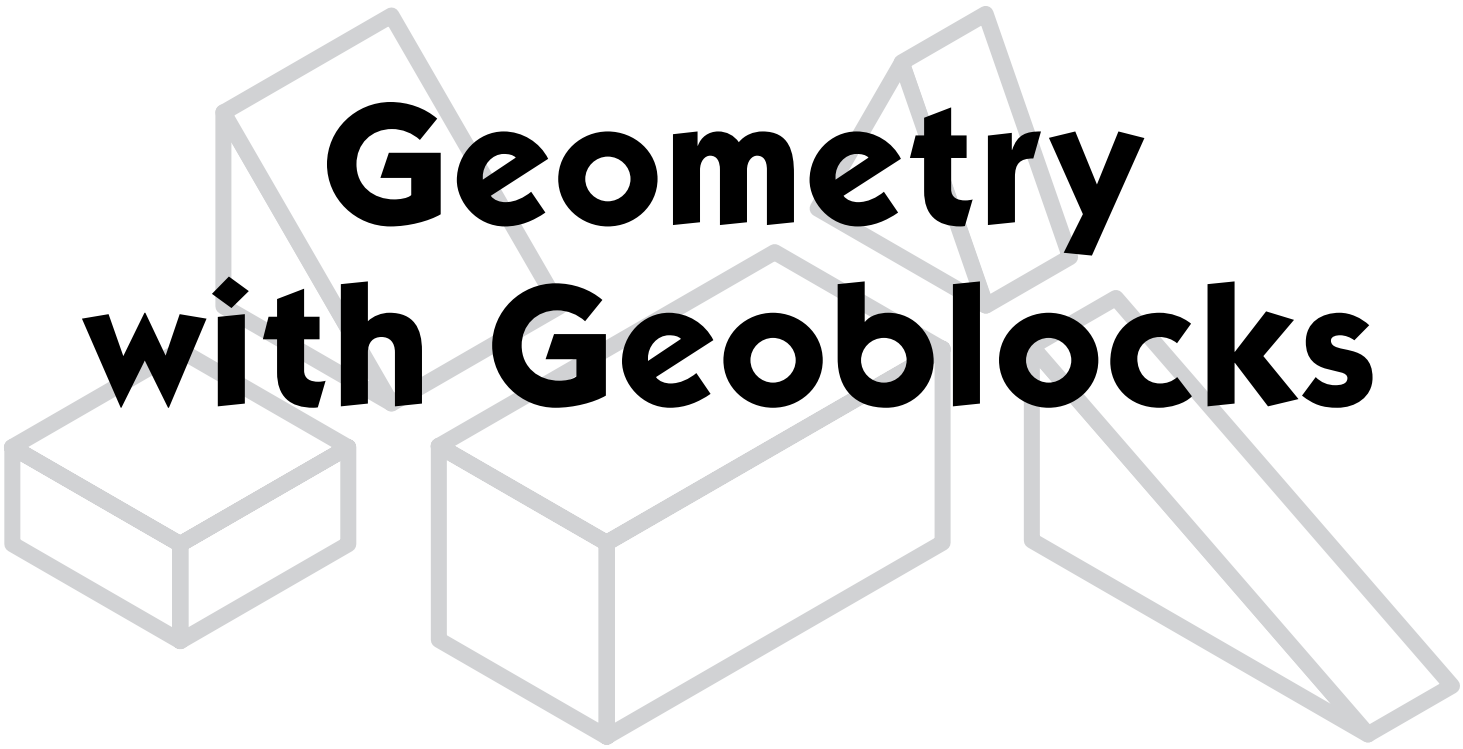
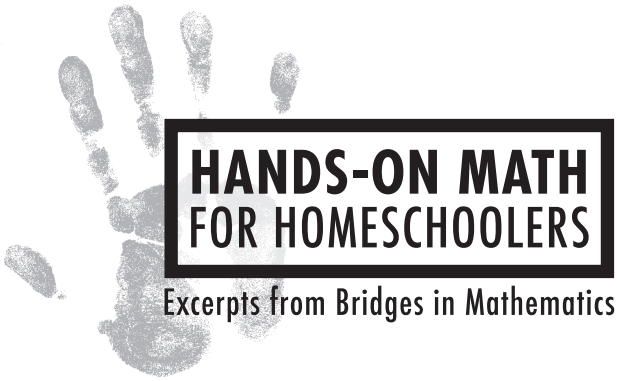
Geometry with Geoblocks





HANDS-ON MATH
FOR HOMESCHOOLERS

Excerpts from Bridges in Mathematics

Geometry with Geoblocks
Hands-On Math for Homeschoolers

A Math Learning Center Publication

Bridges in Mathematics
by Allyn Snider & Donna Burk
illustrated by Tyson Smith

adapted from *Bridges in Mathematics* by
Cynthia Hockman-Chupp

QP364 P0304

This project was supported, in part, by the National Science Foundation. Opinions expressed are those of the authors and not necessarily those of the Foundation.

Prepared for publication on Macintosh Desktop Publishing system.

Geometry with Geoblocks

Geometry Not Just for Big Kids Anymore!

Introduction

Growing up, I don't think I heard the word "geometry" until I got to junior high. When I did finally hear it, I knew it was a big deal. With such complex words—theorems, proofs, axioms—it had to be something important. And scary! As a high school sophomore I felt like I had walked through the door of my geometry class and into another dimension. I'm ashamed to admit that the class met my expectations; geometry felt totally foreign, it was scary, and I had absolutely no idea how to do it. Or why I was doing it.

It didn't surprise me, years later, to learn about a theory proposed by two high school math teachers. They suggest that most students pass through a number of levels as they learn about geometry. Like me, many students enter high school thinking at a geometric level of zero or one. Unfortunately, high school geometry texts are often geared toward a level three. No wonder I had such a difficult time!

Today, students throughout the world can take advantage of this new knowledge about how people learn math. Russian children in grades 1–3 are learning geometry. Shaughnessy and Burger (1985) report "by the time they enter the fourth grade, Soviet children have completed activities that correspond to Level One…; they then begin a semi-deductive study of geometry that continues for the next *seven* years!" Imagine how mathematically prepared these children are. What might we do to make similar opportunities available to our children?

As you introduce geometry to young children, there are several key words to keep in mind: *exploratory, informal, time, and fun.* The Math Learning Center states, "The fact of the matter is that most primary children find geometry fun. Surrounded by 2- and 3-dimensional shapes all their lives, children are already familiar with many geometrical concepts. Most have built symmetrical designs or put shapes together to complete puzzles or build block structures. Legos, Duplos, Tinkertoys, Lincoln Logs, and other construction toys have not declined in popularity among the preschool set. Some children have had more experience than others, but most have cut a sandwich in half and found themselves looking at two triangles or two rectangles instead of a single square. While they might lack the formal language to talk about what they're doing, most children have had plenty of physical experience combining shapes, subdividing shapes, sliding, flipping, and turning shapes, and finding shapes that are either similar or congruent by the time they [start] school.

"We feel that the best way to familiarize children with the language of geometry is to use the vocabulary accurately ourselves in the context of physical

and visual activities. What better setting to talk about faces, edges, and corners than when children are engaged in building structures? Although students might not learn these terms 'for keeps,' they will listen with interest and use them as they are able. As they have repeated opportunities to cut, fold, combine, tessellate, and measure shapes over the primary and later elementary years, words like *symmetrical, area, parallel, congruent, rhombus, trapezoid,* and the like will become part of their vocabularies. This is especially true if their teachers use these terms consistently, with purpose and accuracy." [(Modified from "What's the Big Idea?", The Math Learning Center, *Bridges in Mathematics*, Grade 2, Vol. 2, pp. 327-328.]

General Information

Student Groupings/Ages

The lessons may be used with one child or an entire classroom. Although the lessons were designed for grades 1–4, high schoolers and adults have been able to take the same material to a much higher level. Homeschooling families with a variety of ages may choose to work on the same material at the same time, but at many different levels of mathematical thinking.

Time Frame

The geoblock unit contains 6 lessons and numerous activities. Plan on dedicating a 45–60 minute block of time each day to math. A family could spend anywhere from one to three days or more on any given lesson, depending upon the child's interest and the depth at which the material is covered. Move through the lessons at your child's pace.

Mathematical Vocabulary

As a teacher, your goal is to introduce mathematical vocabulary and use it in daily conversations with your children. The goal is not to immediately memorize, but rather to naturally integrate it into the child's world. The geoblock exercises provide many opportunities to introduce and use geometric terms.

Glossary of terms

Area—the measure of the surface of a solid or a plane.

Congruent—same shape and size; two congruent geometric figures would have the exact same shape and size.

Corner—the point where the edges of a solid meet.

Cube—a solid having six equal, square sides.

Edge—a line segment where two faces of a solid intersect.

Face—the flat surface of a solid.

Parallel—going in the same direction, always the same distance apart, so as never to cross.

Parallelogram—a quadrilateral having two pairs of parallel sides.

Prism—a solid with ends which are parallel, polygonal, and equal in shape/size, with sides that are parallelograms.

Pyramid—a solid with a polygon base in which each side is a triangle that slopes upward to meet at a top vertex.

Quadrilateral—four-sided figure.

Rhombus—a parallelogram in which all four sides are congruent

Symmetrical—when divided, each side is an identical reflection of the other.

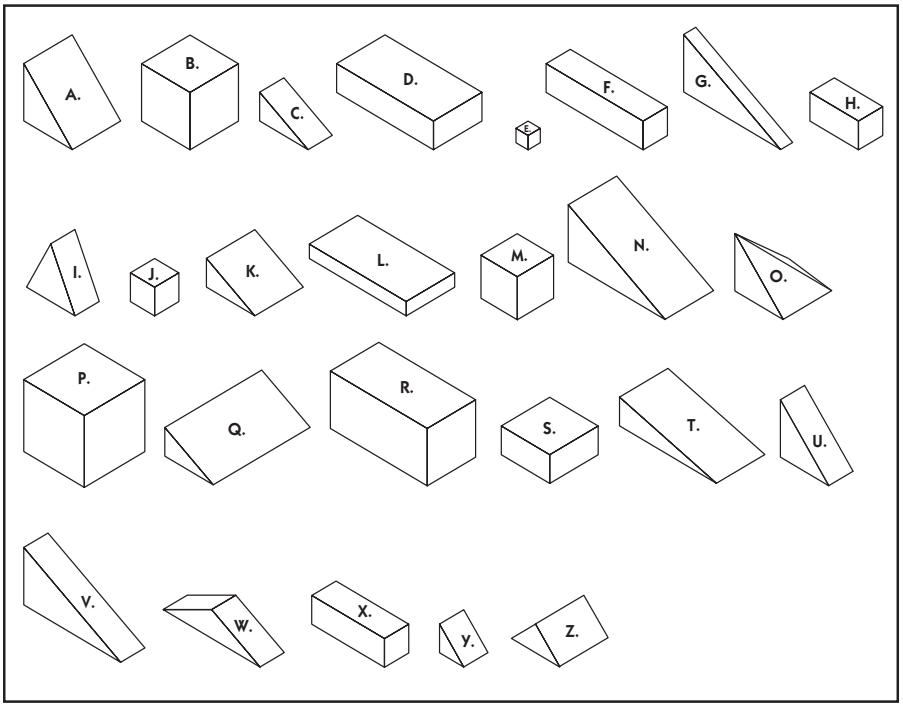
Trapezoid—a four-sided figure in which only two sides are parallel.

Reproducing Curriculum

The student pages may be reproduced as needed for your own children.

Before you begin

Label the geoblocks as shown below. Thin, permanent markers work well. Remember to put a dot after each letter so as not to confuse letters that may be inverted such as M and W.



As you begin

Provide children with many opportunities to play with the geoblocks prior to beginning the more formal lessons. This time will help them to get acquainted with the blocks, making later lessons easier.

Each time the blocks are used, instruct children to count them out of the bag (1, 2…26) and count them back into the bag when finished. All 26 blocks are important for the lessons and this exercise will prevent loss of blocks. (One replacement hint: the tiny E block is sometimes misplaced. If you have centimeter cubes from a set of base 10 blocks, they work well as substitutes.)

Concluding the unit

Provide ample time for children to reflect on what they've learned. Discuss:

1. What did you find easy? Why?
2. What was difficult? Why?
3. What was fun? Why?
4. Describe what you learned.

On a piece of paper have students write "Reflections" on the top. Ask them to reflect on the above questions, thinking about their own learning during this unit.

PORTFOLDER

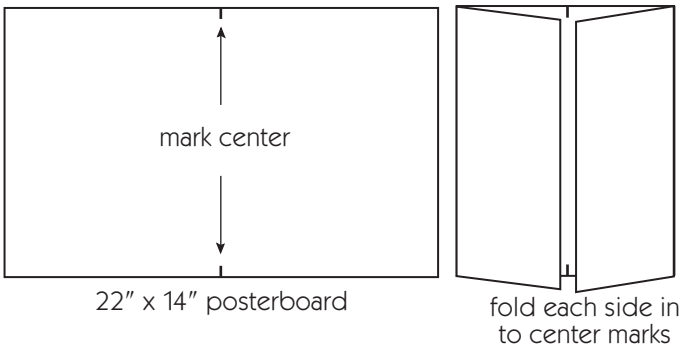
You'll need

- ★ zippered plastic bag to hold each student's work during unit
- ★ half-sheet of posterboard (14″ × 22″) for each student
- ★ colored paper
- ★ glue sticks and scissors
- ★ business-size envelope, cut in half, for each student
- ★ stapler
- ★ colored markers or crayons for decorating portfolder

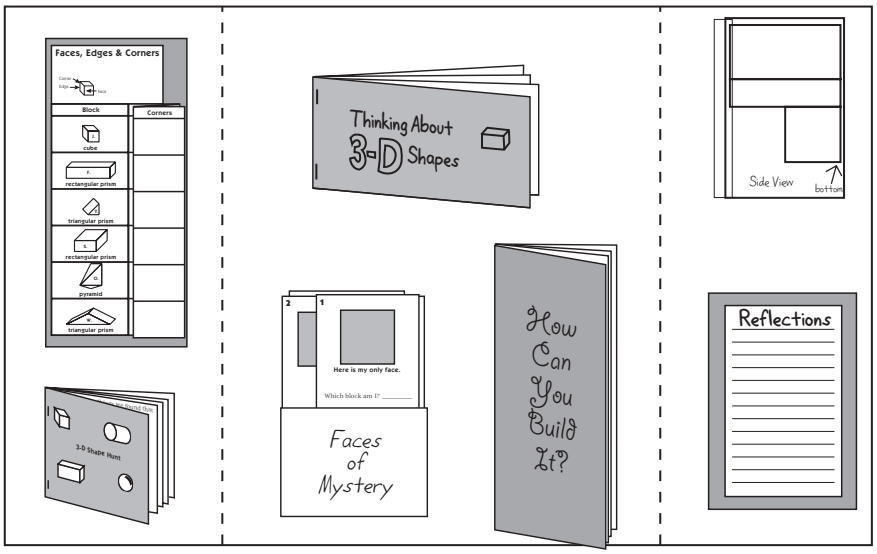
A portfolder is a student folder designed to capture an entire unit of study from the beginning to the end of a unit. In the portfolder students reflect on their learning, making it a good assessment tool. Children return to the folder again and again, reviewing what they've learned and taking pride in what they know.

