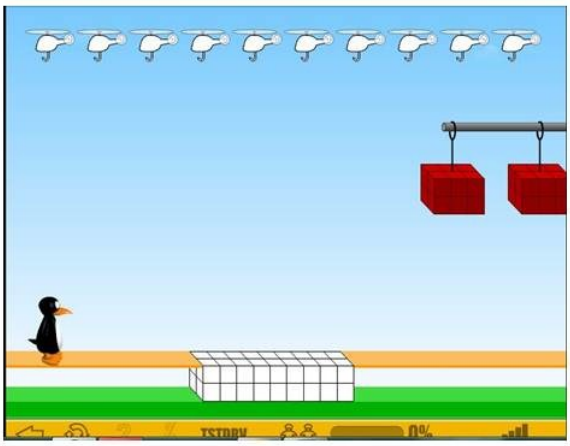
Time to Share Out!

Math Talk

Time to Share Out!

I noticed that _____.
Something else I noticed is _____.
This is like _____ that I did before because _____.
It's different from _____ because.
Jiji needs to _____ because _____.
I would begin by _____.

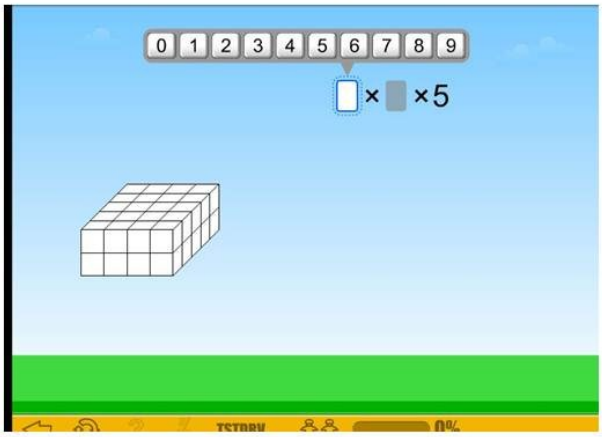
Volume



Math Talk

Volume

In your head think about the following *essential questions*:
How can you find the volume of cubes and rectangular prisms?
Why is it important to know how to measure volume?



Time to Share Out!

Math Talk

Ready to try out your strategy?

St Math Teacher Login Link:
http://web.stmath.com/entrance/microtc.html#/ndl

ST Math (Ji Ji)

Connection to Math-Talk

Day 7 – Lesson 4: "Volume of a Classroom"

NOTE: This Math Talk will be done whole group. Students will not be doing this individually on computers.

- **Follow the "script" on slides 2 – 5 of this lesson's Math Talk PowerPoint.**
- **When you reach the final slide, login in to ST Math as a teacher and display on the big screen.**
- **Follow the steps on the back of this page to be sure that you are opening up the correct game and level.**
- **For today you will be focusing on "Volume Fill" Level 2**
  - **NOTE: Your opening of the game may not look exactly the same, as it could start with a different problem than the one shown on the final slide on the back of this page.**
- **Discuss how the game is played, but do not provide students with strategies or solutions.**
- **Use the ST Math bookmark (each student should have one) to guide students through the process of how they may solve this problem.**
  - **NOTE: You may use your own judgment to select questions from the bookmark that are appropriate for your class.**
- **If you have enough time, you may move on to the next problem(s) in the same game and level and follow the same process.**

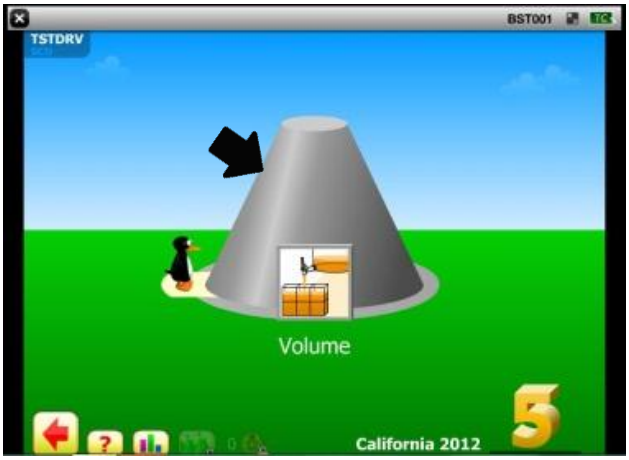
ST Math (Ji Ji)

Connection to Math-Talk

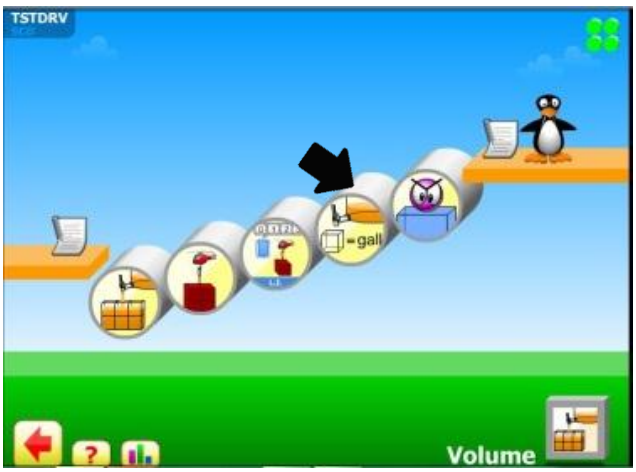
Day 7 – Lesson 4: "Volume of a Classroom"

CLICK ON: Volume

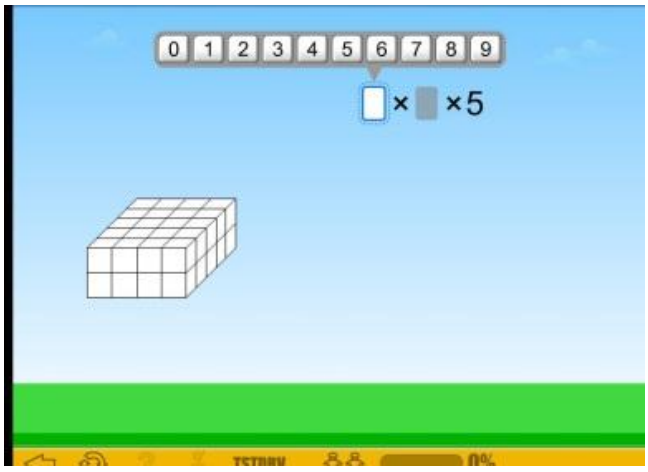
Volume



Volume Fill



Level 2



Thinking Map for Lesson 4

Teacher Sample

Justify why you chose your strategy.

I determined the volume of a smaller box,

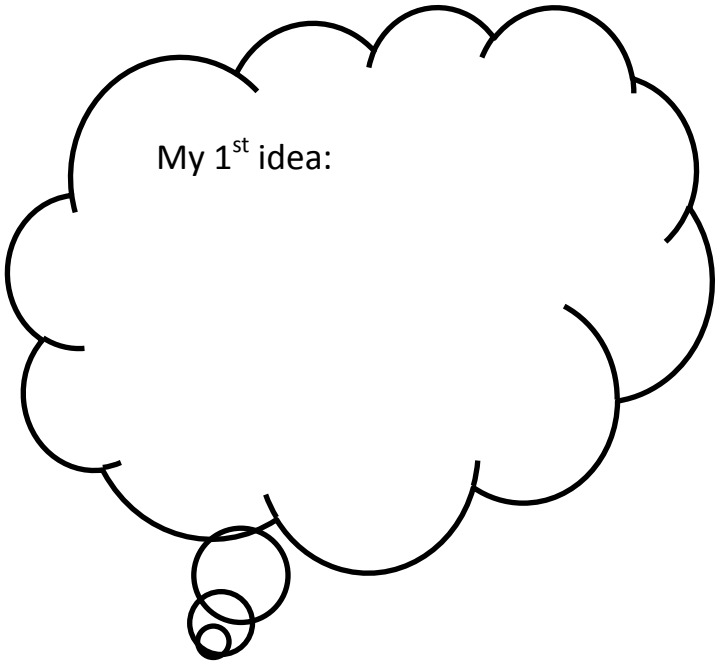
I can multiply that by the number of boxes that will fit in the room

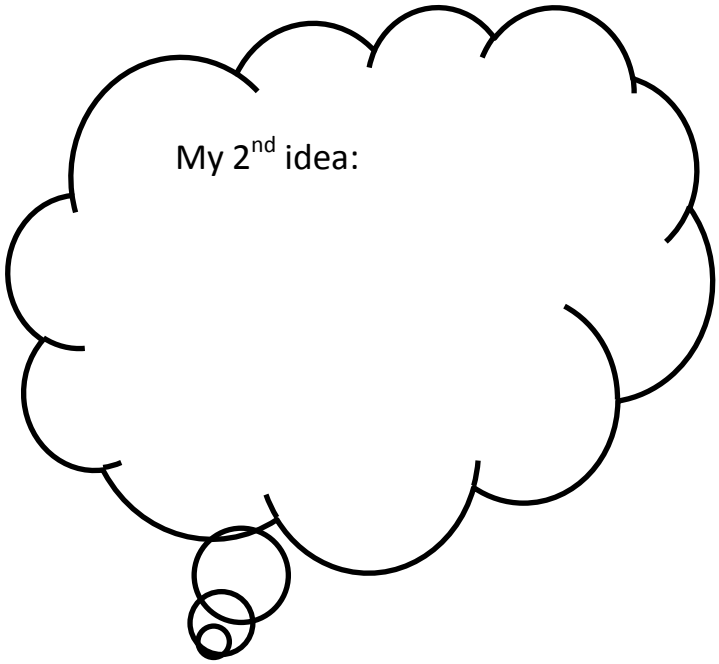
- I _____, because _____.
- I _____ so that _____.
- I _____ in order to _____.

Name:_____

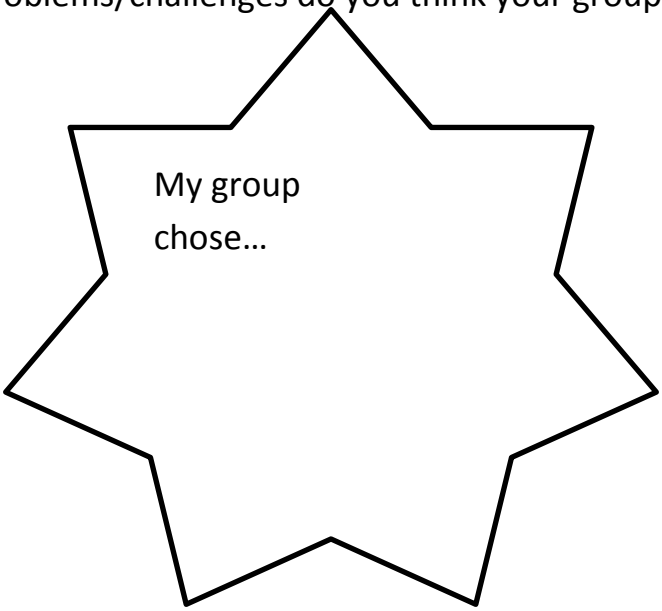
Brainstorming Worksheet– Lesson 4

You need to determine how many linking Cubes will fill our classroom. Think about at least two different ways that you could measure the classroom and figure out how many cubes would be needed. If you have more than two ideas, you may write them on the back of this paper.





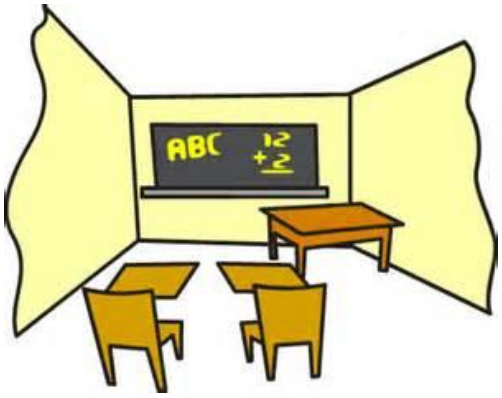
Now that you have met with your group, which strategy or combined strategies did your group decide to use to determine how many linking cubes would fit into our classroom? What problems/challenges do you think your group may have?



