

Module on Surface Area and Volume of Rectangular Prisms
for Grades 6+

By

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Math Module Outline

Strand: Geometry and Spatial Sense

Grade Level Span: 6+

Concepts Included in Module:

UNDERSTANDING SURFACE AREA AND VOLUME OF PRISMS: KNOWING WHAT IT IS AND HOW TO CALCULATE IT

- Isometric Views and Nets
- Calculating Surface Area and Volume
- Modeling

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Rationale for Module:

This module was developed in response to assessments that reveal a need for conceptual models to enhance essential understanding of geometric solids.

Resources Used:

Korean Mathematics. (2001). Edited by Janice Grow-Maienza, translated by Sue Chung Nugent. Kirksville, MO: Truman State University. From Ministry of Education.
Arithmetic. Seoul, Korea: National Textbooks Inc, 1993.

Isometric Dot Paper [printable]. (n.d.). Retrieved July 20, 2010, from <http://www.teachervision.fen.com/geometry/printable/6186.html>

Isometric Drawing Tool [drawing tool]. (n.d.). Retrieved July 20, 2010, from National Council of Teachers of Mathematics website:
<http://illuminations.nctm.org/ActivityDetail.aspx?ID=125>

Using the Isometric Drawing Tool [lesson ideas]. (n.d.). Retrieved July 20, 2010, from National Council of Teachers of Mathematics website:
<http://illuminations.nctm.org/LessonDetail.aspx?id=U166>

Module Materials:

Isometric dot paper, full cereal boxes, Kleenex, or other boxes for each group of students, scissors, isometric dot paper, tape or glue, rulers, paper, pencil, grading rubrics.

Lesson 1: Rectangular Prisms/Solids
Strand: Geometry/Spatial Sense
Grade Level: 6+

Learning Objective:

Students will:

- **create, compare and describe different two-dimensional nets that can be folded into a three-dimensional prisms**
- **examine the properties of the nets and resulting cubes.**

Lesson Resources: isometric dot paper, ruler, paper, and pencil

Standards Addressed:

Show-me Standards/Goals: Geometric and Spatial Relationships: 4. Use visualization, spatial reasoning and geometric modeling to solve problems: A. Recognize and draw three-dimensional representations: given a net of a prism or cylinder, identify the 3-dimensional shape (ST MA 2 3.3)

GLE's:

G4A 6: use spatial visualization to identify isometric representations of mat plans

G4A 7: use spatial visualizations to identify various 2-dimensional views of isometric drawings

G4A8: create isometric drawings from a given mat plan

G4B (6, 7, 8) (DOK 3): draw or use visual models to represent and solve problems

NCTM Content Standards: Analyze characteristics and properties of two-and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships. Use visualization, spatial reasoning, and geometric modeling to solve problems.

Time: This lesson will take 2-3 class periods of 40 minutes each to complete.

Lesson:

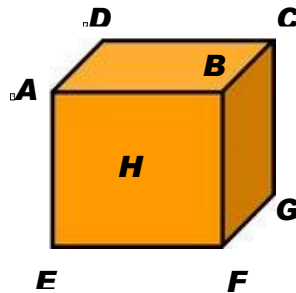
We will begin the study of surface area of a rectangular prism/solid.



In a rectangular solid, find the location of two faces that are opposite to each other.

Would the face *ABCD* and the face *EFGH* meet each other if they were extended?

As shown on the right, the face *ABCD* and the face *EFGH* do not meet no matter how much they are extended.



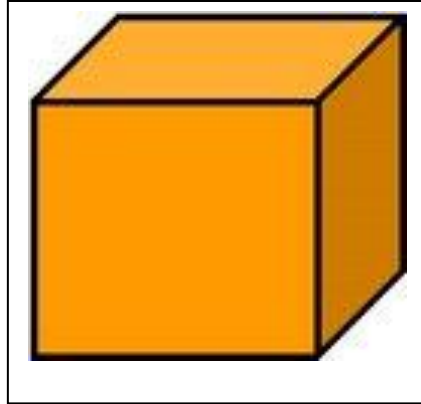
The faces that do not meet are parallel to each other and are called the base faces.

Find the angle formed by a face and another face.

The base faces are the face *ABCD* and the face *EFGH*, the face *AEHD* and the face *BFGC*. And the face *AEFB* and the face *DHGC*. Therefore, in a rectangular solid, there are three pairs

Hint: The angle formed by the face *AEHD* and the face *EFGH* is the angle between two segments, *AE* and *EF*.

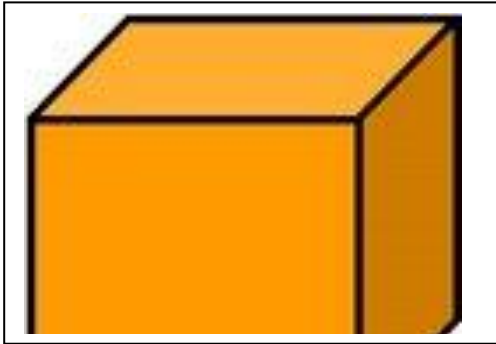
Since angle $AEF = 90$ degrees, the angle between the face and $AEHD$ and the face $EFGH$ is _____. What is the angle formed by two adjacent faces in the rectangular solid? If two adjacent faces form a right angle, then the two faces are perpendicular to each other. The face that is perpendicular to the base is called the perpendicular face.



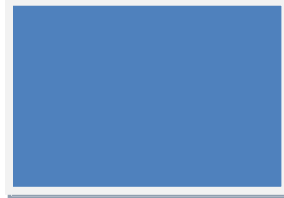
Look back to the cube above. Label the vertices the same as the first one. Draw in the faces with dotted lines that are not visible. It is a rectangular solid with square faces. Find the faces that are parallel and perpendicular to each other in the rectangular solid shown.

Draw a rectangular solid using the isometric dot paper.

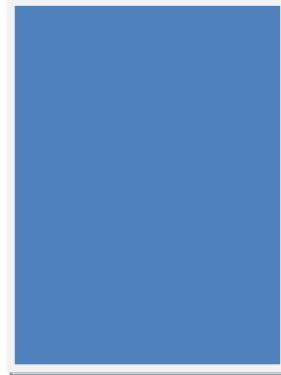
Melissa looked at the box from different angles.



From the top



From the front



From the side

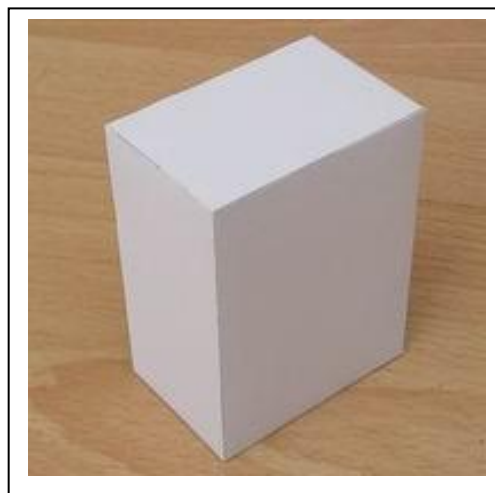


On the isometric paper draw the edges of the box you see in the picture above.

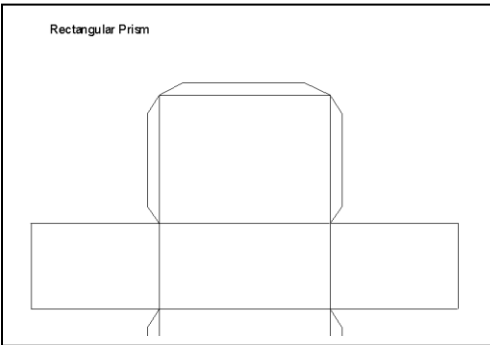
The number of edges that you can see is nine and number of edges that you cannot see is _____.

In the picture above the edges that you cannot see are drawn by dotted lines. A rectangular solid drawn with dotted lines is called a three-dimensional sketch of the rectangular solid.

Study the expanded picture of a rectangular solid.



If a box made of the paper were unfolded, what shape would you see?

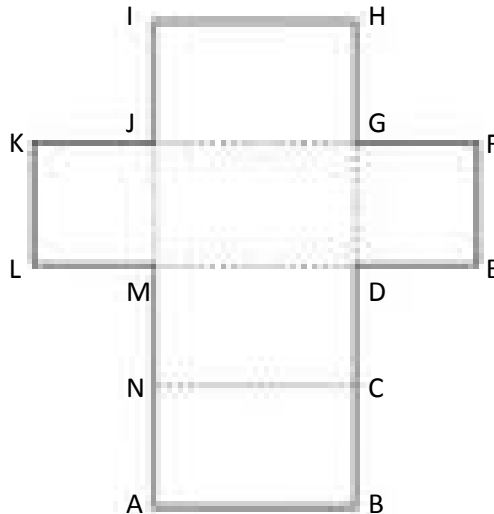


Cut off an edge of the paper box and flatten the box on the flat surface.

The flattened picture of a rectangular solid is called an expanded picture of the rectangular solid.

In the expanded picture, the lines that will be folded are shown as a dotted line and the rest are shown as a solid line.

The net below shows the expanded picture of a rectangular solid.