If you choose to have your children make portfolders, save all of their work from the unit. A zippered plastic bag makes a nice storage container. At the end of the unit students will compile their assignments as described below.

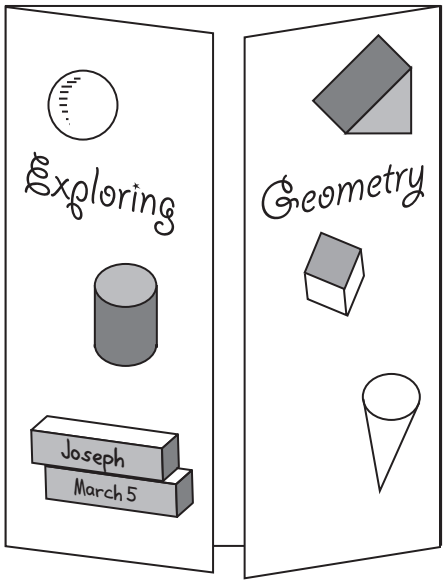
At the conclusion of the unit, give each child a half-sheet of posterboard. Place the 14″ × 22″ paper horizontally in front of them. Mark the center of the 22″ length. Fold the right and left sides to meet the center mark, forming a shutter fold. This is a single-fold portfolder.



Give students time to lay out their assignments inside the portfolder, trying different arrangements until they find the design that bests suits their work. Unleash creativity! Provide colored paper for matting. Ask students to consider where they might draw little geometric shapes as background design. Close the shutters when students are ready to work on the cover. On the cover, children need to write a title for the unit as well as their names and the date. Illustrate the remaining space with geometric designs, including 3-D shapes. See the sample portfolder below.



Portfolder Interior



Portfolder Cover

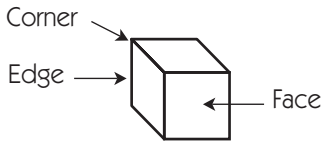
Session 1

PROBLEMS & INVESTIGATIONS

Exploring Geoblocks Faces, Edges & Corners

Overview

Children work in groups of 2 or 3 to re-acquaint themselves with the geoblocks. After they've had some time to play, the teacher introduces the terms *corner*, *face*, and *edge*. Students examine the blocks to find their faces, corners, and edges, and then fill in a record sheet showing how many of each can be seen on 6 of the blocks.



You'll need

★ a set of geoblocks for every 2 or 3 students

★ Faces, Edges & Corners (Blackline 1, run a class set)

Skills

★ combining 3-dimensional shapes to make other shapes

★ observing and describing 3-dimensional shapes

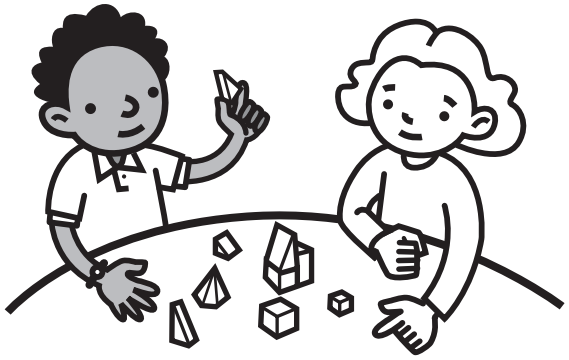
★ exploring some of the relationships between 2- and 3-dimensional shapes

★ learning the names of some 3-dimensional shapes and the terms *face*, *edge*, and *corner*

Note *With small groups of children, you will be able to look at a central worksheet together. You will, however, want to provide one copy of each sheet per child for work time.*

Before you distribute the bags of blocks, let your students know that it will be important to keep their sets separate during the next few lessons. If four children are working with two sets of blocks, for instance, it will be important not to mix them. Once they understand this, distribute sets of blocks to pairs or small groups of children and let them play for ten or fifteen minutes. (Even though students had plenty of playtime with the blocks earlier, they'll still need time to build and get familiar with the single sets before you ask them to do anything more structured.)

Session 1 Exploring Geoblocks (cont.)



After your children have had a chance to build with their blocks for awhile, ask them to share any observations they might have with their partners. Then ask if anyone wants to share observations with the whole group. (It isn't necessary that children use the correct names for each block yet, but you'll want to model the correct language yourself. The most important thing in this lesson is that they have plenty of time to talk about their experiences. This dialogue will help them in clarifying and confirming their ideas.)

> ***Teacher*** *Would anyone like to share his or her observations with the group?*
>
> ***Peter*** *Some of the blocks look like ramps.*
>
> ***John*** *Some of the blocks are triangles and some are rectangles.*
>
> ***Evan*** *There's one really weird one. It looks like a pyramid that's going to fall over.*
>
> ***Kaitlin*** *Some of the blocks have all squares.*
>
> ***Susannah*** *Those are called cubes—like the Unifix cubes.*
>
> ***Danielle*** *Some of the blocks have squares and triangles on them. What are they called?*
>
> ***Teacher*** *Those are triangular prisms. The blocks with faces that are all rectangles are called rectangular prisms.*
>
> ***Rob*** *Some of the blocks are like families, like the cubes. There's a really tiny cube, and then a bigger one, and bigger, and bigger.*
>
> ***Kevin*** *Some of those rectangular things works like that too. You can make steps with them.*
>
> ***Sherwin*** *They're fun to build with, but I wish there were more in my set.*

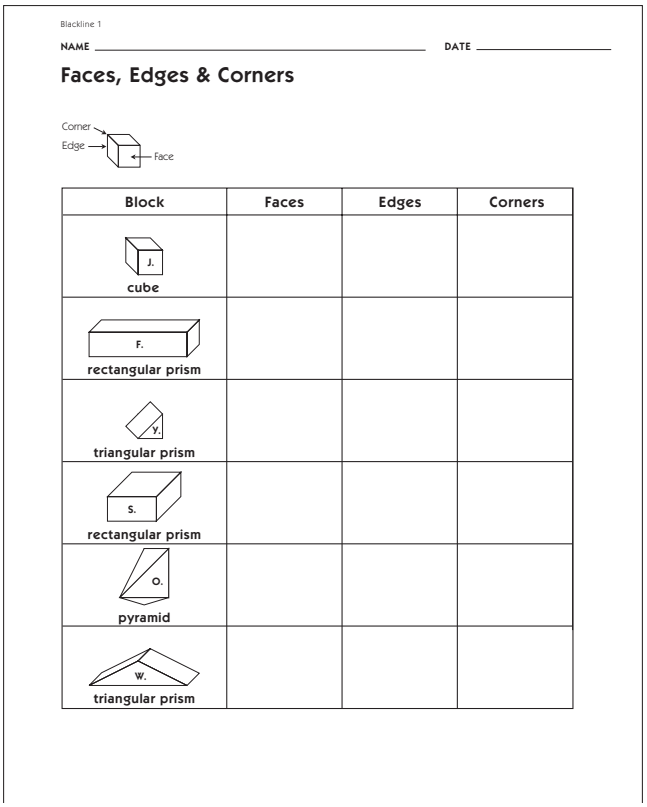
Finally, introduce the terms *face*, *edge*, and *corner* (vertex). These terms are helpful in discussing 3-dimensional figures and will be useful to children in future activities. For your own information, *face* is defined as the flat surface

Session 1 Exploring Geoblocks (cont.)

of a solid. An *edge* is a line segment where two faces of a solid intersect. A *corner* is the point where the edges of a solid meet. Even without formal definitions, though, you will find that many of your students learn the terms fairly quickly. Most will have an intuitive sense of what a corner is. Face and edge seem nearly as comfortable for many children.

After you've introduced the terms and had children find examples using the blocks in front of them, show them Blackline 1, Faces, Edges & Corners. Demonstrate the recording procedure and have children go to work with their own blocks and sheets, counting and recording the numbers of faces, edges, and corners on each block shown. Circulate as they work to encourage cooperation, discussion, and theorizing. Can students find any similarities or differences between the numbers of faces, edges, and corners as they make their way through the set of six blocks on the worksheet? Why do blocks J, F, and S all have the same numbers of faces, edges, and corners? Will these numbers hold for all rectangular prisms? Why?

By the end of the lesson, students will discover that blocks J, F, and S—cube and rectangular prisms—have the same number of faces, edges, and corners. Ask them to test other blocks. Do other rectangular prisms have the same numbers? Other cubes? The triangular prisms also have the same number of faces, edges, and corners. Can your students demonstrate that this holds true for other triangular prisms in the collection? Encourage students to prove their theories through further testing of blocks.



Blackline 1

NAME _____ DATE _____

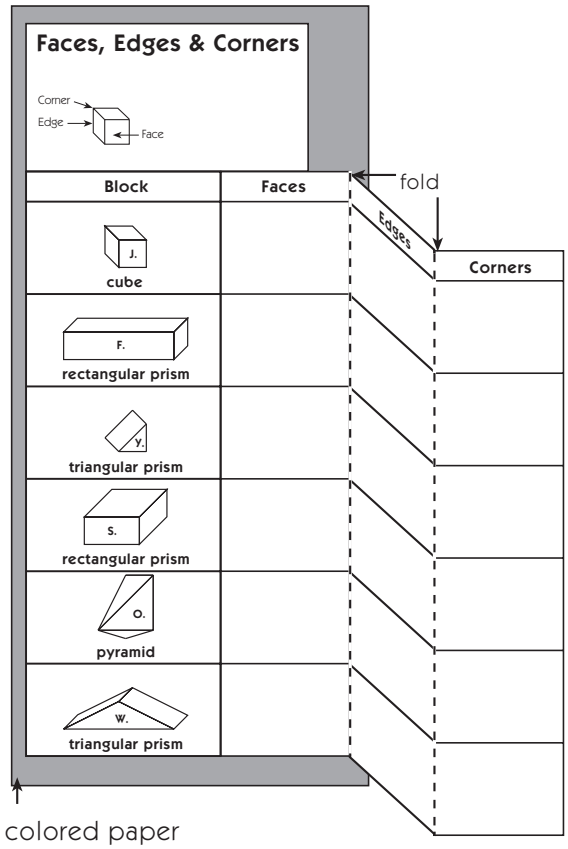
Faces, Edges & Corners

Block	Faces	Edges	Corners
J. cube			
F. rectangular prism			
Y. triangular prism			
S. rectangular prism			
O. pyramid			
W. triangular prism			

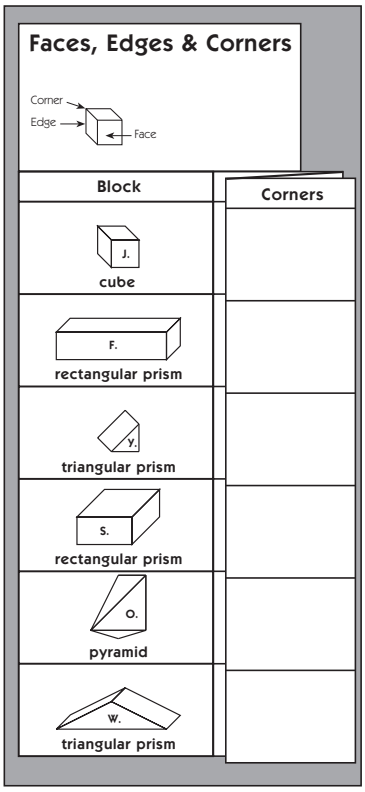
Session 1 Exploring Geoblocks (cont.)

PORTFOLDER

Cut out the Faces, Edges & Corners blackline as shown. Accordian fold the faces, edges and corners columns so they line up on the right side of the block column.



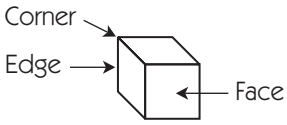
colored paper

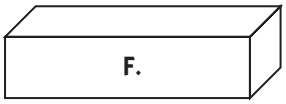
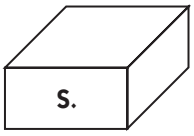
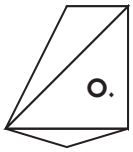
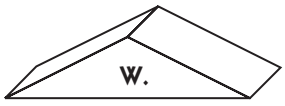


completed project, ready to glue onto portfolder

NAME _____ **DATE** _____

Faces, Edges & Corners



Block	Faces	Edges	Corners
 cube			
 rectangular prism			
 triangular prism			
 rectangular prism			
 pyramid			
 triangular prism			

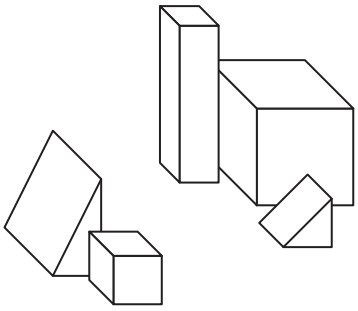
Session 2

PROBLEMS & INVESTIGATIONS

Geoblock Sorting Finding Many Ways

Overview

Children work in small groups to sort sets of geoblocks in as many ways as they can. This sorting activity helps students continue to discover many of the characteristics and properties of the geoblocks.



