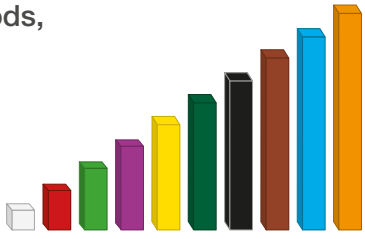
Rod Stamping

OBJECTIVE

Children will explore surface area and use spatial reasoning to make predictions about the surface area of any size rod.

WHAT YOU WILL NEED

Cuisenaire Rods,
1 set per pair



Ink pad (optional for *Introduction*)

OVERVIEW

In this activity, children pretend to "stamp" Cuisenaire Rods with "glow-in-the-dark" ink. Then they look for patterns in the data they collect.

THE BIG IDEA

Rod Stamping provides children with the opportunity to explore *surface area* before encountering a formal mathematical definition or formula. As they manipulate the rods, children intuitively learn that surface area is the "covering" of all sides, including the ends, of a rectangular prism.

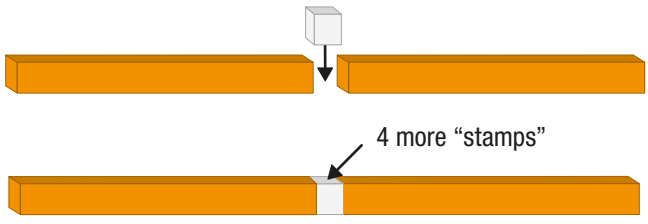
Children usually begin by selecting a rod, then counting the stamps as they move a white rod around the surfaces of their chosen rod. Before long, many notice that (a) each rod has four sides, each the same length, and requires the same number of stamps, and (b) each rod has two sides, or ends, each of which requires only one stamp. Using this information, children can simplify their counting strategy to counting the length of 1 side of a given rod, multiplying by 4, then adding 2.

Rod Stamping, page 101

The number of stamps needed for each rod is as follows:

Rod Color	Number of Stamps
	6
	10
	14
	18
	22
	26
	30
	34
	38
	42

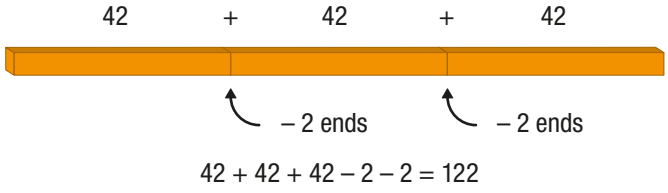
The data show that the number of stamps needed (the surface area) increases by 4 as the length of the rods increase. To explain this, some children might imagine cutting a rod in the middle, stretching it apart, and inserting one white rod, thus adding 4 square centimeters.



Others might see it as adding a white rod to one end. In this case, the "stamp" at one end is eliminated, but five new ones are added.

While working with increasingly longer rods, children may realize that all the rods have two ends and that only the length is changing. Taking this further, some children may verbalize that the number of stamps needed to cover any rod is always 2 more than 4 times the length of the rod. If appropriate, discuss writing this generalization symbolically. If N represents the length of a rod and S represents the number of stamps, then $4 \times N + 2 = S$.

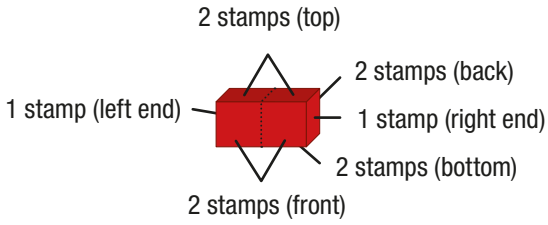
To find the number of stamps, or the surface area, for a rod 3 times as long as an orange rod, some children will look at the chart and see that 1 orange rod requires 42 stamps. A rod 3 times as long should take 42 + 42 + 42, or 3 × 42, stamps minus 2 stamps at each place the rods join, for a total of 122 stamps.