Problems or challenges may include…

Volume of a Classroom RUBRIC

Volume of a Classroom ***Based on these, credit for specific aspects of performance could be assigned as follows***	
1. Materials	**2 points**
2. Steps to Solve the Problem	**2 points**
3. Scale Model	**2 points**
4. Evidence of Math Work	**2 points**
5. Explanation of Reasoning	**2 points**
TOTAL Points	**10 points**



Volume of a Classroom Response Sheet – Lesson 4

Name:_____

QUESTION: How many linking cubes will it take to fill your classroom?

What materials are you using?

Record the steps that you take as you complete the problem:



Make a scale model:	Show your math:

Explain your reasoning:



HOMEWORK

Name _____

FIND THE FICTION

VOLUME REVIEW

Lesson 4

Write three statements about volume:

- **2 true statements**
- **1 false statement (fiction)**

Tomorrow, you will challenge your classmates to "Find the Fiction".

Unit Reflection

Unit: Unit Reflection	**Grade Level/Course: 5th**	**Duration: approximately 60 minutes**
Common Core and Content Standards	***5.MD.3*** – Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid which can be packed without gaps or overlaps using *n* cubic units is said to have a volume of *n* cubic units. ***5.MD.5*** – Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.	
Materials/ Resources/ Lesson Preparation	• Post the Big Idea & Essential Questions • Post Content & Language Objectives • Homework from Lesson 4 (*Find the Fiction*) • Volume Summative Assessment • Volume Summative Assessment Answer Key	
Objectives	**Content:** Students will find the volume of rectangular prisms.	**Language:** Students will identify reasons why understanding volume is important.
Depth of Knowledge Level	☐ **Level 1: Recall** ☐ **Level 2: Skill/Concept** ☐ **Level 3: Strategic Thinking** ☒ **Level 4: Extended Thinking**	
Standards for Mathematical Practice	☐ **1. Make sense of problems and persevere in solving them.** ☒ **2. Reason abstractly and quantitatively.** ☐ **3. Construct viable arguments and critique the reasoning of others.** ☐ **4. Model with mathematics.** ☐ **5. Use appropriate tools strategically** ☐ **6. Attend to precision.** ☐ **7. Look for and make use of structure.** ☐ **8. Look for and express regularity in repeated reasoning.**	
Common Core Instructional Shifts in Mathematics	☐ **Focus on the Standards** ☐ **Coherence within and across grade levels** ☒ **Rigor (Balance of conceptual understanding, procedural skill & fluency, and application of skills)**	

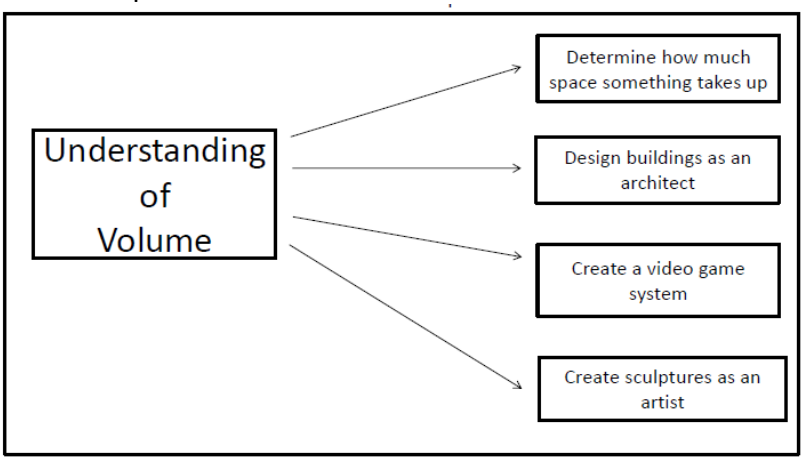
Academic Vocabulary (Tier II & Tier III)		KEY WORDS ESSENTIAL TO UNDERSTANDING	WORDS WORTH KNOWING
	TEACHER PROVIDES SIMPLE EXPLANATION		
	STUDENTS FIGURE OUT THE MEANING		
Pre-teaching Considerations			

Lesson Delivery

Instructional Methods	**Check method(s) used in the lesson:** ☐ **Modeling** ☐ **Guided Practice** ☐ **Collaboration** ☐ **Independent Practice** ☐ **Guided Inquiry** ☒ **Reflection**
Lesson Opening	Always begin your lesson by reviewing the Big Idea and Essential Questions. Additionally, review in kid-friendly terms the content and language objectives. These should all be posted somewhere in your classroom. **Prior Knowledge, Context, and Motivation:** Have students bring out the *Find the Fiction* Homework from Lesson 4. ***"Today, we will reflect on everything we've learned about volume. You will get a chance to review what you've with your classmates, to relate what we've learned to our lives , and then you'll take a test that will sum up everything you know about volume."***

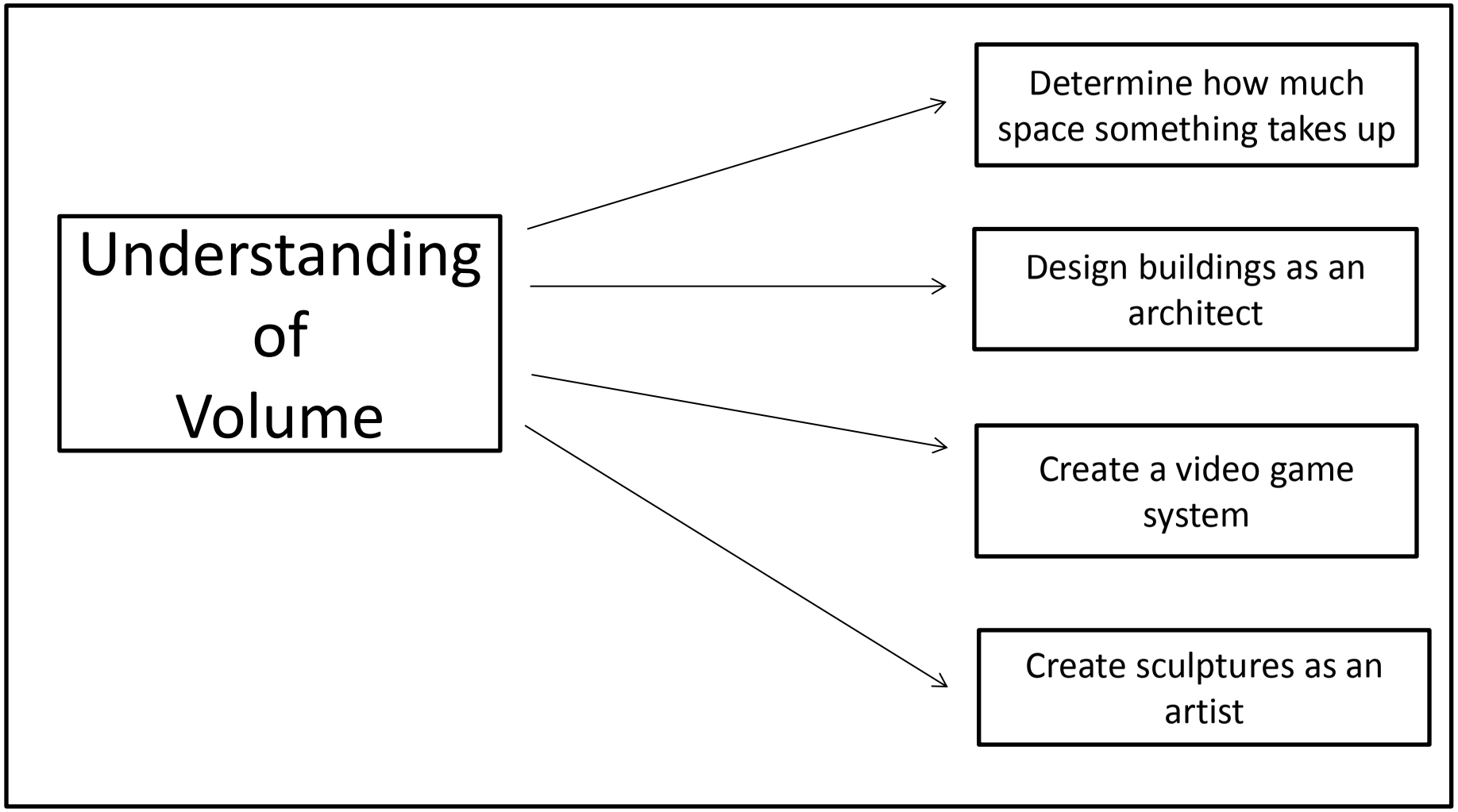
Body of the Lesson: Activities/ Questioning / Tasks/ Strategies/ Technology/ Engagement	**<u>Lesson Overview</u>** *Find the Fiction* Directions: • Within groups, students take turns reading their three statements and challenging their partners to 'find the fiction'. • (Optional) Ask each group to select the best set of its statements to challenge the rest of the class. Class Discussion • Lead the class in a discussion of *"Why is understanding volume important?"*	**Differentiated Instruction:** **English Learners:** Now that I understand volume, I can _____. Understanding volume is important because_____. In the future, I will need to _____. For this reason, _____.

Lesson Continuum

	Example:  • Now that I understand volume, I can _____. • Understanding volume is important because _____. • In the future, I will need to _____. For this reason, _____. **Closure** • Have students take the Summative Assessment. • (Optional) – Redistribute the PreAssessment Test and have students reflect on their performance.	**Students Who Need Additional Support:** See Appendix for additional resources.
Lesson Reflection		
Teacher Reflection Evidenced by Student Learning/ Outcomes		

Thinking Map for Unit Reflection

Teacher Sample



- Now that I understand volume, I can _____.
- Understanding volume is important because _____.
- In the future, I will need to _____. For this reason, _____.

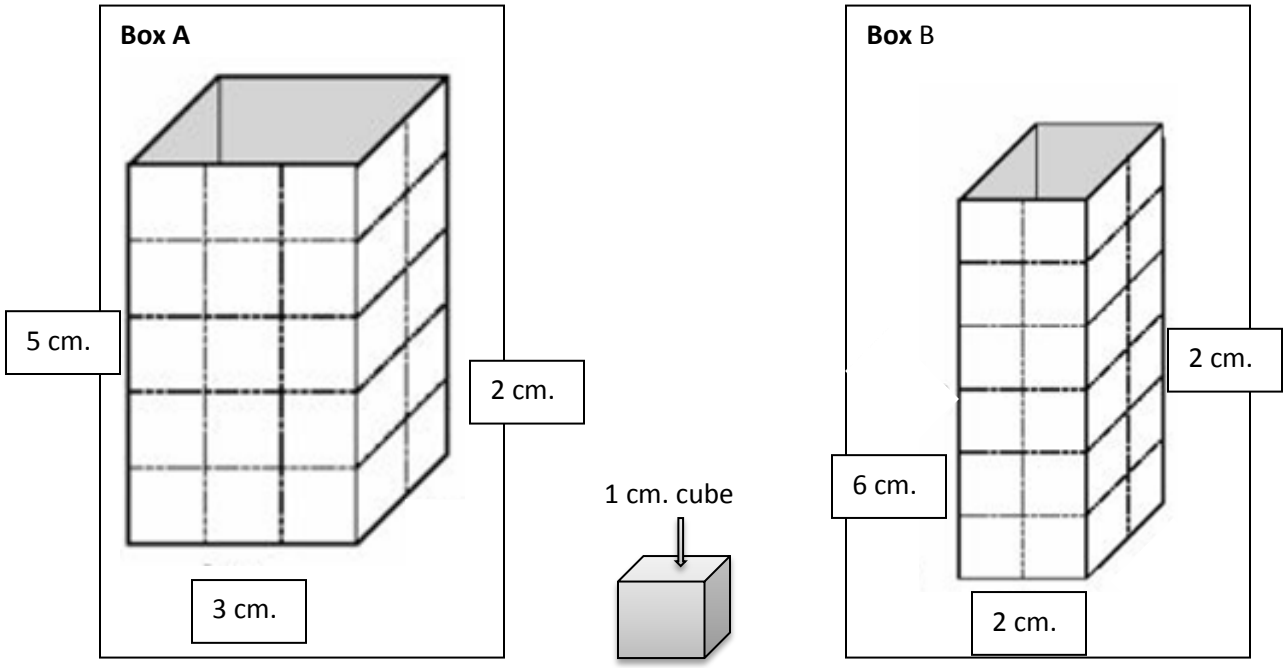
Name _____

Volume Summative Assessment

How Many Cubes?