You'll need

★ a set of geoblocks for each group of children

★ graph paper (optional)

★ Extension Activity and Worksheet (Blacklines 2–3, 1 copy per student)

Skills

★ observing and describing 3-dimensional shapes

★ finding many ways in which to sort 3-dimensional shapes

★ exploring some of the relationships between 2- and 3-dimensional shapes

★ Using the names of some 3-dimensional shapes and the terms *face*, *edge*, and *corner*

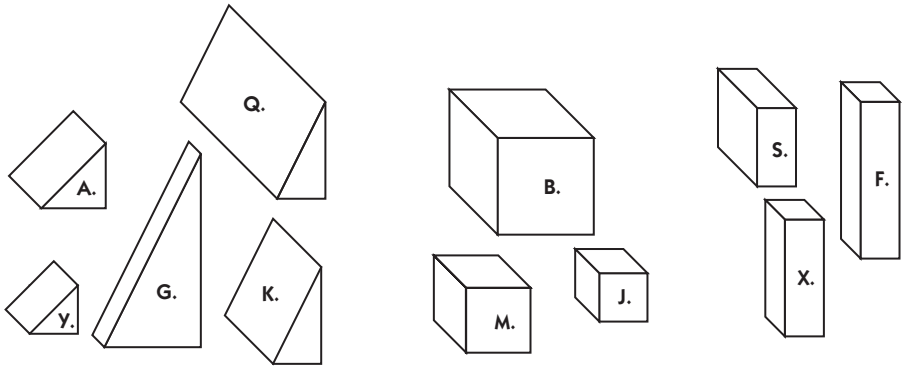
Note *During this activity, children will sort the geoblocks, making as many groupings as they can. Again, the activity may be done at a variety of levels. Young children may say things like "this group looks like the tops of houses" while older children will sort in more sophisticated ways, perhaps even using terminology learned in the previous lesson: triangular prisms, rectangular prisms, cubes, and pyramids.*

Although the lessons may be done at a variety of levels, all ages may work at the same time. Simply give one set of blocks to the younger child(ren) and another to the older. (Or, if you only have one set, let one group go at a time while the other group observes. Children will learn from watching others.)

I ask children to call me over when they've made a new set. I check their work and give them a token (a penny, a block, a chocolate chip) as a counter, allowing them to keep track of how many groups they've made. When two of my children had friends over, we chose to do this activity. The two younger boys loved competing with the two older girls to see which team could get more groups in a designated amount of time. Although competition is not the goal, in this case it made for an enjoyable game.

Session 2 Geoblock Sorting (cont.)

Gather your students in a circle on the rug. Have the two students beside you be part of your "team" for now. Dump out a set of geoblocks and ask the class how you might sort them. Ideas may come slowly until children actually get their hands on the blocks, but you'll hear a few: by size, by face shape, by number of corners. Ask your two teammates which idea they want to try first and work together to sort the blocks in that way.



Faces that are triangles

Faces that are only squares

Faces that are rectangles

Explain to the rest of your students that they'll be working in teams in just a few minutes, and that in order to get credit for each sorting idea, they'll need to decide what to call each subset, raise their hands as a group, and name the subsets as you come around and point to them.

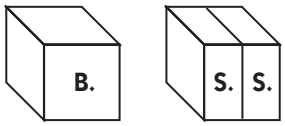
Model this procedure with your team, push the blocks back together, and go through the whole thing once more if needed, using a different attribute. Then send students out in groups of three or four, each with their own set of geoblocks, to start sorting.

As you circulate, take the opportunity to reinforce the idea that everyone in the group has to be ready with her hand up before you'll come to the group. If you cheerfully insist that they all name the subsets each time, they'll work together better and there will be less likelihood that one or two children will

Session 2 Geoblock Sorting (cont.)

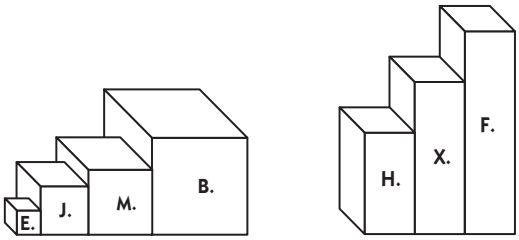
take over.

Once students have had a few minutes to work, the ideas will start to fly. Young children are often more creative and kinesthetic in their sorting than adults. In addition to sorting the blocks by size, shape, and numbers of corners or faces, some of your students may sort the blocks according to what can or can't be built from them or how they behave. We've seen "blocks that can be put together to make alphabet letters" and "blocks that can't." We've also seen "blocks that stand up no matter what" and "blocks that fall over in some positions"; or "blocks that fit together to make other blocks" and "blocks that don't."



> **Student** See how these 2 blocks fit together to make one that's exactly the same size and shape as the big one?"
>
> **Teacher** Yes, I do. When you combine 2 of the S blocks, the shape they make is congruent to block B."

Because most second graders are working somewhere between Level 0 and Level 1 in the Van Hieles' model of geometrical thinking, they will frequently make reference to objects in the world around them. Thus, you might see the blocks sorted into "house bottoms" and "house tops" or "boat sails" and "not boat sails." Some children will find the sets of blocks that are similar by building "staircases."

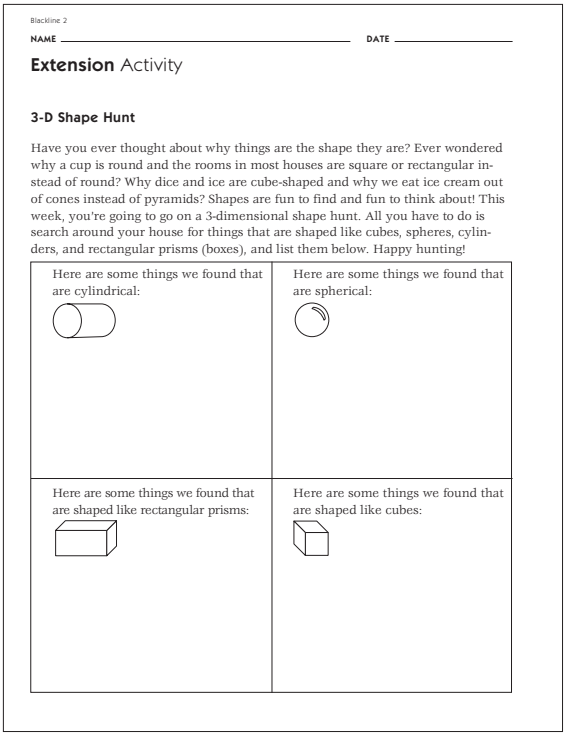


A few of your students, resolutely determined to pursue their own purposes with the geoblocks, may even class the blocks into sets like "the ones that fit together to make our boat" and "the ones we don't need." In any event, we encourage you to be very liberal in accepting children's groupings. They are making discoveries about the characteristics of the blocks with almost any grouping they make—observations about differences, similarities, shapes, sizes, and relationships. With a little encouragement, they're likely to bring a great deal of joy and energy to this task.

Session 2 Geoblock Sorting (cont.)

EXTENSION ACTIVITIES

Activity 3-D Shape Hunt (Blackline 2)
Worksheet Thinking About 3-D Shapes (Blackline 3)
The extension assignment for this week brings 3-dimensional geometry into children's daily lives as they search their homes for objects of various shapes and do some more thinking about shape faces.



Blackline 2

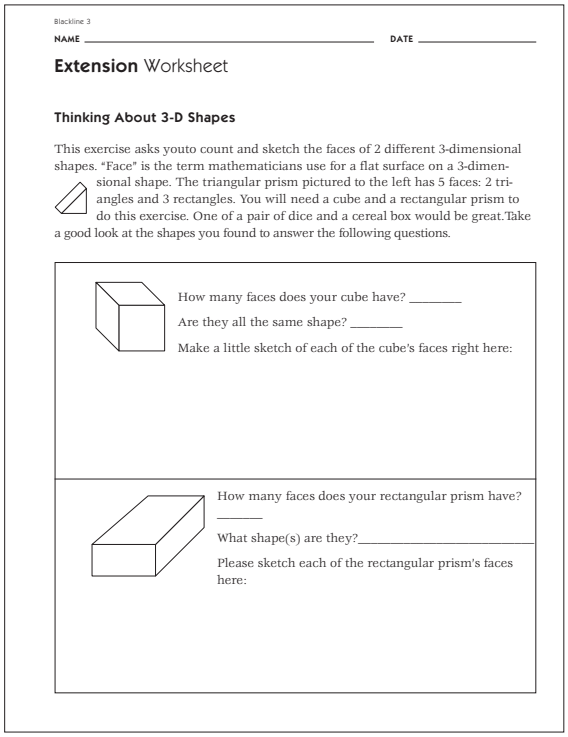
NAME _____ DATE _____

Extension Activity

3-D Shape Hunt

Have you ever thought about why things are the shape they are? Ever wondered why a cup is round and the rooms in most houses are square or rectangular instead of round? Why dice and ice are cube-shaped and why we eat ice cream out of cones instead of pyramids? Shapes are fun to find and fun to think about! This week, you're going to go on a 3-dimensional shape hunt. All you have to do is search around your house for things that are shaped like cubes, spheres, cylinders, and rectangular prisms (boxes), and list them below. Happy hunting!

Here are some things we found that are cylindrical:	Here are some things we found that are spherical:
Here are some things we found that are shaped like rectangular prisms:	Here are some things we found that are shaped like cubes:



Blackline 3

NAME _____ DATE _____

Extension Worksheet

Thinking About 3-D Shapes

This exercise asks youto count and sketch the faces of 2 different 3-dimensional shapes. "Face" is the term mathematicians use for a flat surface on a 3-dimensional shape. The triangular prism pictured to the left has 5 faces: 2 triangles and 3 rectangles. You will need a cube and a rectangular prism to do this exercise. One of a pair of dice and a cereal box would be great.Take a good look at the shapes you found to answer the following questions.

How many faces does your cube have? _____

Are they all the same shape? _____

Make a little sketch of each of the cube's faces right here:

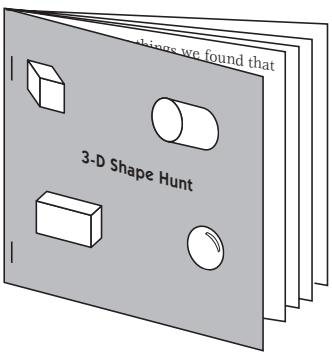
How many faces does your rectangular prism have? _____

What shape(s) are they?_____

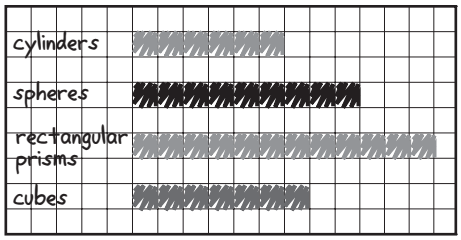
Please sketch each of the rectangular prism's faces here:

PORTFOLDER

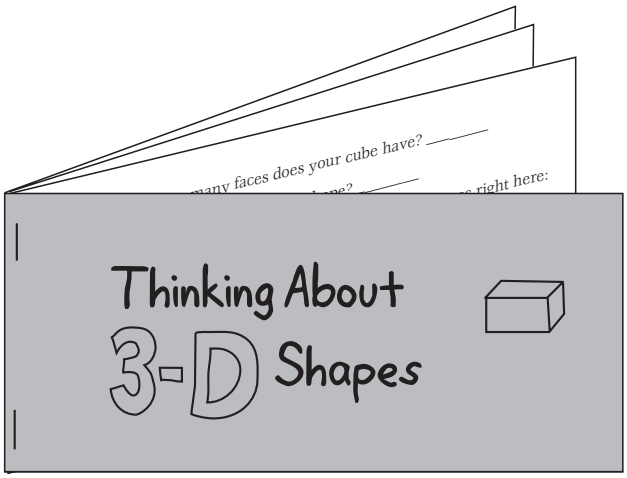
If you intend to make portfolders at the conclusion of the unit, cut the 3-D Shape Hunt activity into four small rectangles and staple them into a little book (see below). Children can record their information on the four pages: cylindrical, spherical, rectangular prism, and cubes.



Optional On a piece of graph paper, create a bar graph by recording how many of each shape were located. Label each bar. Cut the graph down to size and save for the portfolder.



To make a portfolder booklet from Thinking About 3-D Shapes, cut the worksheet into two sections, one on cubes and one on rectangular prisms. Make a mini-book of two pages (or increase to four pages if you want children to draw the shapes on another page) and staple the book together.

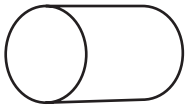
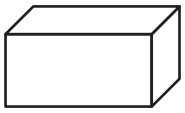
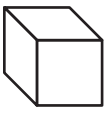


NAME _____ **DATE** _____

Extension Activity

3-D Shape Hunt

Have you ever thought about why things are the shape they are? Ever wondered why a cup is round and the rooms in most houses are square or rectangular instead of round? Why dice and ice are cube-shaped and why we eat ice cream out of cones instead of pyramids? Shapes are fun to find and fun to think about! This week, you're going to go on a 3-dimensional shape hunt. All you have to do is search around your house for things that are shaped like cubes, spheres, cylinders, and rectangular prisms (boxes), and list them below. Happy hunting!

