StackUps

Spatial Reasoning Using Cubes and Isometric Drawings

Teacher's Guidebook

AMERICAN PRINTING HOUSE
FOR THE BLIND, INC.

©2007
Louisville, Kentucky
All Rights Reserved

Product Designer/Author
Karen J. Poppe, Tactile Graphics Project Leader

Tactile/Visual Designer
Tom Poppe, Pattern/Model Maker

Project Assistants
Matt Smith
Monica Vaught

Guidebook/Cover Layout
Bisig Impact Group

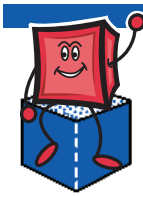
StackUps: Spatial Reasoning Using Cubes and Isometric Drawings
APH Catalog Number: 1-08960-00

Large Print Teacher's Guidebook
APH Catalog Number: 7-08960-00

Braille Teacher's Guidebook
APH Catalog Number: 5-08960-00

American Printing House for the Blind, Inc.
1839 Frankfort Avenue
P.O. Box 6085
Louisville, Kentucky 40206-0085, USA
Phone: 502-895-2405
Toll Free: 800-223-1839
Fax: 502-899-2274
E-Mail: info@aph.org
Web site: www.aph.org

Acknowledgements



The following teachers of the visually impaired contributed their time, knowledge, and creativity to the evaluation of *StackUps: Spatial Understanding Using Cubes and Isometric Drawings*:

Diane Clay, Teacher of the Visually Impaired, Catholic Charities Maine, Lewiston, Maine

Donna Fridgant, Teacher of the Visually Impaired, Tennessee School for the Blind, Nashville, Tennessee

Sister Elaine George, Materials Assistant, St. Lucy Day School for Children with Visual Impairments, Philadelphia, Pennsylvania

Michelle Harbison, Teacher of the Visually Impaired, Anne Arundel County Public Schools, Linthicum, Maryland

Lisa Hodge, Teacher of the Visually Impaired, Washington School for the Blind, Vancouver, Washington

Jennifer F. Johnston, Teacher of the Visually Impaired, Gardendale High School/Jefferson County Public School System, Birmingham, Alabama

Brenda Ireland, Teacher of the Visually Impaired/Certified O&M Specialist, Payette School District, Payette, Idaho

Yvonne Martinez, Teacher of the Visually Impaired, Mesquite Independent School District, Mesquite, Texas

Jill R. Pariso, Teacher of the Visually Impaired, Orleans-Niagara BOCES, Medina, New York

Shari Scott, Teacher of the Visually Impaired, Tennessee School for the Blind, Nashville, Tennessee

Christy J. Shepard, Teacher of the Visually Impaired, Cypress-Fairbanks Independent School District, Houston, Texas

Janet M. Ulwick-Sacca, Teacher of the Visually Impaired, Carroll Center for the Blind, Newton, Massachusetts

Danelle Volk-Heimbach, Teacher of the Visually Impaired, Anne Arundel County Public Schools, Linthicum, Maryland

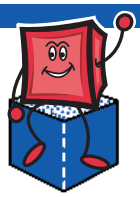
Sally Walton, Teacher of the Visually Impaired, Frederick County Public Schools, Walkersville, Maryland

JoAnn Weatherall, Teacher of the Visually Impaired, Tennessee School for the Blind, Nashville, Tennessee

David Wixom, Teacher of the Visually Impaired, Industrial Arts and Technology, Missouri School for the Blind, St. Louis, Missouri

Special thanks to the 56 students who were involved in the field test of this product.

Table of Contents



Introduction 1

Suggested Activities 7

Determining Possible Stacked Cube Arrangements 7

Constructing 3-D Models and Interpreting Tactile Displays of Stacked Cube Arrangements 8

Using Mat Plans 12

Interpreting Front-Right-Top Views 17

Determining the Volume of Stacked Cube Arrangements 21

Determining the Surface Area of Stacked Cube Arrangements 23

Identifying Cube Nets 25

Appendix A: Stacked Cube Arrangements 29

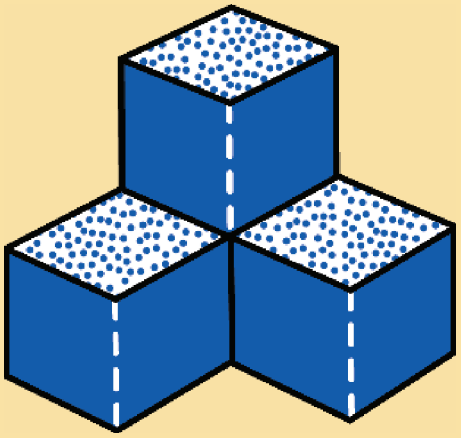
Appendix B: Mat Plans 95

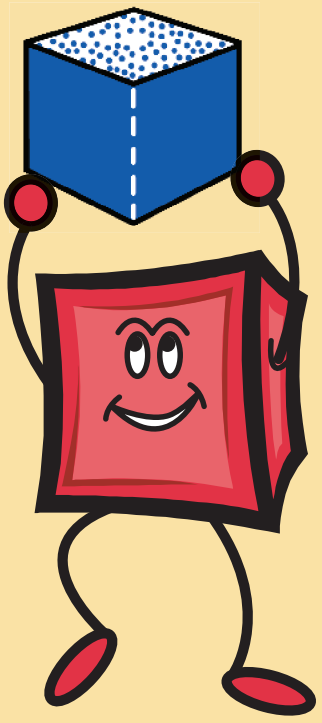
Appendix C: Mat Plan Worksheet 159

Appendix D: *StackUps* Skills Checklist 163

Bibliography 171

Introduction





Introduction

Purpose of *StackUps*

StackUps: Spatial Reasoning Using Cubes and Isometric Drawings is a set of materials designed to assist students with visual impairments and blindness in the interpretation of raised-line graphics depicting 3-dimensional figures, specifically stacked cube arrangements. Using the materials provided, students can practice the following:

- building 3-dimensional models using Velcro® cubes in combination with tactile displays,
- using Mat Plans to construct and create stacked cube arrangements,
- interpreting Front-Right-Top views,
- determining volume and surface area, and
- interpreting cube nets

StackUps addresses the following Geometry Standards from the NCTM Principles and Standards for School Mathematics:

- Analyze characteristics and properties of 2- and 3-dimensional geometric shapes and develop mathematical arguments about geometric relationships
- Use visualization, spatial reasoning, and geometric modeling to solve problems

StackUps encourages students to 1) recognize, name, build, draw, compare and sort 2- and

3-dimensional shapes; 2) describe attributes and parts of 2- and 3-dimensional shapes; and 3) investigate and predict the results of putting together and taking apart 2- and 3-dimensional shapes.

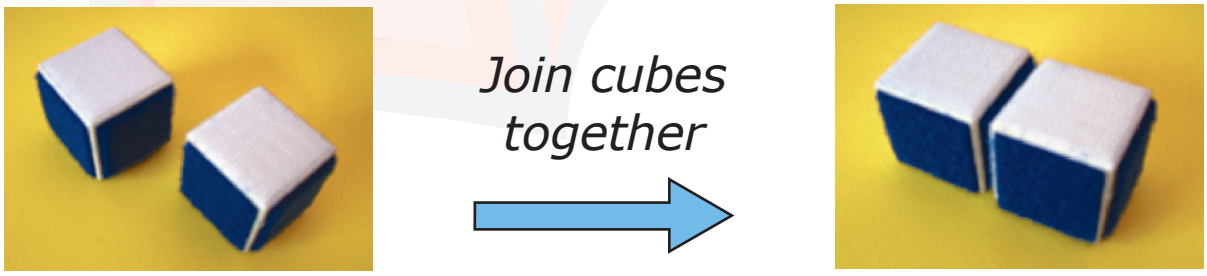
Getting Started with *StackUps*

The *StackUps* kit includes 20 cubes, each covered with hook Velcro (white and rough texture) and loop Velcro (blue and soft texture). These contrasting colors and textures correspond with the accompanying tactile and visual Stacked Cube Arrangement Cards [32 total]. The sides of the cubes covered with soft, blue Velcro are intended to represent the *visible sides* of a cube when shown 2-dimensionally in a tactile display. Therefore, in the accompanying Stacked Cube Arrangement Cards, the sides of each cube always have a smooth texture. Conversely, the side of a cube covered with rough, white Velcro is intended to always represent the *visible top* of a cube when shown 2-dimensionally in a tactile display. On the Stacked Cube Arrangement Cards, the top of each cube is indicated by a rough, pebbled texture.

The Stacked Cube Arrangement Cards depict arrangements that vary in difficulty and are progressive with regard to the number of cubes depicted. For example, one of the Stacked Cube Arrangement Cards shows a single cube. Use Stacked Cube Arrangement #1 [see **Appendix A**] to first acquaint a student with how the textures on the tactile card correspond to the actual *StackUps* cubes. Have the student position the *StackUps* cube on a flat surface that mimics the presentation of the

single cube shown on the tactile card. The rough, white Velcro side should be positioned upward; the two facing sides will have soft, blue Velcro.

Important: As *StackUps* cubes are joined together to build various stacked cube arrangements, it is important that all the cubes be oriented in the same direction to each other. Therefore, white, rough surfaces of the cubes should always attach to blue, soft surfaces of the cubes. This consistent orientation of the cubes becomes essential as cubes are added behind and above the first row of cubes.



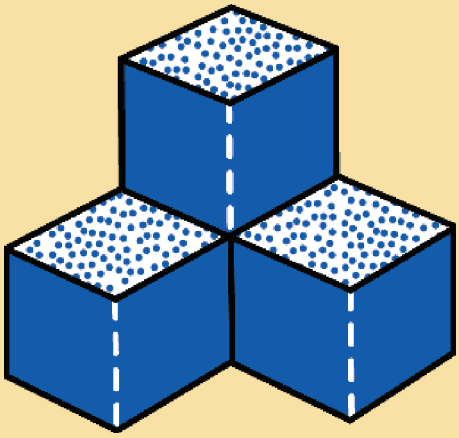
Orient cubes so that rough, white Velcro is on top, and the two facing sides are soft, blue Velcro. Keep all cubes oriented in the same direction as they are stacked.

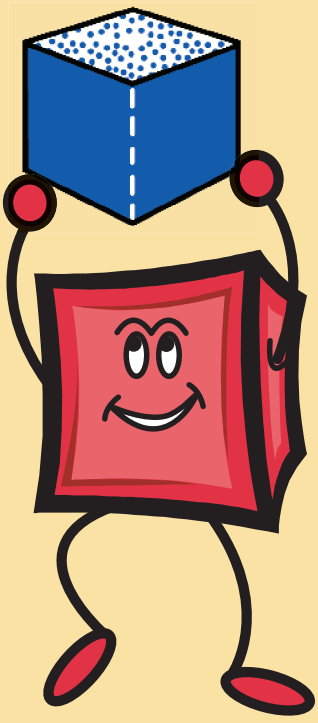
Use the provided 5 x 5 Raised-Line Grid to assist students in keeping the cubes in straight rows and columns as they build stacked cube arrangements.

Before performing the activities described in the next section of this guidebook, allow the student to simply practice stacking the *StackUps* cubes together until she becomes familiar with how the rough, white sides fasten to the soft, blue sides. Document the student's mastering

of this skill in the *StackUps Skills Checklist* found in **Appendix D**.

Suggested Activities





Suggested Activities

Determining Possible Stacked Cube Arrangements

Learning Objective:

- Determine possible cube arrangements using the same number of cubes.

Provide the student with three cubes and ask him to build as many stacked cube arrangements as possible using only three cubes. Continue to do this activity using only four cubes, only five cubes, and so forth. How many different configurations are possible with each number of cubes provided? Some of the student's constructed cube arrangements will match those shown throughout the Stacked Cube Arrangement Cards.

Example: Possible arrangements using only three cubes:

Example: Possible arrangements using only four cubes:

Constructing 3-D Models and Interpreting Tactile Displays of Stacked Cube Arrangements

Learning Objective:

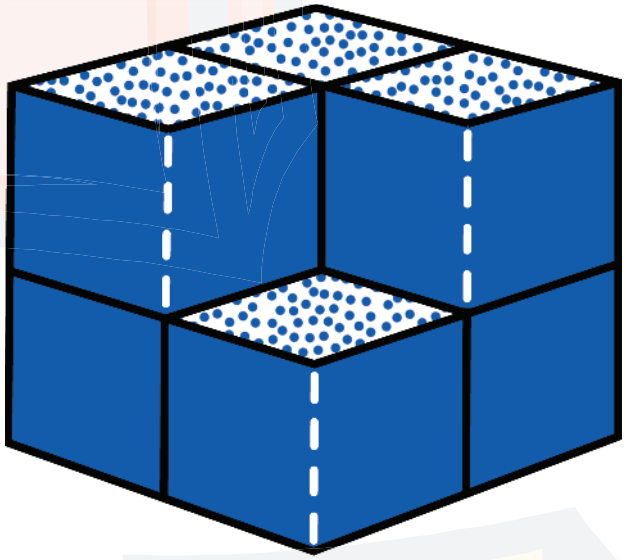
- Build a 3-dimensional model that matches a 2-dimensional tactile display.
- Identify a 2-dimensional tactile display that matches a 3-dimensional model.

Build a 3-dimensional model that matches a 2-dimensional tactile display.

Provide the student with only two *StackUps* cubes and have him join the two cubes together. Then ask him to position the two linked cubes on a flat surface in a variety of positions—with only one cube against the table's surface, with only two cubes against the table's surface, and so forth.

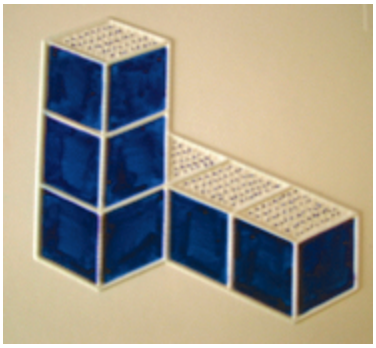
Notice that Stacked Cube Arrangement Cards #2, #3, and #4 show two cubes linked together, but from different perspectives. These three tactile cards can be used to illustrate how 2-dimensional stacked cube arrangements can be shown from a variety of angles. Have the student build each perspective by constructing a *StackUps* model and positioning it on a flat surface in the same perspective shown on the tactile card. Continue to practice building the models so that the sides of the cubes "seen" or facing the student have a soft texture and the tops of the cubes have a rough texture.

Draw the student's attention to the tactile difference between the raised lines used to depict the outer edges of each cube in the Stacked Cube Arrangement Cards. A solid line indicates edges shared by two adjacent cubes OR the outer boundaries of the 2-dimensional drawing. A broken or dashed line is always vertical and indicates the joining line of the two faces of a single cube.

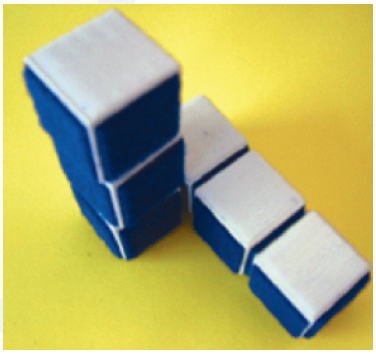


Once the student gains understanding and experience building simpler 3-dimensional models, then progress to more complex stacked cube arrangements. Ask the student to recreate each figure presented 2-dimensionally in the Stacked Cube Arrangement cards. Begin with cards involving only three or four cubes, progressing in the order shown in **Appendix A**. Stacked Cube Arrangement Card #32 involves all 20 cubes, the maximum number of cubes provided with the *StackUps* kit. [Additional

StackUps cubes are available separately in packages of 20 cubes: APH Catalog #: 1-08960-01.] Note that all the Stacked Cube Arrangement Cards have a diagonal cut in the upper-right corner; this cut serves as a cue for correct orientation.

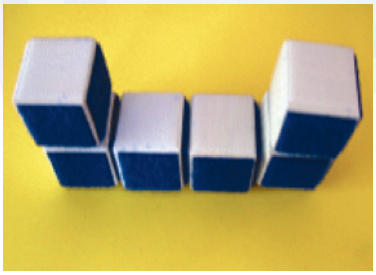


2-D to 3-D

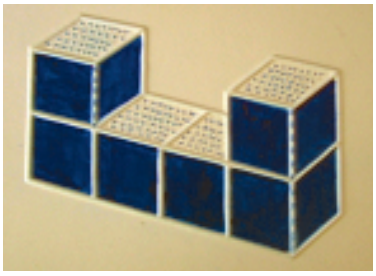


Identify a 2-dimensional tactile display that matches a 3-dimensional model.