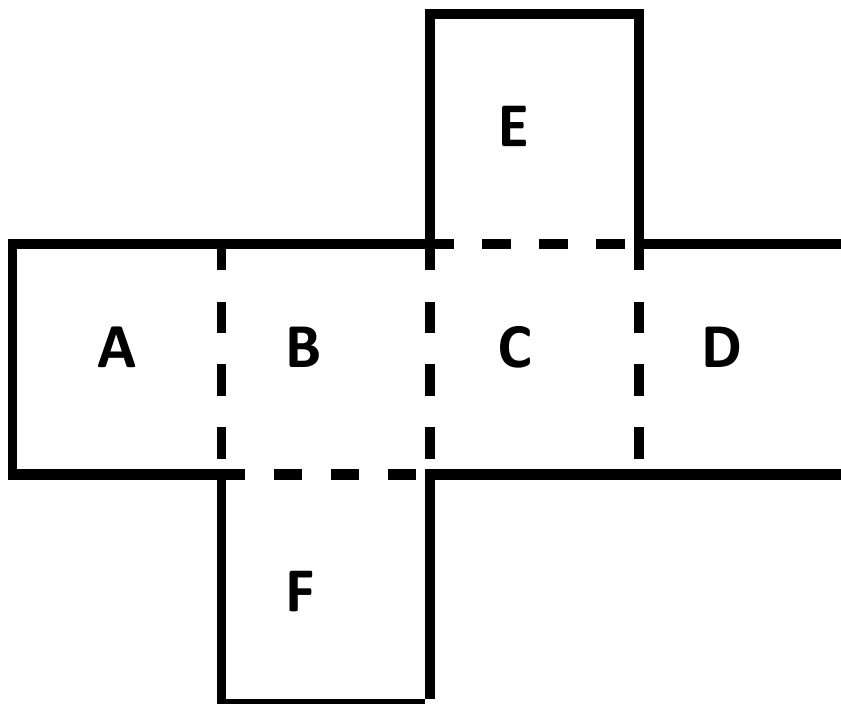


***The sides BCNA and the side _____ have equal shapes and are parallel to each other. There are _____ pairs of the same shape of rectangles. Construct the rectangular solid with the expanded picture of a rectangular solid.**

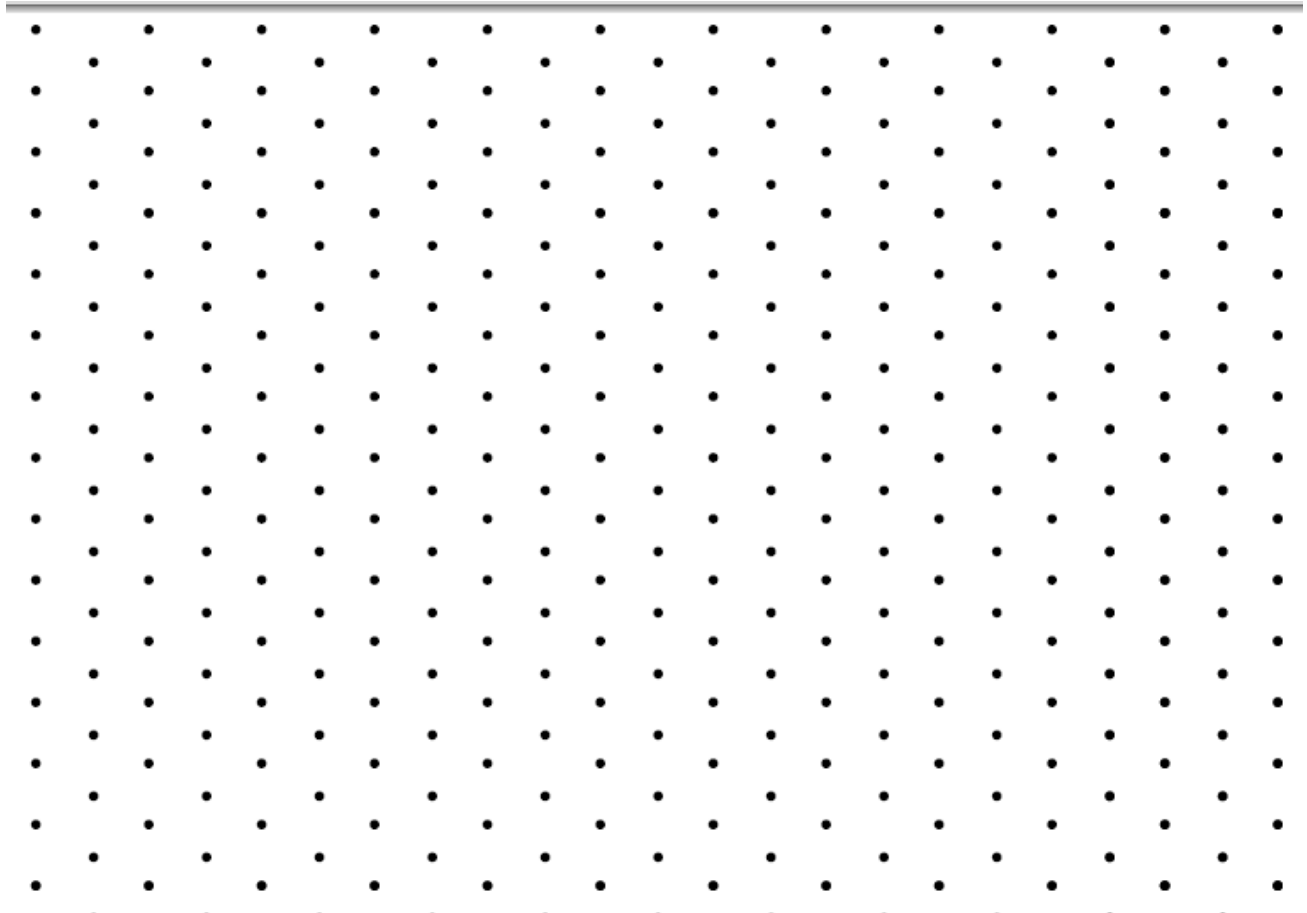
***The side DEFG is parallel to the face _____, and is perpendicular to the face ABCN, the face NCDM, the face _____, and the face _____.**

***The edge CD is attached to the edge _____. The edge EF is attached to the edge _____?**

***From the picture below, construct a regular solid and find the parallel face of the face A and of the face B. _____ & _____**



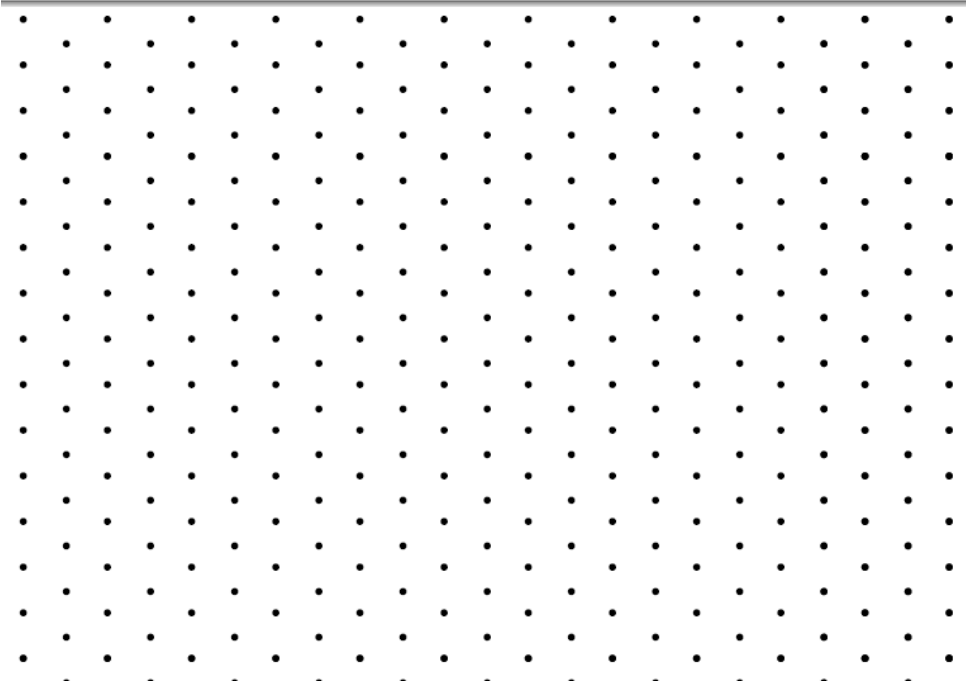
Above is a net of a rectangular prism. Please draw one, either use the above one as a guide or draw another one.



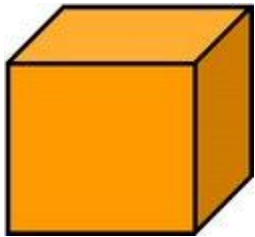
****Using the isometric dot paper draw the 2-dimensional nets:***

1) cube with an edge 2 cm.

2) the prism with the length 3 cm, the width 2 cm, and the height 1 cm.

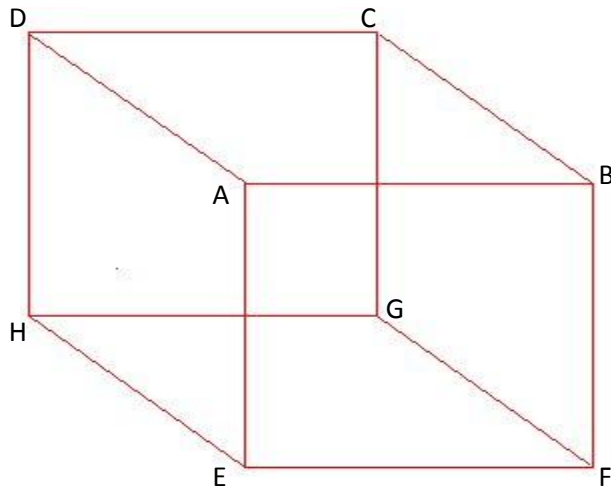


Practice



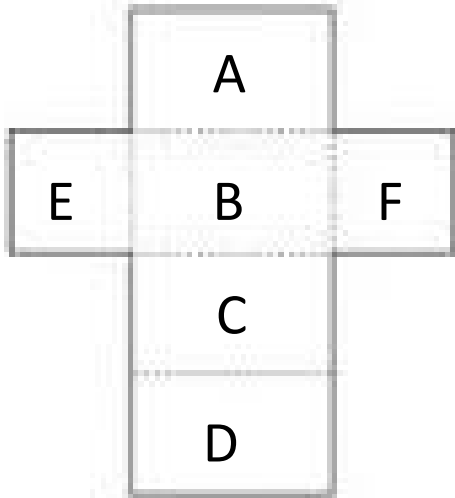
A. Answer the questions looking at the cube on the left.