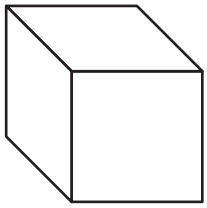
Here are some things we found that are cylindrical: 	Here are some things we found that are spherical: 
Here are some things we found that are shaped like rectangular prisms: 	Here are some things we found that are shaped like cubes: 

NAME _____ **DATE** _____

Extension Worksheet

Thinking About 3-D Shapes

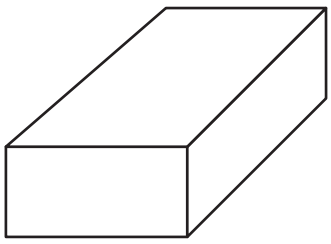
This exercise asks you to count and sketch the faces of 2 different 3-dimensional shapes. "Face" is the term mathematicians use for a flat surface on a 3-dimensional shape. The triangular prism pictured to the left has 5 faces: 2 triangles and 3 rectangles. You will need a cube and a rectangular prism to do this exercise. One of a pair of dice and a cereal box would be great. Take a good look at the shapes you found to answer the following questions.



How many faces does your cube have? _____

Are they all the same shape? _____

Make a little sketch of each of the cube's faces right here:



How many faces does your rectangular prism have? _____

What shape(s) are they?_____

Please sketch each of the rectangular prism's faces here:

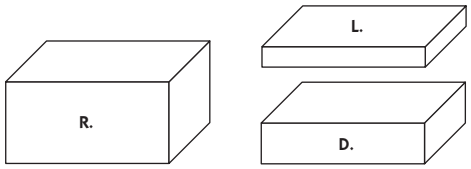
Session 3

PROBLEMS & INVESTIGATIONS

Faces of Mystery Guess My Block

Overview

The teacher reveals one face of a geoblock on a family sheet while children sort through their sets to find the blocks that match. The teacher then shows the other face(s) of the same block. With this additional information, the children work to eliminate all but the block that matches the one on the family sheet.



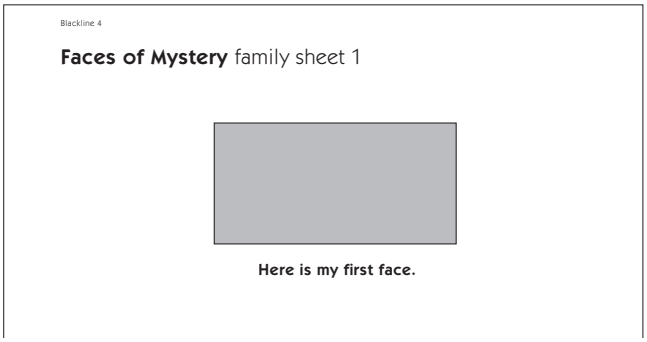
You'll need

- ★ Faces of Mystery family sheets 1–4 (Blacklines 4–7, 1 copy of each)
- ★ a half sheet of construction paper to mask the lower portion of the family sheets
- ★ a set of geoblocks for every 2 or 3 children in your class

Skills

- ★ observing and describing 3-dimensional shapes
- ★ exploring some of the relationships between 2- and 3-dimensional shapes
- ★ sorting
- ★ exploring the ideas of similarity and congruence

Have children arrange themselves in groups of two or three at their tables or on the rug and ask student helpers to distribute the sets of blocks—one set per group. Explain that you are going to give them clues, one at a time, that will help them identify a mystery block in their sets. Then show them the upper half of Faces of Mystery family sheet 1. Children will see one face of the first "mystery block." Ask them to sort through their sets to find the blocks that might match the one on the sheet. *If they want to set their blocks directly on the page to check for a match, that's fine.*

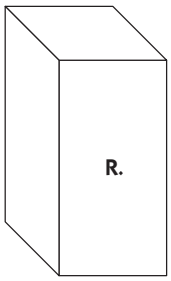

Blackline 4

Faces of Mystery family sheet 1

Here is my first face.

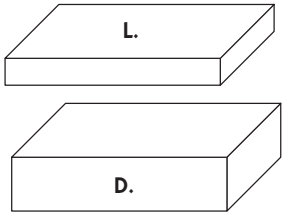
Session 3 Faces of Mystery (cont.)

Children *Oh, that's easy! I already know which block it is.*
It's the big rectangle one—that R block.
It's this one!



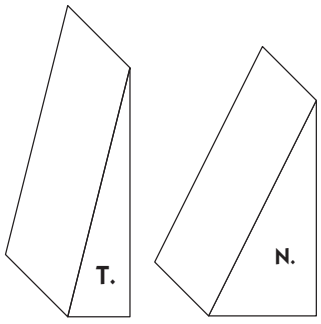
Teacher *Remember that I'm only showing you one face of the mystery block. Do you see any other blocks in your collection that have rectangular faces like this?*

Ciel *Yes! Blocks L and D have rectangles. They're both kind of like the big block. They're just skinnier.*



Teacher *Do you see anything else that might work?*

Children *Nope!*
That's it.
Hey, wait a minute. There are those 2 ramp blocks that have rectangles on them—the T block and the N block. It could be one of them.



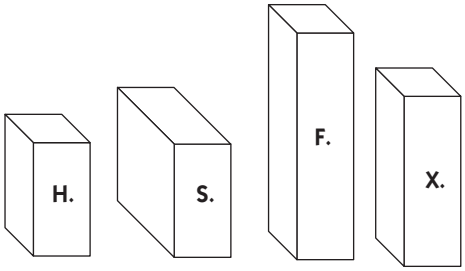
Teacher *How will you be able to tell which block it really is?*

Andrew *Can you show us the next clue?*

Teacher *Sure. I just want you to take one more look at your blocks. Does anyone see any other possibilities?*

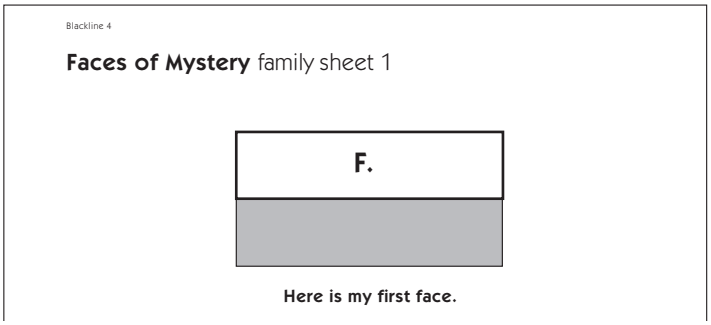
Session 3 Faces of Mystery (cont.)

Rob *There are some other blocks that have rectangles on them, but they look too small.*



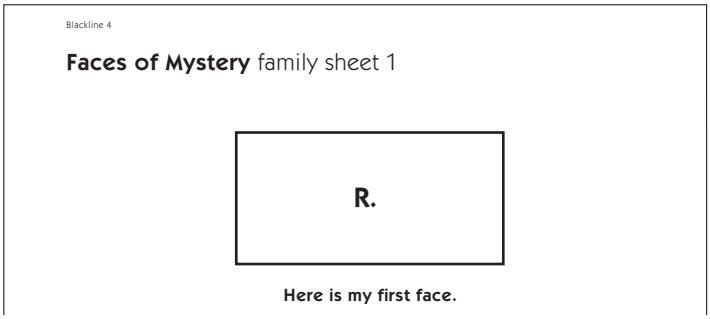
Jake *The rectangle on that F block looks too long and skinny. Can we set our blocks on the sheet to check which ones really fit?*

Teacher *Sure!*



Rob *The F block really is too skinny.*

Gavin *What about the R block? Does it really fit?*



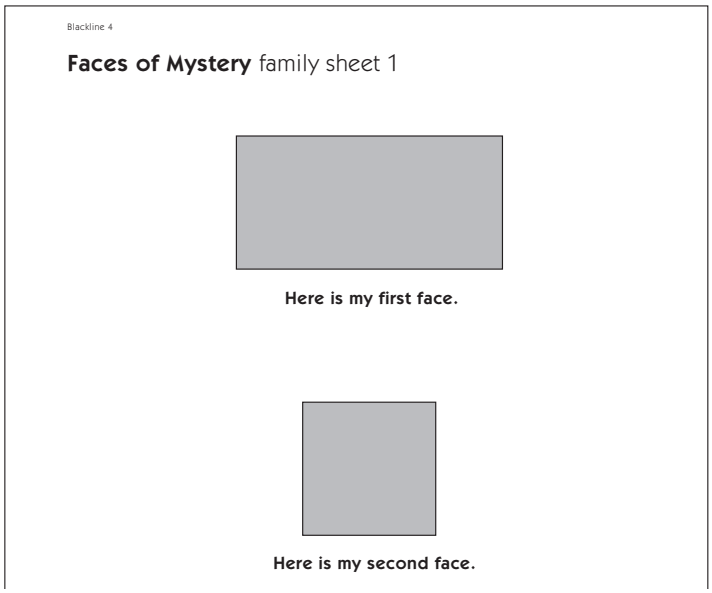
McCall *It's perfect. That must be the mystery block.*

Andrew *But we won't know for sure until he shows us the other clues.*

Once children have had a good look at the first face on sheet 1 and a chance to identify some of the blocks in their own sets that might possibly match the mystery block, show them the next clue. The more discussion and speculation you encourage, the more carefully children will examine their blocks, checking for size and face shapes. As they work, they will begin to spot more relationships among the blocks themselves, noting, for instance, that some of

Session 3 Faces of Mystery (cont.)

the faces are half the size of others. They will also become more aware of how many different blocks have congruent faces.



Children *Yes!*
Now we know for sure that it's R.
That's what I thought all along.
I knew it wasn't one of those others.

Teacher *How do you know it's R for sure?*

Hiroki *R is the only one with a rectangle and a square for faces.*

Teacher *Well, let me get really tricky. What if there was a third clue?*

Children *What do you mean?*
Oh, I get it. Look at the N block. It has a rectangle, a square, and a triangle. Is there another clue?

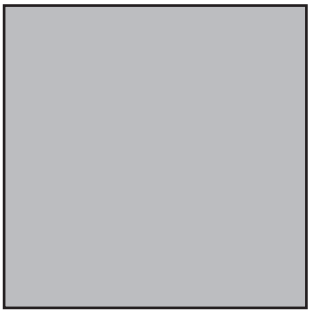
Teacher *Nope. That's it. This mystery block only has 2 kinds of faces—rectangles and squares.*

Children *Then it has to be the R block.*

When children are sure they've identified the block correctly, show the last line on the sheet. There are three more sheets in the set. Depending on the level of interest among your students, work your way through all of the others, or save one or two for future sessions.

Faces of Mystery family sheet 1

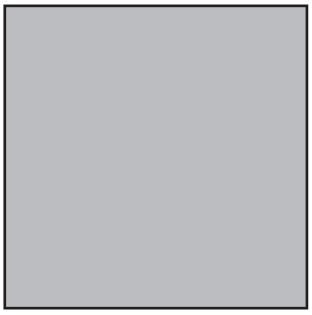
Here is my first face.



Here is my second face.

I am Block R.

Faces of Mystery family sheet 2



Here is my first face.

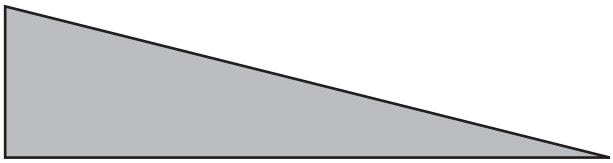
Here is my second face.

I am Block S.

Faces of Mystery family sheet 3

Here is my first face.

Here is my second face.



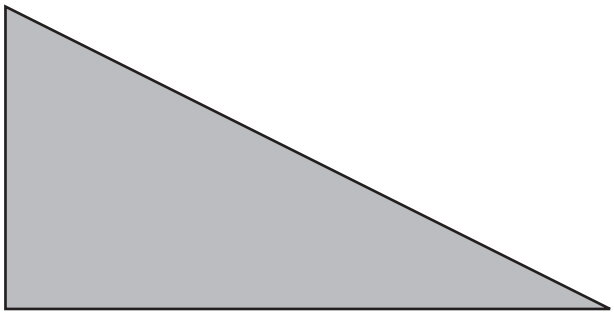
Here is my third face.

I am Block T.

Faces of Mystery family sheet 4

Here is my first face.

Here is my second face.



Here is my third face.

Here is my fourth face.

I am Block V.

Session 4

INDEPENDENT PRACTICE

Faces of Mystery

Students will need

★ geoblocks

★ Faces of Mystery sheets 1–4 (Blacklines 8–11, run 1 copy of each for each student)

Skills

★ observing and describing 3-dimensional shapes

★ exploring some of the relationships between 2- and 3-dimensional shapes

★ sorting

★ exploring the ideas of similarity and congruence

Give each child a copy of Faces of Mystery sheets 1–4. Please note that these are the sheets with two to three mysteries per page as opposed to the Faces of Mystery family sheets that only have one mystery per page.

Children may cut out and solve the mysteries. If you want to be able to refer to the answer key, have children label the cards "sheet 1," "sheet 2," and so on. The answer key uses sheet number as well as box number to record the correct answers.

Independent Practice Instructions

1. Choose a sheet from the folder and spread out a set of geoblocks where you can see them easily.

2. Take a good look at the faces shown on the sheet. Can you find the block in the set that matches all of the faces shown? Take a good look through the collection of blocks. When you think you've found the mystery block, test it by setting it directly on the paper to see if it fits. Don't forget to test all of the faces!

3. When you're positive you've found the right block, record the letter on the answer line. Repeat until you've figured out all the blocks on the sheet. (Some of the sheets have 2 and some have 3 mystery blocks.)

Session 4 Faces of Mystery (cont.)