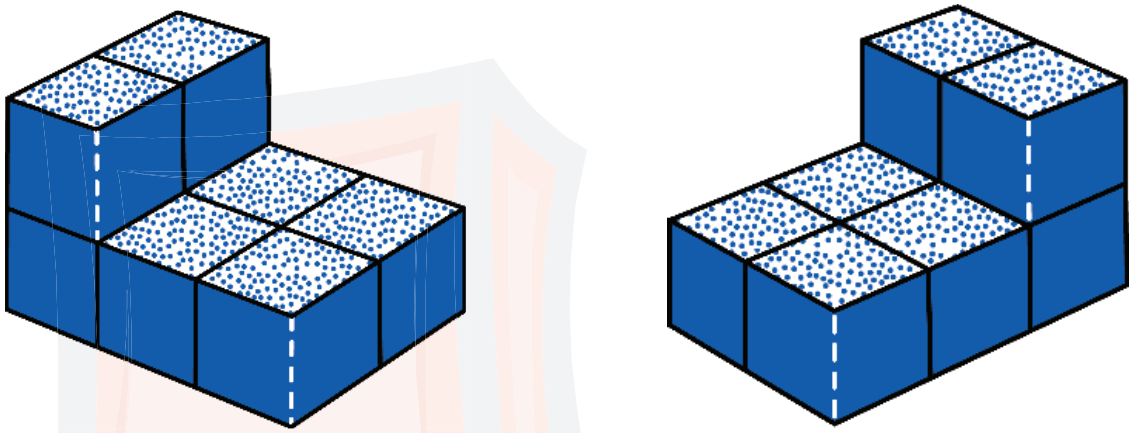
Provide the student with a pre-assembled 3-dimensional model, made with *StackUps* cubes, that matches one of the provided Stacked Cube Arrangement Cards. Ask the student to locate the tactile card that matches the 3-dimensional model. Narrow the selection of cards by providing only three or four possibilities for the student to choose from.



3-D to 2-D

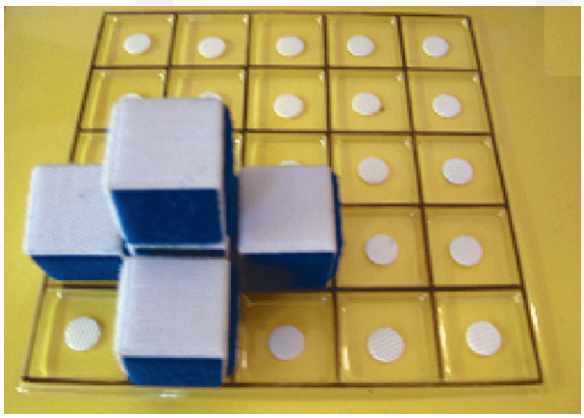


Stacked Cube Arrangement Cards #23 and #24 represent the same solid. These two cards are added to illustrate mirrored images of the same 3-dimensional shape.



Instructional Tip:

Use a Raised-Line Grid from the *StackUps* kit to provide a stable working surface as cubes are being stacked. The blue, soft Velcro sides of the cubes will stick to the rough Velcro circles on the grid. The grid will also assist the student in aligning the cubes in straight rows and columns.



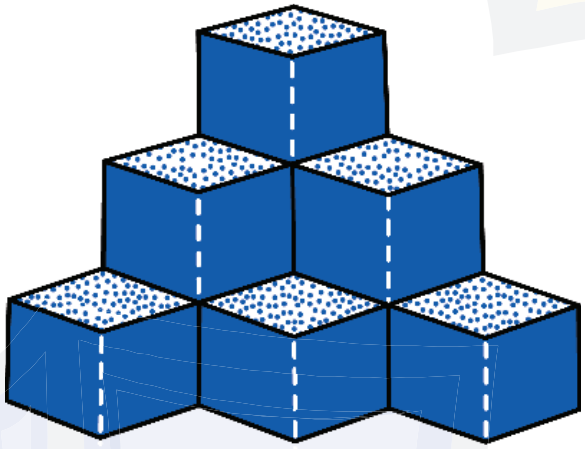
Using Mat Plans

Learning Objectives:

- Build a 3-dimensional solid when given a Mat Plan.
- Create a Mat Plan when given a 3-dimensional solid.

Build a 3-dimensional solid when given a Mat Plan.

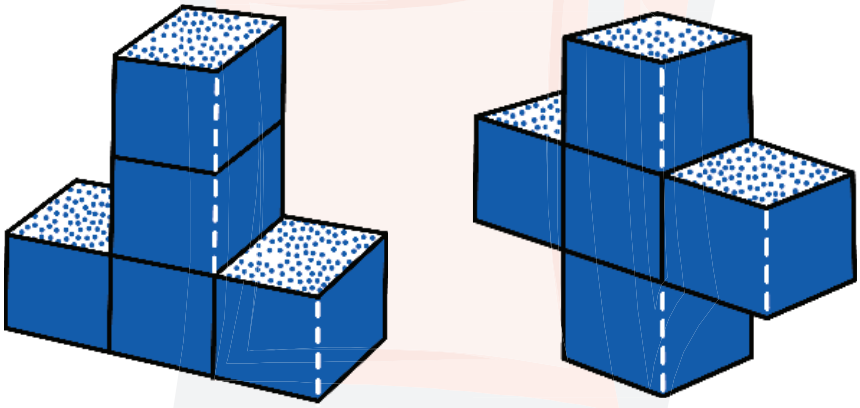
A Mat Plan is a top view of a 3-dimensional cube arrangement, with the number of cubes appearing in each vertical column recorded in the corresponding box.



3	2	1
2	1	
1		

The number within each box indicates how many cubes are stacked vertically in that specific spot. It is essentially a blueprint or building plan for constructing the 3-dimensional model of a stacked cube arrangement. A tactile/print Mat Plan is provided for each of the Stacked Cube Arrangement Cards. **Appendix B** pairs each Mat Plan with its corresponding Stacked Cube Arrangement Card.

Present the Mat Plans one at a time to the student and ask her to build a corresponding 3-dimensional solid. Demonstrate that sometimes a Mat Plan can represent more than one stacked cube arrangement. For example, the Mat Plan for Stacked Cube Arrangement #13 also represents Stacked Cube Arrangement #14, according to NCTM.



However, a Mat Plan will always be unique to a specific cube arrangement if instructions are given to always build each vertical column of cubes from the base upward, with the bottom cube of each column against a flat surface. With this instruction, Mat Plans can provide a foolproof construction plan for stacked cube arrangements. This directive will ensure, for example, that the Mat Plan shown above will only represent Stacked Cube Arrangement #13, and not the suspended cube presentation as encountered in Stacked Cube Arrangement #14 or any other arrangement.

Note that the Mat Plan Cards are intentionally unnumbered so that students cannot memorize which Mat

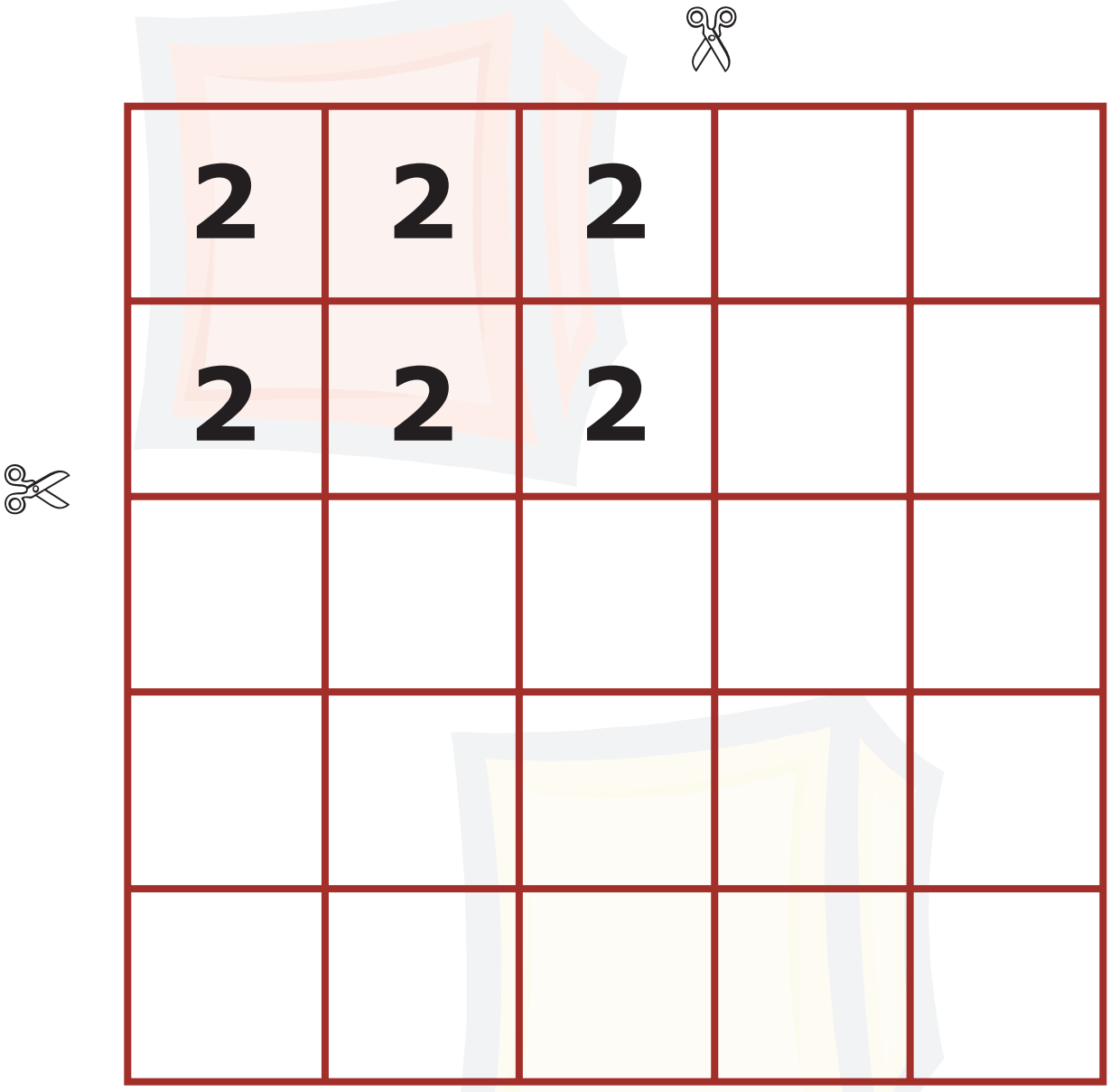
Plan corresponds to which Stacked Cube Arrangement Card. The Mat Plan Cards also have a curved orientation cut in the upper-right corner.

Create a Mat Plan when given a 3-dimensional solid.

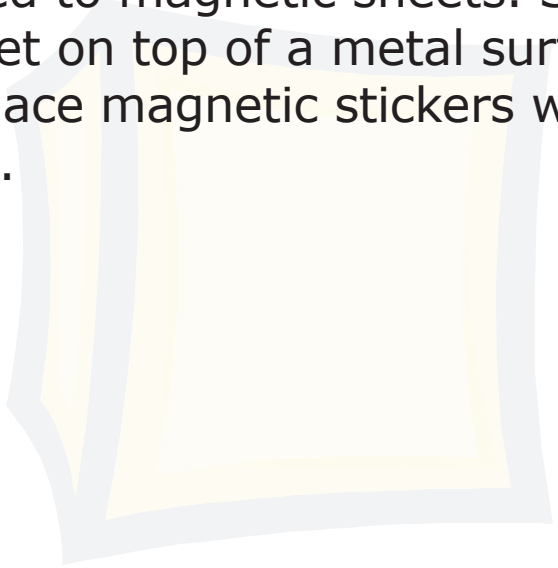
The *StackUps* kit includes a package of 25 consumable Mat Plan Worksheets. [Additional Mat Plan Worksheets are available separately in packages of 25 sheets: APH Catalog #: 1-08960-02.] Each Mat Plan Worksheet has an embossed raised-line grid in a 5 x 5 configuration. These embossed grid sheets can be used by the student to "draw" Mat Plans of stacked cube arrangements. By using a braillewriter, slate and stylus, or by applying adhesive braille number stickers, the student can independently build a Mat Plan by plotting the number of cubes in each vertical column within the tactile squares. Numbers can be handwritten inside the grid as well. Note: A print version of the Mat Plan Worksheet is found in **Appendix C.** Permission is given to photocopy this page as needed for low vision students.

Have the student create a Mat Plan to match one of the provided Stacked Cube Arrangement Cards. Start with simple cube arrangements and progress to more challenging ones. Then ask the student to design Mat Plans that build cube arrangements not provided within the *StackUps* kit. For each newly designed Mat Plan, the student can build a 3-dimensional solid that corresponds to it. The teacher can also use Mat Plan Worksheets to

generate additional Mat Plans from which the student can practice building matching 3-D solids with the *StackUps* cubes. After numbers have been brailled and/or printed on the Mat Plan Worksheet for a particular stacked cube arrangement, the unused squares can be cut away to present the final Mat Plan.



To make the Mat Plan Worksheets reusable, use them in conjunction with adhesive braille and/or print number stickers that are affixed to magnetic sheets. Simply place the Mat Plan Worksheet on top of a metal surface (e.g., a cookie sheet) and place magnetic stickers within the raised outline squares.

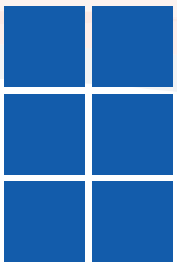


Interpreting Front-Right-Top Views

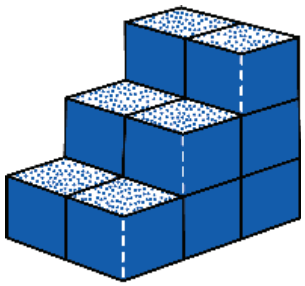
Learning Objectives:

- Create a Front-Right-Top view when given a 3-dimensional stacked cube arrangement.
- Create a 3-dimensional stacked cube arrangement when given a Front-Right-Top view.

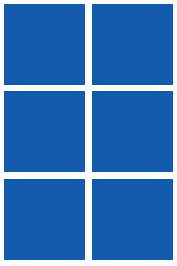
A Front-Right-Top view provides three separate perspectives of a cube arrangement. For example, the three views below represent the construction of the Stacked Cube Arrangement #29.



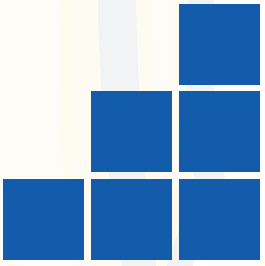
Top View



Isometric Drawing

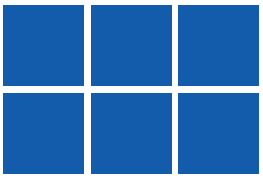


Front View

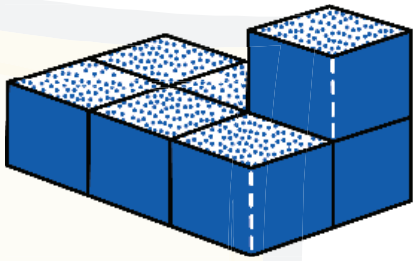


Right Side View

Below is another example of a Front-Right-Top view using Stacked Cube Arrangement #21.

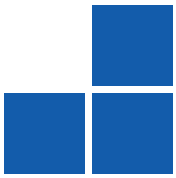


Top View



Isometric Drawing

Front View

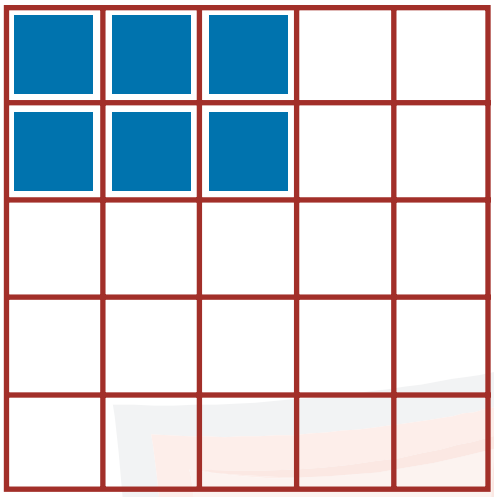


Right Side View

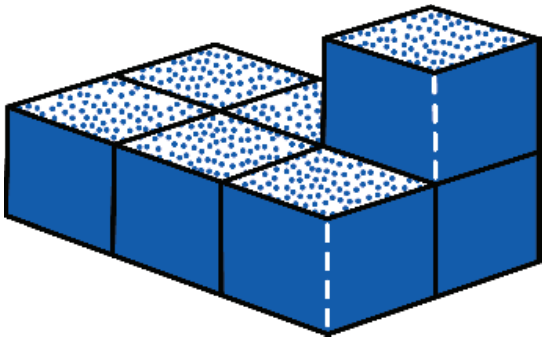
The Front-Right-Top view for each of the Stacked Cube Arrangements included in *StackUps* is found in **Appendix A**.

Create a Front-Right-Top view when given a 3-dimensional stacked cube arrangement.