This problem gives an opportunity to explain your understanding of volume.

Steve fills Box A and Box B with centimeter cubes.



1. How many cubes can Steve fit into Box A? _____

Explain in detail how you solved this problem.

_____

_____

_____

2. What is the volume of Steve's Box B? _____

Show your calculations.

3. Which of the two boxes can hold more cubes? _____

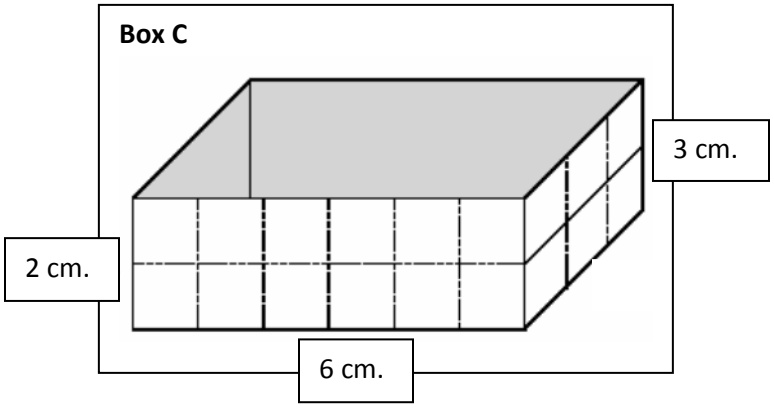
Explain your answer.

_____

_____

4. Here is another box. How many centimeter cubes can this box hold?

_____



List the measurements of a different box that holds the same number of cubes as Box C.

_____ cm long _____ cm wide _____ cm high

Adapted from Noyce Foundation

Volume Summative Assessment Answer Key

How Many Cubes? ***Based on these, credit for specific aspects of performance could be assigned as follows***	
1. Gives correct answer: **30 cubes** Gives correct explanation such as: ***There are 6 cubes on each layer and 5 layers. 3 x 2 x 5 =***	**1 point** **1 point**
2. Gives correct answer: **24 cubes** Shows work such as: ***2 x 2 x 6 =***	**1 point** **1 point**
3. Gives correct answer: **Box A**	**1 point**
4. Gives correct answer: **36 cubes** Gives a correct answer such as: ***4 x 3 x 3 =*** ***Or*** ***2 x 2 x 9 =*** ****Do not accept boxes with a 6 x 3 or 3 x 6 base.****	**1 point** **1 points**
TOTAL Points	**7 points**

Adapted from Noyce Foundation

Appendix

I. Instructional Methods and Procedure
II. Student Talk Strategies
III. Math Talk
    a. Daily Warm Up: Math Talk Problem Teacher Sheet
    b. ST Math Helpful Hints Bookmark
    c. Directions to enter teacher mode of ST Math/Ji-Ji
IV. Close Read Lesson on "Cool Jobs: Math as Entertainment"
V. Centimeter Graph Paper
VI. Additional Nets
VII. Cooperative Math Team Jobs
VIII. Teacher Resources
    a. Houghton Mifflin website: *http://www.eduplace.com/eservices* (SAUSD Login: santaana5 and Password: sausd5)
IX. Accelerated Learner Resources
    a. Art – Native American Geometry

       http://www.earthmeasure.com/Designs/index.html

    b. History – Geometry through History

       http://www.geometryalgorithmns.com/history.htm#Greek

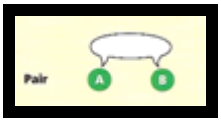
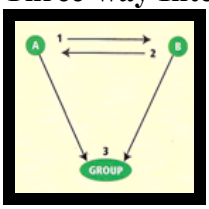
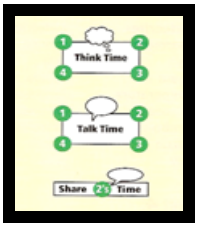
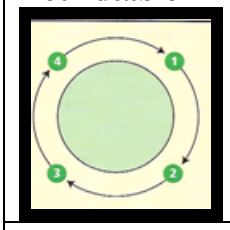
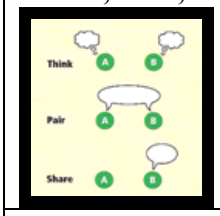
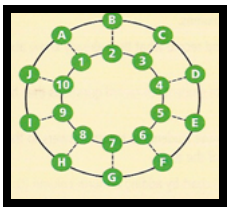
    c. Geometry

       http://www.scienceforkids.kidipede.com/math/geometry

APPENDIX – Instructional Methods and Procedure

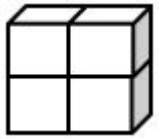
Speaking and Listening	
Numbered Heads	1. Have students number off within groups. 2. The teacher asks a question and each group discusses and agrees upon an answer. 3. The teacher calls a number at random (1-4), and the student with that number stands. 4. The teacher calls on one of these students to answer, then asks the other standing students if they agree. 5. Students sit and the next question is asked.
Partner Squared	1. A pair of students finds another pair of students nearby. 2. The teacher asks a question and each group discusses and agrees upon an answer. 3. The teacher calls on one of these students to answer.
Stroll Pair Share	1. Write questions/prompts based on the activity/lesson. 2. Clear the outside perimeter of the classroom. Have students form a double parade line – each student with a partner, facing forward. 3. At the teacher's signal, students are to begin walking facing forward, while talking to their partners. Beginning with the person on the inside, they are to tell everything they remember about the topic of discussion. After about one minute, the teacher signals for the outside partners to speak. After about one more minute, the teacher signals for the line to stop. The inside partners move up to a new partner from the outside line. The first person goes to the back. 4. The process continues through a few shifts of partners as time permits.
Lines of Communication	1. Students form two lines facing each other. One is line A, the other line B. 2. Students will share information on the topic. Begin with line A. 3. After one minute, allow line B to share. 4. On the teacher's signal, line B moves 1 person to the right. The first person in the line moves to the end. 5. Depending on the material being shared teacher will decide on the number of rotations.
Writing	
Two Minute Write	1. After the lesson, provide students with a prompt/question. 2. Everyone writes something for the ENTIRE two minutes.

Student Talk Strategies

Design	Description	Benefits and Purposes
Report to a partner 	-Each student reports his/her own answer to a peer. -The students listen to their partner's response. ("Turn to a partner on your left." "Now turn to a partner on your right" etc.)	-This allows students to talk to different students in the class and gives each student an opportunity to share and listen to various answers and language structures. -Talking one-on-one with a variety of partners gives risk free fluency practice. -Students practice speaking and listening.
Three-way Interview 	-Students form pairs. -Student A interviews student B about a topic. -Partners reverse roles. -Student A shares with the class information from student B; then student B shares information from student A.	-Interviewing supports language development in question formation. -Students participate in speaking and active listening. -This ensures participation by all students.
Numbered Heads 	-Students number off within each group. -Teacher prompts or gives a directive. -Students think individually about the topic. -Groups discuss the topic so that any member of the group can report for the group. -Teacher calls a number and the student from each group with that number reports for the group.	-Group discussion of topics provides each student with language and concept understanding. -Random recitation provides an opportunity for evaluation of both individual and group progress.
Roundtable 	-Teacher seats students in small groups around tables. -Teacher asks a question with many possible answers. -Each student around the table answers the question a different way.	-Encouraging elaboration creates appreciation for diversity of opinion and thought. -Eliciting multiple answers enhances language fluency.
Think, Pair, Share 	-Students think about a topic suggested by the teacher. -Pairs discuss the topic. -Students individually share information from their discussion with the class.	-The opportunity for self-talk during the individual think time allows for the student to formulate thoughts before speaking. -Think time allows students to think about the concepts and the language before producing. -Discussion with a partner reduces performance anxiety and enhances understanding.
Inside-Outside Circle 	-Students stand in concentric circles facing each other -Students in the outside circle ask questions--those inside answer -On a signal, students rotate to create new partnerships -On another signal, students trade inside/outside roles	-Talking one-on-one with a variety of partners gives risk-free fluency practice -Interactions can be structured to focus on specific speaking skills -Students practice both speaking and active listening

Daily Warm Up: Math Talk Problem Teacher Sheet

Lesson	Real Life Scenario	Guiding Questions for Teacher to Ask Students Throughout Daily Warm Ups:
Preparing the Learner A Algebra review in order to understand the Math Talk procedure	**Problem Number 1** A teacher wanted to know the ages of Susan and Juan. She knew that Ricky was 12 years old. What are the ages of Susan and Juan if the total age of the 3 students is 22? **x + y + 12 = 22** **Problem Number 2** A student wanted to know how many blue and red marbles were in the bag. He already knew that there were 8 purple marbles. How many blue and red marbles are there if the total number of marbles in the bag is 20? **8 + y + x = 20** **Prompt for Students:** **In your head think:** •What are some strategies you might try? •What do the variables (x and y) used in the problem represent? •Are there other solutions to the problem?	1. What information is given in the problem? 2. How did you decide what the problem was asking you to find? (What was unknown) 3. What was the first step you took to solve the problem? 4. What did you do next? 5. How did you know your solution was reasonable? 6. Is there another strategy you can use to solve the problem? 7. Which strategy would work the best? 8. Did you try a method that did not work? Why didn't it work? Would it ever work? Why or why not?
Preparing the Learner B Continue with algebra in order to review and understand the Math Talk procedure	Miguel has a rock collection of 30 rocks. Most of his collection consists of igneous rocks. There are 15 igneous rocks. The rest are metamorphic and sedimentary rocks. What could the possible number of metamorphic and sedimentary rocks be? **x + 15 + y = 30** **Prompt for Students:** In your head think: •What are some strategies you might try? •What do the variables (x and y) used in the problem represent? •Is there more than one solution to the problem?	

<table>
<tr><td>Lesson 1
Review: Area</td><td>Jonathan’s dad told him that he could grow a garden in his backyard. However he could only take up 24 square feet of space. What could the possible length and width of Jonathan’s garden be?
Area = 24 square feet
Prompt for Students:
In your head think:
•What are some strategies you might try?
•What do the variables (length and width) used in the problem represent?
•Is there more than one solution to the problem?</td><td rowspan="2">What information is given in the problem?
How did you decide what the problem was asking you to find? (What was unknown)
What was the first step you took to solve the problem?
What did you do next?
How did you know your solution was reasonable?
Is there another strategy you can use to solve the problem?
Which strategy would work the best?
Did you try a method that did not work? Why didn’t it work? Would it ever work? Why or why not?</td></tr>
<tr><td>Lesson 2
Review: Compare surface area and volume</td><td>She needs a box with a volume of 4 cubic units. She looked at this box and concluded that it has a volume of 16 cubic units.
 