- 1. Find the number of faces, edges, and vertices.**
- 2. What is the shape of the base face?**
- 3. How many perpendicular faces are there to a face?**



B. Here is a picture of a rectangular prism.

- 1. This picture is called the _____ of a rectangular solid.**
- 2. Find all parallel and perpendicular edges to the edge BC.**
- 3. Find all perpendicular faces to the face AEFG**



C. Answer the questions from the net above.

- 1. Name the prism that can be constructed by the net.**
- 2. Find the parallel faces to the face A.**
- 3. Find the perpendicular faces to the face B.**
- 4. Find all faces attached to the face E.**

D. In a regular solid, do the edges have the same length? Do the faces have the same dimensions?

Lesson 2: Isometric Drawings of 3D figures

Strand: Geometry/Spatial Sense

Grade Level: 6+

Objectives:

- **Students will be able to draw 3D figures using isometric dot paper and an online isometric drawing tool.**
- **Given a mat plan, students will be able to draw 3D figures on isometric dot paper.**

Standards Addressed:

Content Standards:

- **MA2: geometric and spatial sense involving measurement (including length, area, volume), trigonometry, and similarity and transformations of shapes.**

Process Standards:

- **1.6: discover and evaluate patterns and relationships in information, ideas and structures**
- **1.8: organize data, information, and ideas into useful forms (including charts, graphs, outlines) for analysis or presentation**
- **3.1: identify problems and define their scope and elements**
- **3.2: develop and apply strategies based on ways others have prevented or solved problems**
- **3.3: develop and apply strategies based on one's own experience in preventing or solving problems**
- **3.6: examine problems and proposed solutions from multiple perspectives**

Missouri Grade Level Expectations:

- **G4A/6th(DOK2): use spatial visualization to identify isometric representations of mat plans**

- **G4A/7th(DOK2): use spatial visualizations to identify various 2-dimensional views of isometric drawings**
- **G4A/8th (DOK3): create isometric drawings from a given mat plan**
- **G4B/6th, 7th, and 8th(DOK3): draw or use visual models to represent and solve problems**

NCTM Content Standard:

- **Use visualization, spatial reasoning, and geometric modeling to solve problems.**

Materials:

Isometric dot paper:

<http://www.teachervision.fen.com/geometry/printable/6186.html>

Isometric Drawing: NCTM illuminations drawing tool:

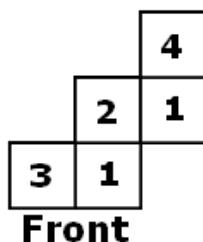
<http://illuminations.nctm.org/ActivityDetail.aspx?ID=125>

Example problems: see next page

Time: This lesson will take about one class period (30-35 minutes)

Lesson:

Teacher will introduce mat plans and isometric paper, giving a concrete demonstration of translating a mat plan to 3D (use blocks on a table,



stacking them to represent the different amounts of blocks shown on a sample mat plan).

For example, the mat plan above means to stack three blocks on the left in the front row, then one block to the right of them. Stack two blocks in the second row behind the one block, and stack one block to the right of those two blocks. Behind the one block in the second row stack four blocks. The students will understand the concrete examples and better be able to translate the idea to the isometric paper.

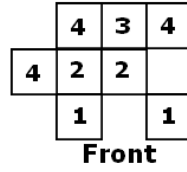
The teacher will show how the isometric [dot paper](#) works, either on a chalkboard, overhead transparency, or SmartBoard. The teacher will also need to demonstrate the NCTM [isometric drawing tool](#) for the students. This activity will work best in a computer lab or with a SmartBoard.

After introductions, teacher will let students practice using the isometric drawing tool to draw cubes and rectangular prisms. After they have mastered the technique online, the teacher will let them practice drawing cubes and rectangular prisms on the dot paper.

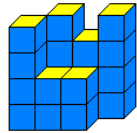
The teacher will then model a problem that gives a mat plan and asks them to translate to a 3D drawing. Students will then work through practice problems individually or in pairs.

Sample problems:

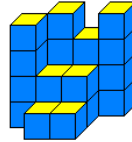
1.



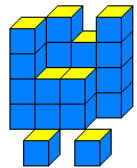
Which solid is represented by the mat plan pictured above?



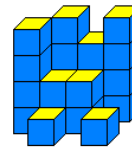
W.



X.

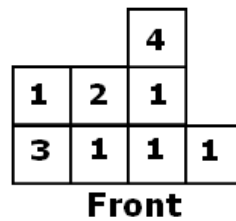
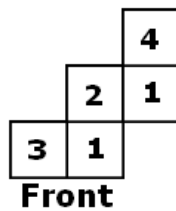
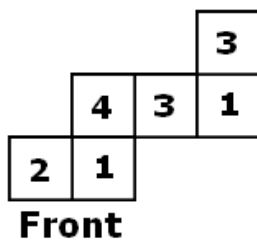


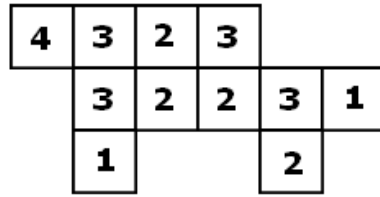
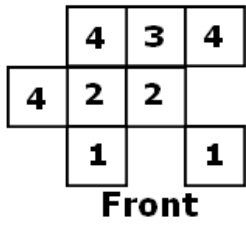
Y.



Z.

2. Draw the solid represented by the following mat plans.





Lesson 3: The Surface Area and Volume of a Rectangular Solid

Strand: Geometry/Spatial Sense

Grade Level: 6+

Objectives:

- **Students will be able to find the surface area and volume of a rectangular prism.**
- **Students will be able to understand and explain the process for finding surface area and volume of a rectangular prism.**

Standards Addressed:

Missouri Content Standards:

- **MA1: addition, subtraction, multiplication and division; other number sense, including numeration and estimation; and the application of these operations and concepts in the workplace and other situations**
- **MA2: geometric and spatial sense involving measurement (including length, area, volume), trigonometry, and similarity and transformations of shapes.**

Missouri Process Standards:

- **1.6: discover and evaluate patterns and relationships in information, ideas and structures**
- **3.1: identify problems and define their scope and elements**
- **3.2: develop and apply strategies based on ways others have prevented or solved problems**
- **4.1: explain reasoning and identify information used to support decisions**

Missouri Grade Level Expectations:

- **G1A|7th: *identify the 2-dimensional cross-section of a 3-dimensional shape**
- **G4B|6th, 7th, and 8th: draw or use visual models to represent and solve problems**
- **M1A|6th and 7th: identify and justify the unit of measure for area and volume (customary and metric)**

NCTM Content Standards:

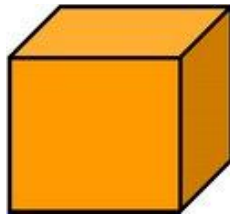
- **Analyze characteristics and properties of two-dimensional geometric shapes and develop mathematical arguments about geometric relationships.**
- **Use visualization, spatial reasoning, and geometric modeling to solve problems.**
- **Understand measurable attributes of objects and the units, systems, and processes of measurement.**

Lesson:

We will begin the study of surface area of a rectangular prism/solid.

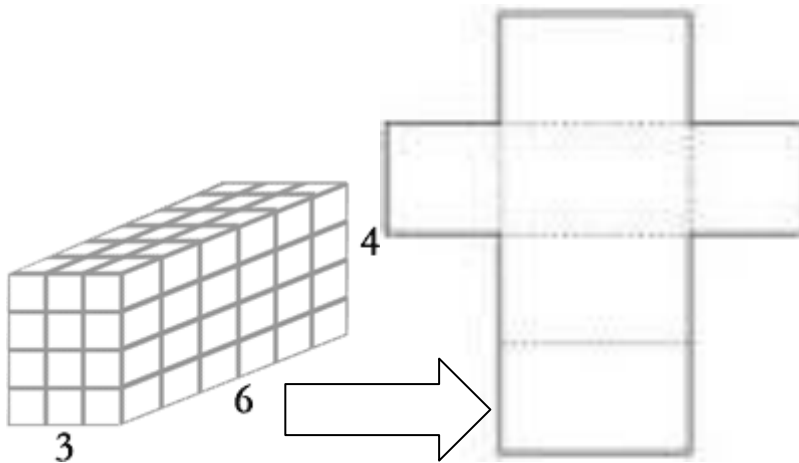


REAL LIFE: Consider wrapping a birthday present. How do you know how much wrapping paper that you will need to cover all the faces?



A rectangular solid consists of 4 sides and 2 base sides. The area of a base side is called the base area and the area of the 4 sides is called the side area, and the area of adding these two is called the surface area.

*Find the surface area of the following rectangular solid.