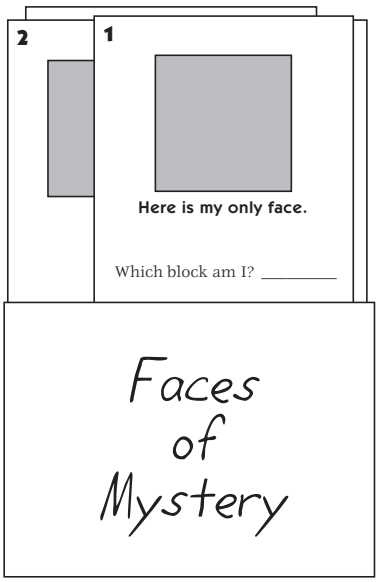
Here is the answer key for the four sheets:

Answer Key for Faces of Mystery Sheets

Sheet 1	**Sheet 3**
Box 1: B	Box 1: I
Box 2: D	Box 2: X
Box 3: H	Box 3: J
Sheet 2	**Sheet 4**
Box 1: A	Box 1: U
Box 2: M	Box 2: W
Box 3: F	

PORTFOLDER

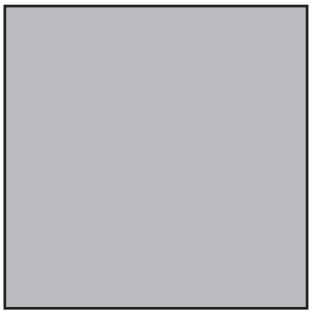
Seal a business envelope, cut in half width-wise, and store the Faces of Mystery cards in the pocket. (Save the other envelope section for a later project or use with another child.) If you want to reuse the cards, have children record their answers lightly in pencil on the back of each card. Students may then return to their portfolders, take out the geoblocks, and try the mysteries again and again.



NAME _____ DATE _____

Faces of Mystery sheet 1

1



Here is my only face.

Which block am I? _____

2

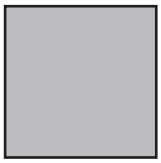
Here is my first face.

Here is my second face.

Here is my third face.

Which block am I? _____

3



Here is my first face.

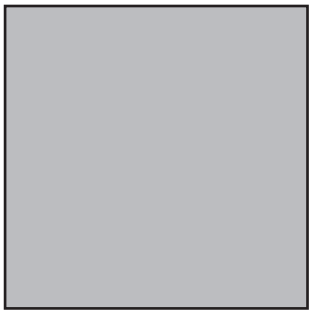
Here is my second face.

Which block am I? _____

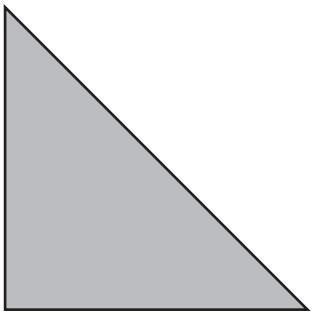
NAME _____ DATE _____

Faces of Mystery sheet 2

1



Here is my first face.

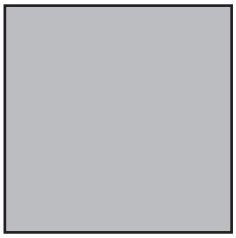


Here is my second face.

Here is my third face.

Which block am I? _____

2

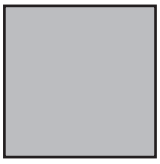


Here is my only face.

Which block am I? _____

3

Here is my first face.



Here is my second face.

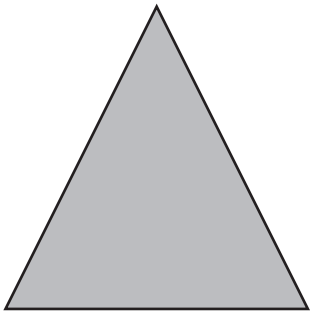
Which block am I? _____

NAME _____ DATE _____

Faces of Mystery sheet 3

1

Here is my first face.

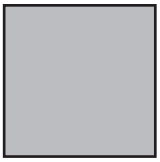


Here is my second face.

Here is my third face.

Which block am I? _____

2

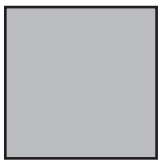


Here is my first face.

Here is my second face.

Which block am I? _____

3



Here is my only face.

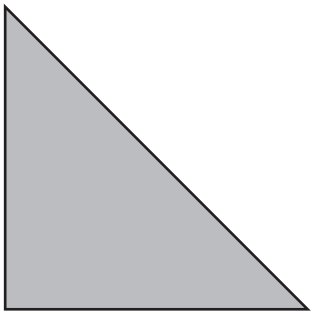
Which block am I? _____

NAME _____ DATE _____

Faces of Mystery sheet 4

1

Here is my first face.



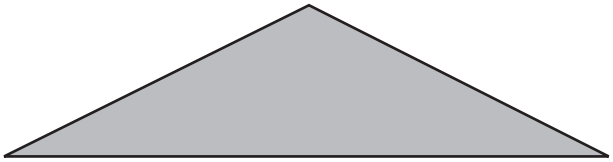
Here is my second face.

Here is my third face.

Which block am I? _____

2

Here is my first face.



Here is my second face.

Here is my third face.

Which block am I? _____

Session 5

INDEPENDENT PRACTICE

How Can You Build It?

Students will need

★ geoblocks (2 sets are helpful but not required)

★ How Can You Build It? sheets 1–4 (Blacklines 12–15, run 1 copy of each for every student)

Skills

★ combining shapes to make other shapes

★ exploring similarity and congruence

As a family, work through sheet 1, block B. Answers will range from the very basic (S + S = B) to the very advanced. Encourage older children to expand their thinking to more complex combinations.

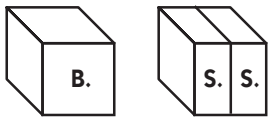
After students understand the assignment, allow them to work on ways to build other blocks. Challenge younger children to find a minimum of four ways to make each block. Encourage older children to make longer lists. This is a more challenging assignment and you may wish to limit the activity to one sheet per day.

Independent Practice Instructions

1. Choose one of the four building sheets (see the next page).

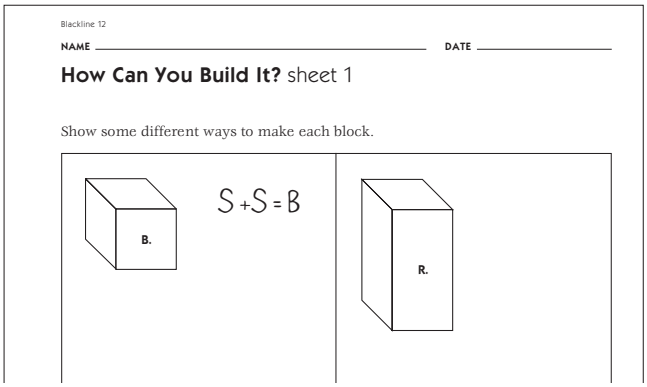
2. Find the first block pictured and set it in front of you.

3. Find some other blocks that you can put together to replicate the size and shape of the first block. You will be combining other blocks to make a shape that is congruent to the first. Here is an example: you can place 2 S blocks side by side or stack them on top of each other to make a shape that is just the same as, or congruent to, the B block.



Once you find a way to build the first block with other blocks, find a way to record your discovery in the appropriate box on your sheet.

Session 5 How Can You Build It? (cont.)


Blackline 12

NAME _____ DATE _____

How Can You Build It? sheet 1

Show some different ways to make each block.

B.

S + S = B

R.

4. There are many, many ways to build each block shown on the four sheets. See if you can record at least four or five different ways for each block on the sheet you choose. You may have to experiment a bit to come up with ideas once you're past the first two or three, but that's part of the fun!

Instructional Considerations

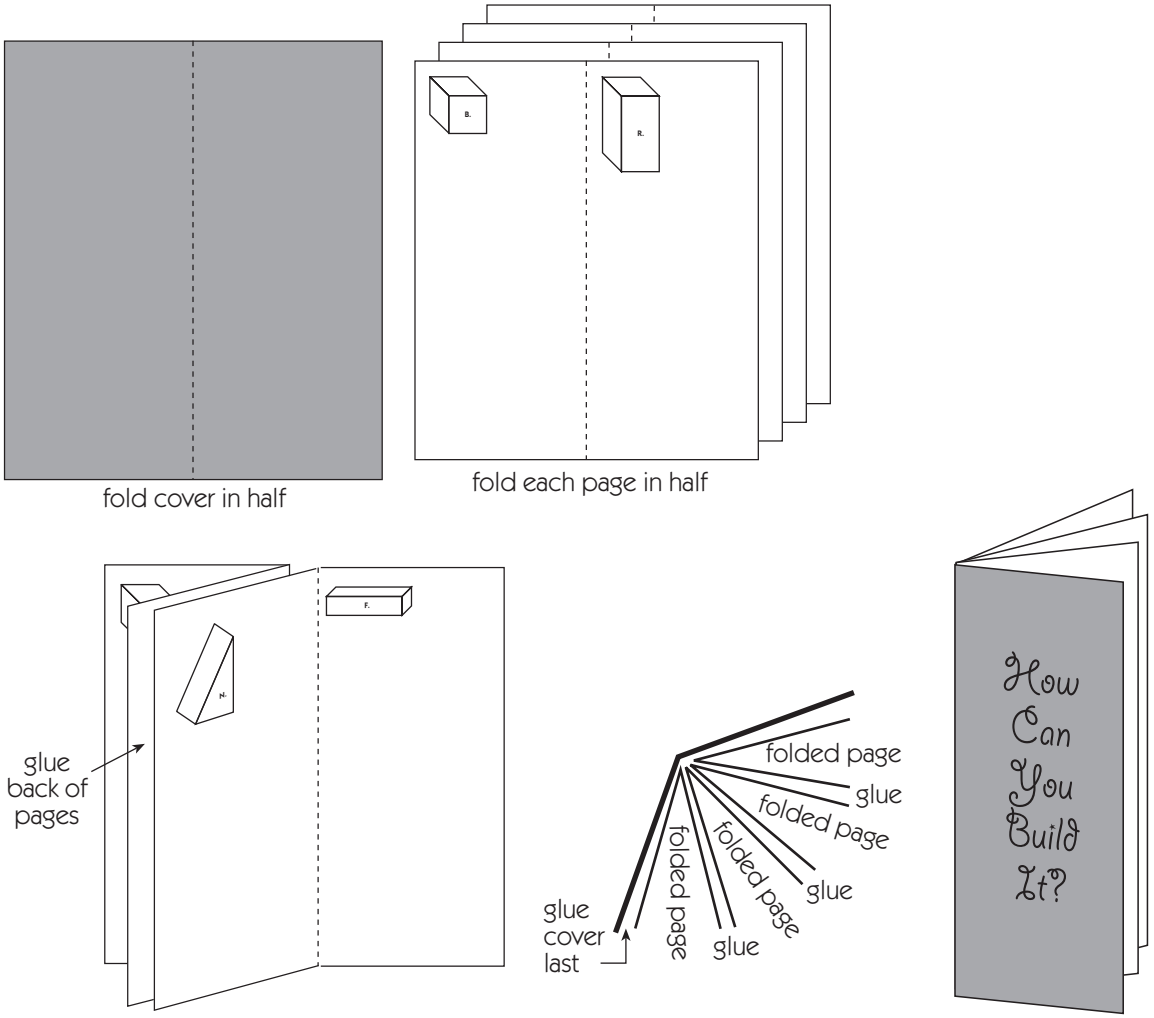
This Work Place can be very exciting, especially if you encourage children to persevere and think beyond the obvious. While some students will draw or trace the blocks to show their discoveries, others may prefer to use letters Here's a list of some of the solutions and notation methods we've seen students use as they tried to find block combinations for cube B.

S + S = B	U + U + S = B	U + U + U + U = B
4U = B	2H + S = B	4H = B
8J = B	4J + S = B	K + K + K + K = B
R ÷ 2 = B	8C = B	S + 4C = B

The assignment need not end with the completion of sheet 4. Challenge students to come up with combinations for other blocks. Older children will find ways to build blocks such as "E," in which they need to use fractions or division.

PORTFOLDER

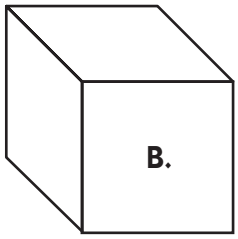
Cut around the outside perimeter line on each "Can You Build It?" sheet. *Do not cut down the center line*! Fold each page in half along the center line. Glue the back of the right side of page 1 to the back of the left side of page 2. Continue in this manner until all the pages have been glued together into a little book as shown below.

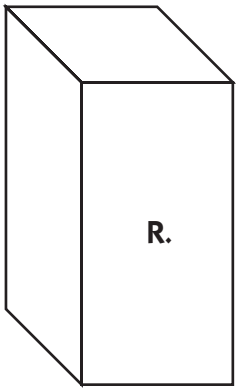


NAME _____ DATE _____

How Can You Build It? sheet 1

Show some different ways to make each block.

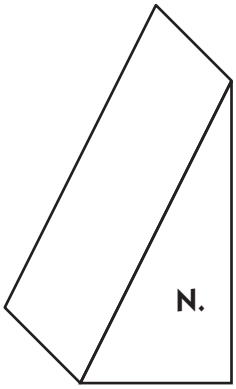


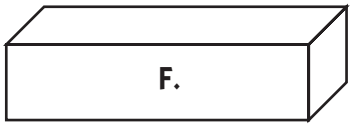


NAME _____ DATE _____

How Can You Build It? sheet 2

Show some different ways to make each block.

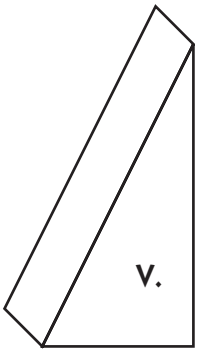


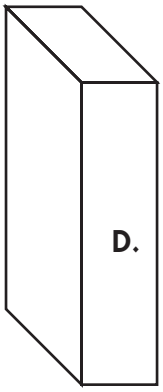


NAME _____ DATE _____

How Can You Build It? sheet 3

Show some different ways to make each block.

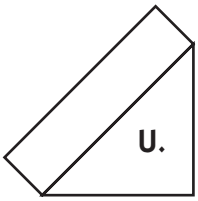


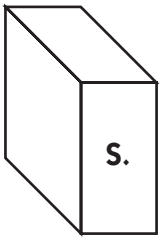


NAME _____ DATE _____

How Can You Build It? sheet 4

Show some different ways to make each block.