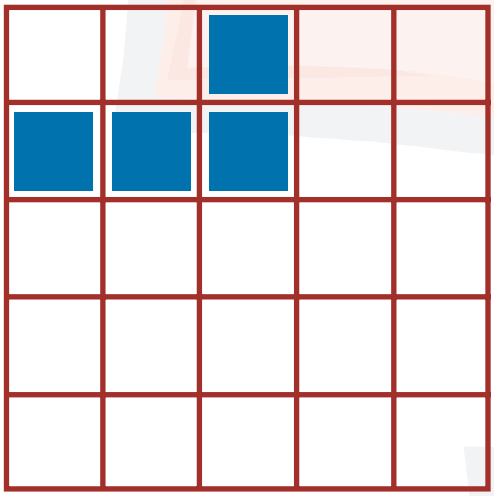
Provide the student with a constructed 3-dimensional stacked cube arrangement, as well as all three Raised-Line Grids. Have the student "draw" each perspective on a separate grid by inserting Velcro-backed blue squares into the grid compartments.



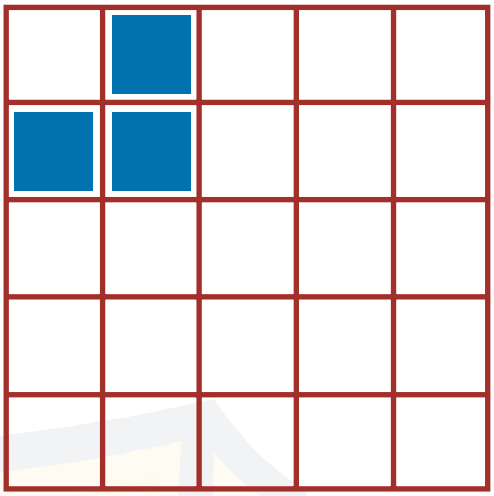
Top View



Stacked Cube Arrangement #21



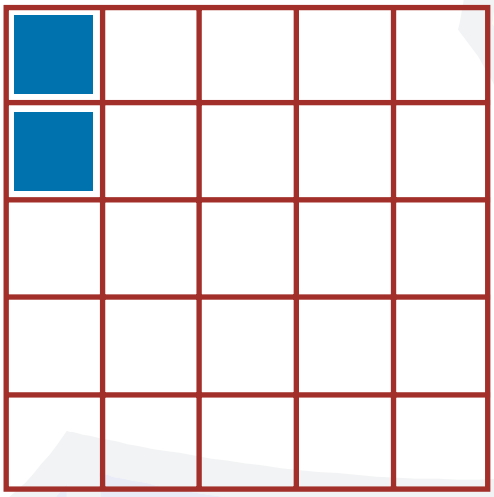
Front View



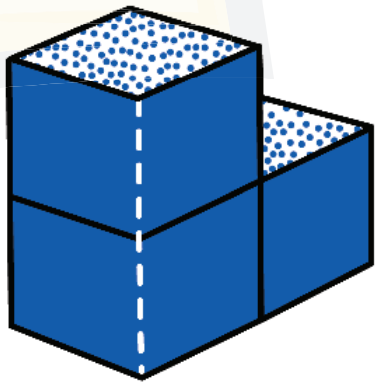
Right Side View

Create a 3-dimensional stacked cube arrangement when given a Front-Right-Top view.

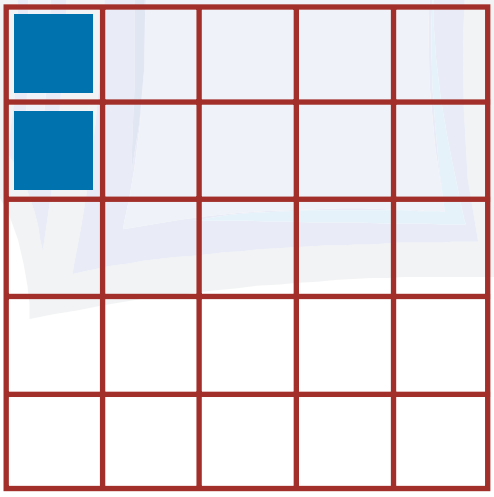
Creating a 3-dimensional model of a stacked cube arrangement given a Front-Right-Top view can be more challenging. Begin with simple cube arrangements like Stacked Cube Arrangement #6 [shown below] and then progress to more complicated ones.



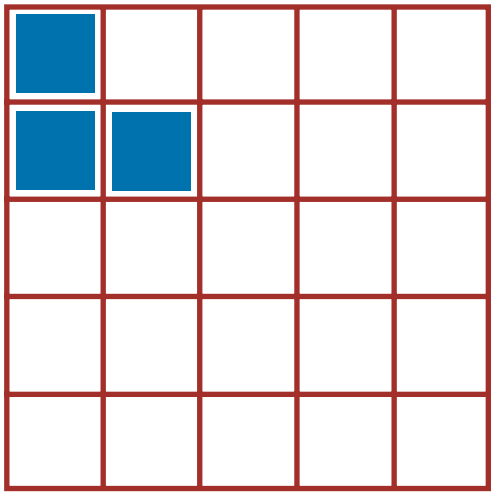
Top View



Stacked Cube Arrangement #6



Front View



Right Side View

Determining the Volume of Stacked Cube Arrangements

Learning Objective:

- Find the volume of stacked cube arrangements.

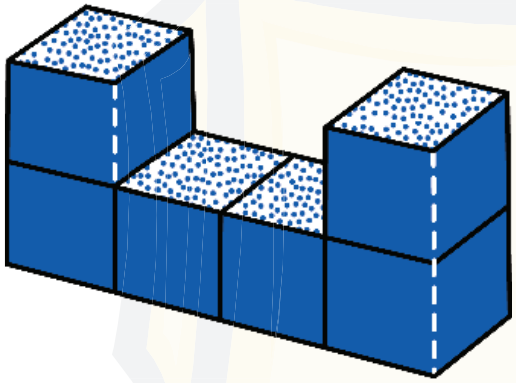
Have the student find the volume of the figure depicted on a selected Stacked Cube Arrangement Card in combination with a constructed *StackUps* 3-dimensional model that matches the card. The volume of each figure can be found by counting the number of cubes it contains. Have the student indicate the volume in "cubic units," not in inches. The volume of each Stacked Cube Arrangement Card is given in **Appendix A**.

Instruction Tips for the Tactile Learner:

Always begin with the 3-dimensional model of a stacked cube arrangement when determining volume. Determining volume from the tactile 2-dimensional display will be difficult even for the most proficient tactile reader. Complement the 3-dimensional model by showing the 2-dimensional display in a side-by-side manner.

When attempting to count the number of cubes in a tactile 2-dimensional display, encourage the tactile reader to start by counting tops of cubes that can be touched, that is, the number of individual rough areas surrounded by solid raised lines. Using Cube Arrangement #16 as an example, the student would first count four rough areas

and determine that there are *at least* four cubes in the arrangement.



He would then count the number of cubes in each vertical column, going left to right. Still using card #16 as an example, the number of cubes per column (left to right) would be "2, 1, 1, 2," with a total volume of 6 cubic units.

Determining the Surface Area of Stacked Cube Arrangements

Learning Objective:

- Find the surface area of stacked cube arrangements.

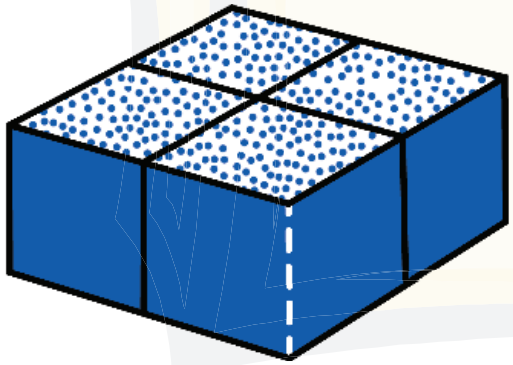
Using a constructed 3-dimensional *StackUps* model of a selected Stacked Cube Arrangement Card, have the student determine the surface area of the figure, that is, the number of square units that are exposed on the outside. The student should report the surface area in square units instead of inches. The surface area of each Stacked Cube Arrangement Card is provided in **Appendix A**.

When finding the surface area, remind the student to count the surface squares that cannot be touched when the figure is sitting flat on a table. For example, only five sides of a single cube can be touched when it sits flat on a table, but when the cube is held in one's hand, all 6 sides can be detected. Therefore, the surface area of a single cube is 6 square units.

Instruction Tips for the Tactile Learner:

When asking the student to determine the surface area of a stacked cube arrangement, it is advisable to use a 3-dimensional model whenever possible, either alone or in combination with the tactile 2-dimensional drawing. Providing a model will allow the student to more readily

count the exposed or outside square surfaces. Using Stacked Cube Arrangement #7 as an example, first provide a 3-dimensional model of the tactile display for the student's exploration.



When handling the model, the student might recount the same surfaces more than once as he examines the model. To prevent this, the student can mark off the sides of the cubes as they are counted (e.g., by attaching temporary tactile stickers). The student can then count each square surface, one by one, as stickers are added, allowing the student to count without retracing his steps. He should arrive at the answer "16 square units" for this cube arrangement.

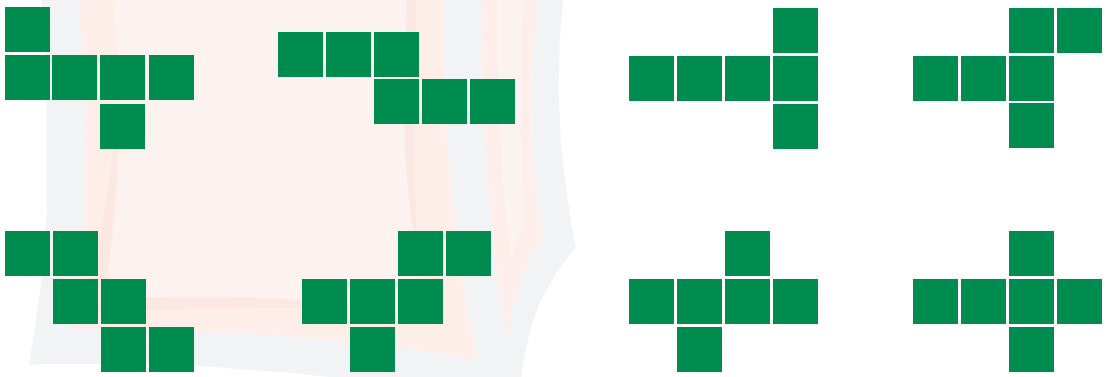
Determining surface area based upon a tactile display alone is extremely challenging, even for the proficient tactile reader. In the 2-dimensional display, the tactile reader will not be able to feel the bottom of each cube, nor the hidden sides of each cube. A side-by-side instruction, using both the 3-dimensional model and the tactile display would be advantageous to the student's understanding of surface area.

Identifying Cube Nets

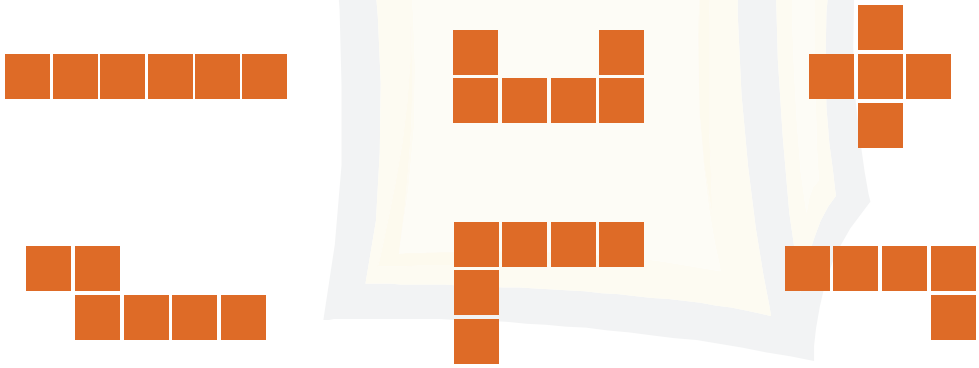
Learning Objective:

- Identify cube nets that build 3-dimensional cubes.

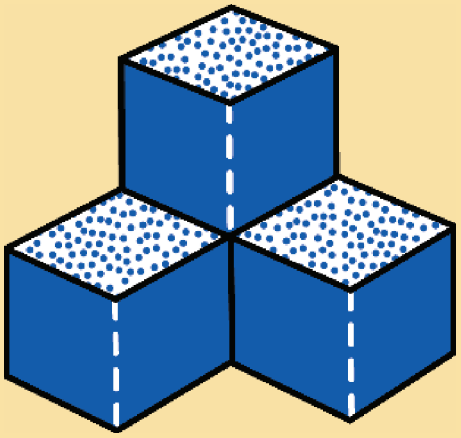
A net is a 2-dimensional figure that can be folded into a 3-dimensional object. The following nets will fold to build a cube:

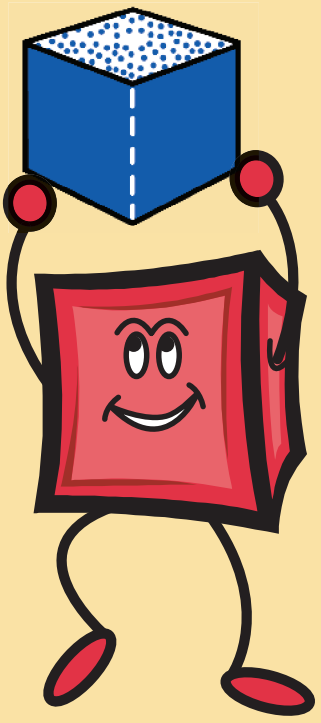


Create foldable cube nets by cutting them out of embossed Mat Plan Worksheets. Then have the student fold each to determine if a 3-dimensional cube results. Mix in cube nets that will not produce 3-dimensional cubes such as the following:



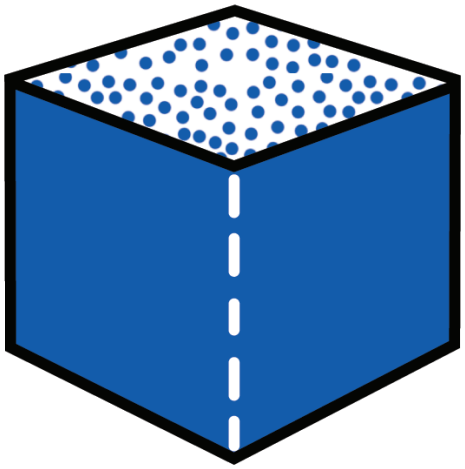
Appendix A: Stacked Cube Arrangements





StackUps: Stacked Cube Arrangement 1

Volume: 1 cubic unit
Surface Area: 6 square units



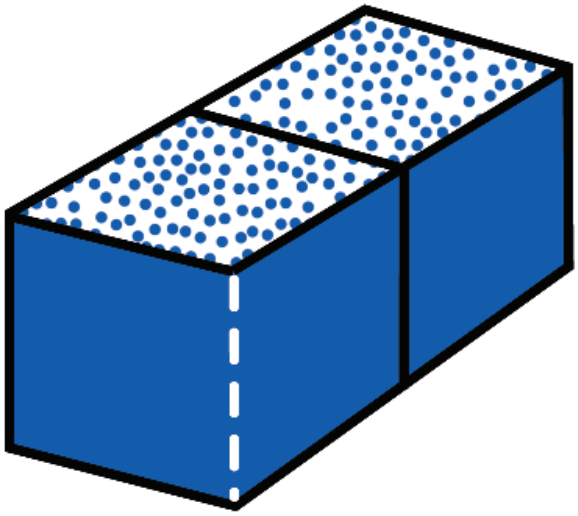
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 2

Volume: 2 cubic units
Surface Area: 10 square units



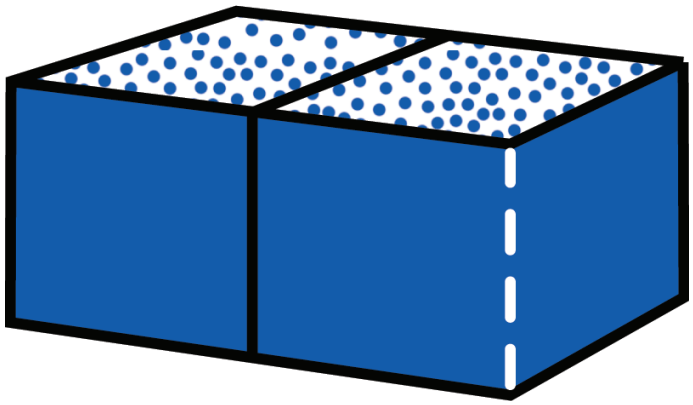
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 3

Volume: 2 cubic units
Surface Area: 10 square units



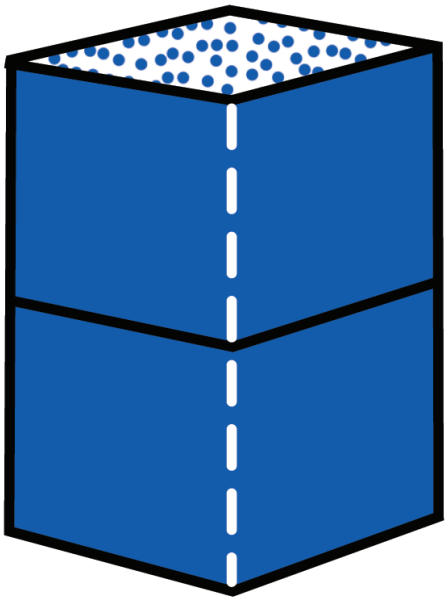
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 4