Prompt for Students:
In your head think:
•What are some strategies you might try?
•What do the numbers 4 and 16 represent?
•How do the numbers 4 and 16 differ?</td></tr>
<tr><td>Lesson 3
Review:
Fit given dimensions into a cubic area</td><td>ST Math Extension
Volume
Helicopter Volume LI
Level 3</td><td>Ask Questions from the St Math Facilitating Questions Bookmark as needed for your class.
For example: What does Jiji need to do?</td></tr>
<tr><td>Lesson 4
Review:
Determine how many units fit into a space</td><td>ST Math Extension
Volume
Volume Fill
Level 2</td><td>Ask Questions from the St Math Facilitating Questions Bookmark as needed for your class.
For example: How might you begin?</td></tr>
</table>

Step 1
Uncover Thinking

What have you tried?
What happened then?
Why did you __?

Step 2
Examine Animation

What is happening in the animation?
What did you notice? What else?
When you clicked ____, what happened?

Step 3
Apply Hypothesis

What do you think will happen?
How will this work on this problem?
What steps will you take?
How did you decide that was correct?

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Step 3
Apply Hypothesis

What do you think will happen?
How will this work on this problem?
What steps will you take?
How did you decide that was correct?

Facilitating Questions

- What does JiJi need to do?
- How might you begin?
- What do you need to do next?
- Why did that happen?
- How can you help JiJi?
- How did the earlier problems/levels work?
- Is this like _____ that you did earlier? How is it the same? How is it different?
- What did you see that showed you the answer was wrong?
- Why do you think that was not the right answer?
- What will happen if you click on _____?
- What have you tried? What happened?
- What do you notice? What else do you notice?
- What did you try that did not work? Why did it not work?
- Please explain it in a different way.
- Show me how this will work on the next problem.
- What do you already know about?
- Why did you ____?

MIND Research Institute
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TT-ED-110-130318

Facilitating Questions

- What does JiJi need to do?
- How might you begin?
- What do you need to do next?
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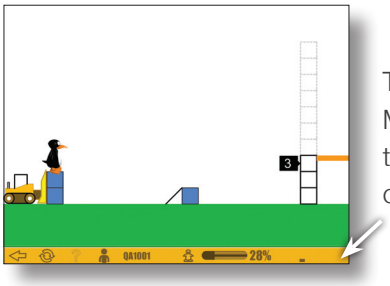
Teacher Mode

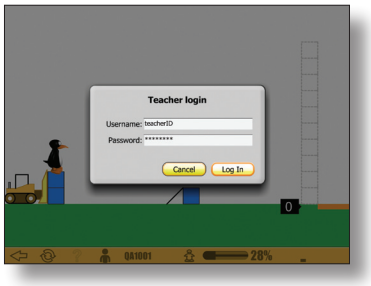
Teacher Mode allows you to access tools for controlling the game animation (visual feedback). In Teacher Mode you can pause and replay the action frame by frame. Controlling the visual feedback is an excellent strategy to help students when they are stuck on a particular game or to get students to articulate strategies and analyze the models they are using to solve puzzles. You can access Teacher Mode from any puzzle.

1

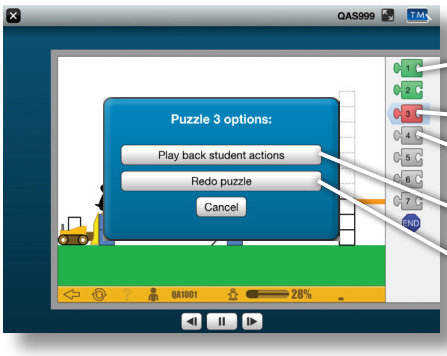


To enter Teacher Mode triple-click in the lower right hand corner of the screen.

2



If asked, enter your username and password, then click the Log In button.



1 C — **GREEN** means student solved puzzle correctly.

3 C — **RED** means student got the puzzle wrong.

4 C — **GRAY** means puzzle has not been played yet.

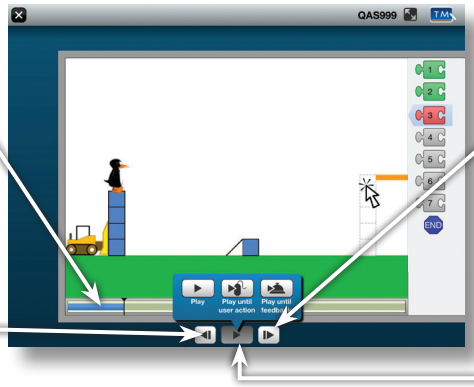
Allows replay of student's actions

Allows unlimited replay of a puzzle

When in Teacher Mode, use the controls to replay and pause the animation so students can analyze visual feedback.

Progress bar: Indicates the current playback position within the animation.

Rewind/Step back: When held down, rewinds animation. When pressed and released, rewinds frame-by-frame.



Fast forward/Step forward: When held down, fast-forwards animation. When pressed and released, advances frame-by-frame.

Play/Pause: Toggles between play and pause. When paused, click and hold for additional playback options.

Tip: Begin by asking students to explain what is happening in the puzzles by paying close attention to the visual feedback. Get students to articulate why they got a puzzle correct or incorrect. Focus on the visual models in the game and use the Think Before You Click Protocol and Facilitating Students Questions. Practice using Teacher Mode when test-driving games in order to become fluent in controlling the visual feedback! This can be a great instructional tool to illustrate important mathematical concepts as ST Math games are integrated into classroom lessons.

Close Reading Lesson

Grade 5 Content Area Math Unit _____ Pages _____

Story Title/ Independent Text Cool Jobs: Math as Entertainment CCSS: RL5.1, RL5.8

Purpose of Close Reading (check all that apply):

- ✓ ☐ Rich or Academic Language
- ☐ Linguistically Complex Language
- ☐ Plot Highlights
- ✓ ☐ Text Organization or Structure
- ☐ Big Idea or Theme Revealed
- ☐ Demanding Content
- ✓ ☐ Text Features or Illustrations
- ☐ Character Analysis or Motivation
- ☐ Other: _____
- ☐ Author's Craft (i.e. perspectives, mood, tone, word choice, syntax, purpose, etc.)

Reading Task: Students will silently read the passage—first independently and then following along with the text as the teacher reads aloud. Students will then reread specific passages in response to a set of concise, text-dependent questions that compel them to examine the meaning and structure of the selection.

Vocabulary Task: Students will annotate the text during the first read, marking any words and/or phrases that are unfamiliar or difficult. The teacher will use discussions and think alouds during the second read to model and reinforce how to learn vocabulary from contextual clues.

Discussion Task: Students will discuss the text in depth with their teacher and their classmates, performing activities that result in a close reading of the excerpt. The goal is to foster student confidence when encountering complex text and to reinforce the skills they have acquired regarding how to build and extend their understanding of a text. A general principle is to always reread the passage that provides evidence for the question under discussion. This gives students another encounter with the text, helping them develop fluency and reinforcing their use of text evidence.

Writing Task: Students will respond to a series of text dependent questions and then write an informal paragraph/journal citing evidence from the text to support their position/claim.

Instructional Strategies and Suggested Procedures:

1. **Establish the Purpose for reading and introduce the text:** *Tell students that the purpose of today's lesson is to learn how to read a text "closely" and keep track of our thinking while we read. As we read this math article, we will use our pencils/highlighters to annotate, or mark-up the text. ry! (This is a new concept to most students who are used to not being able to write in the books). We are going to circle words or phrases that we find confusing and underline what we think are important or "key" parts of the story. As we read this portion of the story, we will learn how mathematics adds dazzle to the visual world.*
2. **First Read:** Students read independently "with a pencil": *Remind students to read the text independently and keep track of any words or phrases that are confusing to them by circling them. They should also underline any parts of the selection that they think are important to the overall piece. They*

may also write notes in the margin (sides of the paper) or write questions that they think of while reading.

3. **Partner Discussion with sentence starters:** *After students have finished reading with a pencil, have them work with their groups or partners to discuss the text. Use the following frames to support the discussion.* (I underlined_____ because _____. I was confused by _____. I was surprised to read_____.) *Have students discuss and then call on some groups to share out, noting the words/phrases that caused confusion so that they can be addressed in the teacher read aloud.*
4. **Second Read:** *Teacher reads the passage aloud as students follow along. Model with think aloud. Clarify any confusion that came up in the first read by modeling the process (read ahead, use context clues, word structure, etc.).*
5. **Class/Group Discussion/Text Dependent Questioning:** *Using the questions provided below, guide the class in a discussion by asking students the questions and requiring them to point to/cite the evidence in the text to support their answers. For each question, give students an opportunity to discuss with their partner/in the group first, and then share out.*

Text Dependent Questions	Answers
1. How does the structure of this excerpt help the reader to understand the content?	The author uses _____. This makes it _____. • Headings/ easier to organize information • Italics / easy to find the names of the movies • illustration / easy to see an example of math in the visual world
2. In paragraph 3, Bin Zafar states that he works with the skimpiest of instructions. How does this pose a problem for him?	Since he only get the skimpiest of instructions he must _____.
3. How does Bin Zafar make a virtual building collapse on-screen in a realistic way?	He uses three things: _____, _____, and _____. • Engineering • Computer skills • Lego
4. What two skills does Bin Zafar think are important to work in a digital movie studio?	Bin Zafar feels that _____ and _____ are necessary skills to work in a digital movie studio. • Communitcating effectively • Solving word puzzles

Text Dependent Questions

- How does the structure of this excerpt help the reader to understand the content?

  Sentence Frame:

  The author uses _____. This makes it _____.

- In paragraph 3, Bin Zafar states that he works with the "skimpiest of instructions". How does this pose a problem for him?

  Sentence Frame:

  Since he only gets the skimpiest of instructions he must _____.

- How does Bin Zafar make a virtual building collapse on-screen in a realistic way?

  Sentence Frame:

  He uses three things: _____, _____, and _____.

- What two skills does Bin Zafar think are important to work in a digital movie studio?

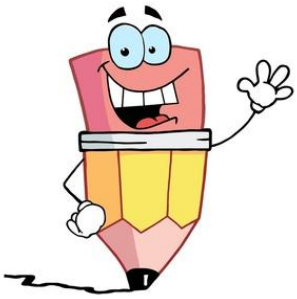
  Sentence Frame:

  He feels that _____ and _____ are necessary skills in order to work in a digital movie studio.

Discussion Time

- I underlined_____ because _____.
- I was confused by _____.
- I was surprised to read_____.
- I wonder why _____.
- I circled this word because _____.
- I think _____means _____ because _____.

How to Annotate a Text
Read with a Pencil



- **Circle words or phrases that are confusing/unclear**
- **Underline words, phrases, or sentences that are important/key**
- **Take notes in the margin (sides of the paper) of anything that comes to mind as you read**
- **Write any questions you have in the margin**

Cool Jobs: Math as entertainment

Magic, movies and metal: How mathematics adds dazzle to the visual world

This is one in a series on careers in science, technology, engineering and mathematics made possible by support from the Northrop Grumman Foundation.

Credit: "Madagascar 3" © 2012 DreamWorks Animation LLC, used with permission of DreamWorks Animation LLC

When a band of zoo buddies tears through a Monte Carlo casino, the marble columns don't have a chance. Nafees Bin Zafar used mathematics to power the visual effects behind this madcap scene in Madagascar 3.

"I seem to specialize in the area of mayhem," says Nafees Bin Zafar with a smile. This visual effects expert helps bring some of the most memorable smashes, crashes and dashes to the movie screen. The one in *Madagascar 3* where the fearless heroes flee a casino, leaving all sorts of rubble in their wake? Check. The scene in *2012* where Los Angeles slides into the Pacific Ocean? Check. The light cycle chase scenes in *Tron: Legacy*? Check.

At DreamWorks Animation (and previously at another company called Digital Domain) Bin Zafar creates software used to make the special effects in motion pictures — and sometimes cartoons — look as realistic as possible. Often he works with the skimpiest of instructions. "For *2012*," he recalls, "all we really had was one line in the script: 'And then California sinks into the ocean.'" Bin Zafar and a team of nine other programmers and animators took that one line and turned it into a five-minute montage of falling buildings, collapsing freeways and enormous cracks splitting Earth. To make all this fakery look real, it has to *act* real. "Do we know the math of how this stuff bends and flexes and shakes around?" Bin Zafar asks. "It turned out that we didn't."