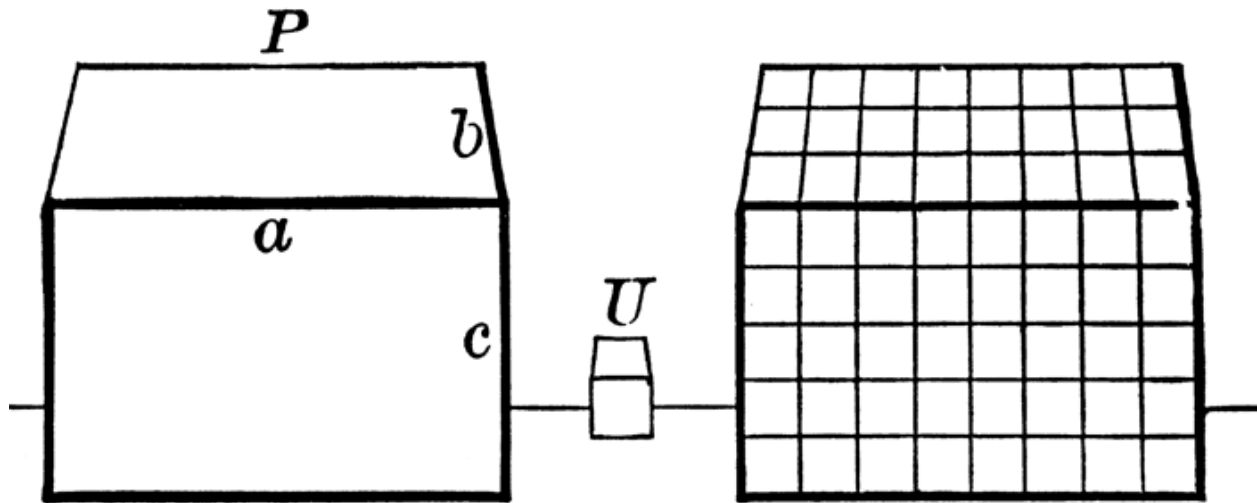


The base area..... $3 \times 4 = 8 \text{ cm}^2$

The side area..... $6 \times 4 = 24 \text{ cm}^2$

The surface area..... $8 \times 2 + 24 = 40 \text{ cm}^2$

The surface area of a rectangular solid is equal to the base area times 2 plus the side area.



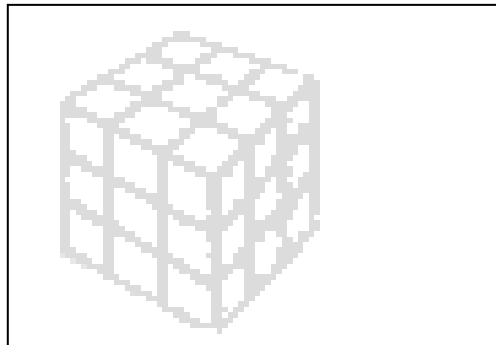
Find the surface area of the above shape.

If $b = 4$ cm, $c = 3$ cm, and $a = 6$ cm

The surface area is the base area = $4 \times \underline{\hspace{1cm}} = \underline{\hspace{1cm}} \text{ cm}^2$

The side area = $(3 + 4 + 3 + 4) \times \underline{\hspace{1cm}} = \underline{\hspace{1cm}} \times 6 = \underline{\hspace{1cm}} \text{ cm}^2$

*Find the surface area of the given cube.



A cube has six congruent sides.

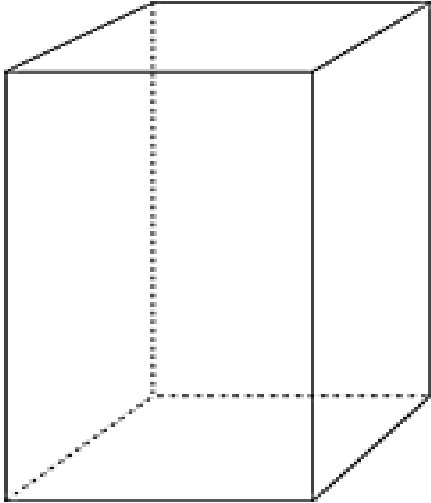
Therefore, the surface area of a cube is 6 times of the base area.

Find the surface area of a rectangular solid with the base area 12 cm^2 , the perimeter of the base side is 14 cm, and the height is 5 cm.

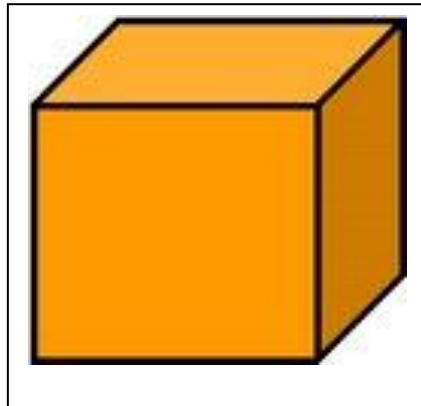
The base area is $3 \times 3 = 9 \text{ cm}^2$

The surface area must be

$\underline{\hspace{1cm}} \times \underline{\hspace{1cm}} = \underline{\hspace{1cm}} \text{ cm}^2$



>Find the surface area of a cube with a length of 9 cm for an edge



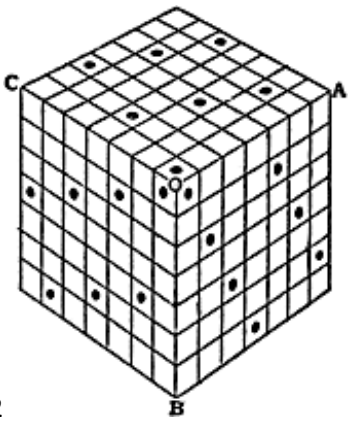
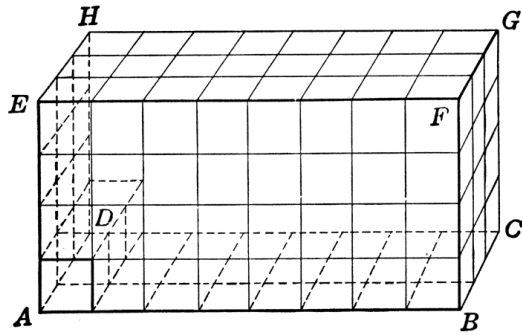
Let us begin the study volume.



REAL LIFE: Consider how many sugar cubes it would take to fill a box.

Volume is how much three-dimensional space a substance (solid, liquid, gas, or plasma) or shape occupies or contains, using cubic meters. The volume of a container is generally understood to be the capacity of the container, or the amount of fluid (gas or liquid) that the container could hold, rather than the amount of space the container itself displaces.

Shape #1



Shape #2

Find the number of cubes in both shapes above and compare the volumes. _____

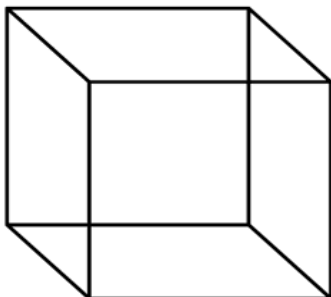
The number of cubes in shape 1 _____

The number of cubes in shape 2 _____

Which is greater, the volume of shape 1 or the volume of shape 2?

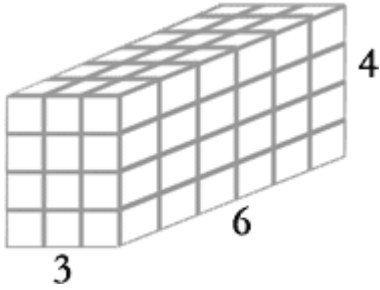
Practice:

- A) To find the volume of a solid a cube with the side of 1 cm is used. The volume of this cube is 1 cm^3 , which is read as 1 cubic centimeter.



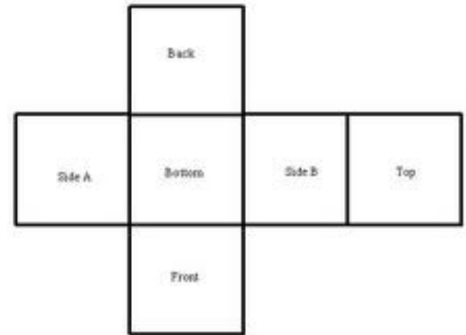
The volume of the cube is 1 cm^3

B) Find the surface area and the volume of the following prism.



C) Find the surface area of a rectangular solid with the length 30, width 24, and height 80 cm.

D) A water tank was built with the following net. What is the capacity of the tank if the bases are 1.25m and 0.8m?