Volume: 2 cubic units
Surface Area: 10 square units



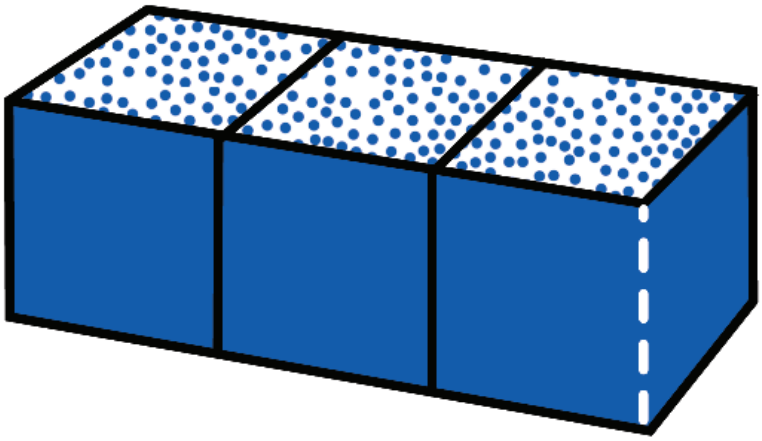
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 5

Volume: 3 cubic units
Surface Area: 14 square units



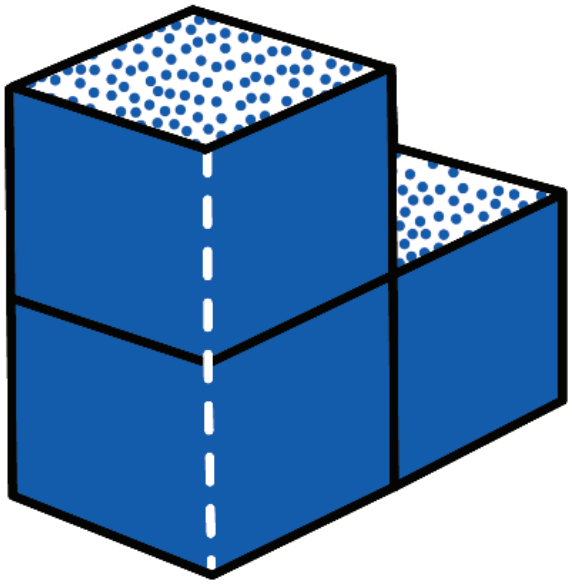
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 6

Volume: 3 cubic units
Surface Area: 14 square units



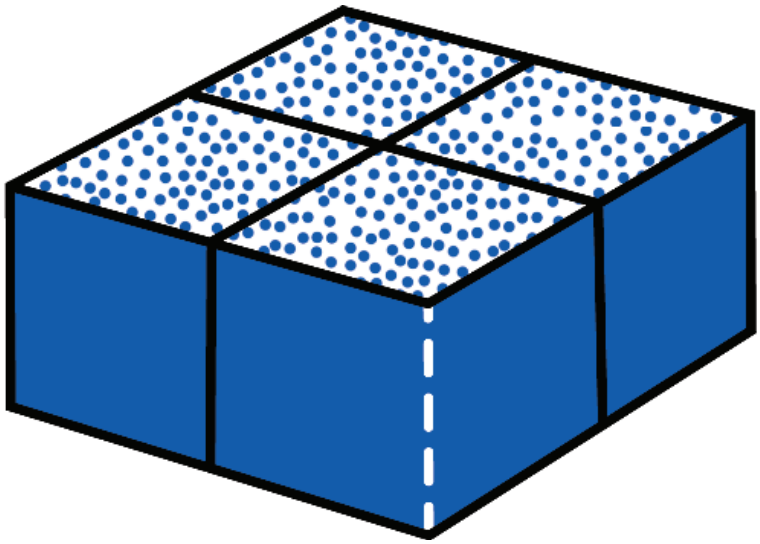
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 7

Volume: 4 cubic units
Surface Area: 16 square units



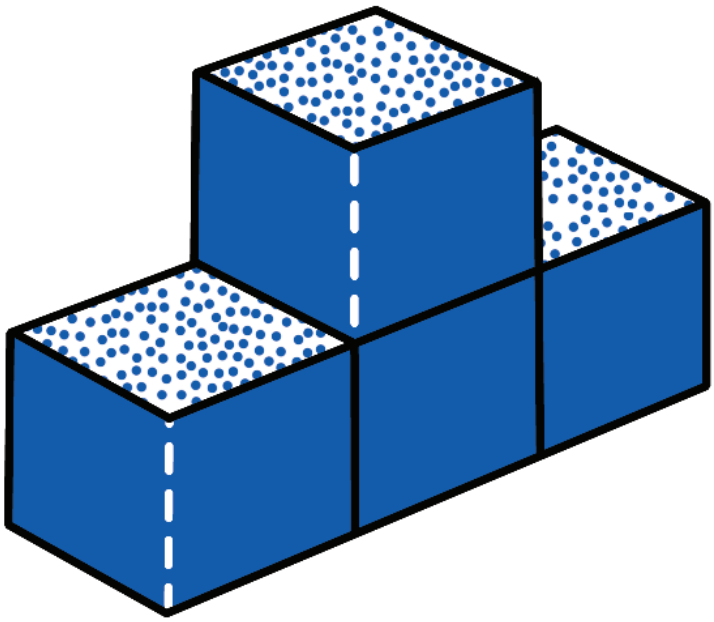
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 8

Volume: 4 cubic units
Surface Area: 18 square units



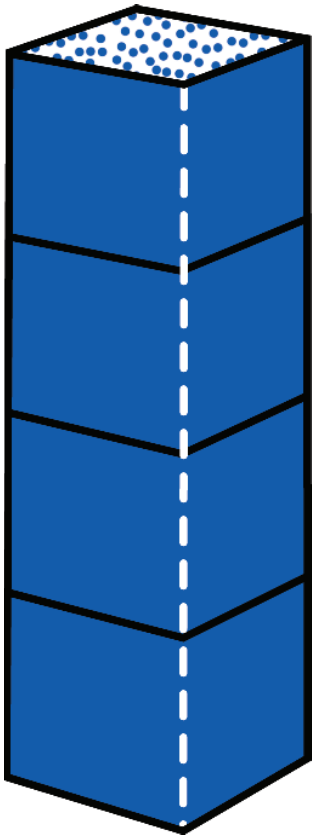
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 9

Volume: 4 cubic units
Surface Area: 18 square units



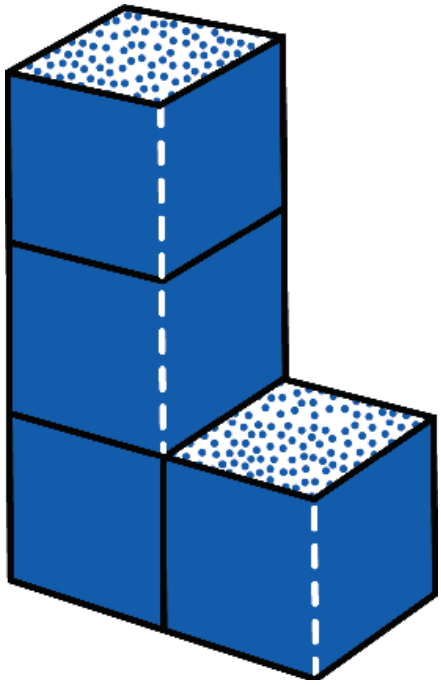
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 10

Volume: 4 cubic units
Surface Area: 18 square units



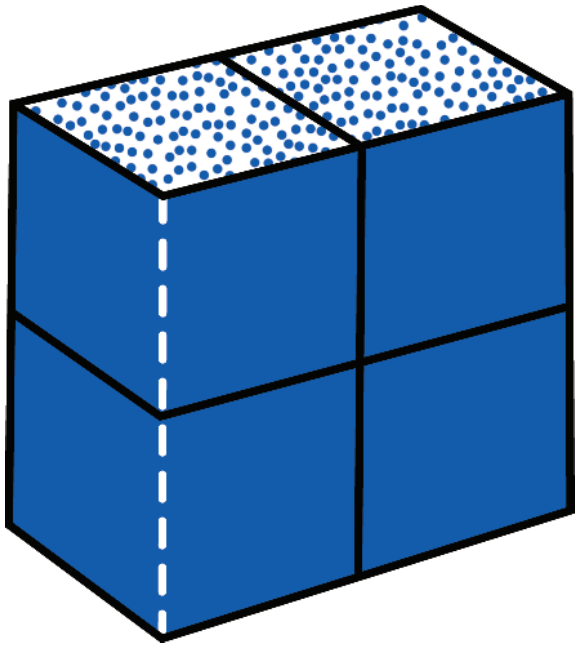
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 11

Volume: 4 cubic units
Surface Area: 16 square units



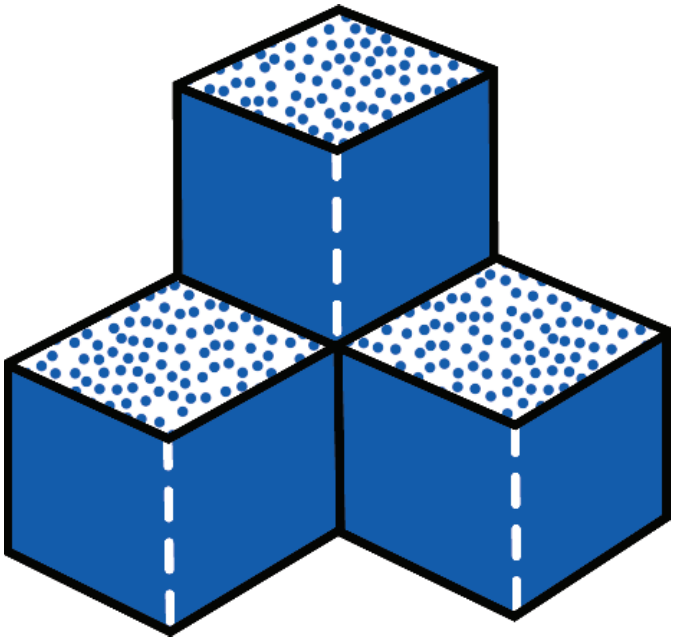
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 12

Volume: 4 cubic units
Surface Area: 18 square units



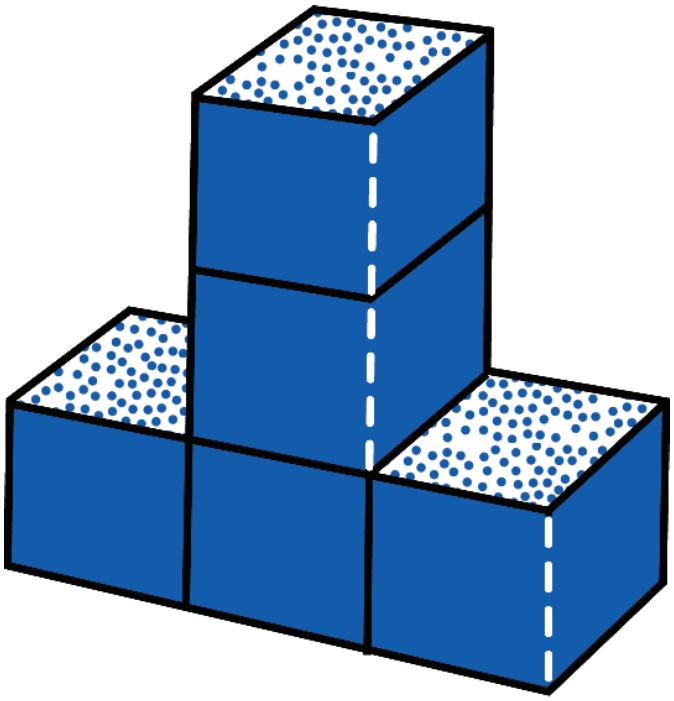
Front View

Right Side

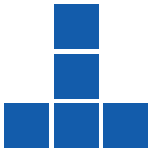
Top View

StackUps: Stacked Cube Arrangement 13

Volume: 5 cubic units
Surface Area: 22 square units



Front View

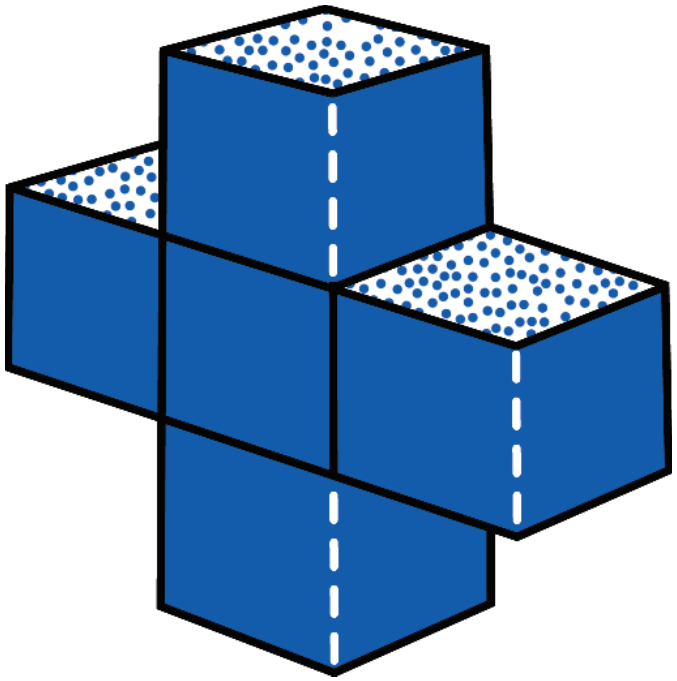


Right Side

Top View

StackUps: Stacked Cube Arrangement 14

Volume: 5 cubic units
Surface Area: 22 square units



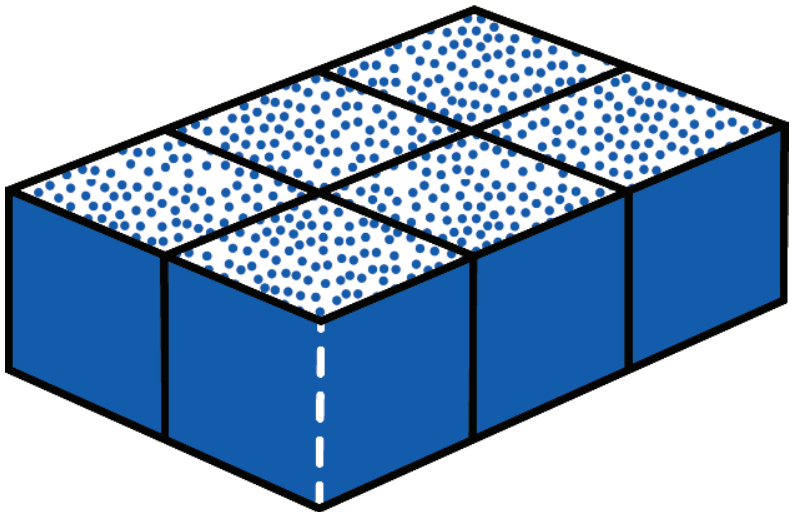
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 15

Volume: 6 cubic units
Surface Area: 22 square units



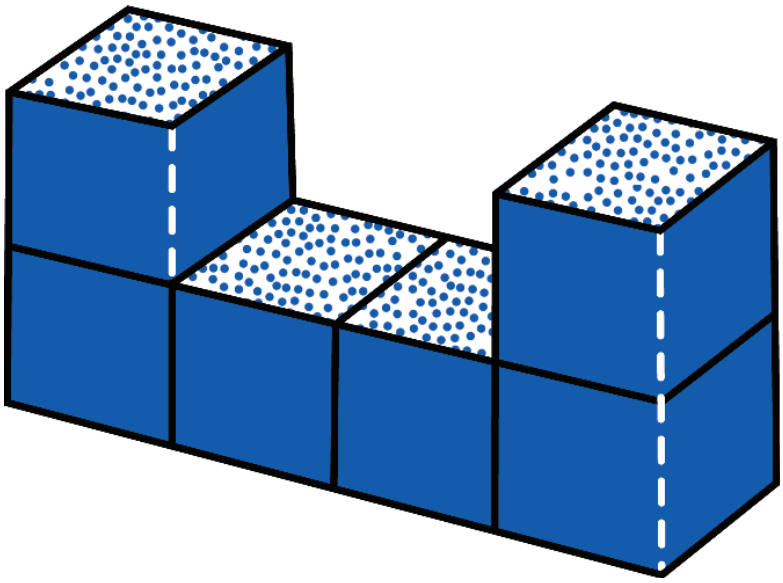
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 16