Bin Zafar eventually solved that math problem along the way to helping create some cutting-edge visual effects. He's just one of three experts profiled in this article who rely on math to entertain — and amaze.

How to realistically destroy a fake building

To compute how a virtual building should collapse on-screen in a convincingly real way, Bin Zafar uses engineering, computer skills and a toy familiar to most kids. Yes, he starts by pretending the building is made of Lego bricks connected by springs. (He actually keeps a box of Legos — the regular kind without springs — in his office for inspiration.) The virtual Legos form the large chunks into which the building crumbles, while the virtual springs simulate the forces that would act on the building. Once the building starts to collapse, Bin Zafar then ensures that the thousands of computer-drawn pieces fall in a realistic way, without their passing through each other — something that would immediately spoil the illusion of reality.

Although Bin Zafar instructs his computer program to apply the laws of physics in most instances, he also knows when to bend them. This was especially true in *Madagascar 3*. "We do things like change gravity's direction all the time," Bin Zafar says. "In a cartoon," he explains, "it's quite reasonable for a character to start walking up a wall — and yet have everything look natural."

As a kid, Bin Zafar was a big fan of cartoons and movies. "*Looney Tunes* were my favorites," he recalls. He also loved the original *Tron*, a movie that came out in 1982. Imagine his thrill at being asked to work on the film's sequel, 28 years later. Bin Zafar points to two important skills he has needed to work in a digital movie studio: communicating effectively and solving word puzzles.

Communication is critical because creating visual effects is a team job. When Bin Zafar writes a computer program, he also has to explain the program to the animators who use it. "My work makes things look believable, but it really takes an artist to make things look spectacular," he says.

Solving word problems is almost as important, Bin Zafar notes, because requests are never described in numerical terms. Instead he gets: "And then Los Angeles sinks into the ocean." It's his job to translate that request into the language of mathematics, so that a computer can render it into believable images.

In the exciting environment in which Bin Zafar works, the distinctions between artist and mathematician often blur: Artists need to understand math and the mathematicians need to understand art. Says Bin Zafar: "We're all exploring our imaginations together."

Adapted from "Cool Jobs: Math as Entertainment – Magic, movies and metal: How mathematics adds dazzle to the visual world"

By Dana Mackenzie/December 19, 2012 *http://www.sciencenewsforkids.org/2012/12/cool-jobs-math-as-entertainment/*

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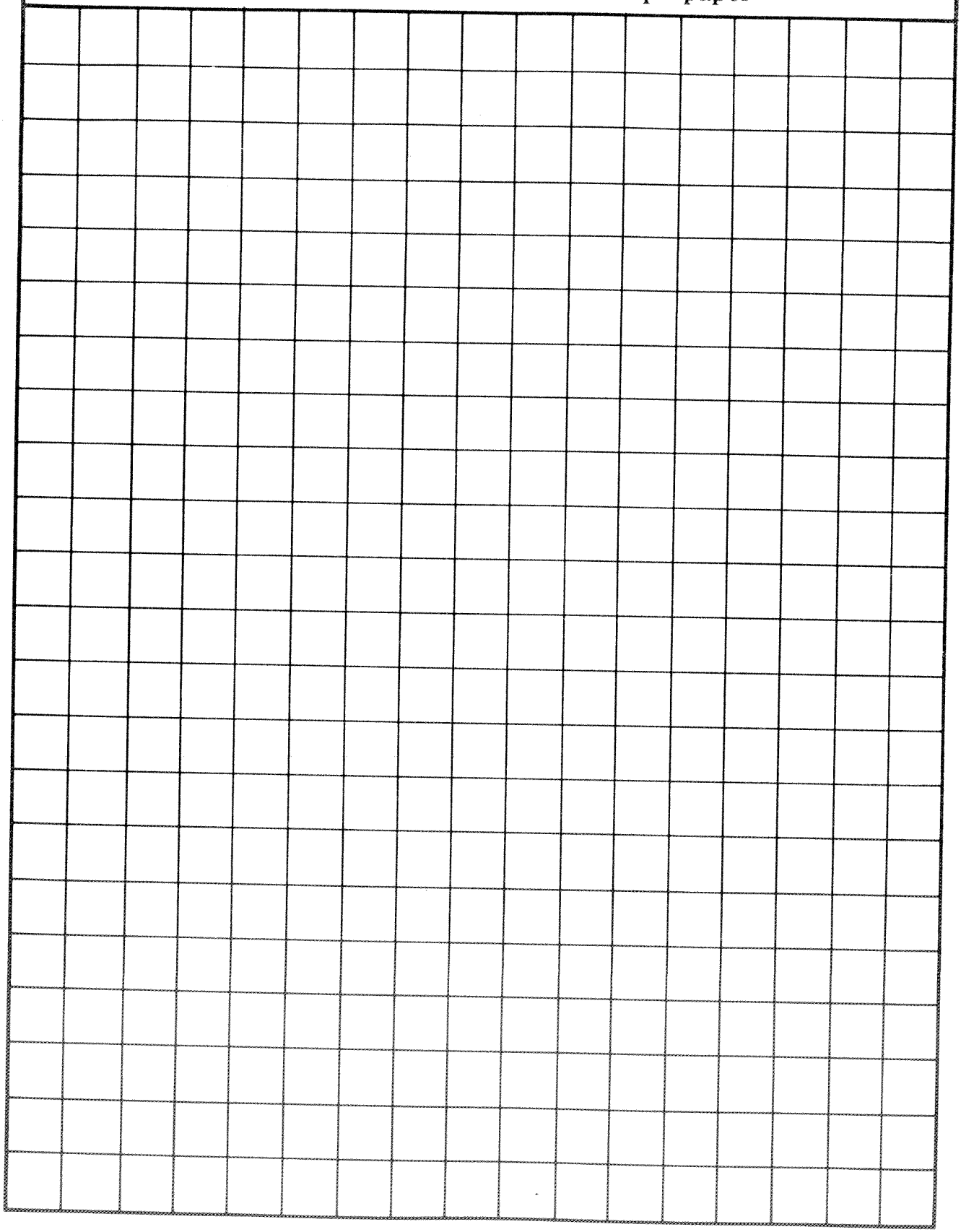