Lesson 4: Design Time

Strand: Geometry and Measurement/Surface Area and Volume

Grade Level: 6+

Objectives:

- **Students will be able to find the surface area and volume of a rectangular prism.**
- **Students will understand the concepts of surface area and volume, and be able to explain an algorithm to find them.**
- **Students will be able to work effectively together in a group.**
- **Students will be able to implement the problem-solving process to complete the project.**
- **Students will be able to use centimeters or inches to accurately measure objects to the nearest $\frac{1}{4}$ inch or nearest centimeter.**

Standards Addressed:

Content Standards:

- **MA1: addition, subtraction, multiplication and division; other number sense, including numeration and estimation; and the application of these operations and concepts in the workplace and other situations**
- **MA2: geometric and spatial sense involving measurement (including length, area, volume), trigonometry, and similarity and transformations of shapes.**

Process Standards:

- **1.6: discover and evaluate patterns and relationships in information, ideas and structures**
- **1.10: apply acquired information, ideas and skills to different contexts as students, workers, citizens, and consumers**
- **2.1: plan and make written, oral and visual presentations for a variety of purposes and audiences**

- **2.3: exchange information, questions and ideas while recognizing the perspectives of others**
- **3.1: identify problems and define their scope and elements**
- **3.2: develop and apply strategies based on ways others have prevented or solved problems**
- **3.3: develop and apply strategies based on one's own experience in preventing or solving problems**
- **3.4: evaluate the processes used in recognizing and solving problems**
- **3.5: reason inductively from a set of specific facts and deductively from general premises**
- **3.6: examine problems and proposed solutions from multiple perspectives**
- **3.7: evaluate the extent to which a strategy addresses the problem**
- **3.8: assess costs, benefits and other consequences of proposed solutions**
- **4.1: explain reasoning and identify information used to support decisions**
- **4.4: recognize and practice honesty and integrity in academic work and in the workplace**
- **4.6: identify tasks that require a coordinated effort and work with others to complete those tasks**

Missouri Grade Level Expectations:

- **G4B|6th, 7th, and 8th (DOK3): draw or use visual models to represent and solve problems**
- **M1A|6th and 7th(DOK3): identify and justify the unit of measure for area and volume (customary and metric)**
- **M2C|7th(DOK2): solve problems involving circumference and/or area of a circle and surface area/volume of a rectangular or triangular prism, or cylinder**

NCTM Content Standards:

- **Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.**
- **Use visualization, spatial reasoning, and geometric modeling to solve problems**

- **Understand measurable attributes of objects and the units, systems, and processes of measurement**
- **Apply appropriate techniques, tools, and formulas to determine measurements**

Materials: Full cereal boxes, Kleenex boxes, or other boxes for each group of students, scissors, tape or glue, rulers, paper and pencil, grading rubric.

Time: This project will take 2-3 class periods of 40 minutes each to complete.

Lesson:

Introduction: Imagine that you are part of a design team for General Mills. Your boss has given you a project—one of the biggest challenges of your career! Your mission is to change the design for Lucky Charms boxes. Because of the declining economy, your company needs to become more efficient with production without cheating American consumers in the process. They have asked you to use less cardboard (decrease the surface area of the box), but...there's a catch! The amount of Lucky Charms cereal put into the box (volume) cannot change. If your team's design is good enough, you get a promotion. If you fail to meet the challenge with your new design, you will be one of the General Mills employees to lose your job. What will you do? What steps can you take to make sure your job is saved?

(Take a few minutes for class discussion of the situation. Example topics to discuss: how to plan for the project, using pen/paper or computers to sketch the new design, ideas for different designs, reasons why companies might use rectangles and cylinders to package food items, ideas for how to maximize volume, review the definitions for surface area and volume of

rectangular prisms and cylinders and go through examples/practice problems if needed.)

(Break students into groups of 3. Then hand out a box, scissors, glue or tape, paper, pencil, and rulers, and project sheets to each group. Designate the jobs of design artist, communications specialist, and measurement technician to each group. Explain each person's role and give general directions to the students.)

You need to decide in your groups which person will be best in each of the following jobs: Design artist is in charge of coming up with a good design concept and drawing the plans on paper or computer. Communications specialist will communicate with the teacher and with other groups to ask questions, report progress, and present the final design concept. Measurement technician is in charge of providing initial measurements of the dimensions of your box, and of providing new measurements after you have redesigned your box. ALL OF YOU are in charge of finding surface area and volume of your original container and of the redesigned container, and cutting/pasting your box.

(Give students 30 seconds to pick jobs, and then verify by a show of hands that jobs have been selected.)

Your project sheet outlines basic directions, but let me emphasize the most important points now:

- 1. DO NOT CUT YOUR BOX UNTIL I TELL YOU TO DO SO!**
- 2. Make sure you have a plan before you start cutting!**
- 3. Ask any questions to me or other students through your communications specialist.**

- 4. You may make your redesigned container any shape you would like, but remember that you should use less surface area (cardboard) and have at least enough volume to contain the same amount of product as before. MAXIMIZE your volume. Also, having bases that are polygons will make your calculations easier. The simpler your base, the simpler your calculation.**
- 5. Measure, measure, measure! If you're not sure how to measure or what to measure, have your communications specialist ask me or another group.**

(Walk around and assist groups as they work to develop plans for redesigning. Make sure they take measurements to find original surface area and volume before they start drawing their new designs. Also, make sure they don't cut their boxes prematurely!)

(Once everyone has a design drawn, assist groups as needed with figures for measurements of the new container and estimated surface area/volumes. Then they may start cutting and rebuilding.)

(As groups finish, have them answer the reflection questions on their project sheets and prepare a presentation.)

All groups have finished their containers, so now we'll start the presentations. Pretend I am your boss—the person you need to impress.

(After presentations, engage students in a class discussion of the project results. Were they happy with how their containers turned out? Are there other factors we might not have considered? How do you think we could change this project to make another challenge for design teams? Is it possible to decrease surface area and increase volume? How are surface area and volume related?)

4. Calculate your anticipated surface area and volume of the new design. If needed, change your measurements and calculate again. You need to have a really good idea that your design will work before you start cutting!

5. Now it's finally time to cut your container and rebuild with your new design. Let your teacher know when you have finished this step.

Answer the reflection questions below:

6. Explain your process of finding the surface area for your new design. Can you put it in a formula?

7. Explain your process of finding the volume for your new design. Can you put it in a formula?

8. Do you believe that everyone shared equal responsibility in this project? If your design fails, would you be able to pick which person in your group most deserves to be fired? If your design wins, could you pick which person most deserves the promotion? Give reasons to explain your decision.

9. Now you need to design a presentation for your communications specialist to present. You must demonstrate your new container, explain why your container is well designed, give the old and new measurements/surface areas/volumes, and convince your boss why your group's design is the best. Presentations must be about 2 minutes long.

Rubric for scoring projects (30 points)

(5 points) Each student effectively played the role they were assigned in the group and contributed equally to the group effort.

(5 points) Measurements were made accurately and recorded correctly.

(5 points) Surface area and volume were calculated correctly.

(5 points) A new container was constructed.

(5 points) Presentations were given in a professional manner.

(5 points) The group's container met the criteria of the challenge.

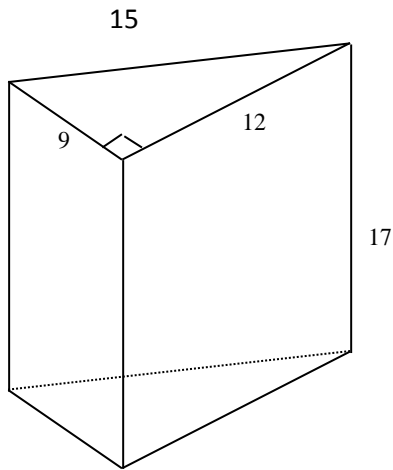
Pretest

Name _____

Surface Area and Volume of Prisms

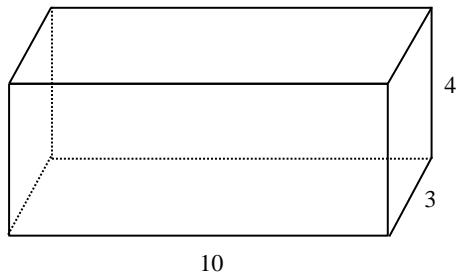
Find the lateral area of the prism. (G.4.B.6) DOK1

_____ 1.

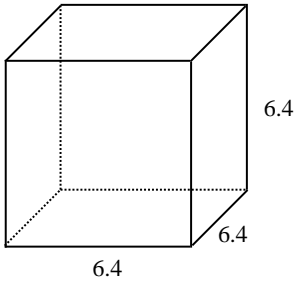


Find the surface area of each prism. Round to the nearest tenth if necessary while doing your calculations as well as in your final answer. (G.4.B.6) DOK1

_____ 2.

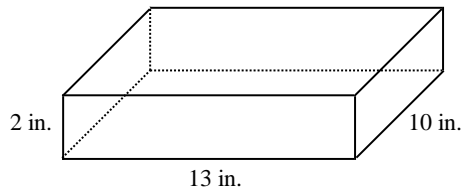


_____ 3.



Find the volume of the prism. (G.4.B.6) DOK 1

_____ 4.



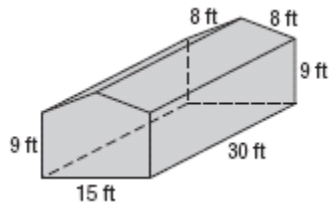
_____ 5. Find the amount of glass needed to make an aquarium 36 inches in length, 18 inches in width, and 20 inches in height, the base of which is also made from glass. (G.4.B.6) DOK 1

6. John is studying the concept of volume and surface area. He looked at a fish tank and wondered how this volume will fit on his desk. He seems to be confused about the mathematical meaning of volume and surface area. Compare and contrast the mathematical meaning of volume and surface area as it applies to this scenario. (G.4.B.6) DOK 3