Volume: 6 cubic units
Surface Area: 24 square units



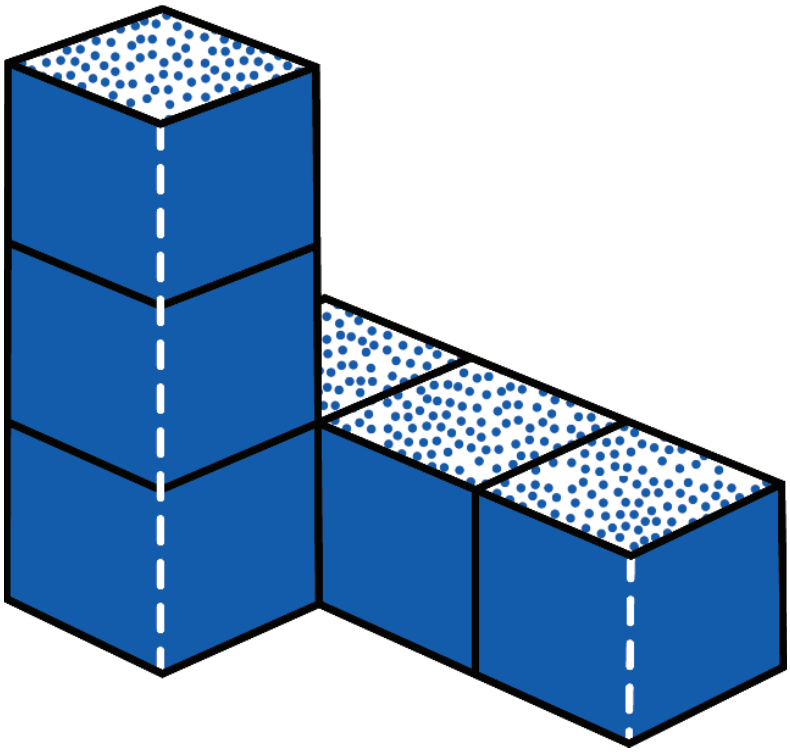
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 17

Volume: 6 cubic units
Surface Area: 26 square units



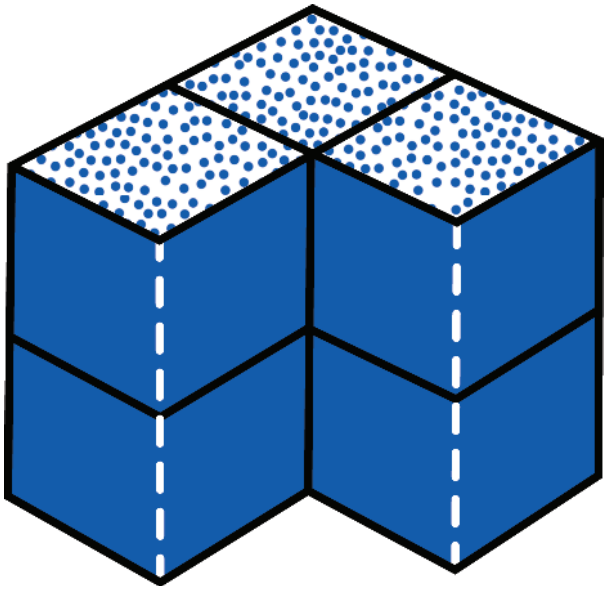
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 18

Volume: 6 cubic units
Surface Area: 22 square units



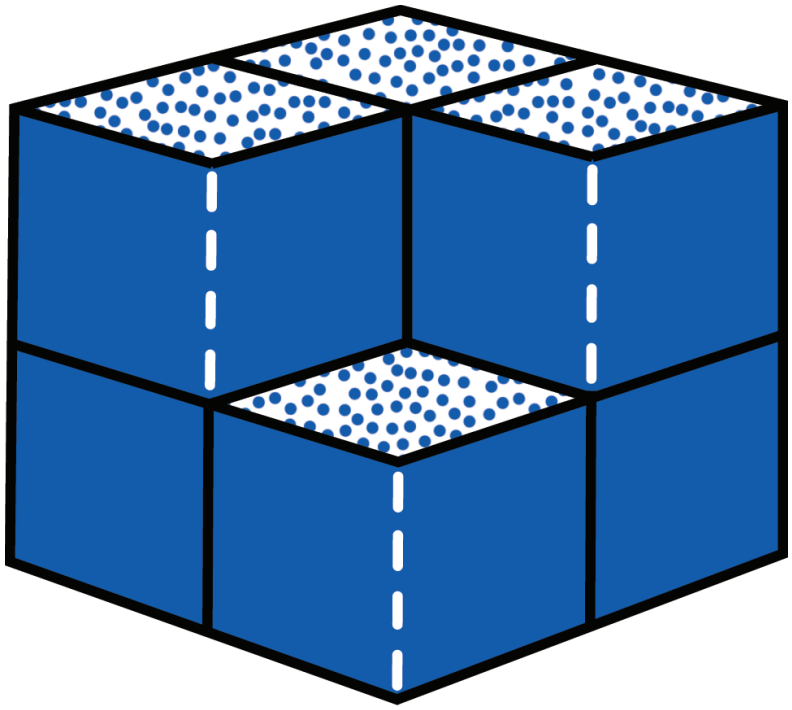
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 19

Volume: 7 cubic units
Surface Area: 24 square units



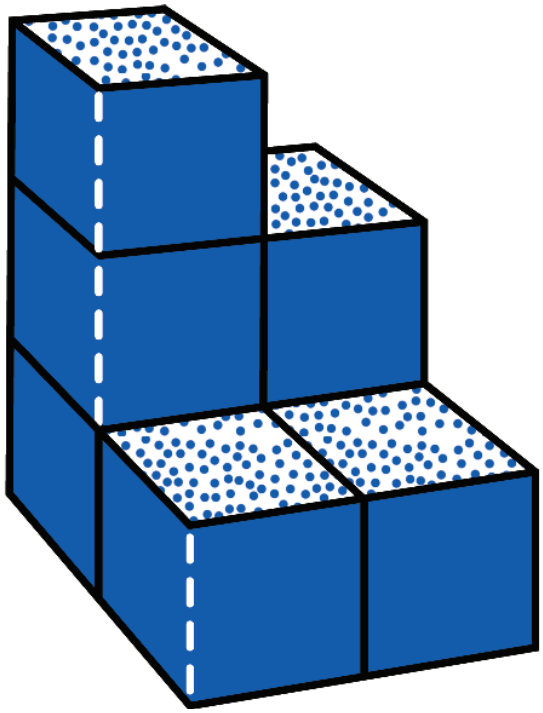
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 20

Volume: 7 cubic units
Surface Area: 26 square units



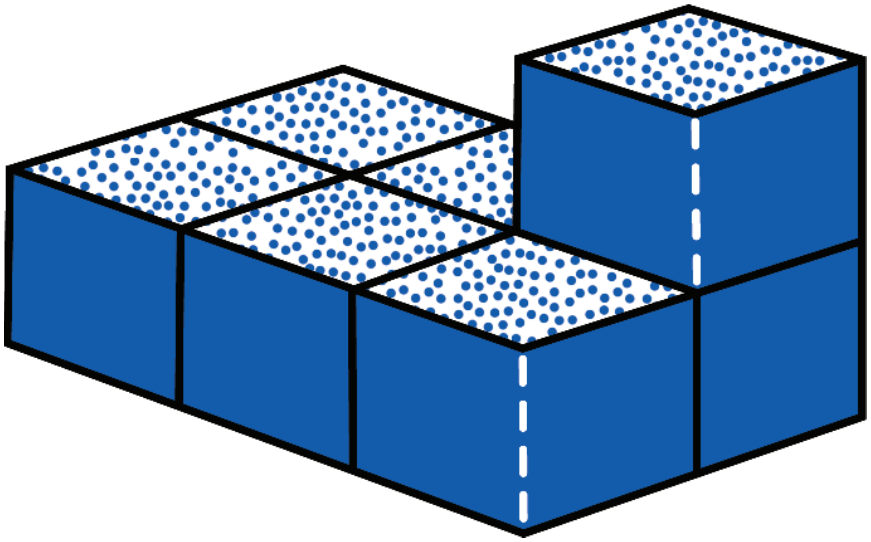
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 21

Volume: 7 cubic units
Surface Area: 26 square units



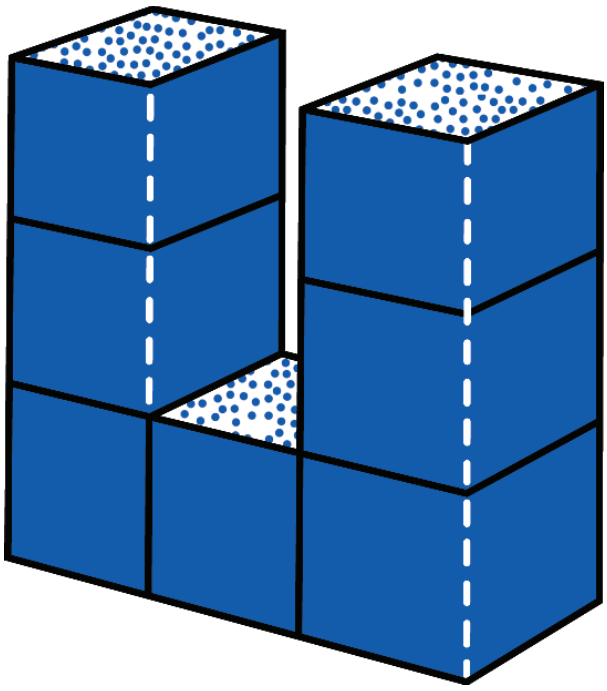
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 22

Volume: 7 cubic units
Surface Area: 30 square units



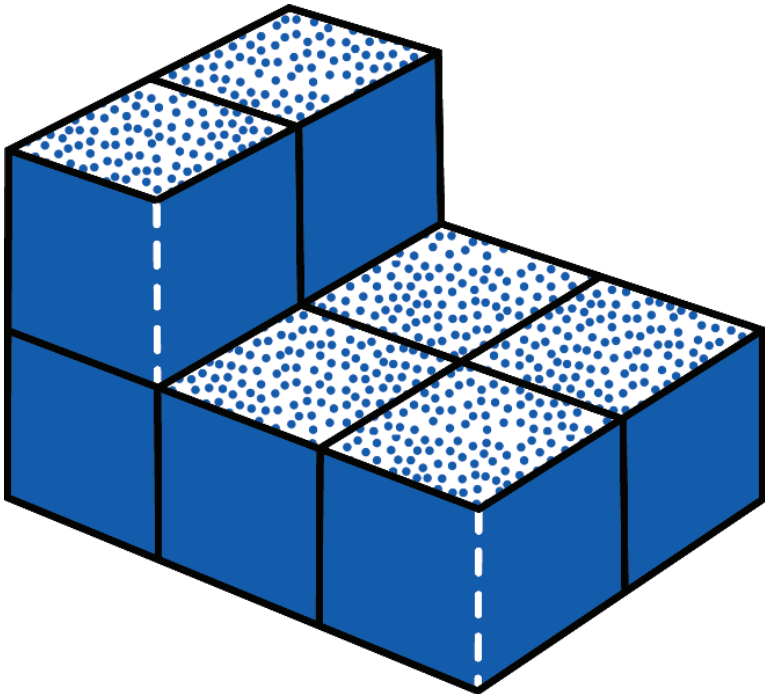
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 23

Volume: 8 cubic units
Surface Area: 28 square units



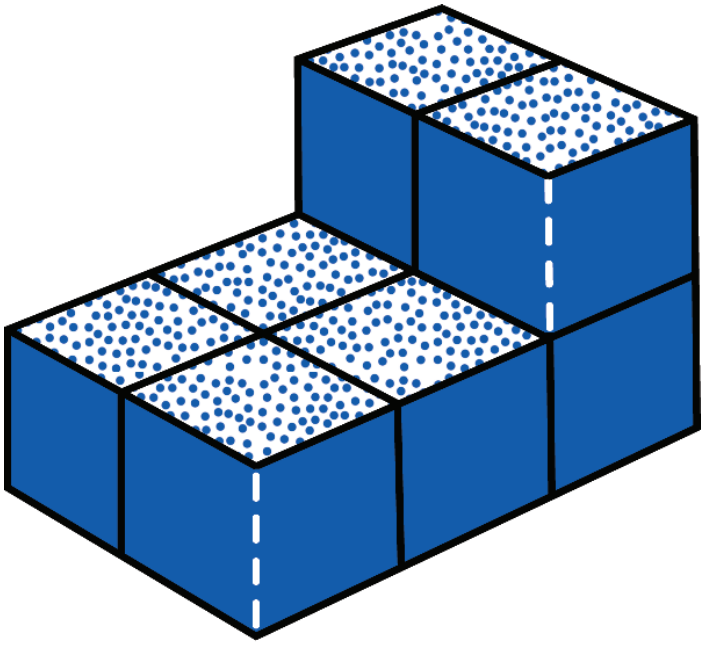
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 24

Volume: 8 cubic units
Surface Area: 28 square units



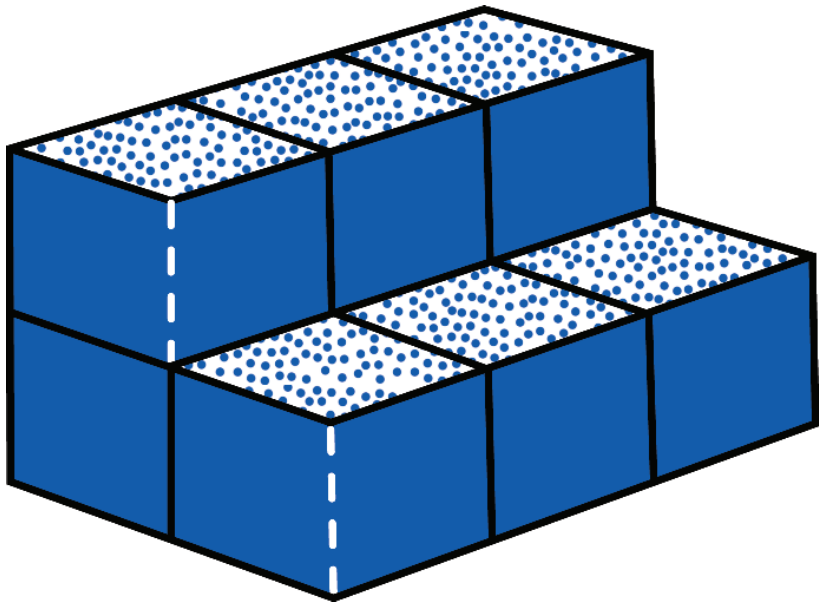
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 25

Volume: 9 cubic units
Surface Area: 30 square units



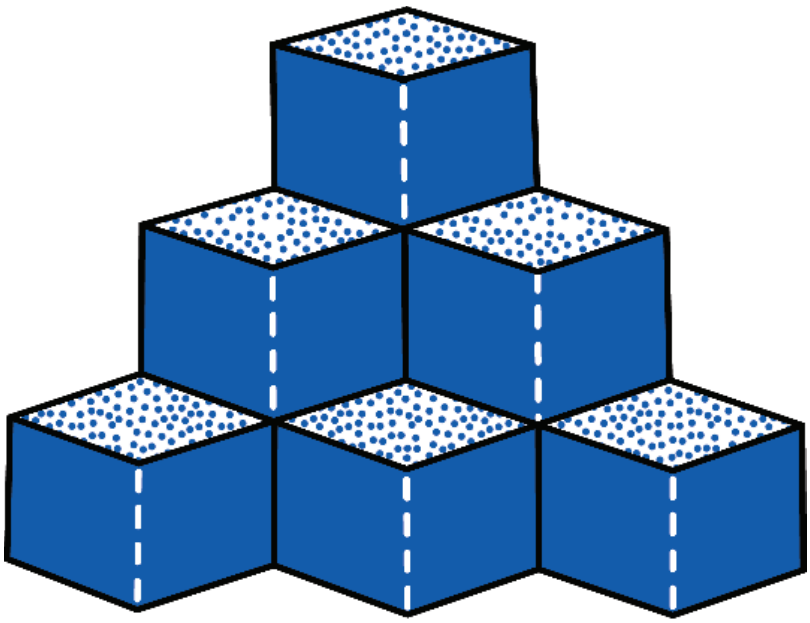
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 26

Volume: 10 cubic units
Surface Area: 36 square units



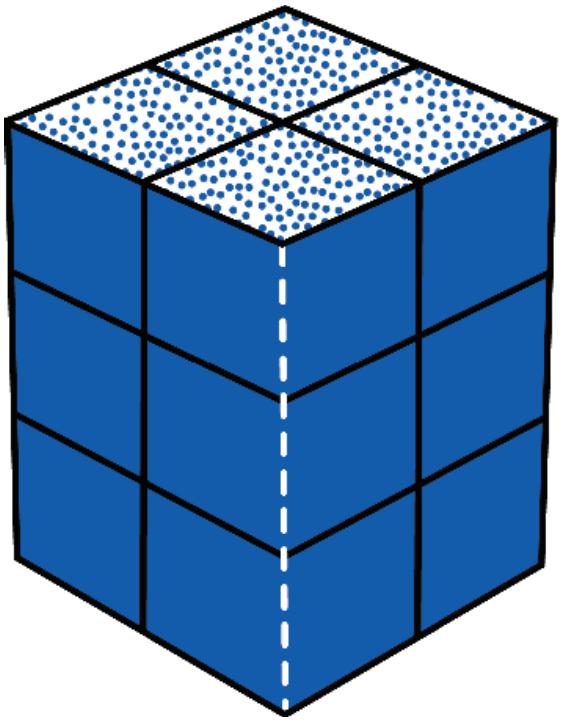
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 27