Session 6

INDEPENDENT PRACTICE

Geoblock Architecture

Students will need

★ geoblocks

★ Geoblock Architecture Cards (Blacklines 16–32; Slip the geoblock architecture cards into plastic sheet protectors and store in a 3-ring binder, preserving pages and allowing students to return to the activity again)

★ 4″ × 6″ blank cards

Skills

★ observing and describing 3-dimensional shapes

★ exploring some of the relationships between 2- and 3-dimensional shapes

★ exploring relationships among 3-dimensional shapes

★ building structures using top and side-view plans

Independent Practice Instructions

1. Choose one of the architecture cards and spread out a set of geoblocks where you can see them easily.

2. Take a good look at the drawings on the card. Each one shows a structure made of geoblocks drawn from the side and from the top. Working from these plans, can you build the structure with geoblocks?

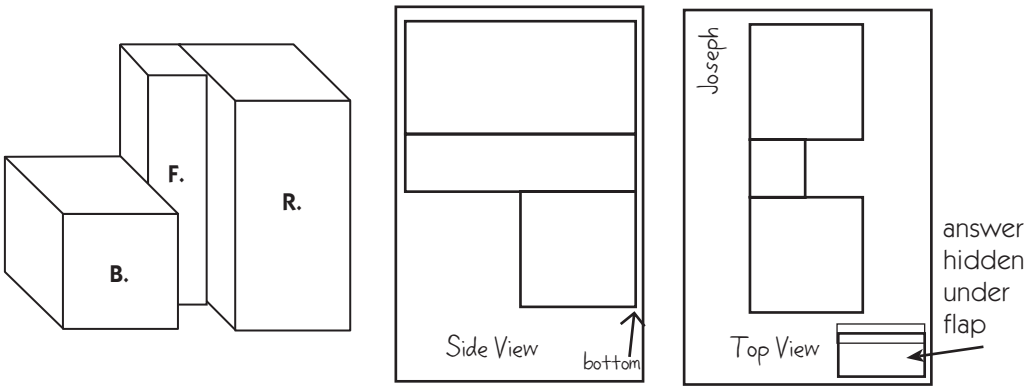
3. When you think you've built the structure pictured on the card, check it with someone else who is working at this activity to see if he or she agrees with you.

4. Build at least 4 of the structures shown on the cards while you're here. If you work with other students, you might be able to create a whole geoblock city.

Instructional Considerations

After students have built several geoblock architecture structures, provide them with opportunities to build their own, starting with simple three block designs and progressing to more complex designs, perhaps with four or more blocks. Students should record their designs; 4″ × 6″ blank index cards work well. If the side and top views do not fit on one side, put one view on the back. Be sure to also have students note which blocks were used, either on the back or under an answer flap. Collect the cards in an envelope or basket for others to construct.

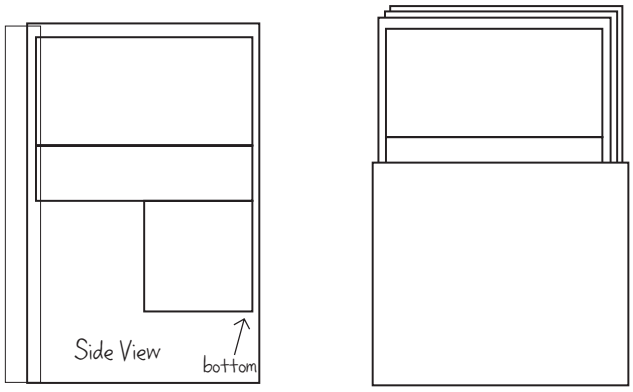
Session 6 Geoblock Architecture (cont.)



3-D recorded design

PORTFOLDER

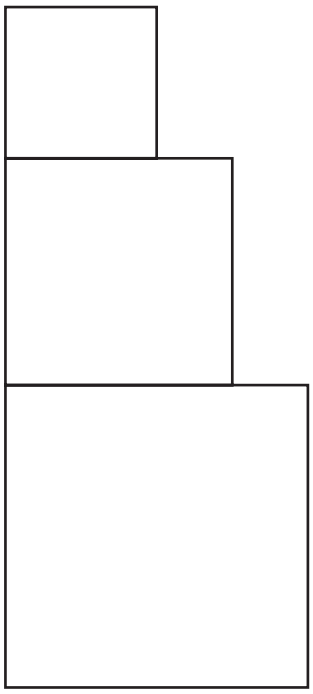
Collect the child's own geoblock architecture cards. If a child makes only one card, tape it into the portfolder along one edge (like a hinge) so that the back of the card might be viewed. If the child makes several cards, slip them into a pocket so they may be taken out and used again and again.



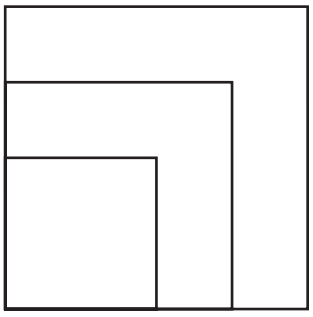
single card can be taped onto the portfolder