Other children may continue to use the pattern they discovered on the chart. They might reason that if each orange rod is 10 stamps long, each long side of the 3-car train needs 30 stamps. Multiplying 30 by 4 and adding 2 gives the required number of stamps.

1 INTRODUCTION

- Show children an ink pad, a white rod, and a red rod.
- Tell children to pretend that this is a "glow-in-the-dark" ink pad and that you are going to press the white rod into the ink and use it as a stamp.
- Ask how many stamps it would take to cover the red rod completely if the stamps do not overlap and have no spaces between them.
- Model volunteers' suggestions.
- Establish that the red rod requires 10 stamps.



2 ON THEIR OWN

Children will complete the On Their Own. During this time, the teacher's role is to:

- ask probing questions to guide and extend
- record student thinking
- record student conversation that promotes collaboration

Use the information gathered to inform the Math Talk.

3 MATH TALK

Use prompts such as these to promote class discussion:

- What patterns do you notice?
- How did you keep track of your data?
- Could you predict the number of stamps for any rod without actually stamping it? Explain.
- Imagine a long rod that is 3 times the length of an orange Cuisenaire Rod. How can you predict the number of stamps needed to cover it?

4 EXTENSION

- Have children repeat the activity, this time pretending that the longer side of the red rod is the stamp. Ask children to compare their new data to their original results.
- Display Jumbo Cuisenaire Rods, or describe them to children. Each jumbo rod is based on a 2-centimeter measurement. (The white rod, for example, measures 2 centimeters along each edge; the orange rod measures 2 centimeters along the edges at the ends and is 20 centimeters long.) Ask children to chart the results of using a jumbo white rod to stamp each of the jumbo rods. Suggest that they look for a way to use the data they have already collected to do this.

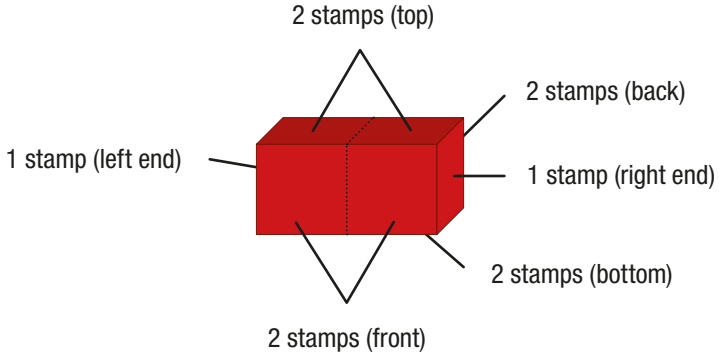
Rod Stamping

ON THEIR OWN

How many stamps of "glow-in-the-dark" ink, each the size of a white Cuisenaire Rod, would be needed to completely cover a rod of any color?

1. Pretend you have a "glow-in-the-dark" ink pad. You are going to use a white rod to stamp each different-length rod. The stamps may neither overlap nor have spaces between them. Here is an example:

   The red rod would need 10 stamps. Here's why:



2. Stamp a rod of each color. For each color, record the number of stamps it took to cover the rod.

3. Look for patterns in your results.

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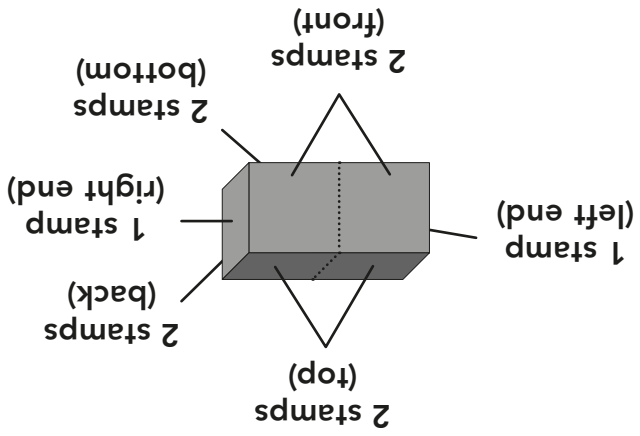

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