Volume: 12 cubic units
Surface Area: 32 square units



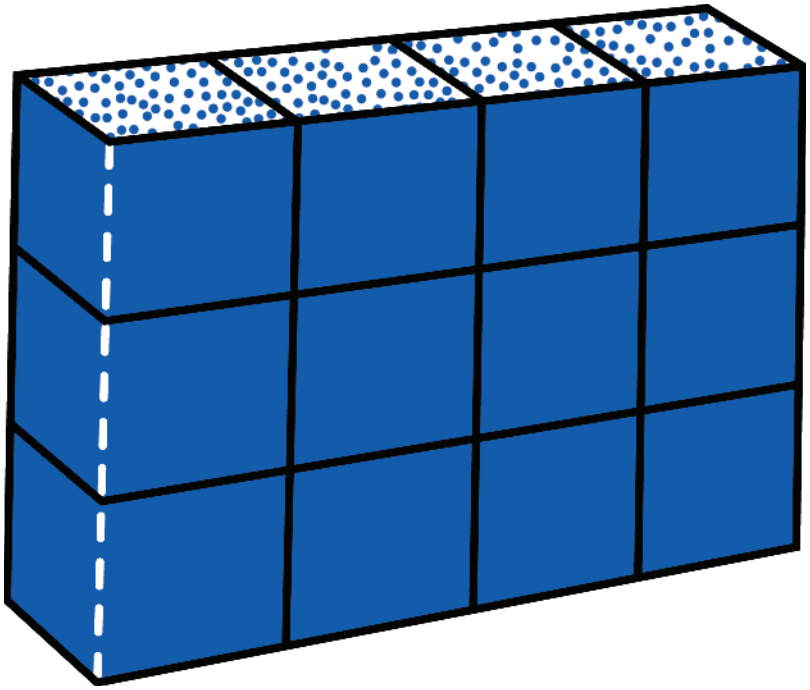
Front View

Right Side

Top View

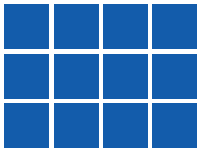
StackUps: Stacked Cube Arrangement 28

Volume: 12 cubic units
Surface Area: 38 square units



Front View

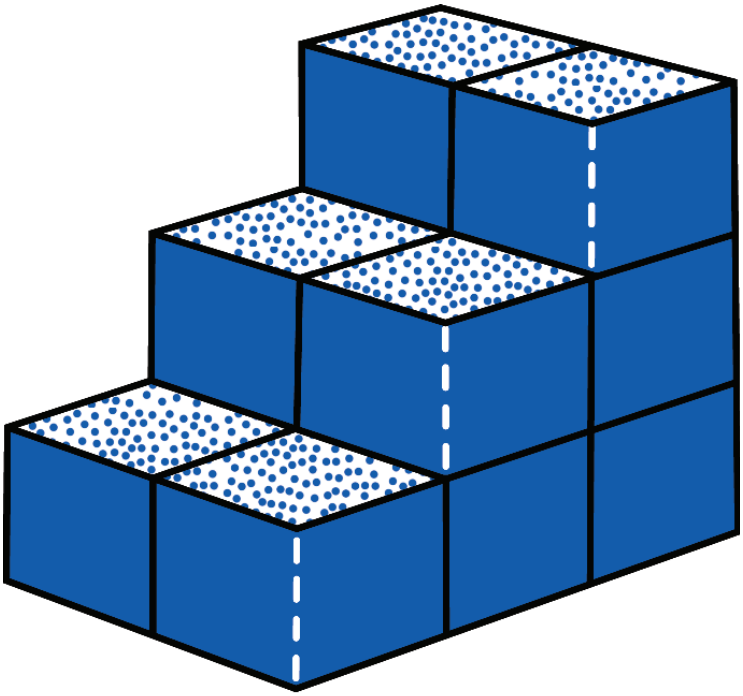
Right Side



Top View

StackUps: Stacked Cube Arrangement 29

Volume: 12 cubic units
Surface Area: 36 square units



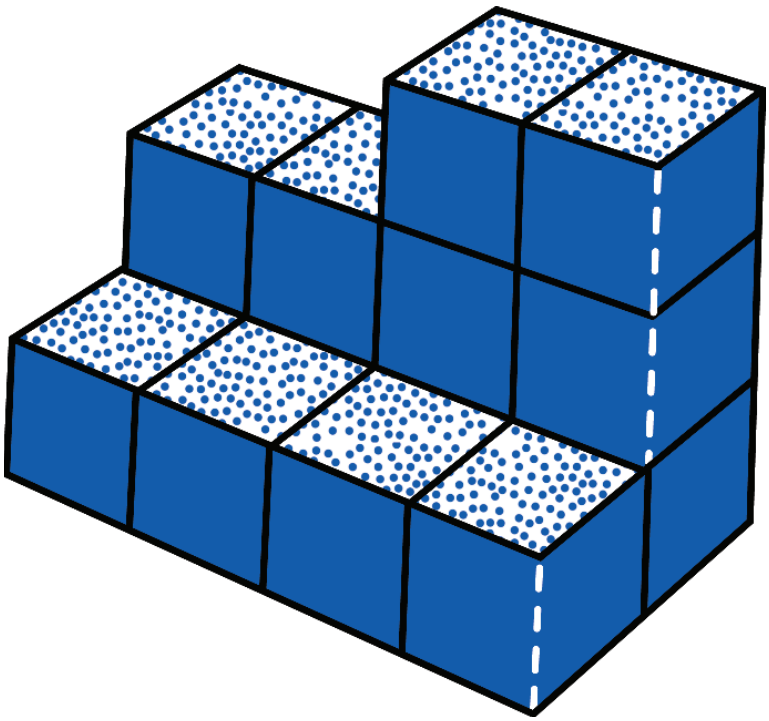
Front View

Right Side

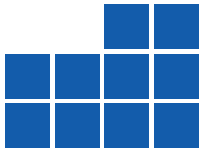
Top View

StackUps: Stacked Cube Arrangement 30

Volume: 14 cubic units
Surface Area: 44 square units



Front View

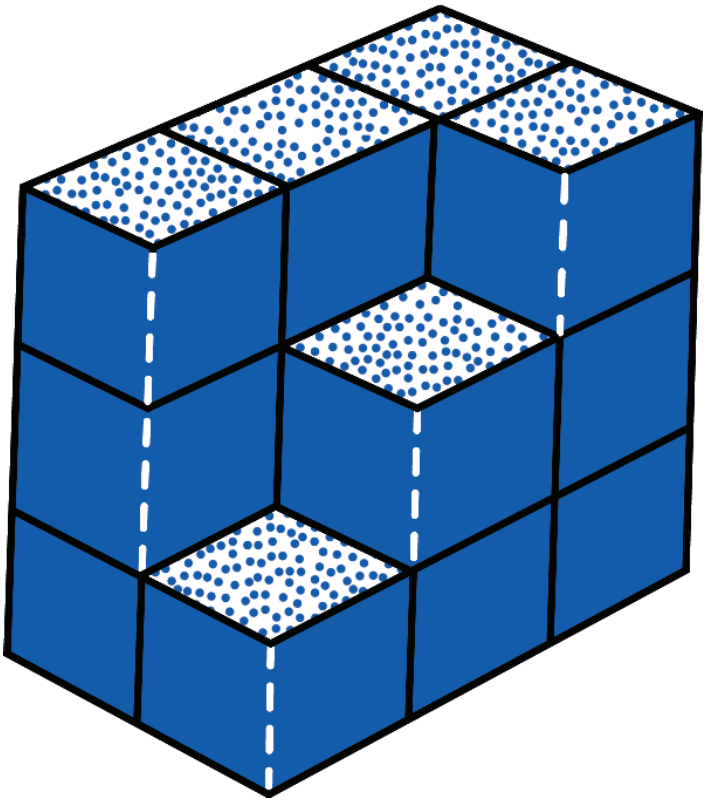


Right Side

Top View

StackUps: Stacked Cube Arrangement 31

Volume: 15 cubic units
Surface Area: 42 square units



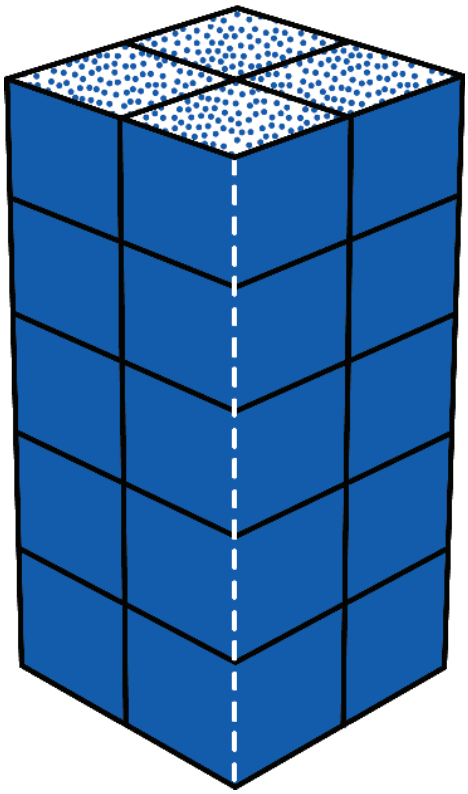
Front View

Right Side

Top View

StackUps: Stacked Cube Arrangement 32

Volume: 20 cubic units
Surface Area: 48 square units

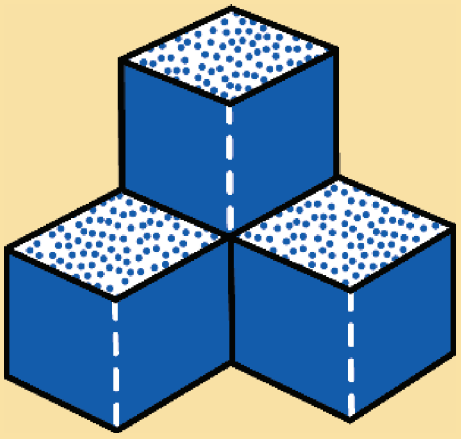


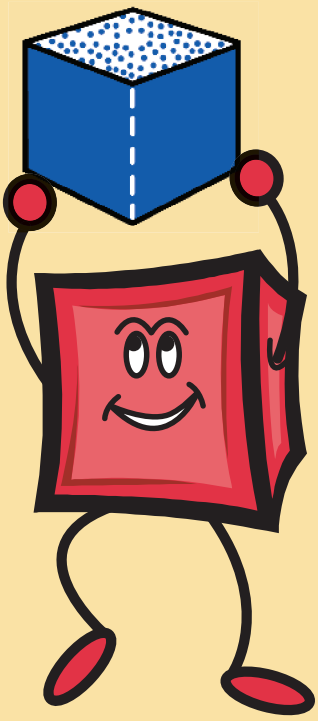
Front View

Right Side

Top View

Appendix B: Mat Plans



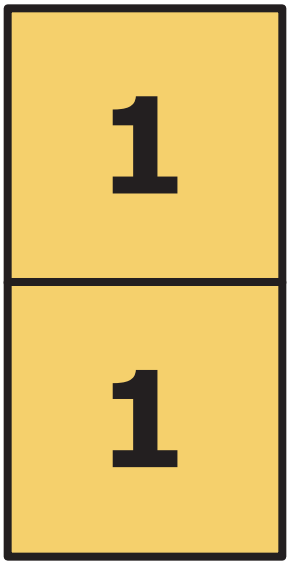


Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 1.

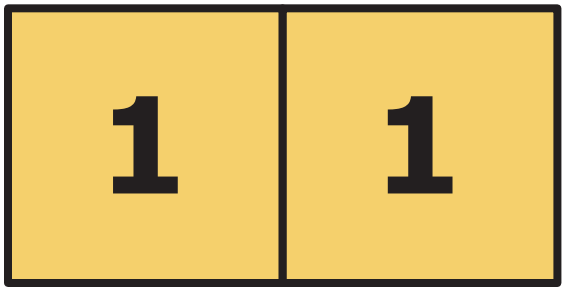
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 2.



Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 3.



Mat Plan

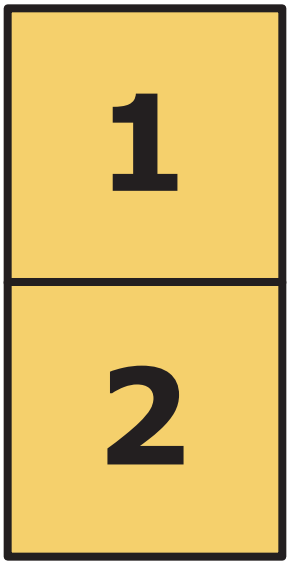
This Mat Plan corresponds to Stacked Cube Arrangement 4.

Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 5.

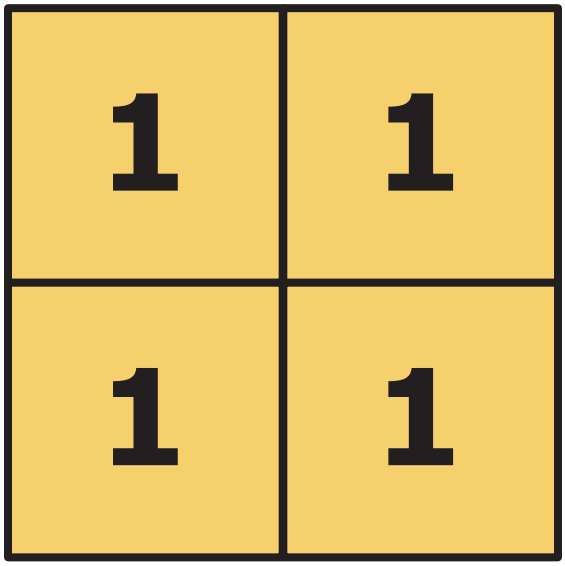
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 6.



Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 7.



Mat Plan

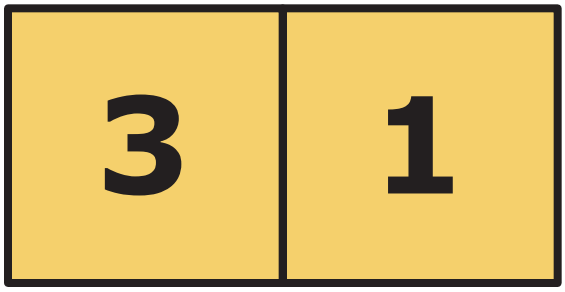
This Mat Plan corresponds to Stacked Cube Arrangement 8.

Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 9.

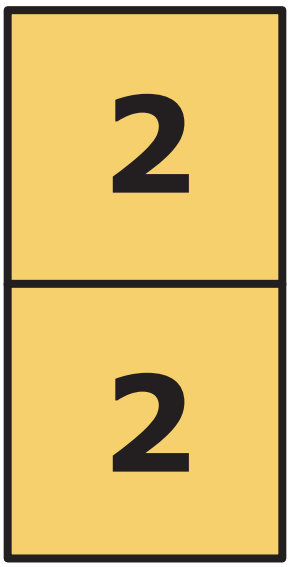
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 10.



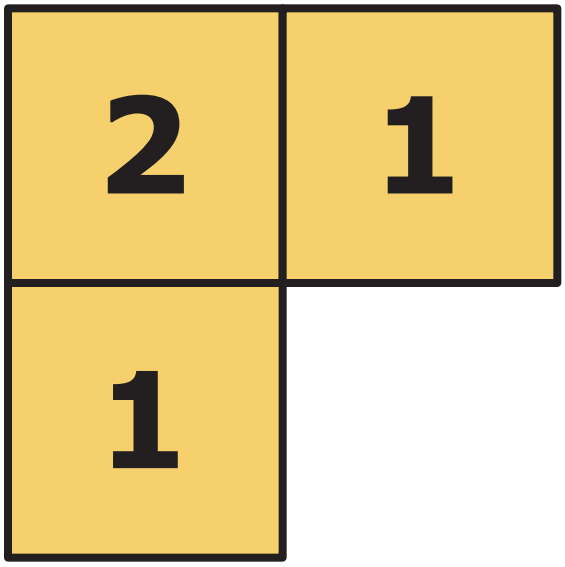
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 11.



Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 12.