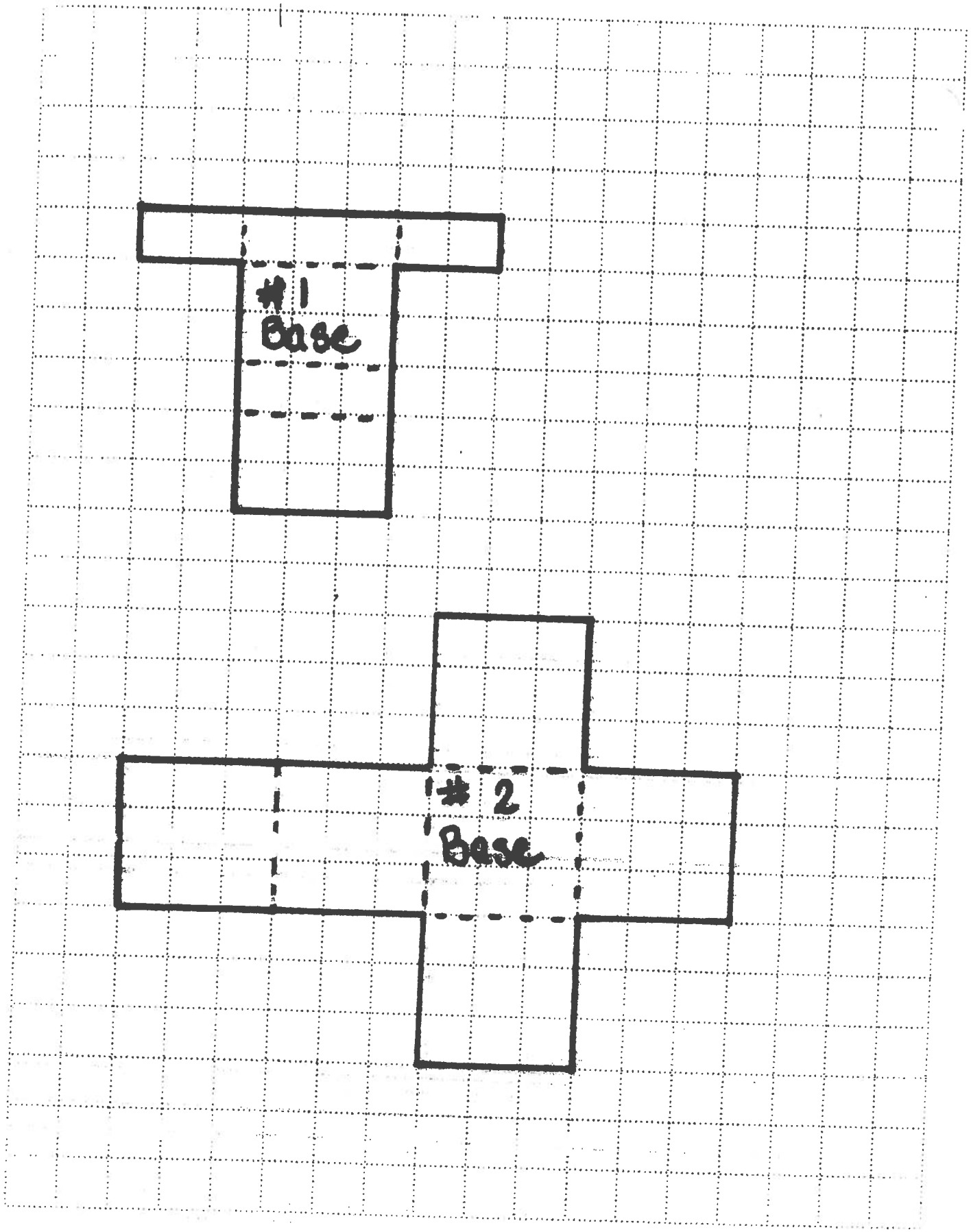
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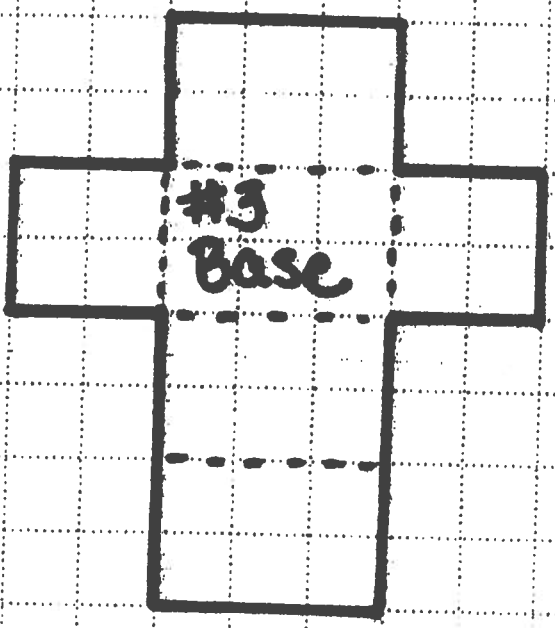
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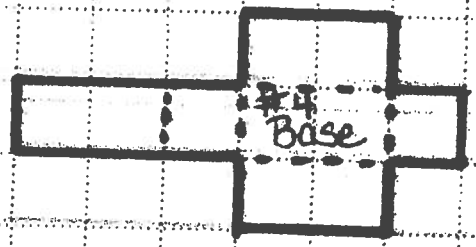
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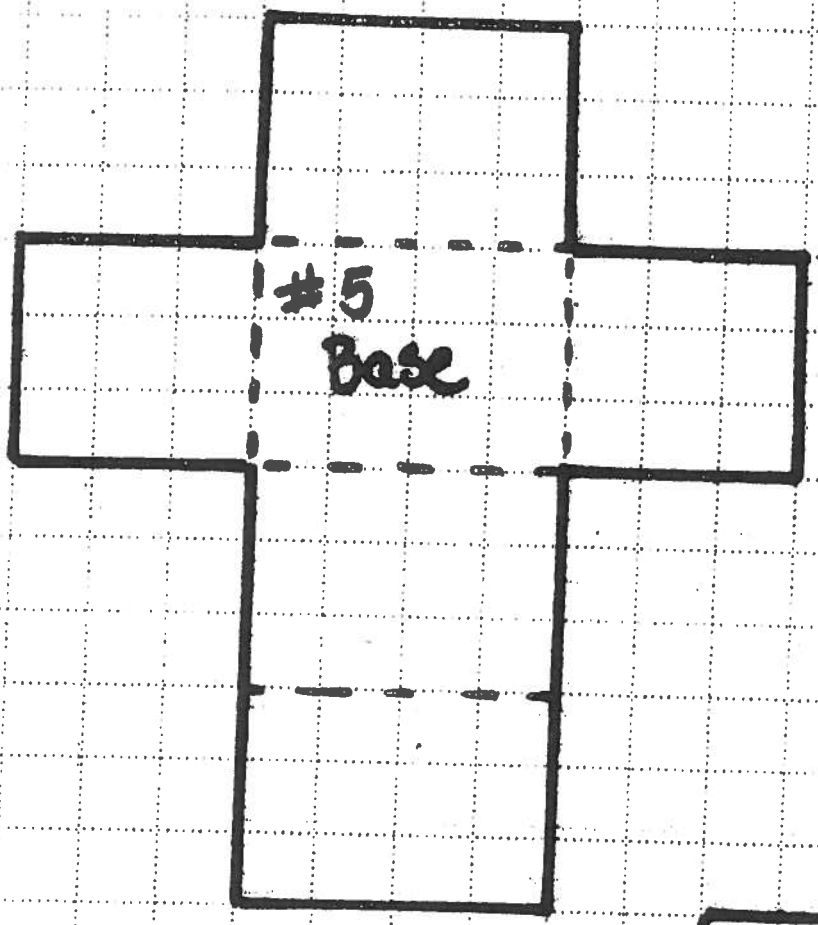
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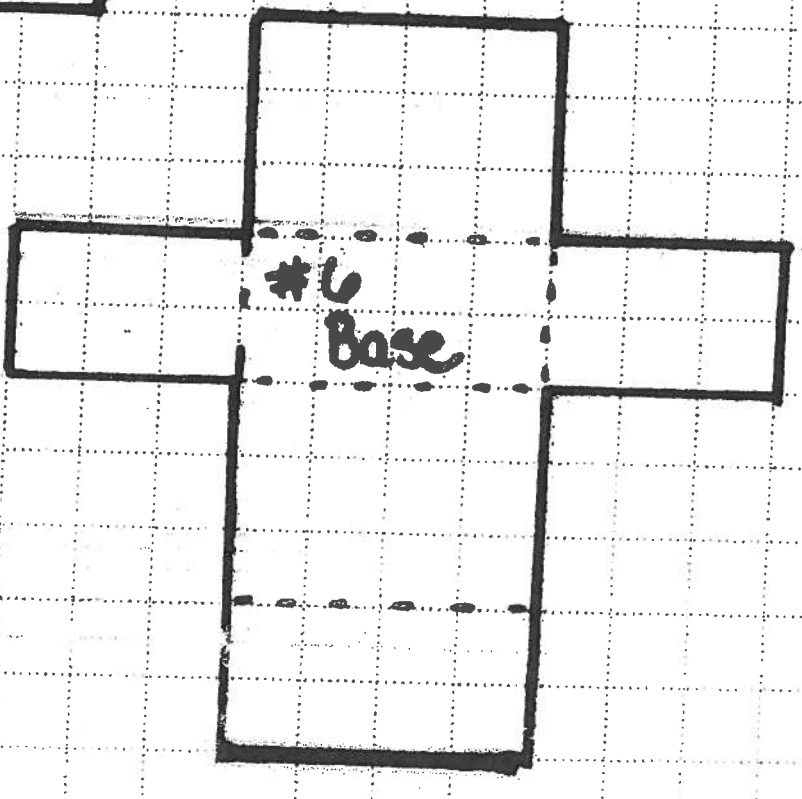
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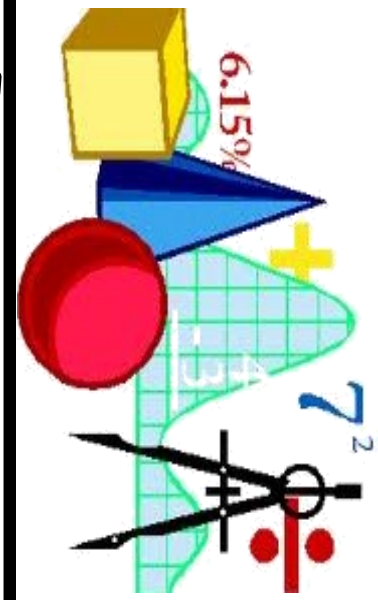
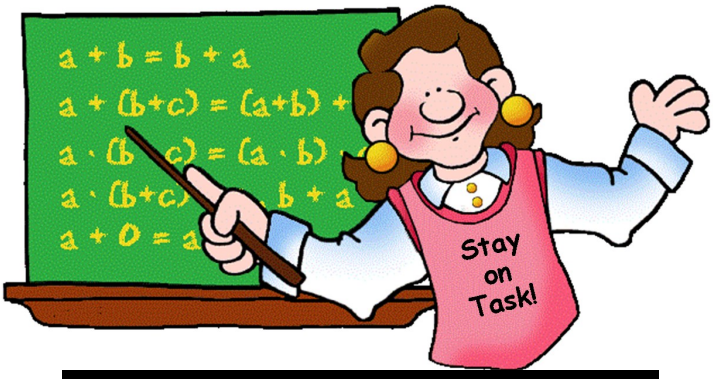
Team Jobs

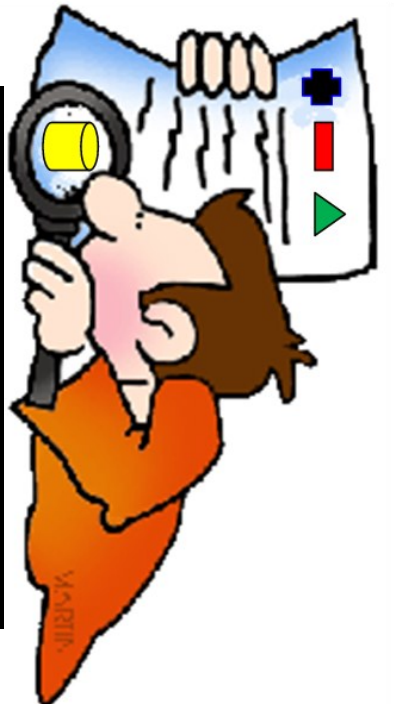
Resource Manager





Task Manager

Editor



Time Manager

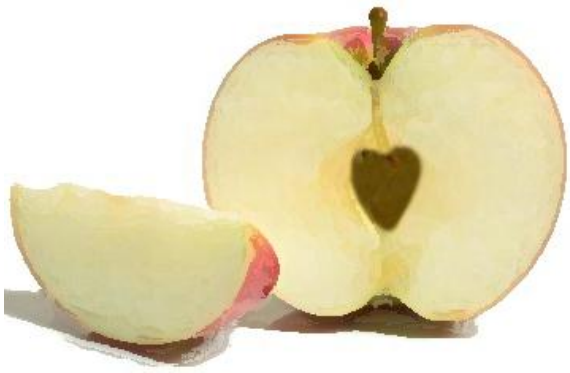
Cooperative Math Team Jobs

Task Manager: **Task manager keeps team members focused on assigned tasked. Everyone participates**

Editor: **Editor checks to make sure team members are recording calculations and procedures on worksheets and in journals when applicable.**

Time Manager: **Time manager keeps team members aware of time expectation**

Resource Manager: **Resource manager gathers and distributes materials needed for lesson. When lesson is complete the RM is responsible for returning manipulatives and making sure students clean up their area.**



Getting to the Core

Special Education

Appendix

Special Education Development of Appendices

CCSS Application to Students with Disabilities

Students with Disabilities-students eligible under the Individuals with Disabilities Act (IDEA) must be challenged to excel within the general curriculum and be prepared for success in their post school lives, including college and/or careers.

In order for students to meet high academic standards and fully demonstrate their conceptual and procedural knowledge and skills in mathematics, reading, writing, speaking, and listening (English language arts), their instruction must incorporate supports and accommodations.
-Orange County Department of Education, 2012

The Santa Ana Unified School District, in the foundation that ALL students will be college and career ready, is creating a compilation of resources including scaffolds, strategies, accommodations, and modifications. These supports will ensure that students with disabilities, a majority of whom are English learners, will have the access and support necessary to be college and career ready.

Superior Standards | **Supportive School Climate** | **Successful Students**

Pre-Assessment

Teacher Talk

The pre-assessment is measuring students understanding of volume and ability to calculate volume. Students are asked to solve problems, demonstrate work, and explain their process. You may use the following accommodations and modifications for students who would benefit from them.

- Read questions aloud
- Deconstruct the questions to support students with meaning
- Complete first problem to support students with a model of the task

Preparing the Learner Lesson A

Teacher Talk

This lesson calls for students to be able to deepen their understanding of mathematical procedures, connections, and relationships by giving them the opportunity to solve algebraic problems in their head.

Students will need to know and when to break down a math problem, inverse operation, and variables. Some of the following accommodations may be used to support students.

- Teachers may want to use the problem below with "Think Alouds" (if necessary). This will provide a model of solving algebraic equations.

Problem: A teacher wanted to know the ages Ana and Luis. If Luis is 7 and the students' combined age is 12, what is Ana's age? X+Y=12

- A video resource that supports the learning objective: http://www.eduplace.com/kids/hmcam/help/eh_5.html and selecting Unit 3: Lesson 5.4 Write and Solve Equations.

- The same Guiding Questions in the lesson can be used as the teacher models one way to solve the problem.

- The sentence frames can be modeled by the teacher and practiced whole group to get students familiar with responses.

- Some students would benefit from oral rehearsal of the sentence frames and/or visual support of the sentence frames

Lesson B

Teacher Talk

Lesson B provides the students with the opportunity to describe the dimensions of a robot they create and measure using surface area.

Some students will benefit from a visual reference of a rectangle.

