BLUEPRINTS

GEOMETRY • LOGIC

- Spatial visualization
- Transformational geometry

Getting Ready

What You'll Need

Cuisenaire Rods, 1 set per pair

1-centimeter grid paper, page 99

Transparent tape and/or glue sticks

3" x 5" cards onto which 1-centimeter grid paper has been glued, 2 per pair

Large books or folders to act as barriers

Overhead Cuisenaire Rods and/or 1-centimeter grid paper transparency (optional)

Overview

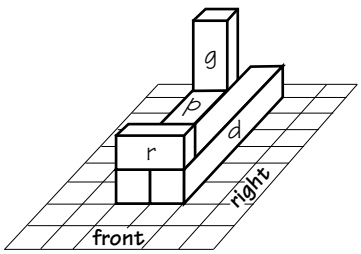
Children build structures with Cuisenaire Rods and draw the different two-dimensional views of each—front, back, left, right, top, and bottom. Then they reverse the process by using one another's drawings to build matching structures. In this activity, children have the opportunity to:

- draw a three-dimensional figure in two dimensions
- interpret two-dimensional drawings to create a three-dimensional figure

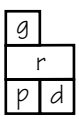
The Activity

Make sure that the parts of the rods in the structure that touch are multiples of one square centimeter.

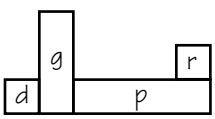
Introducing



- Show children this Cuisenaire Rod structure attached to a 3" x 5" card.
- Help children identify the six possible views (front, back, left, right, top, and bottom).
- Point out that each view of your structure can be drawn on grid paper.
- On the grid, draw the two views of the structure shown below in colors that match the rods.
- Display the two views and ask children to determine which two of the six possible views are shown.
- Verify that View A is the front of the structure and View B is the left.



View A

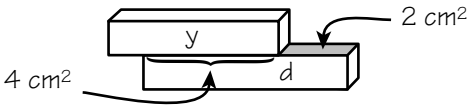


View B

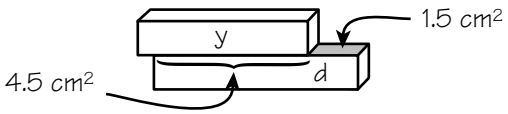
On Their Own

How can you use drawings of a Cuisenaire structure to build it?

- Work with a partner. Each of you should secretly build a structure with up to 6 Cuisenaire Rods.
- Follow these rules when building your structure:
  - The rods should be taped or glued together so that the structure is in 1 piece. Each rod must touch at least 1 other rod.
  - Where the rods are joined, they must touch along 1 or more whole square centimeters (cm^2).



Okay



Not okay

- Attach your structure to a card covered with 1-centimeter grid paper. Make sure that the rods on the bottom of your structure lie within the grid lines. Decide which side of your structure is the front.
- Draw and color all 6 views of your structure on grid paper. Label each view as *front, back, top, bottom, right,* and *left.*
- Exchange drawings with your partner. Use your partner's drawings to try to build an exact copy of your partner's hidden structure.
- Compare and discuss the structure you built from your partner's drawings.

The Bigger Picture

Thinking and Sharing

Invite children to display their structures and related drawings. Have them explain how their own drawings show different views of their structures.

Use prompts such as these to promote class discussion:

- What was hard about building structures? about drawing structures? How did you solve these problems?
- What are some good ways to re-create structures from drawings?
- When you re-created structures, which views were more helpful than others? Why?
- Was the structure you built from the drawings different from the original? Why? What needs to be changed to make them match?

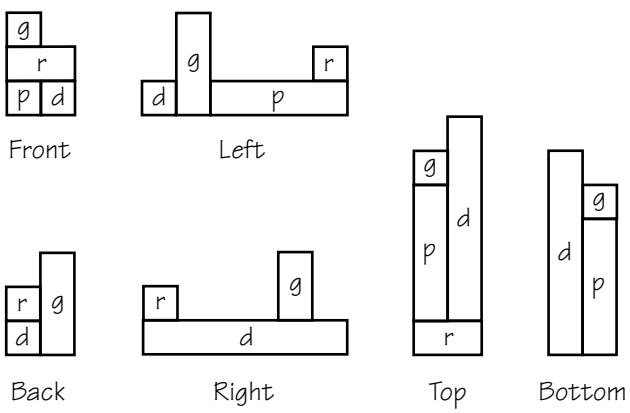
- Did your structure match your partner's drawings but not your partner's structure? Why?
- What might you do differently if you build and draw structures again?

Teacher Talk

Where's the Mathematics?

The skills used in *Blueprints* are important in our three-dimensional world where objects are commonly recorded in two dimensions in diagrams, floor plans, and maps. Such skills, however, are often not easy for children to develop. Many opportunities to work through problems of visualization and interpretation are necessary if children are to gain a useful level of proficiency.

Most children will find the drawing phase easier than the building phase. This is because while drawing, they can refer to and manipulate their structure as often as necessary to confirm and revise their work. Some children may have trouble holding structures in a way that allows them to see a single view plainly. Suggest that they place the structure on a flat surface and then bend down until they are eye level with the structure so that they see only the square or rectangular faces of rods nearest to the eye. The view from the bottom may be the hardest to draw because the card obstructs the view. Here are the six views of the structure given in the *Introducing* activity:



When starting to construct from drawings, most children will first identify the rods used in the hidden structure by matching rod colors with the colors on the drawings. Many will then study the structure from the bottom up, determining which rods are used in the base and how they are attached before considering other views and how they influence upper layers of the

Extending the Activity

1. Have children build and draw views of Cuisenaire Rod structures using any number of rods they choose.
2. Have children repeat the activity with a new structure, this time without using colors in their drawings.

structure. Another approach children may take is to study the dimensions of the structure in its tallest, widest, and longest views. Children who do this realize that any structure they make cannot possibly match the original if it exceeds these dimensions.

However children approach the problem of building from drawings, successful strategies must be based on creating rod configurations suggested by one or more views and checking the accuracy of those configurations by making sure they are consistent with all the other views. Taking that job on all at once may be very difficult for some children. Those who organize their work by working from the bottom up or by focusing on how rods are attached two at a time may make smoother progress.

Children are accustomed to looking at real-world objects, such as houses, from their sides. This may explain why many children will find side views (front, back, left, right) easy to interpret. They may also notice that the outlines of opposite views of structures often "mirror" one another, making the appearance of a side easier to figure out once they are sure how its opposite side looks.

Without colored drawings, this activity would be very difficult for many children. Using color gives some added opportunities for interpretation. Some children will recognize that a single square of color can only be interpreted as the end of a rod or part of a rod face that is blocked from view by another rod. Other children will expand on this idea and realize that whenever a color appears in a length shorter than the length of the corresponding rod, (for example, seeing only three square centimeters of purple) then part of that rod is blocked by another rod. Looking at other views can confirm this. When a color appears in a length greater than the length of the corresponding rod, then children may see that more than one rod of that color must have been used in the structure.

If you want to make the activity easier, you can have children use fewer rods, have the the whole class work with exactly the same rods, or tell children that rods used in structures must all be of different colors.

1-CENTIMETER GRID PAPER