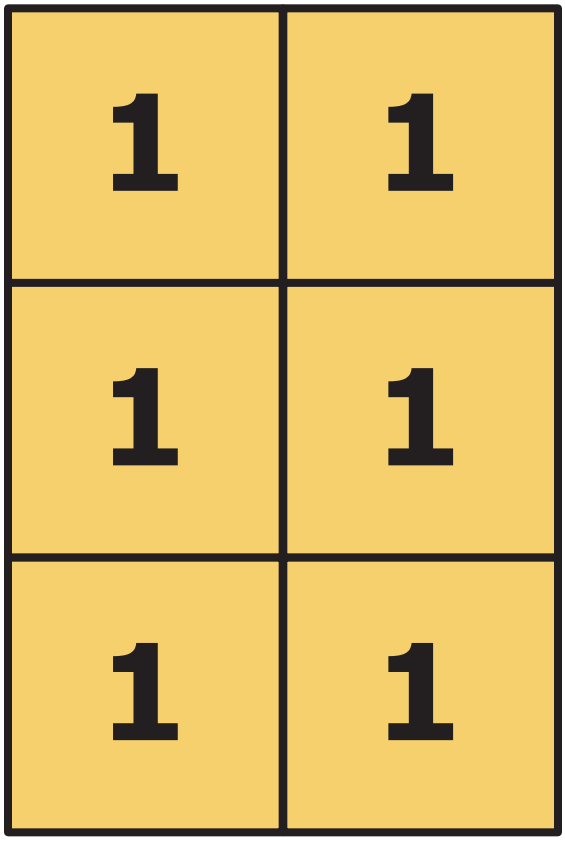


Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 13 and 14.

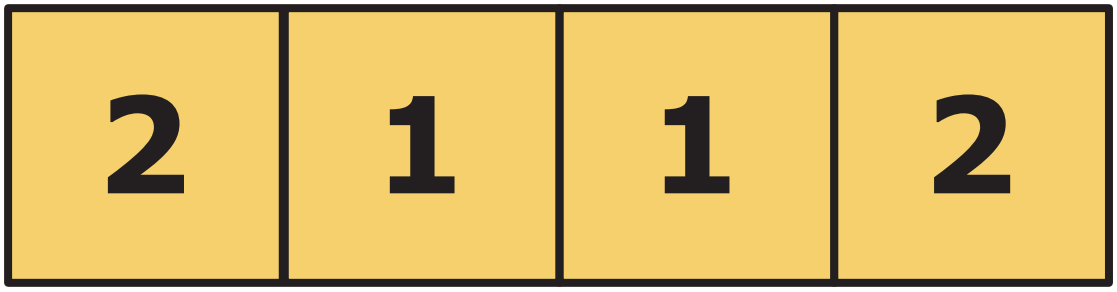
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 15.



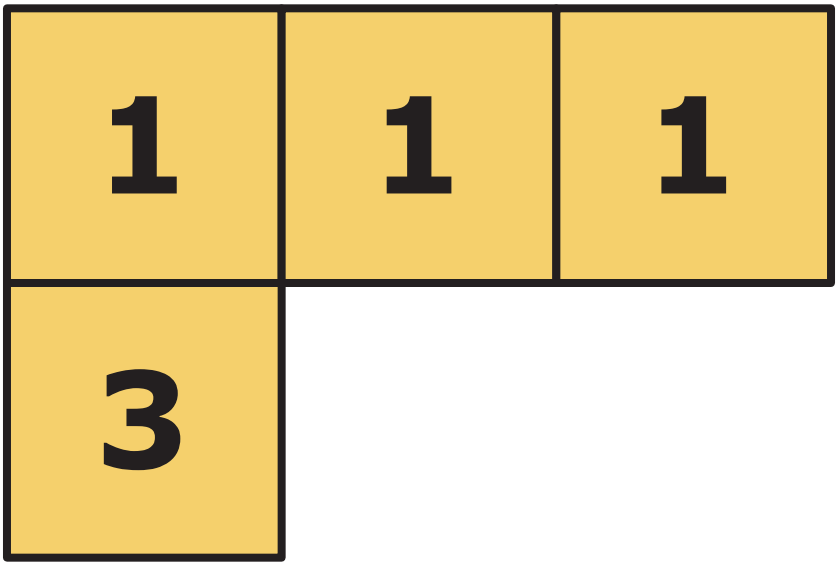
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 16.



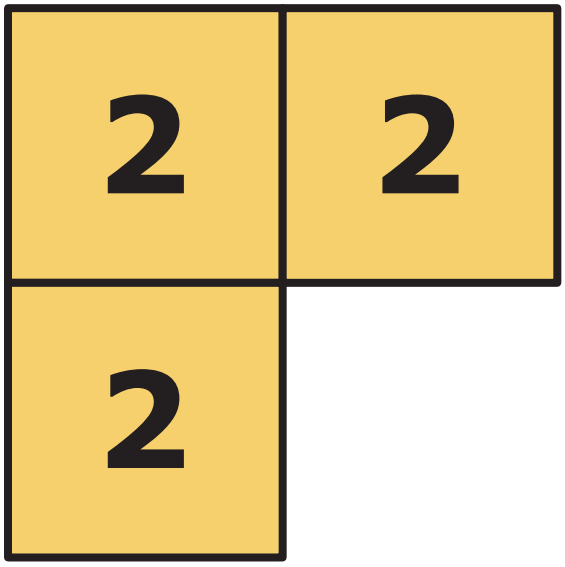
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 17.



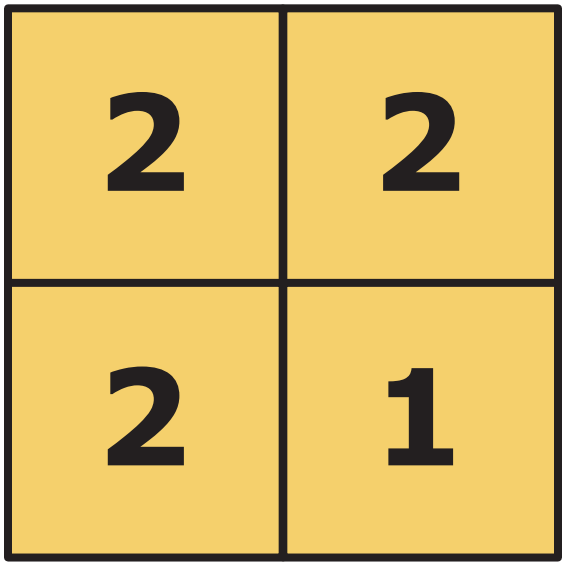
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 18.



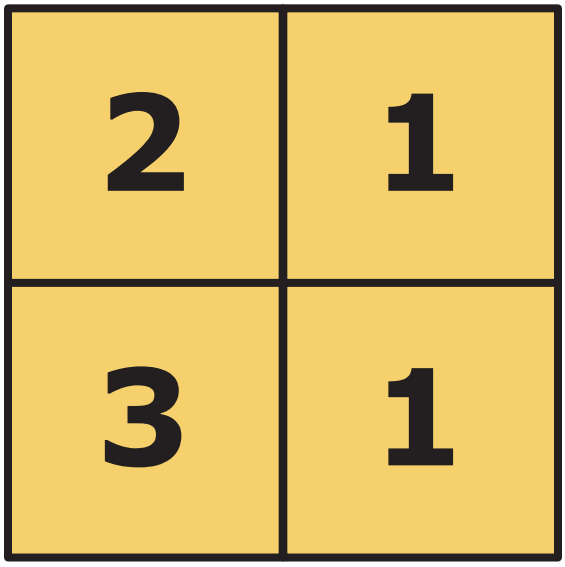
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 19.



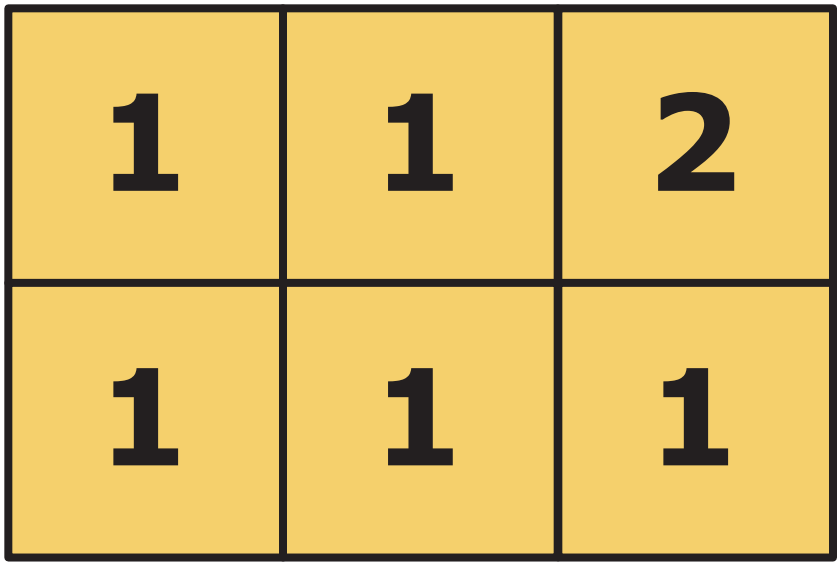
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 20.



Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 21.

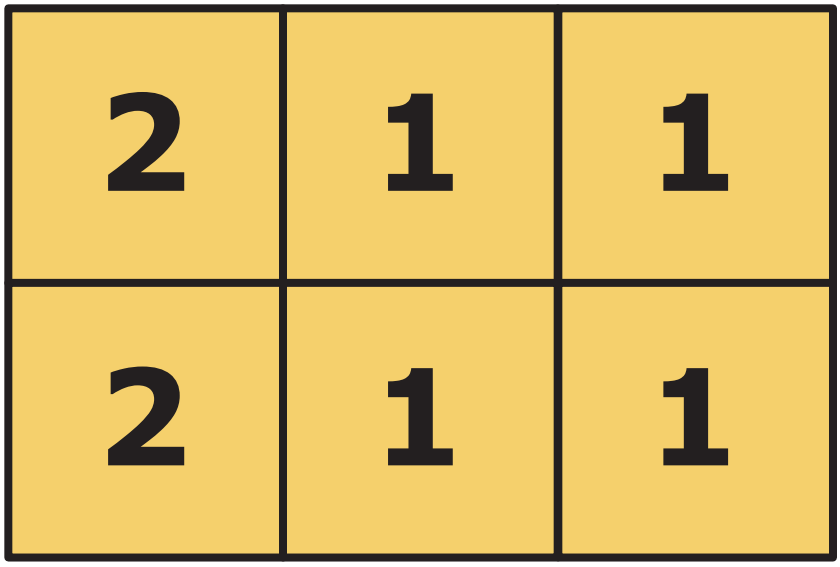


Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 22.

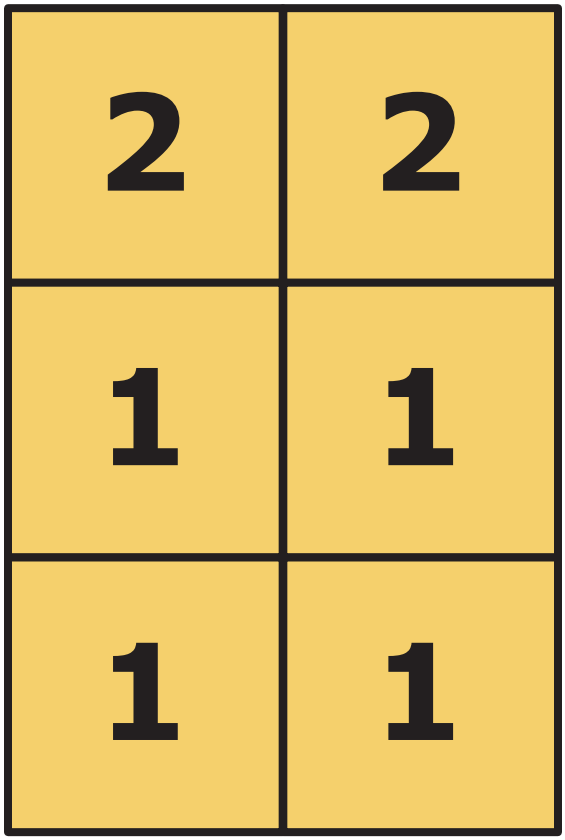
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 23.



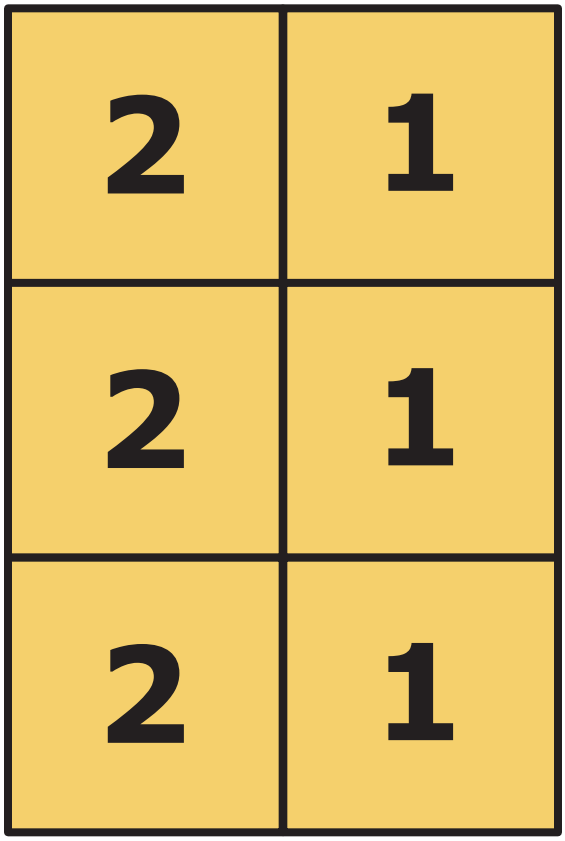
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 24.



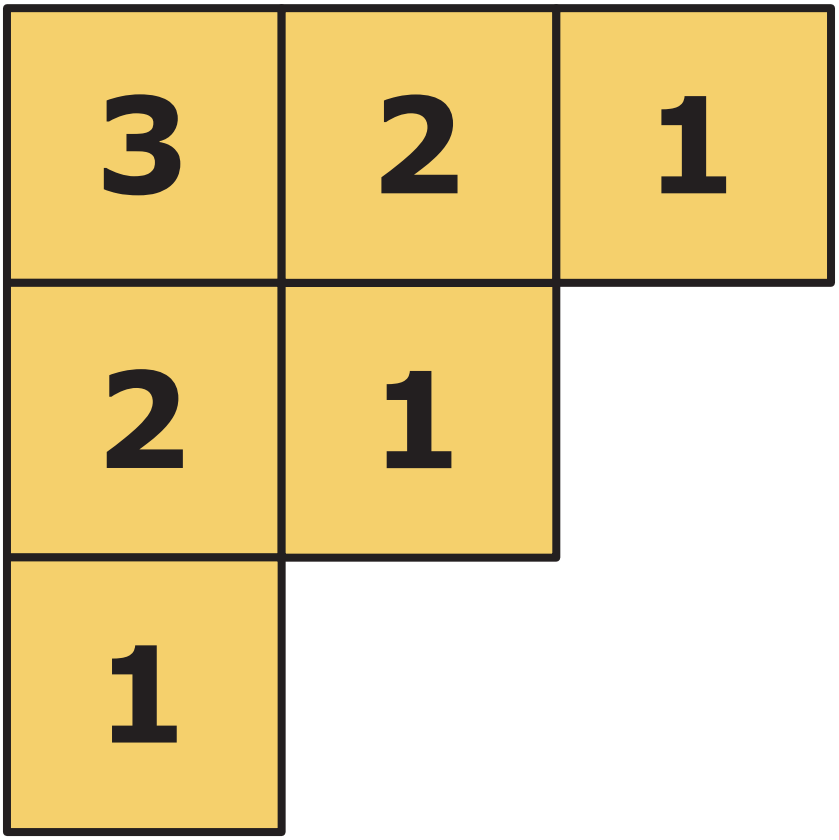
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 25.



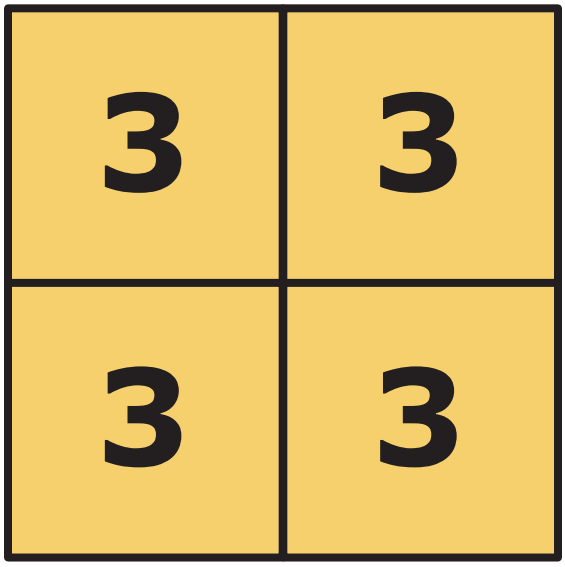
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 26.



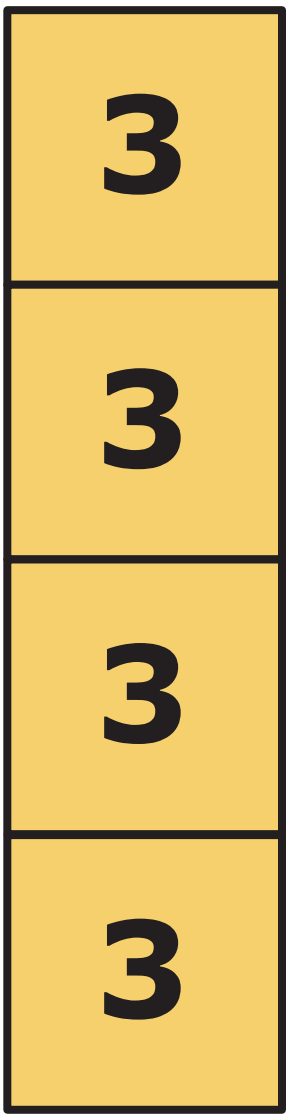
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 27.