Prerequisite Skills:

The vocabulary terms that must be understood to develop the concept of volume are:

Volume	Area	Perimeter	Width
Height	Length	Rectangular Prism	Face

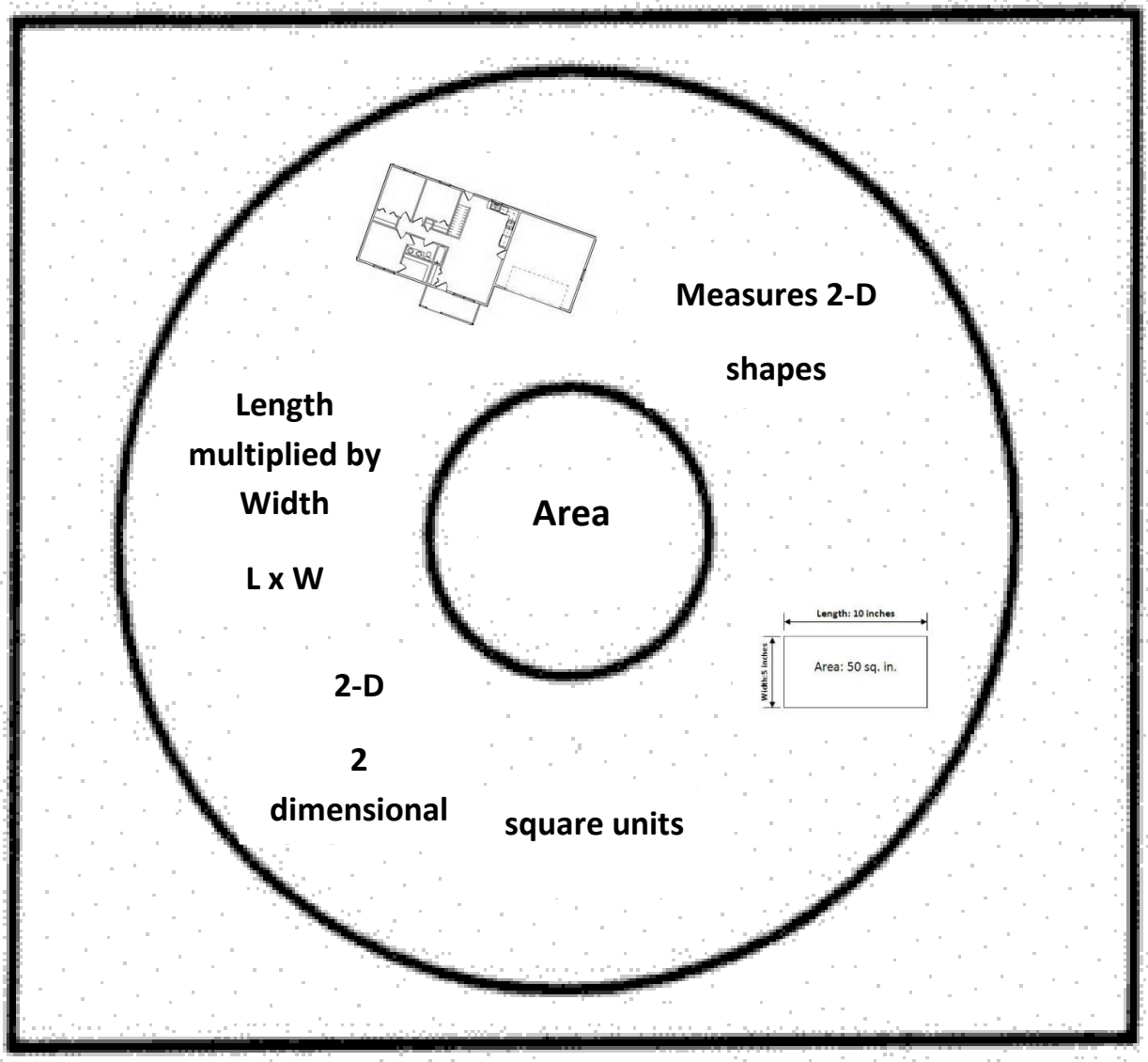
- Building comprehension of these terms can be done using the Vocabulary Grid and Thinking Maps to demonstrate the relationships between the terms (see Vocabulary Grid, Area Bubble Map, Volume Bubble Map, and Area/Volume Double Bubble Map).

- Some students will benefit from the use of a multiplication table or repeated addition to solve formulas (See Multiplication Table Resource).

- Some students may benefit from an instructional video resource to give students an example of how to find surface area (See Resources).

- Some students may benefit from more practice figuring out the areas of additional rectangles. This may be accomplished by using tiles or graph paper. Teacher may begin by giving the dimensions of various rectangles for students to find the area, followed by giving the area allowing students to figure out possible dimensions.

- Some students may benefit from Alternative Approach 22.3 Pg.110 of HM to provide additional practice
- Some students will benefit from having exposure to the linguistic patterns using a visual representation, teacher-modeling, and/or oral rehearsal BEFORE they are expected to describe their robot to their partner.


Measures 2-D
shapes
Length
multiplied by
Width
L x W
Area
Length: 10 inches
Width: 5 inches
Area: 50 sq. in.
2-D
2
dimensional
square units

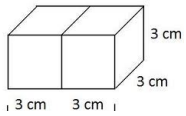
Measure of space that

3-D objects occupy

Length multiplied by Width multiplied by Height LxWxH

Cubic units

Volume



3-D

3 dimensional

Lesson 1 Teacher Talk

In this lesson students are expected to recognize volume as an attribute of solid figures and understand concepts of volume measurement. They are taught to relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. They are developing this knowledge through a cooperative learning project that involves construction of a robot and calculation of the properties. You may use the following modifications and accommodations to support students, as needed:

- Teachers can reinforce the concepts presented by reviewing the terms from the Vocabulary Grids and Bubble Maps.

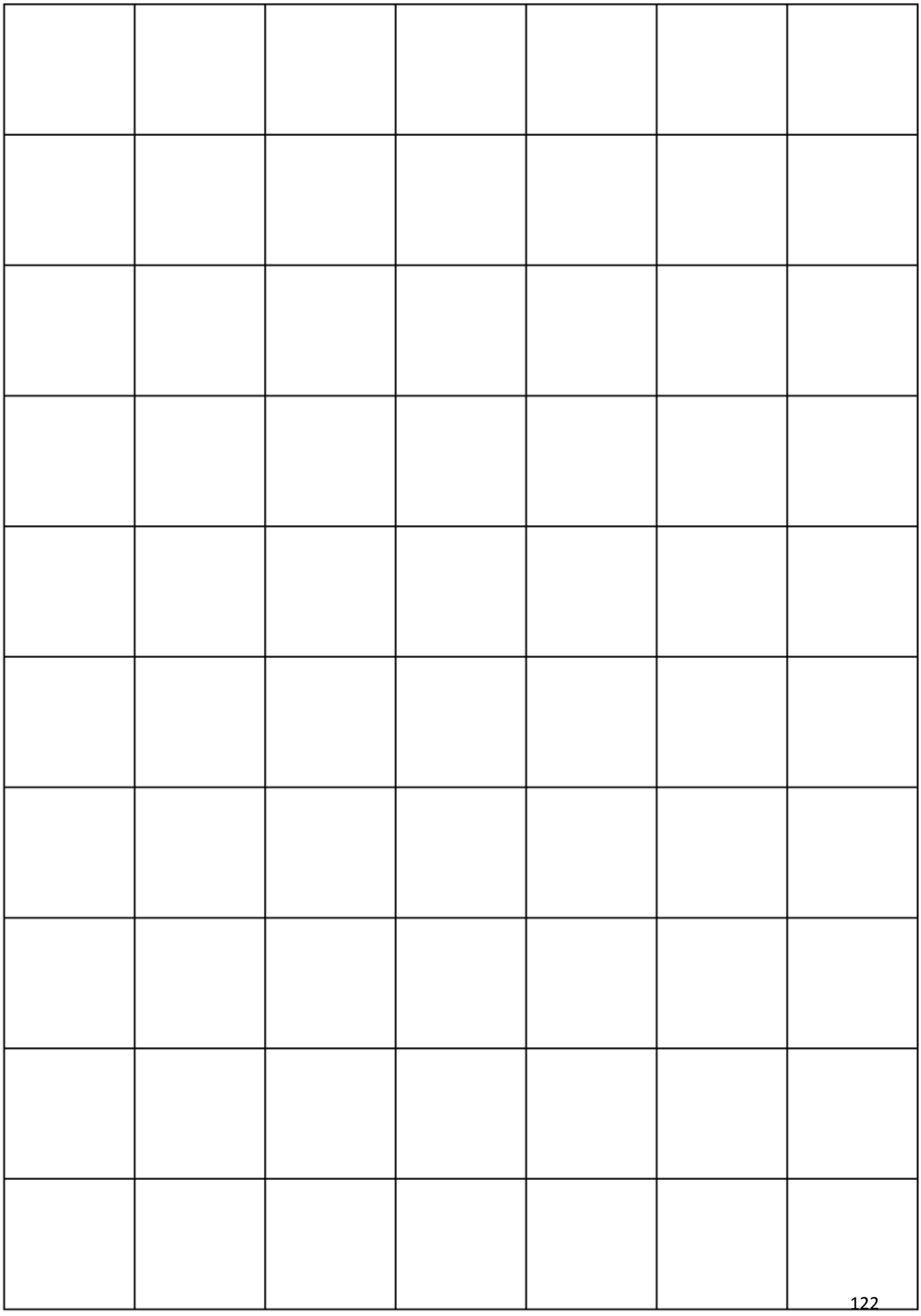
- The teacher and students may collaboratively practice making 3D rectangular prisms with nets in a small group prior to the lesson. Additional nets can be found in the Appendix.

- Some students would also benefit from watching the video of the step by step process of the construction of the nets (See video "How to Create Nets") before the project.

- The teacher could supply the larger graph paper for students who would benefit from this.

http://members.enchantedlearning.com/math/graphs/graphpaper/1

(7X7 one-inch graph paper)



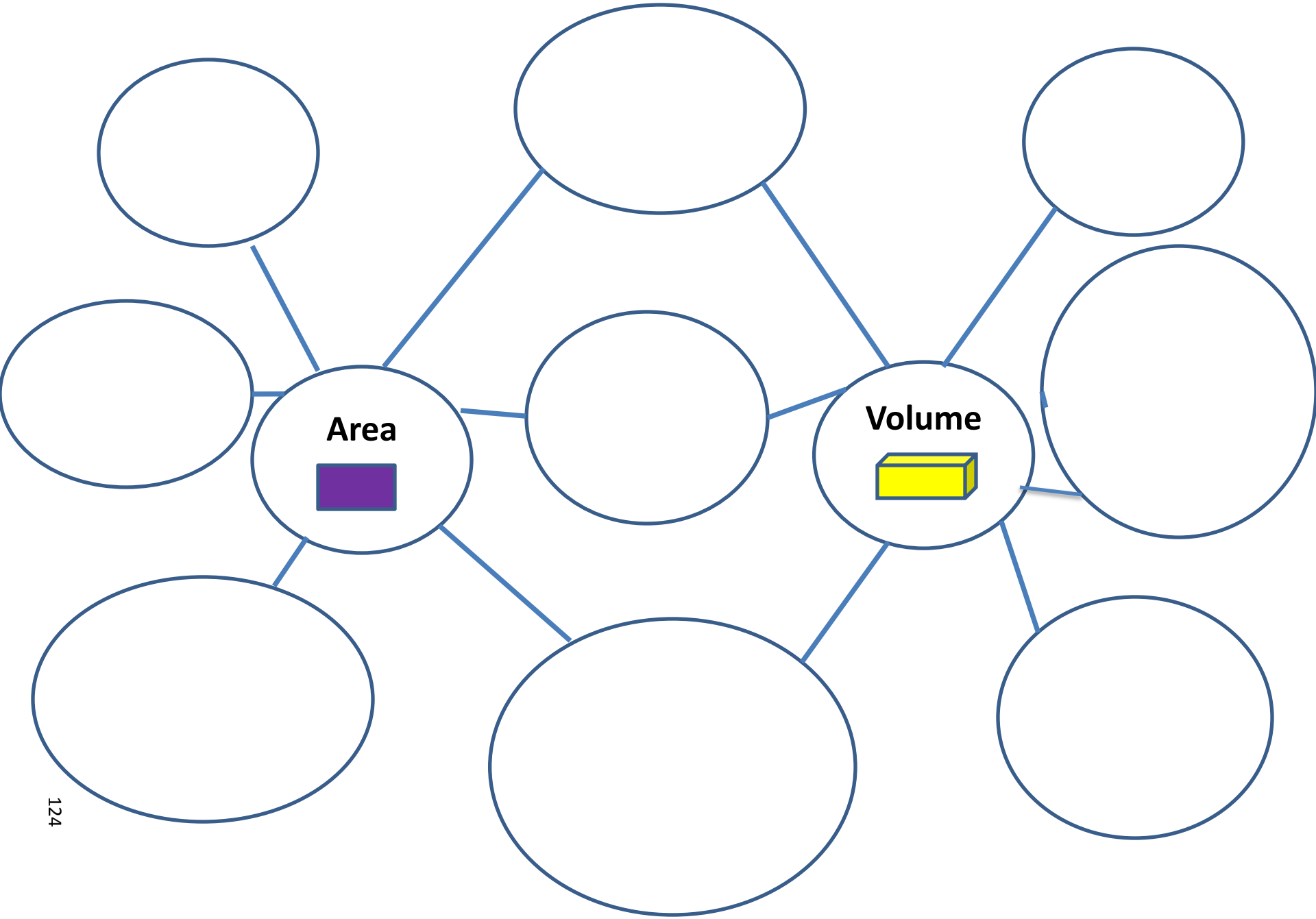
Lesson 2 Teacher Talk

This lesson builds upon the work of lesson 1. After students have constructed a robot (lesson 1) in lesson 2 students have the opportunity to add volumes of 3D figures to find the total volume of the robot.