_____ **7. What is the volume of a cube that has a 5-inch edge? (G.4.B.6) DOK 1**

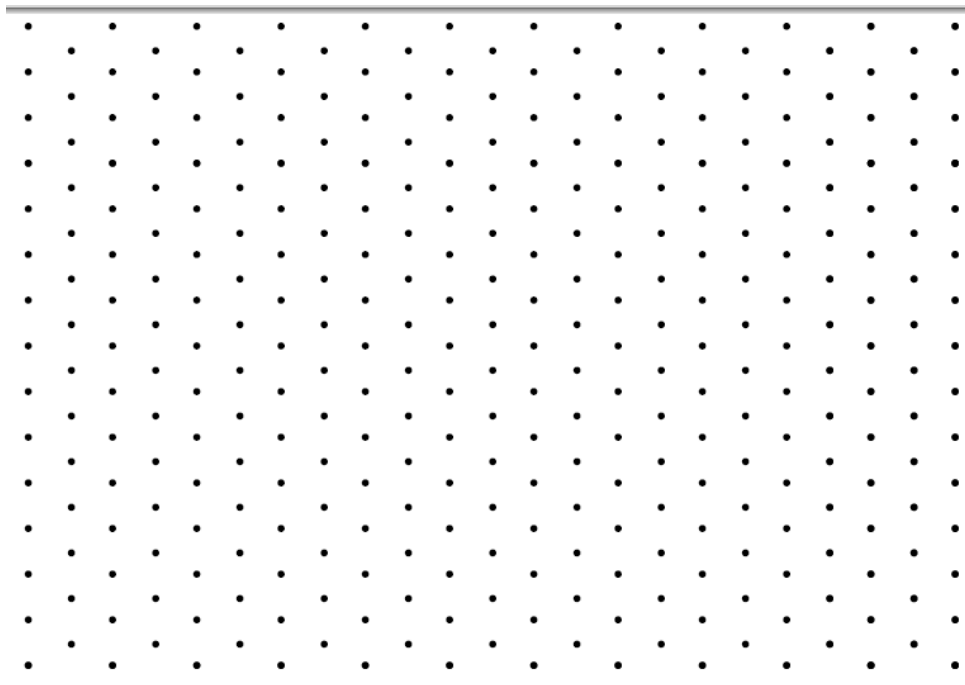
_____ **8. Find the lateral area and surface area of a rectangular prism that has a length of 12cm, width of 7cm and height of 14cm. (G.4.B.6) DOK 1**

_____ **9. Find the amount of metal needed to cover the sides and roof of the building shown. The bottom, front, and back are not metal. (G.4.B.6) DOK 1**



10. Sketch a rectangular prism 5 units high, 5 units long and 4 units wide using isometric dot paper.

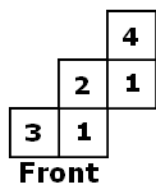
(G.4.A.6) DOK 1

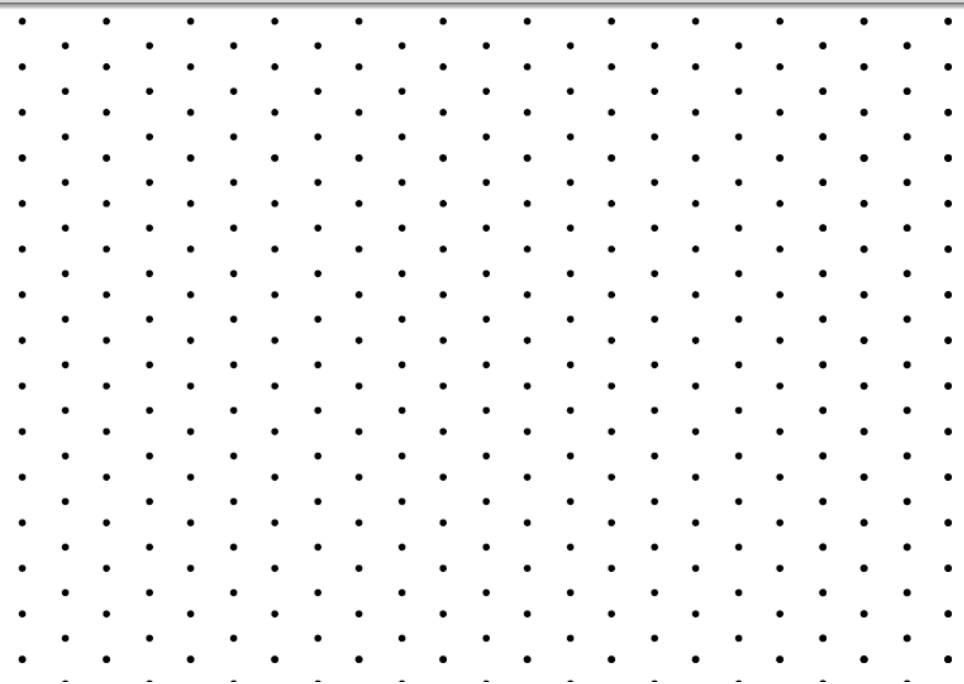


11. Compare and contrast surface area and volume. (G.4.B.6) DOK 2

12. Create a method to find the surface area of any geometric solid. (G.4.B.6) DOK 3

13. Given the mat plan create an isometric drawing of the figure. (G.4.A.6) DOK 1





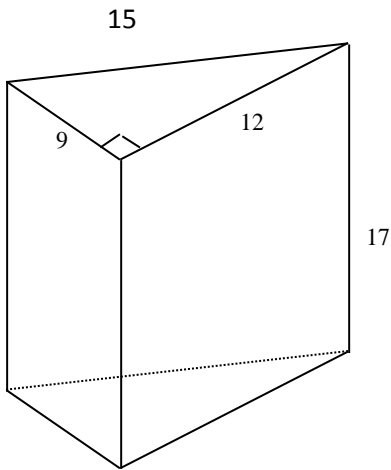
Pretest rubric

Name _____

Surface Area and Volume of Prisms

Find the lateral area of the prism. (G.4.B.6) DOK1

_____ 1.



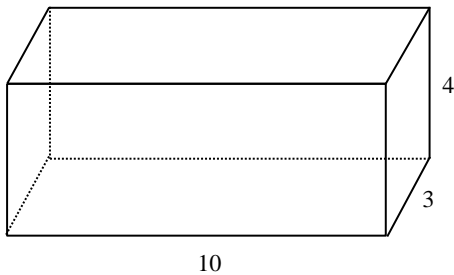
2 points possible

612 units²

1 pt for work, 1 pt for answer

Find the surface area of each prism. Round to the nearest tenth if necessary while doing your calculations as well as in your final answer. (G.4.B.6) DOK1

_____ 2.

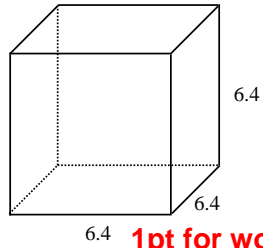


2 points possible

164 units²

1 pt for work, 1 pt for answer

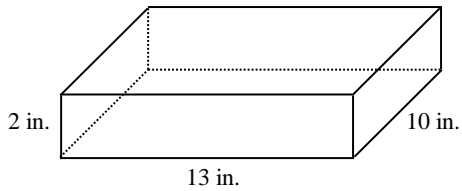
3.



1 pt for work, 1 pt for answer: 245.76 units²

Find the volume of the prism. (G.4.B.6) DOK 1

4.



2 points possible

260 in³

1 pt for work, 1 pt for answer

5. Find the amount of glass needed to make an aquarium 36 inches in length, 18 inches in width, and 20 inches in height, the base of which is also made from glass. (G.4.B.6) DOK 1

2 points possible: 1 pt for work, 1 pt for answer: 2808 in²

6. John is studying the concept of volume and surface area. He looked at a fish tank and wondered how this volume will fit on his desk. He seems to be confused about the mathematical meaning of volume and surface area. Compare and contrast the mathematical meaning of volume and surface area as it applies to this scenario. (G.4.B.6) DOK 3

2 points possible, 1 pt for correctly defining volume and surface area, 1 pt for connecting the information to the given situation.

Sample response: The base of the fish tank is what John needs to worry about fitting on his desk. This is a 2-dimensional area, not a volume. Volume is the amount of space (or amount of water) to fill the fish tank.

_____ 7. What is the volume of a cube that has a 5-inch edge? (G.4.B.6) DOK 1

2 points possible, 1 pt for work, 1 pt for answer: 125 in^3

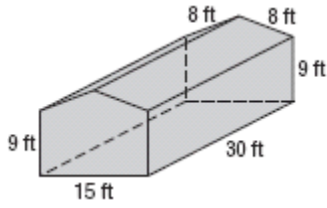
_____ 8. Find the lateral area and surface area of a rectangular prism that has a length of 12cm, width of 7cm and height of 14cm. (G.4.B.6) DOK 1

4 points possible, 2 pts for work, 2 pts for answers.

LA= 532 cm^2

SA= 700 cm^2

_____ 9. Find the amount of metal needed to cover the sides and roof of the building shown. The bottom, front, and back are not metal. (G.4.B.6) DOK 1



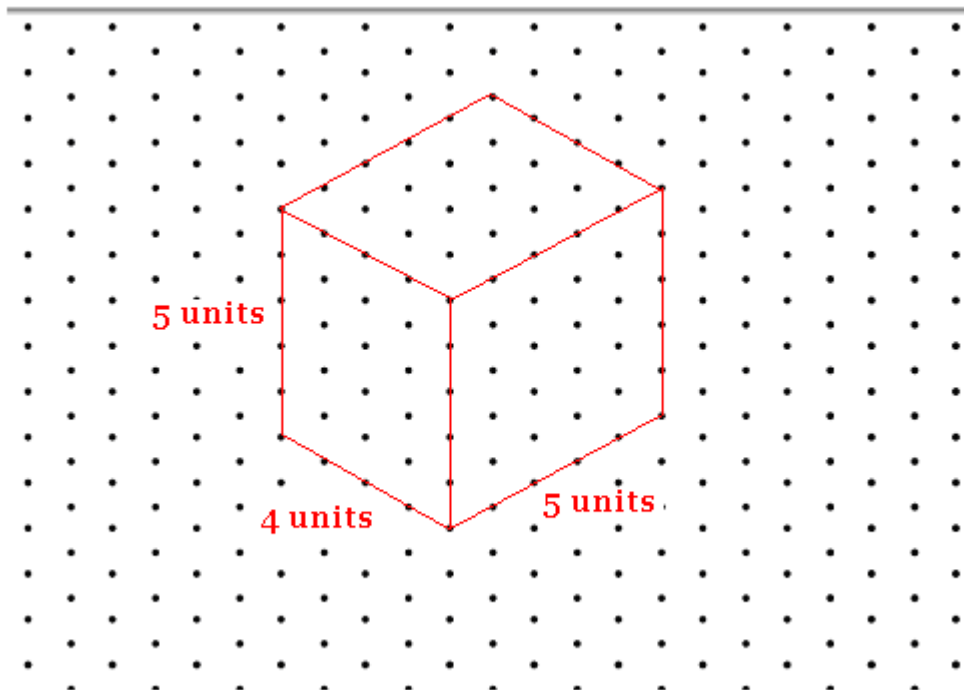
2 pts possible, 1 pt for work, 1 pt for answer: 1020 ft²