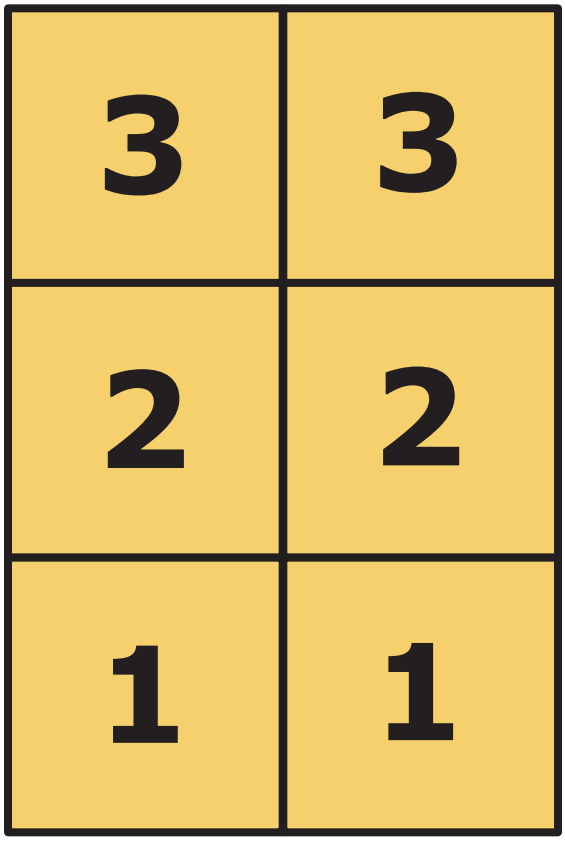
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 28.



Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 29.



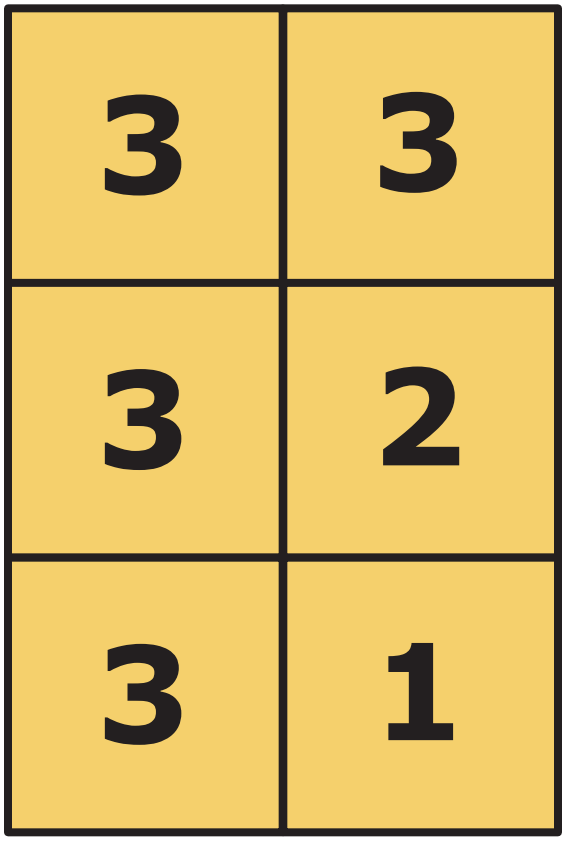
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 30.

2	2	3	3
1	1	1	1

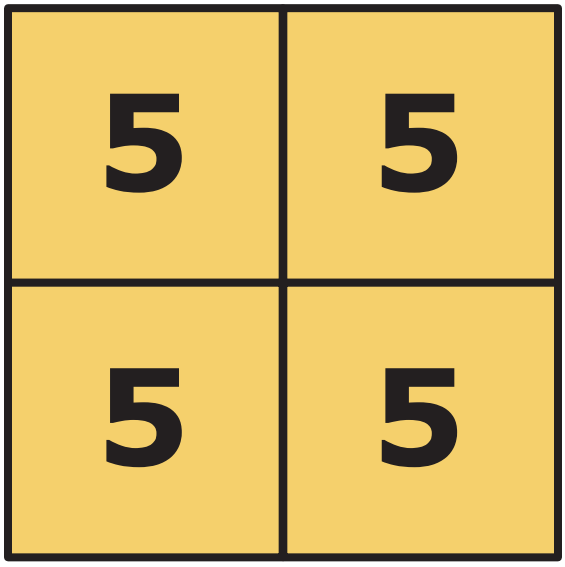
Mat Plan

This Mat Plan corresponds to Stacked Cube Arrangement 31.

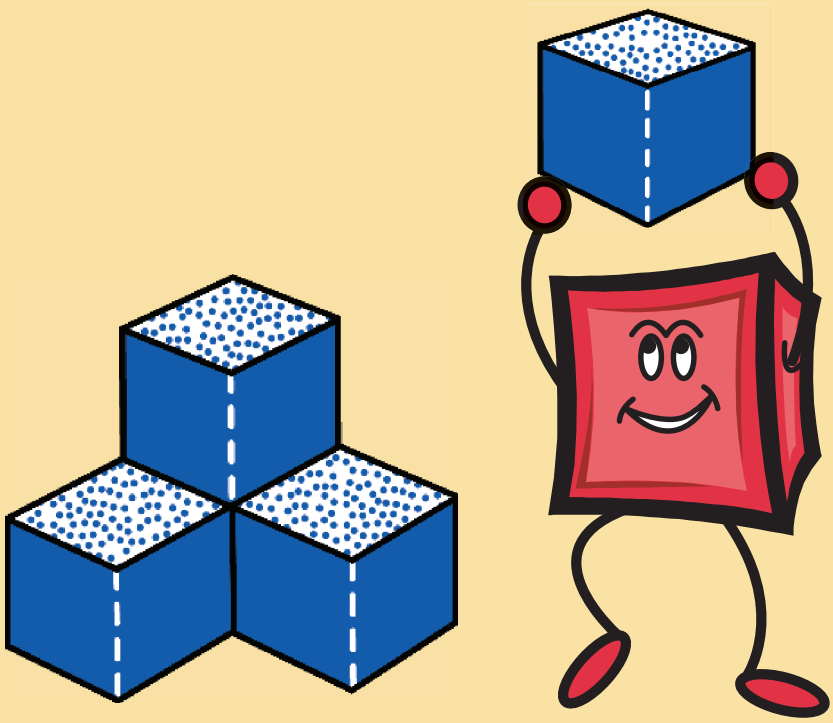


Mat Plan

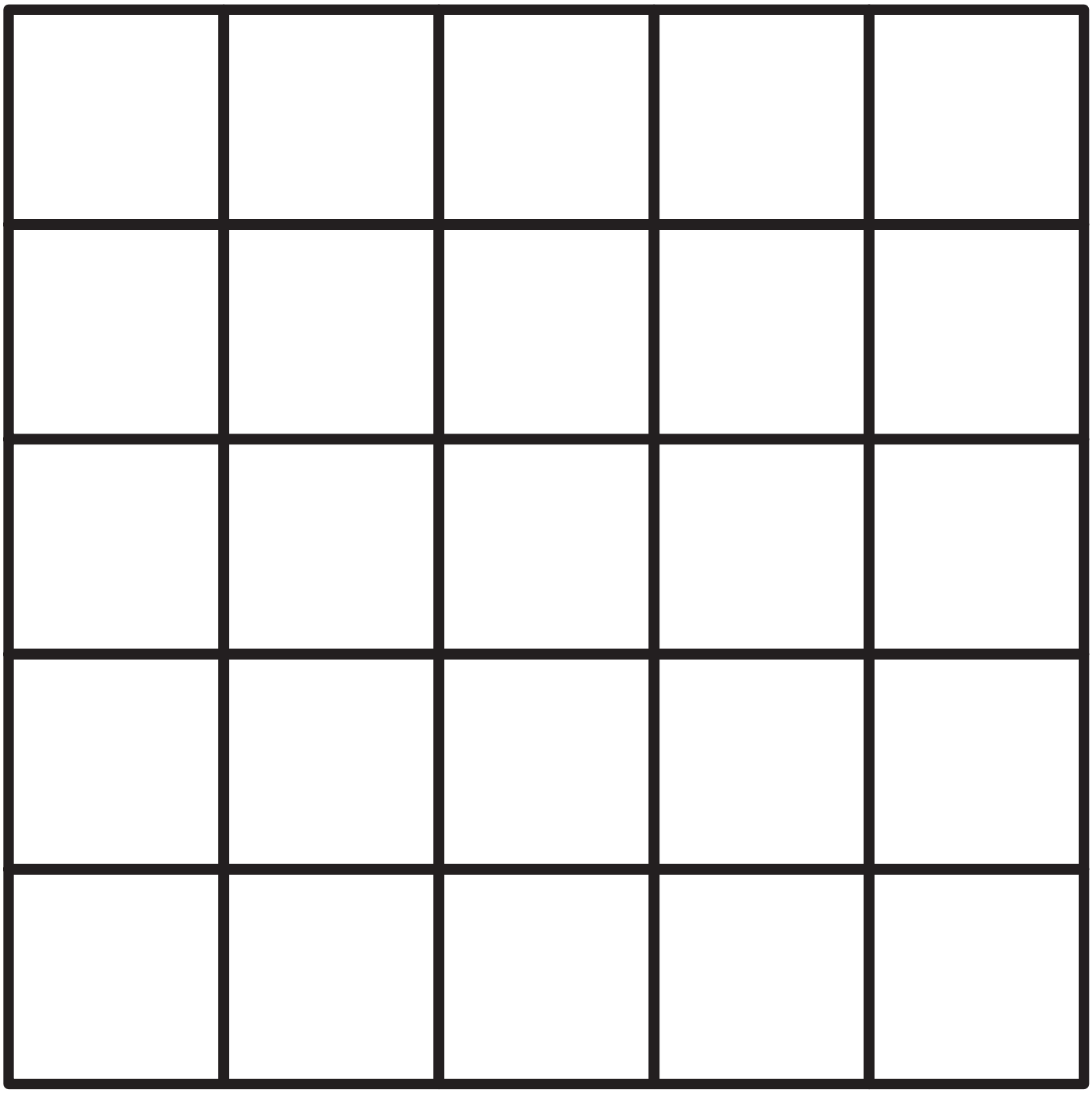
This Mat Plan corresponds to Stacked Cube Arrangement 32.



Appendix C:
Mat Plan Worksheet

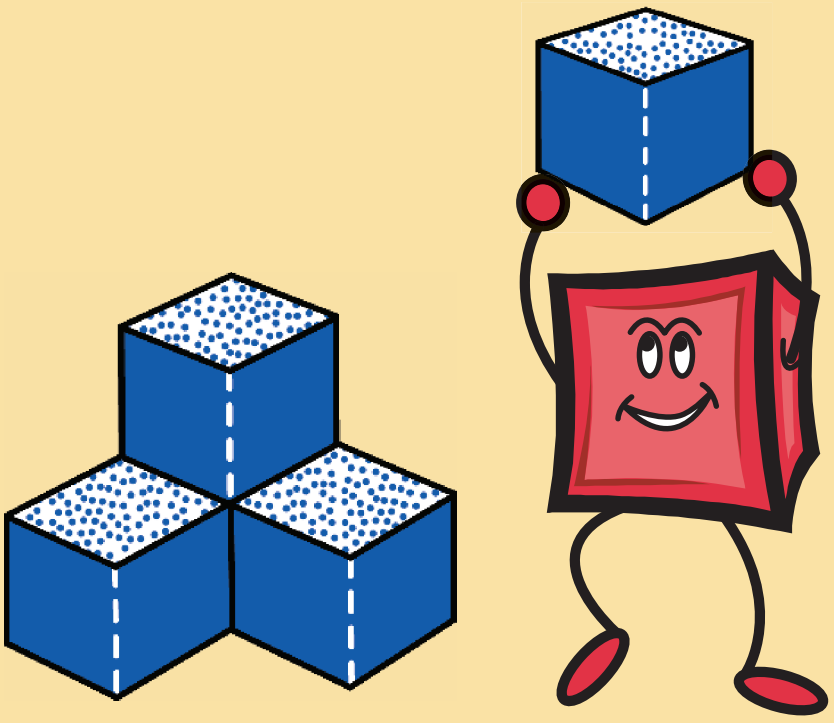


Mat Plan Worksheet

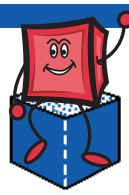


Permission is given to photocopy this page
as needed for low vision students.

Appendix D:
StackUps Skills Checklist



StackUps Skills Checklist



Student's Name: _____

Instructor's Name: _____

Directions: Use the following rating scale to indicate the student's current level of understanding of each skill/concept:

1 = Beginning level of performance
2 = Developing level of performance
3 = Mastered/Accomplished level of performance

Objective/Skill Stack *StackUps* cubes independently.	Date:	Date:	Date:	Date:
	Rating:	Rating:	Rating:	Rating:
Comments:				
Objective/Skill Determine possible cube arrangements from a given number of cubes.	Date:	Date:	Date:	Date:
	Rating:	Rating:	Rating:	Rating:
Comments:				

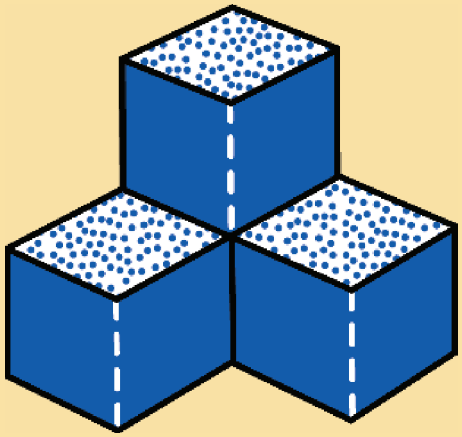
Objective/Skill Build a 3-D solid that matches a 2-D tactile display.	Date:	Date:	Date:	Date:
	Rating:	Rating:	Rating:	Rating:
Comments:				
Objective/Skill Identify a 2-D tactile display that matches a 3-D solid.	Date:	Date:	Date:	Date:
	Rating:	Rating:	Rating:	Rating:
Comments:				
Objective/Skill Build a 3-D solid when given a Mat Plan.	Date:	Date:	Date:	Date:
	Rating:	Rating:	Rating:	Rating:
Comments:				

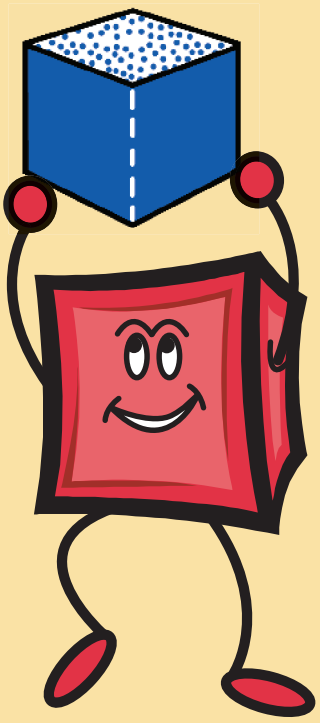
Objective/Skill	Date:	Date:	Date:	Date:
Create a Mat Plan when given a 3-D solid.	Rating:	Rating:	Rating:	Rating:
Comments:				
Objective/Skill	Date:	Date:	Date:	Date:
Create a Front-Right-Top view when given a 3-D solid.	Rating:	Rating:	Rating:	Rating:
Comments:				
Objective/Skill	Date:	Date:	Date:	Date:
Build a 3-D solid when given a Front-Right-Top view.	Rating:	Rating:	Rating:	Rating:
Comments:				

Objective/Skill	Date:	Date:	Date:	Date:
Determine the volume of a stacked cube arrangement.	Rating:	Rating:	Rating:	Rating:
Comments:				
Objective/Skill	Date:	Date:	Date:	Date:
Determine the surface area of a stacked cube arrangement.	Rating:	Rating:	Rating:	Rating:
Comments:				
Objective/Skill	Date:	Date:	Date:	Date:
Identify cube nets that build 3-D cubes.	Rating:	Rating:	Rating:	Rating:
Comments:				

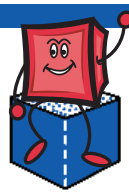
Permission is given to make copies of this checklist as needed. You may also complete this form electronically using the *StackUps Skills Checklist* provided as an MSWord file on the accompanying CD.

Bibliography





Bibliography



National Council of Teachers of Mathematics. (2005). *Illuminations: i-Math Investigation/6-8: Spatial Reasoning and Using Cubes and Isometric Drawings.* Retrieved July 15, 2005, from http://illumtest.nctm.org/imath/6-8/isometric/index.html

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics.* Reston, VA: The National Council of Teachers of Mathematics, Inc.