- In this lesson, teachers may choose to address the “Pre-teaching Considerations” by modeling with cubic unit manipulatives that the same cube has different faces, and that those faces represent the same cube.

- Some students would benefit from constructing a model within a small group with teacher support and computing the total volume.

- Students may use multiplication chart or calculator, as needed.



Compare/Contrast

Area _____, **but**…

…volume _____.

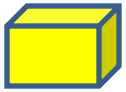
Area and volume **both**_____.

Area _____, **while**…

…volume _____.

Area

Volume

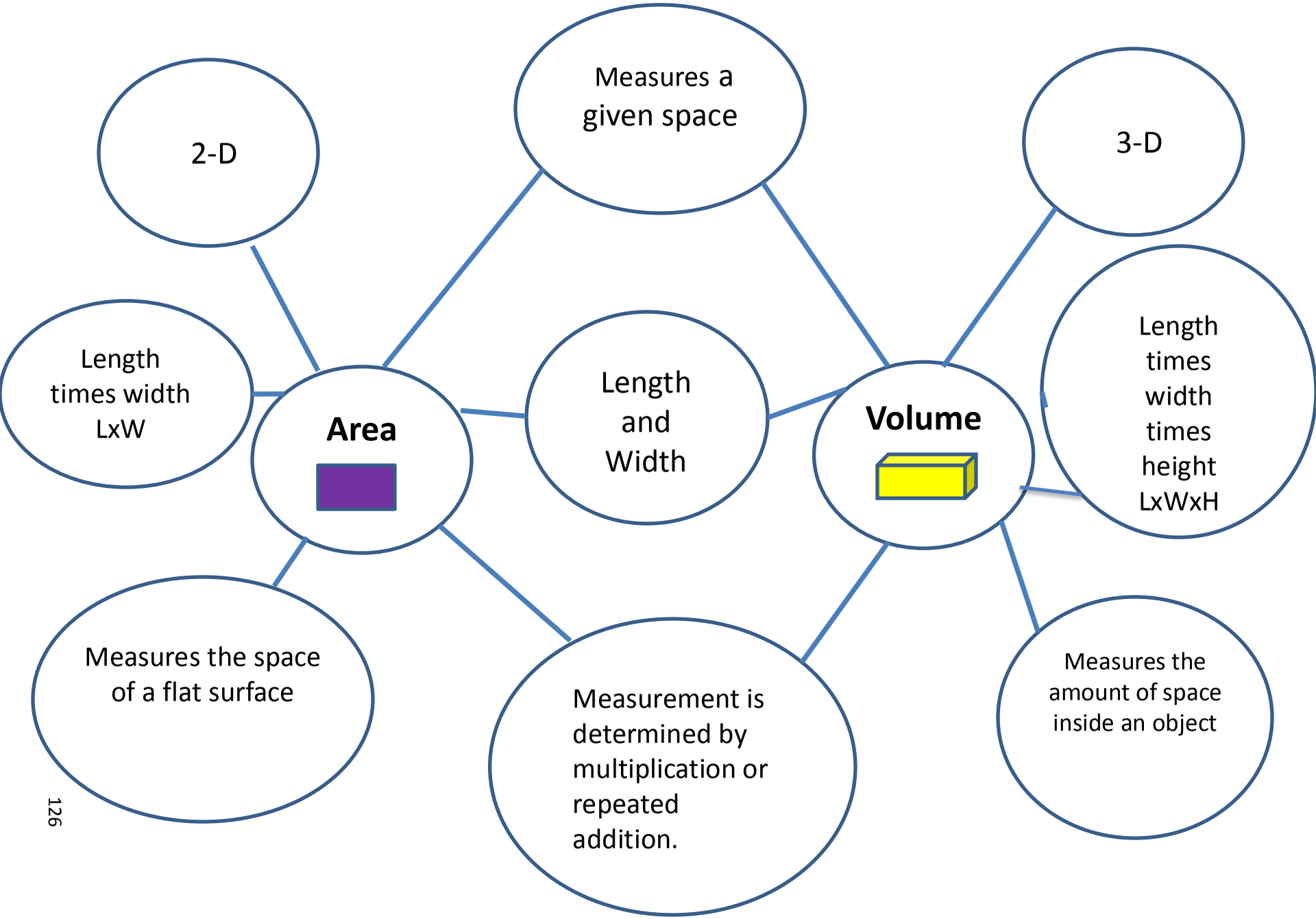


Like area, volume also _____.

Both the volume and area _____.

Unlike volume, area _____.

However, volume _____.



Compare/Contrast

Lesson 3 Teacher Talk

This lesson builds upon the work of Lesson 2. Students would benefit from having additional practice creating nets to build 3D rectangular prisms and figure out the volumes.

- Students may benefit from watching the video on “How to draw a net” again.

- In this lesson, teachers may choose to modeling with cubic unit manipulatives and placing it on graph paper to show how a net is drawn.

- Students would benefit from additional practice constructing a model and determine its volume within a small group. Teacher should reduce the scaffolding to build student independence.

- Students may use a multiplication chart or calculator, as needed.

Teacher Talk
Culminating Project Part 1

This lesson calls for students to use mathematical reasoning to calculate the approximate volume of their classroom using linking cubes.

Teachers can replicate the same project on a smaller scale using the following materials. It is suggested that this be done in a small group with the teacher directing, using "Think Alouds" and questioning prior to the introduction of Culminating Project Part 1.

Materials:

linking cubes 

Shoe box 

Copy paper box 

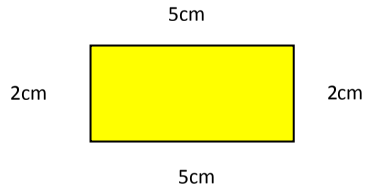
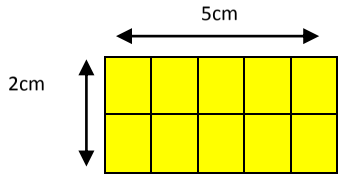
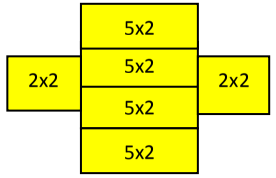
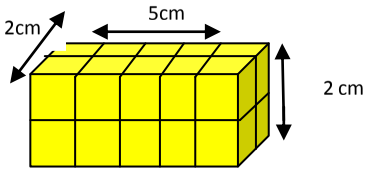
Paper

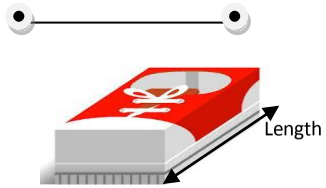
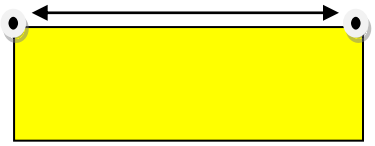
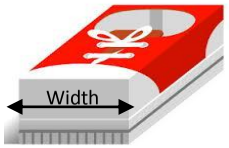
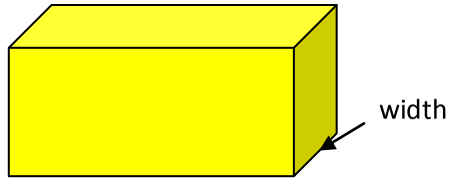
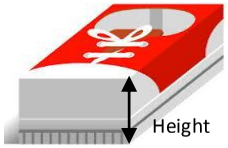
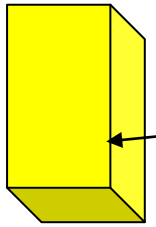
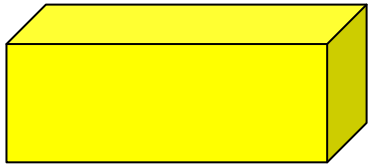
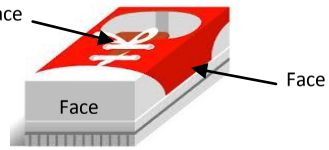
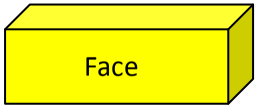
Pencil

Multiplication chart (Optional)

Calculator (Optional)

Determine approximately how many linking cubes will fill a shoebox → Determine approximately how many shoeboxes will fill a copy paper box → Determine approximately how many copy paper boxes will fill a classroom

Word	Definition	How We Remember	Formula	Example
Perimeter	The distance around a 2 dimensional figure	• Distance Around • Measuring the outside • Fence around a yard 	P=Adding the length of each side P=L+W+L+W 2L+2W	 P= 2+5+2+5=14 cm
Area	The number of square units inside a region	• Measuring the inside flat surface • 2 Dimensional (2-D) • Tile inside the kitchen 	A= Length times width LxW	 A= 2x5=10 cm
Surface Area	The total area of the surface of a solid figure	• Measuring around a 3 Dimensional object • Paper to cover an object 	Surface Area = the sum of the area of the faces of the solid figure	 Surface Area= (5x2)+(5x2)+ (5x2)+(5x2)+(2x2)+(2X2)= 48 cm^2
Volume	The number of cubic units that can fit inside a three dimensional object	• 3 Dimensional (3-D) • Using Cubic units (cubes) • The amount of space inside a packing box 	V=Length times width times height LxWxH	 V= 5x2x2=20 cm^3

Word	Definition	How We Remember	Formula	Example
Length	The distance between two points	• From this point to that point 	No Formula	Length 
Width	The measure of how wide something is from side to side	• Car fitting into a parking space  	No Formula	
Height	The perpendicular distance from the base of a parallelogram to its opposite vertex	• How tall something is 	No Formula	
Rectangular Prism	A 3D figure that has two parallel rectangular congruent faces	• Brick  • Stick of butter 	No Formula	
Face	A flat surface of a geometric figure	• One view of a figure 	No Formula	

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4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

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Additional Resources

HOUGHTON MIFFLIN HARCOURT
Education Place

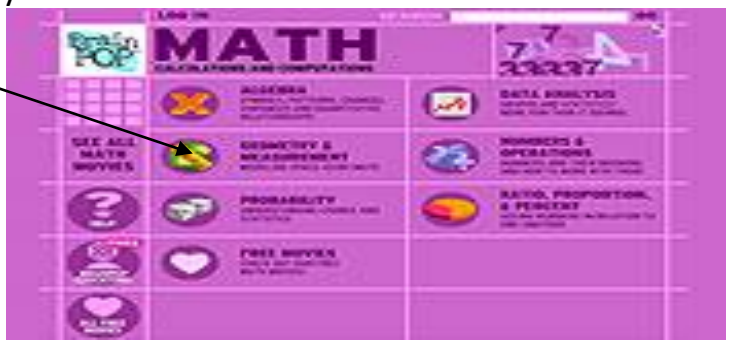
Surface Area Video
Go to http://www.eduplace.com/kids/hmcam/help/eh_5.html
Click on 22.3 Surface Area

Write and solve equations; inverse operations

http://www.eduplace.com/kids/hmcam/help/eh_5.html

Volume of Rectangular Prisms
Go to http://www.brainpop.com
Login: sausd Password: sausd
Click on Math

Click on Geometry and Measurment



Click on Volume of Prisms