make a pocket if there are several cards, glue pocket onto portfolder

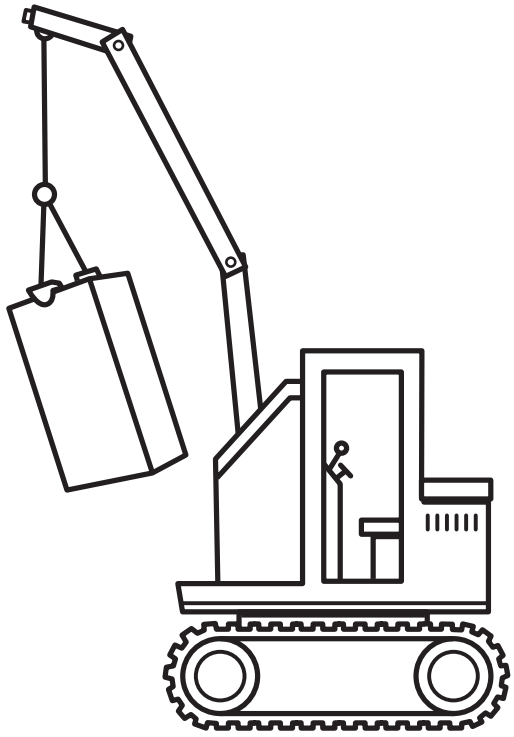
Geoblock Architecture Card 1



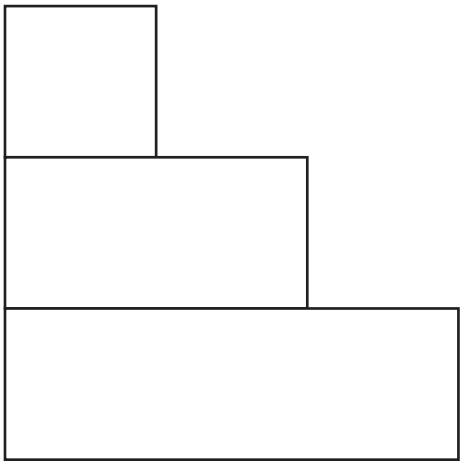
Side View



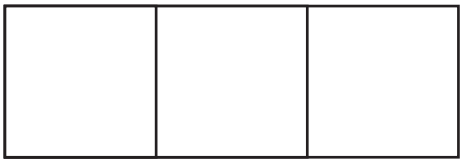
Top View



Geoblock Architecture Card 2

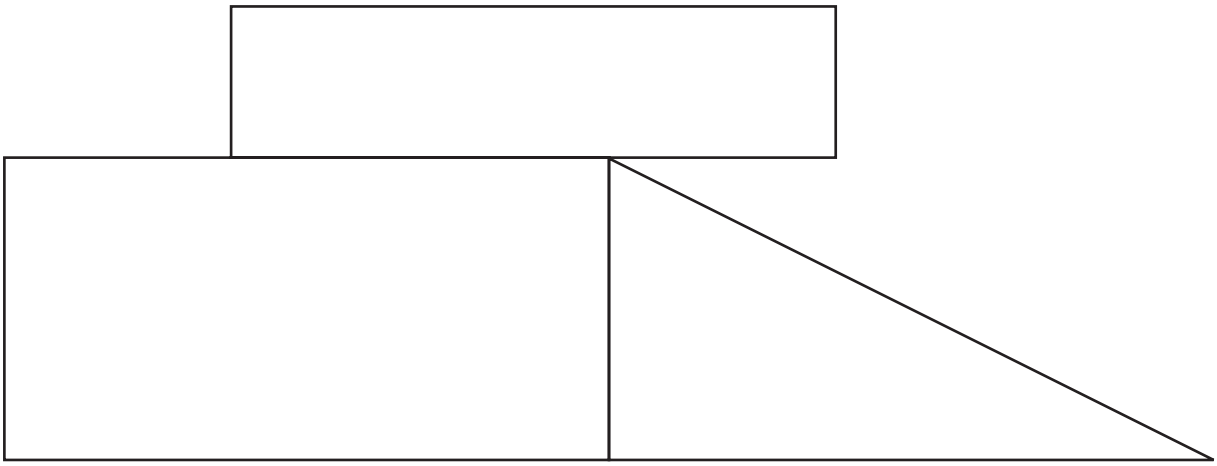


Side View

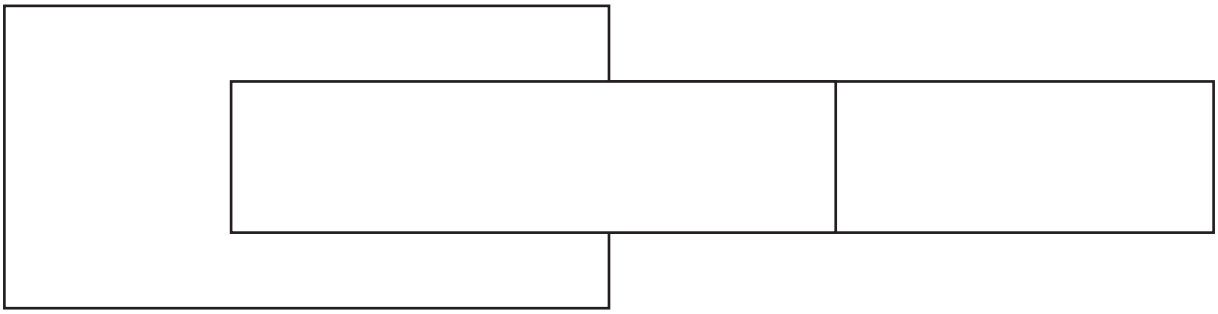


Top View

Geoblock Architecture Card 3

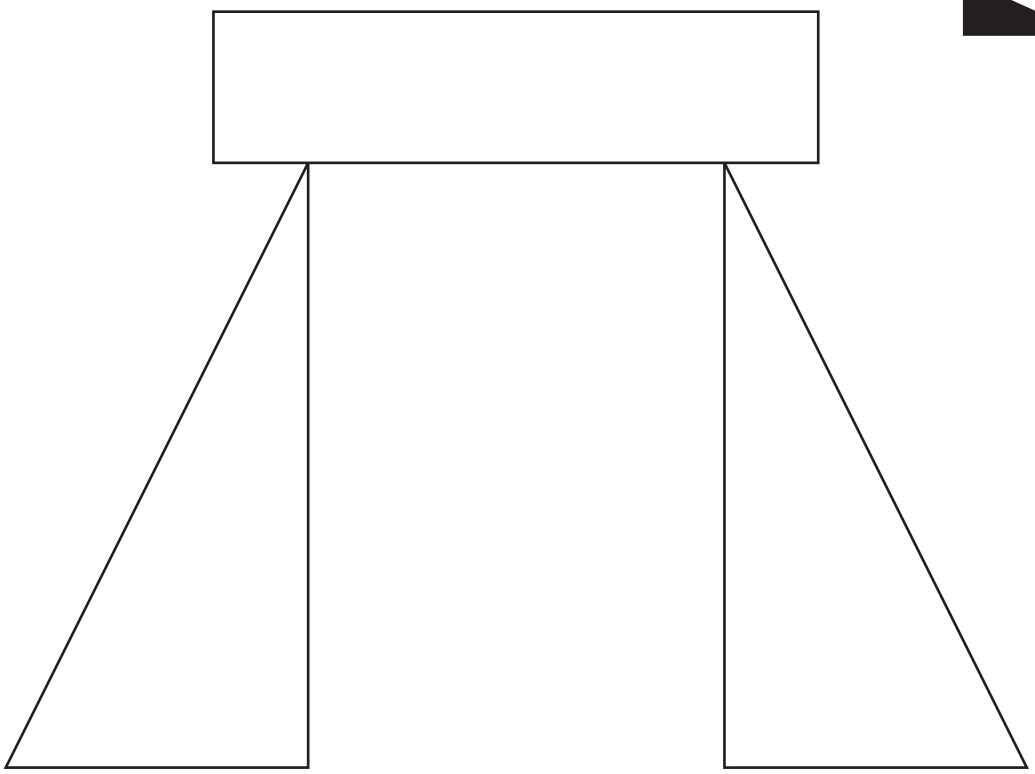


Side View

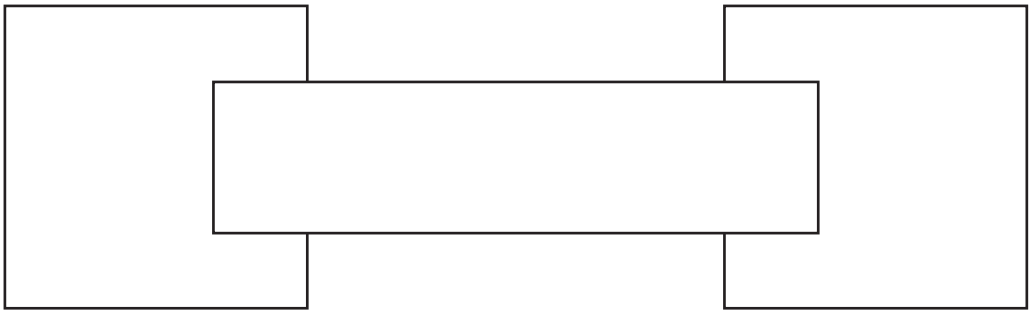


Top View

Geoblock Architecture Card 4

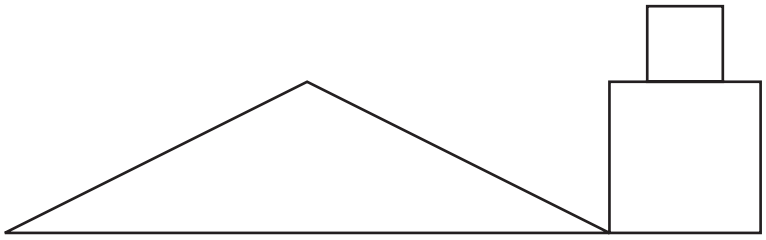


Side View



Top View

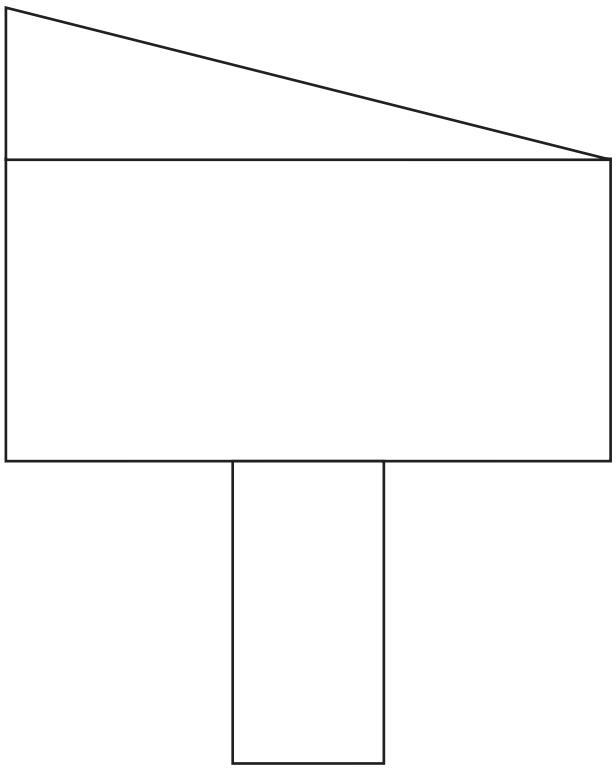
Geoblock Architecture Card 5



Side View

Top View

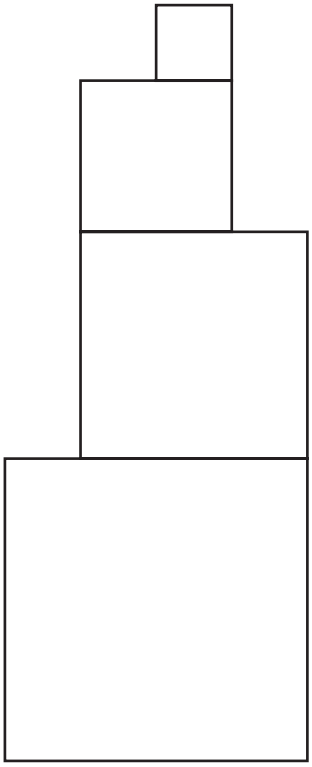
Geoblock Architecture Card 6



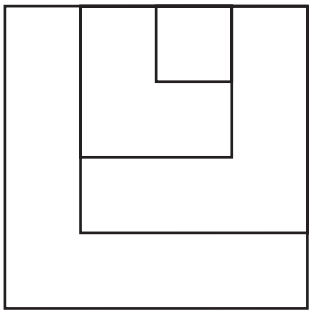
Side View

Top View

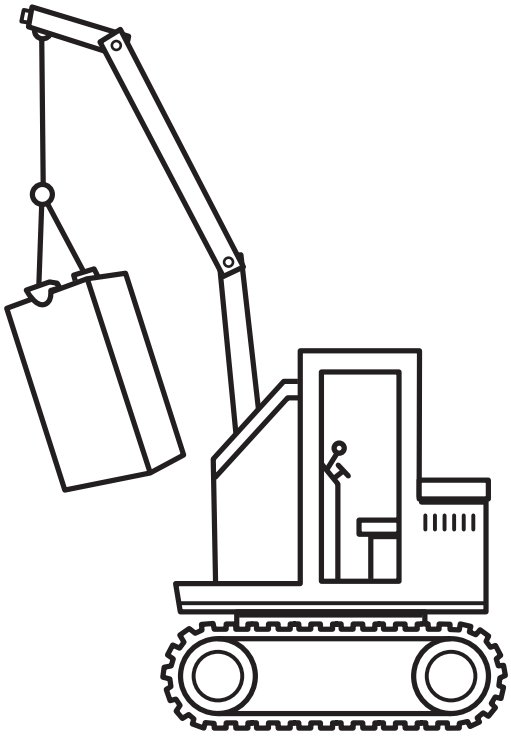
Geoblock Architecture Card 7



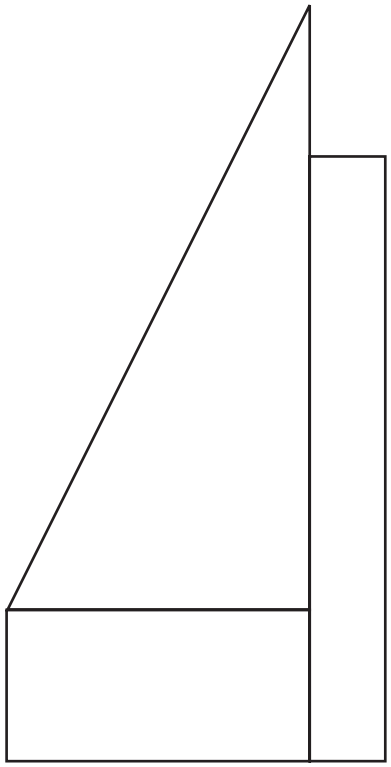
Side View



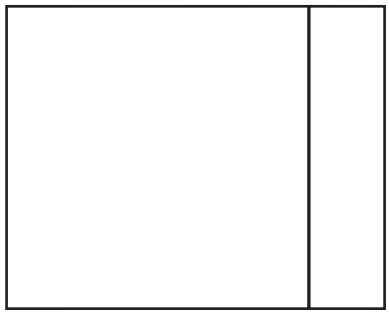
Top View



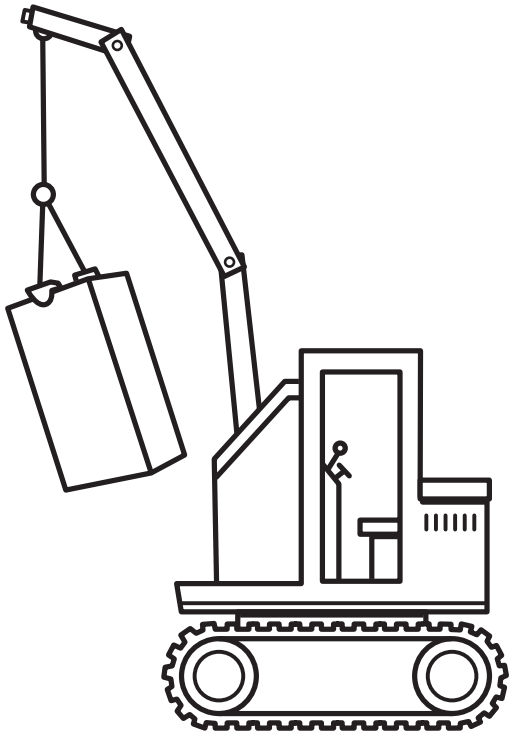
Geoblock Architecture Card 8



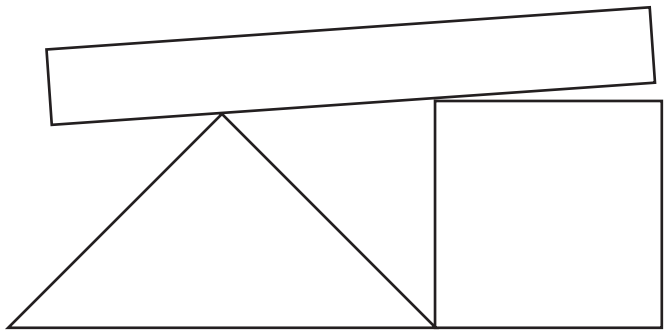
Side View



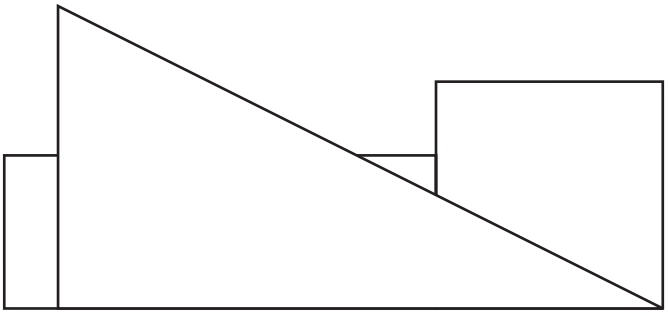