10. Sketch a rectangular prism 5 units high, 5 units long and 4 units wide using isometric dot paper.

(G.4.A.6) DOK 1

3 pts, 1 pt for each correct dimension to complete the prism

-1 pt if all dimensions are correct but prism is not drawn correctly



11. Compare and contrast surface area and volume. (G.4.B.6) DOK 2

2 pts, 1 pt for understanding of surface area and 1 pt for understanding of volume

Sample response: Surface area is the total area of all exposed surfaces of a solid. Surface area is 2-dimensional. Volume is the measure of the amount of space inside a solid figure. Volume is 3-dimensional.

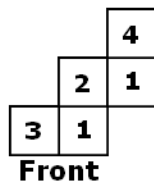
12. Create a method to find the surface area of any geometric solid. (G.4.B.6) DOK 3

2 pts possible

Sample answer: Surface Area= area of bases + lateral surface area

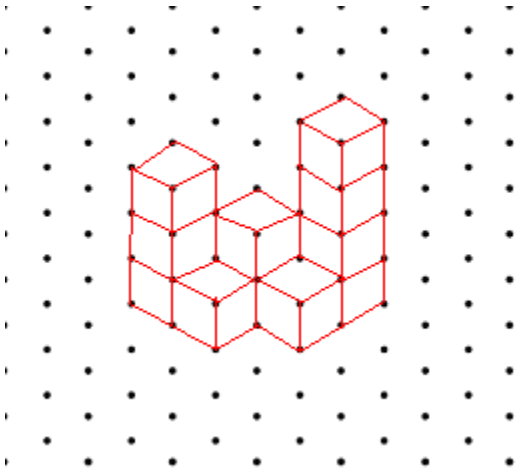
Lateral Surface Area= perimeter of base x height

13. Given the mat plan create an isometric drawing of the figure. (G.4.A.6) DOK1



2 pts possible, 1 pt for understanding of drawing cubes, 1 pt for of entire drawing

correct completion

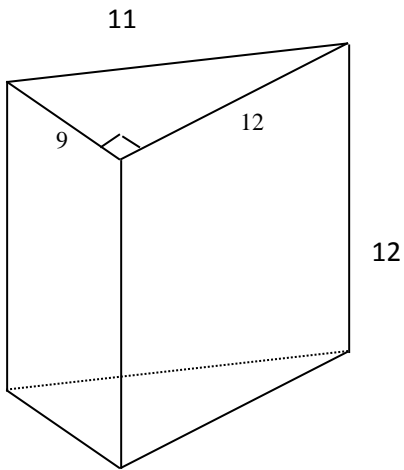


Post test

Name _____

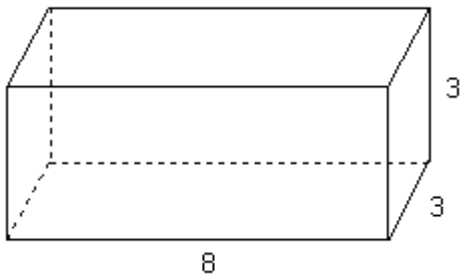
Find the lateral area of each prism. (G.4.B.6) DOK1

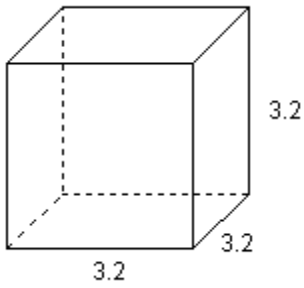
_____ 1.



Find the surface area of each prism. Round to the nearest tenth if necessary while doing your calculations as well as in your final answer. (G.4.B.6) DOK1

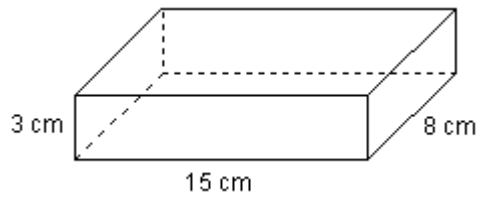
_____ 2.





_____ 3.

Find the volume of the solid. (G.4.B.6) DOK1



_____ 4.

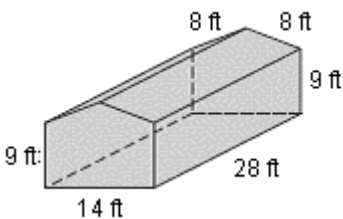
_____ 5. **Find the amount of glass needed to make an aquarium 31 inches in length, 18 inches in width, and 20 inches in height, the base of which is also made from glass. (G.4.B.6) DOK1**

6. John is studying the concept of volume and surface area. He looked at a shoe box and wondered how this volume will fit on his shelf. He seems to be confused about the mathematical meaning of volume and surface area. Compare and contrast the mathematical meaning of volume and surface area as it applies to this scenario. (G.4.B.6) DOK3

_____ 7. What is the volume of a cube that has a 13-inch edge? (G.4.B.6) DOK1

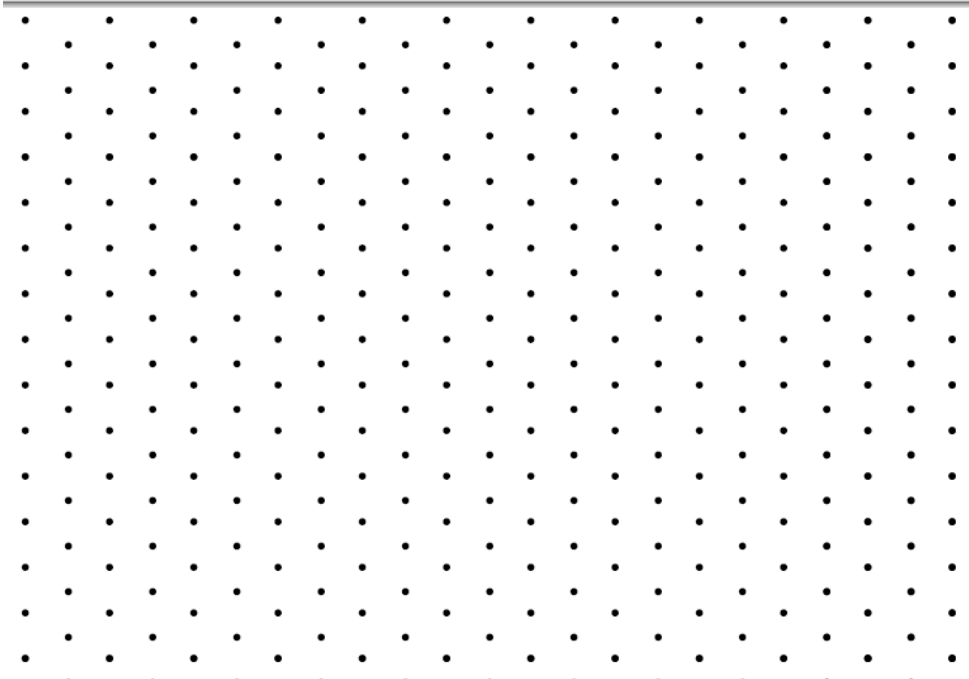
8. Find the lateral area and surface area of a rectangular prism that has a length of 11cm, width of 8cm and height of 14cm. (G.4.B.6) DOK1

9. Find the amount of siding needed to cover the building shown. Include the roof but not the front, back and floor. (G.4.B.6) DOK1