Top View



Geoblock Architecture Card 9

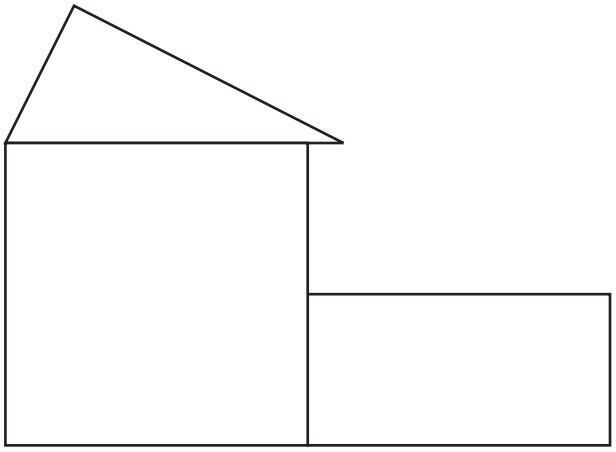


Side View

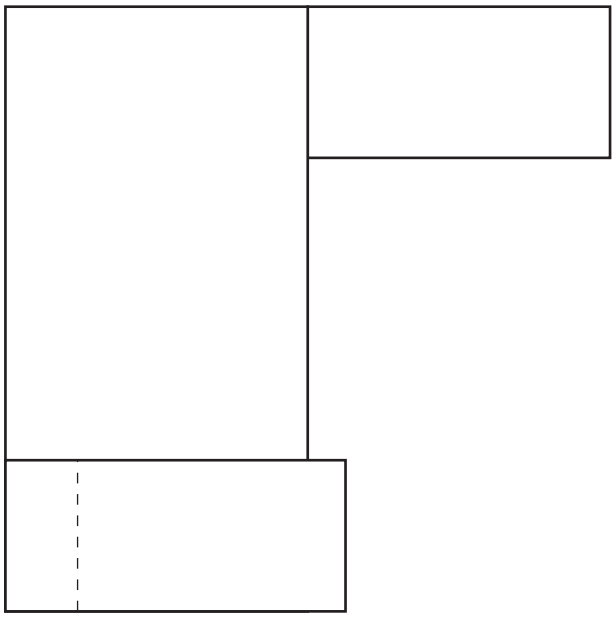


Top View

Geoblock Architecture Card 10

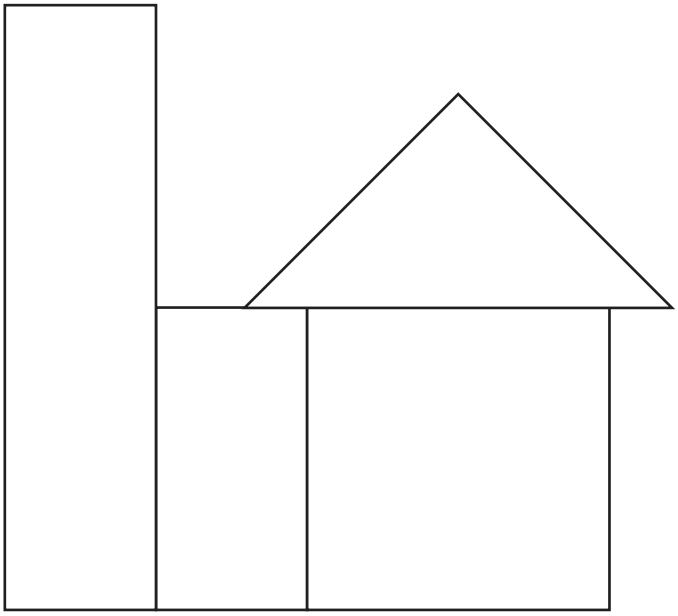


Side View

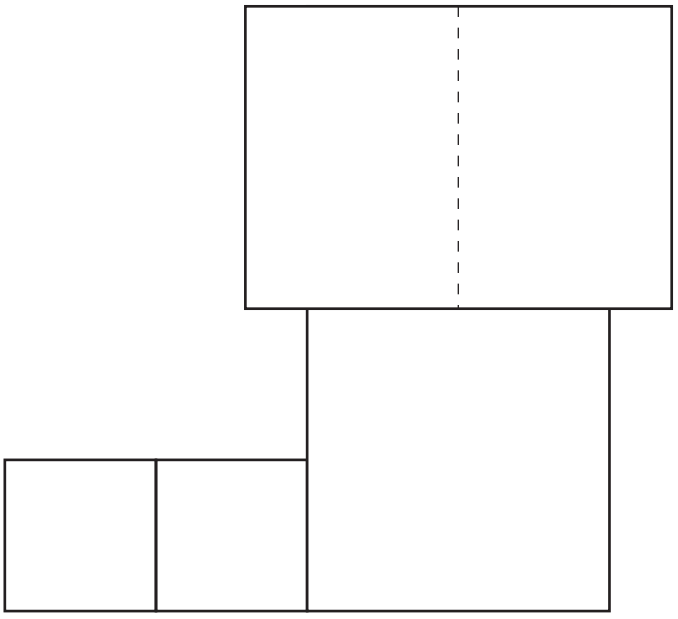


Top View

Geoblock Architecture Card 11

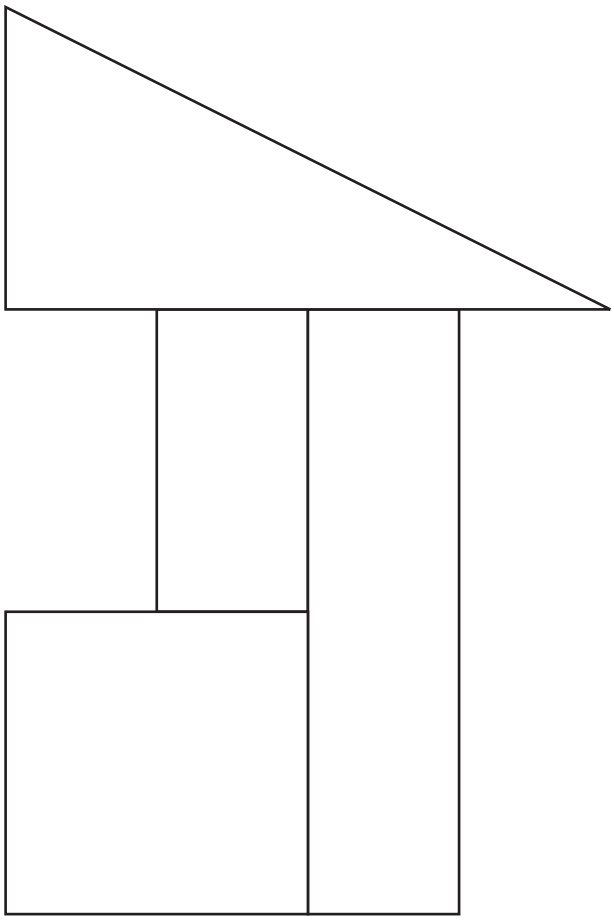


Side View

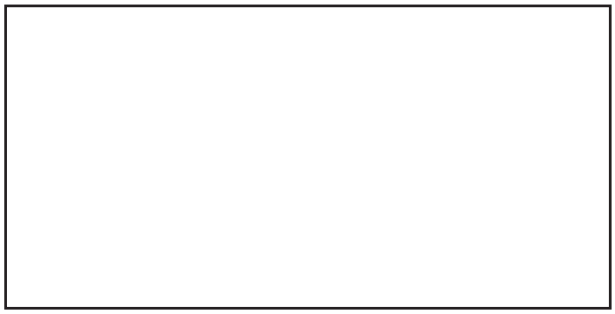


Top View

Geoblock Architecture Card 12

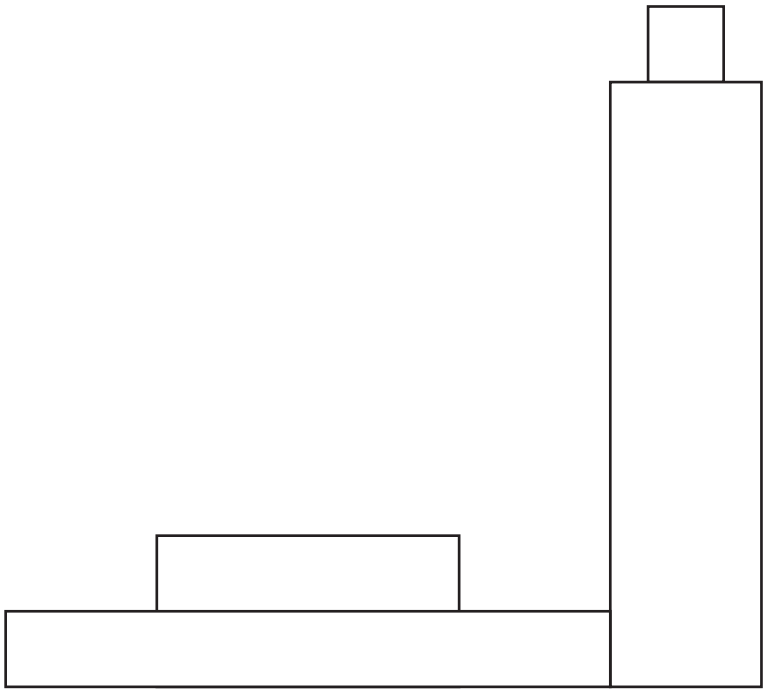


Side View

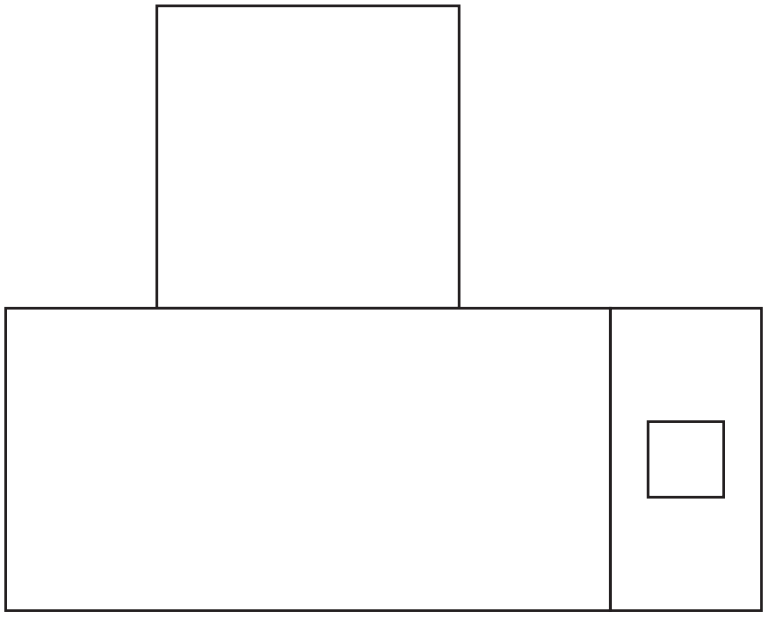


Top View

Geoblock Architecture Card 13

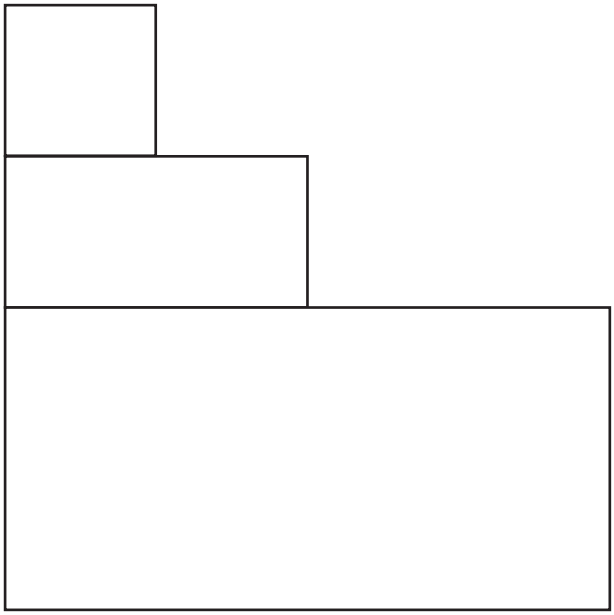


Side View

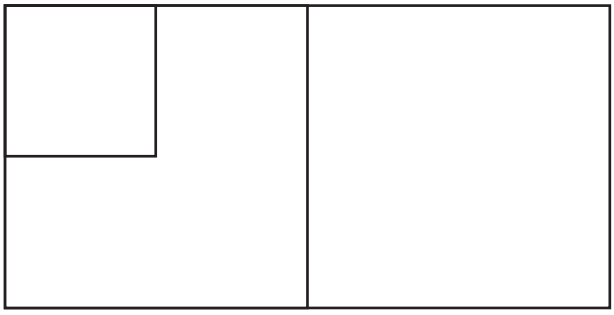


Top View

Geoblock Architecture Card 14

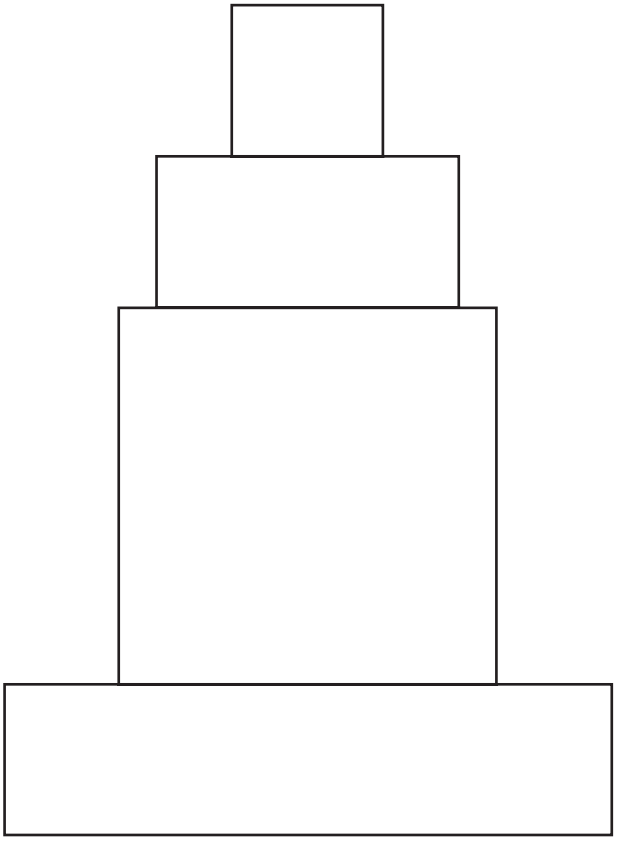


Side View

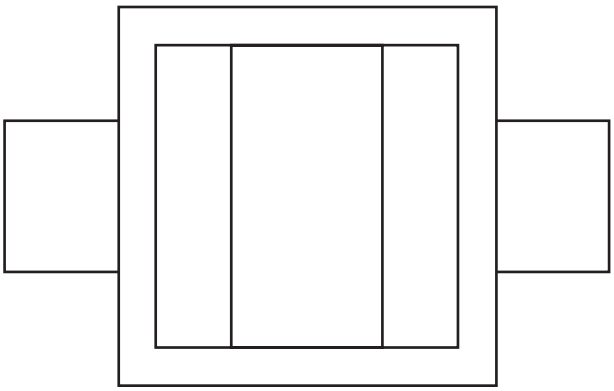


Top View

Geoblock Architecture Card 15

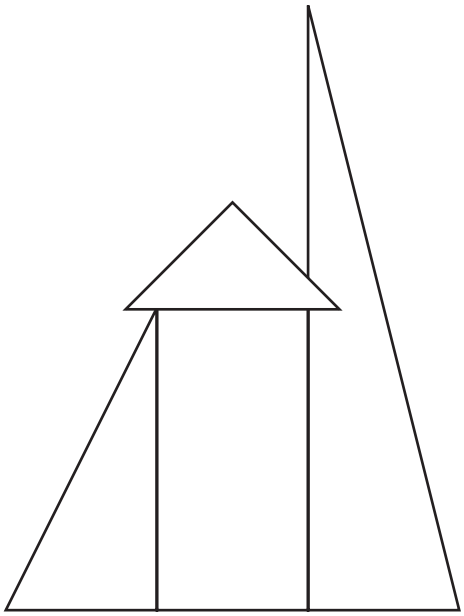


Side View

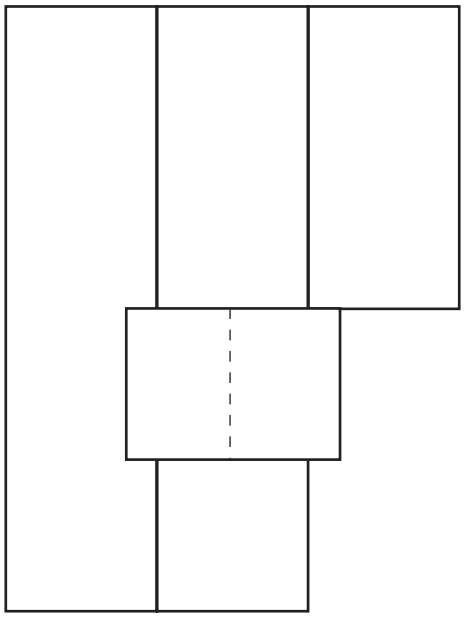


Top View

Geoblock Architecture Card 16

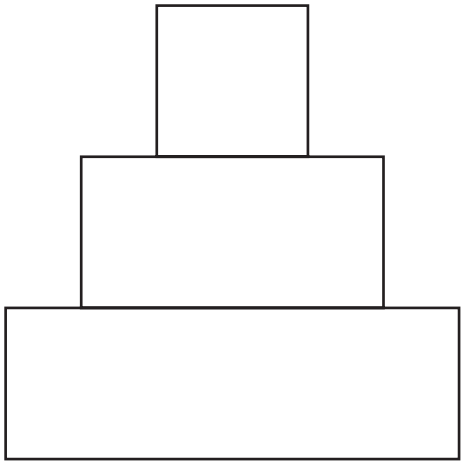


Side View

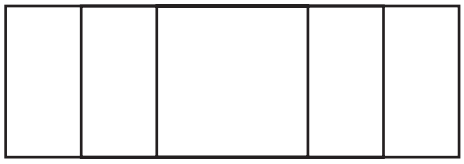


Top View

Geoblock Architecture Card 17



Side View



Top View