10. Use isometric dot paper to draw a rectangular prism with dimensions of 3 units by 5 units by 10 units.

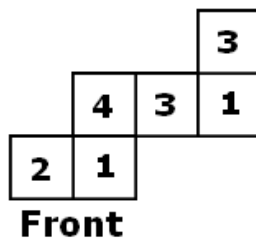
(G.4.A.6) DOK1

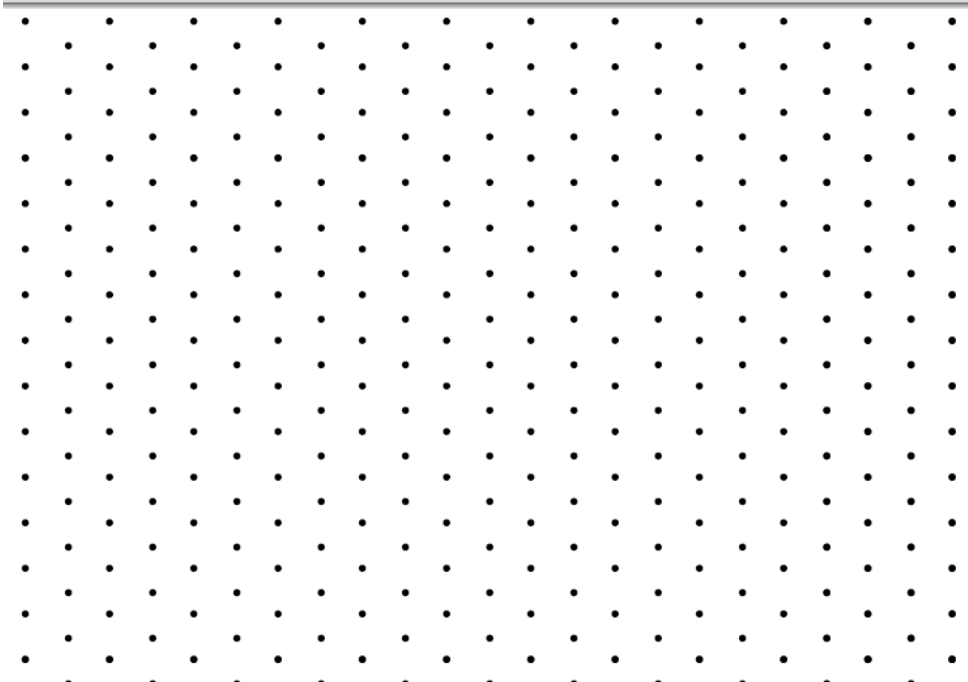


11. Compare and contrast lateral and surface area. (G.4.A.6) DOK3

12. Create a method to find the lateral area of any geometric solid. (G4.B.6) DOK4

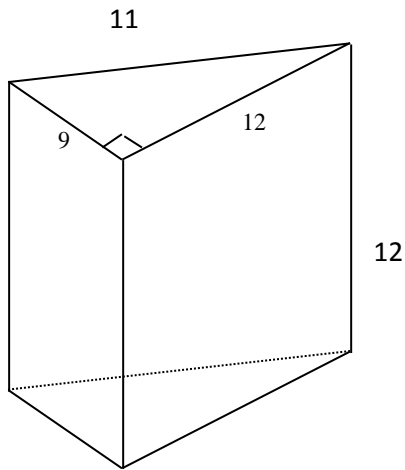
13. Given the mat plan create an isometric drawing of the figure. (G.4.A.6) DOK 1





Find the lateral area of each prism. (G.4.B.6) DOK1

_____ 1.



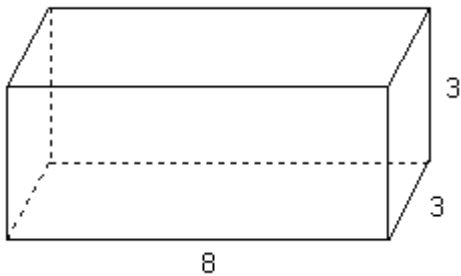
2 points possible

384 units²

1 pt for work, 1 pt for answer

Find the surface area of each prism. Round to the nearest tenth if necessary while doing your calculations as well as in your final answer. (G.4.B.6) DOK1

_____ 2.

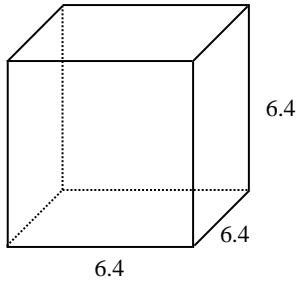


2 points possible

114 units²

1 pt for work, 1 pt for answer

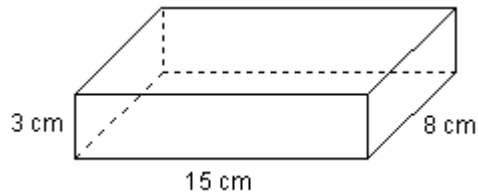
3.



2 pts possible: 1 pt for work, 1 pt for answer

61.44 units²

Find the volume of the solid. (G.4.B.6) DOK1



4.

2 points possible

360 cm³

1 pt for work, 1 pt for answer

5. Find the amount of glass needed to make an aquarium 31 inches in length, 18 inches in width, and 20 inches in height, the base of which is also made from glass. (G.4.B.6) DOK1

2 points possible: 1 pt for work, 1 pt for answer: 3076 in²

6. John is studying the concept of volume and surface area. He looked at a shoe box and wondered how this volume will fit on his shelf. He seems to be confused about the mathematical meaning of volume and surface area. Compare and contrast the mathematical meaning of volume and surface area as it applies to this scenario. (G.4.B.6) DOK3

2 points possible, 1 pt for correctly defining volume and surface area, 1 pt for connecting the information to the given situation.

Sample response: The base of the shoe box is what John needs to worry about fitting on his shelf. This is a 2-dimensional area, not a volume. Volume is the amount of space needed to fill the shoe box.

- _____ 7. What is the volume of a cube that has a 13-inch edge? (G.4.B.6) DOK1

2 points possible, 1 pt for work, 1 pt for answer: 2197 in^3

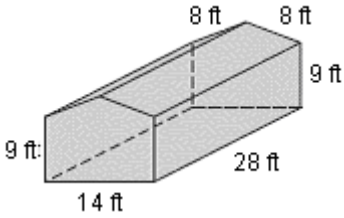
8. Find the lateral area and surface area of a rectangular prism that has a length of 11cm, width of 8cm and height of 14cm. (G.4.B.6) DOK1

4 points possible, 2 pts for work, 2 pts for answers.

$$LA=532 \text{ cm}^2$$

$$SA=708 \text{ cm}^2$$

9. Find the amount of siding needed to cover the building shown. Include the roof but not the front, back and floor. (G.4.B.6) DOK1



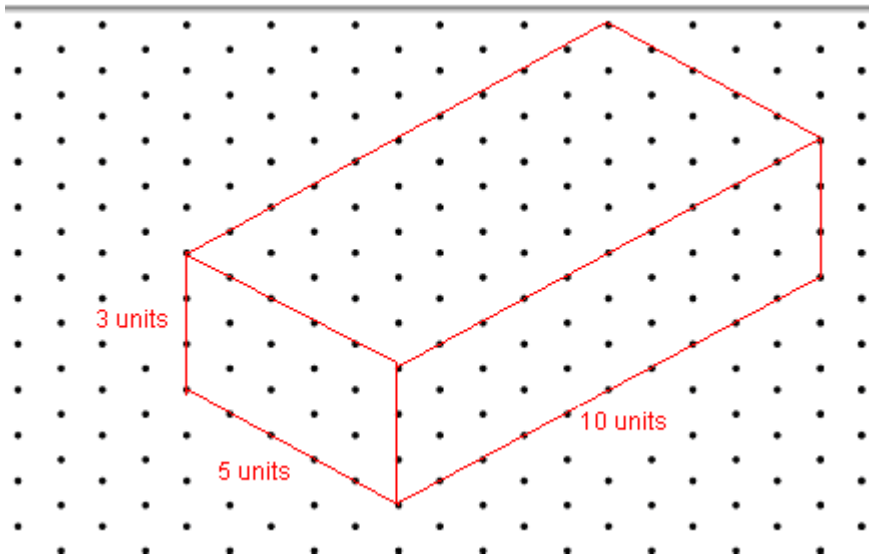
2 pts possible, 1 pt for work, 1 pt for answer: 952 ft²

10. Use isometric dot paper to draw a rectangular prism with dimensions of 3 units by 5 units by 10 units.

(G.4.A.6) DOK1

3 pts, 1 pt for each correct dimension to complete the prism

-1 pt if all dimensions are correct but prism is not drawn correctly



11. Compare and contrast lateral and surface area. (G.4.A.6) DOK3

2 pts, 1 pt for understanding of surface area and 1 pt for understanding of lateral surface area

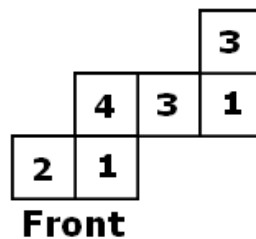
Sample response: Surface area is the total area of all exposed surfaces of a solid. Surface area is 2-dimensional. Lateral surface area is the area of the surfaces of a solid, not including the bases. Lateral surface area is also 2-dimensional.

12. Create a method to find the lateral area of any geometric solid. (G4.B.6) DOK4

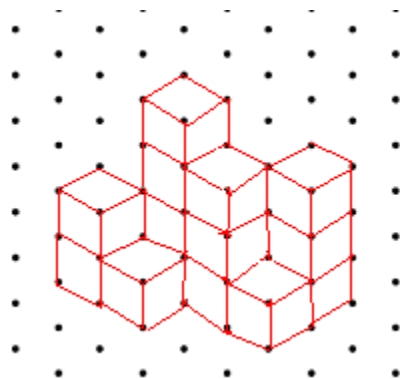
2 pts possible

Sample answer: Lateral Surface Area= perimeter of base x height

13. Given the mat plan create an isometric drawing of the figure. (G.4.A.6) DOK 1



2 pts possible, 1 pt for understanding of drawing cubes, 1 pt for correct completion of entire drawing



Progress Chart: Pre-test / Post-test

Student	Total # Correct	Total % Correct	Nets/Isometric Drawings % (DOK1)	Lateral Area % (DOK1)	Surface Area % (DOK1)	Volume % (DOK1)	Area/Volume % (DOK2)	Area/Volume % (DOK3)
A								
B								
C								
D								
E								
F								
G								
H								
I								
J								
K								
L								
M								
N								
O								
P								
Q								
R								
S								
T								

Nets/Isometric Drawings (DOK1): Questions 10, 13

Lateral Area(DOK1): Questions 1, 8

Surface Area (DOK1): 2, 3, 5, 8, 9

Volume (DOK1): 4, 7

Surface Area/Volume (DOK 2): 11

Surface Area/Volume (DOK 3): 6, 12