SQUARE COVER-UP

Getting Ready

What You'll Need

Tangrams, 1 set per child

Cover-Up Squares, several sheets per child, page 95

Overhead Tangram pieces and/or *Cover-Up Squares* transparency (optional)

Overview

Children cover a grid with Tangram pieces and find the percent of the grid that is covered. In this activity, children have the opportunity to:

◆ develop measurement and estimation strategies

◆ investigate percent spatially

◆ make connections between fractions and percents
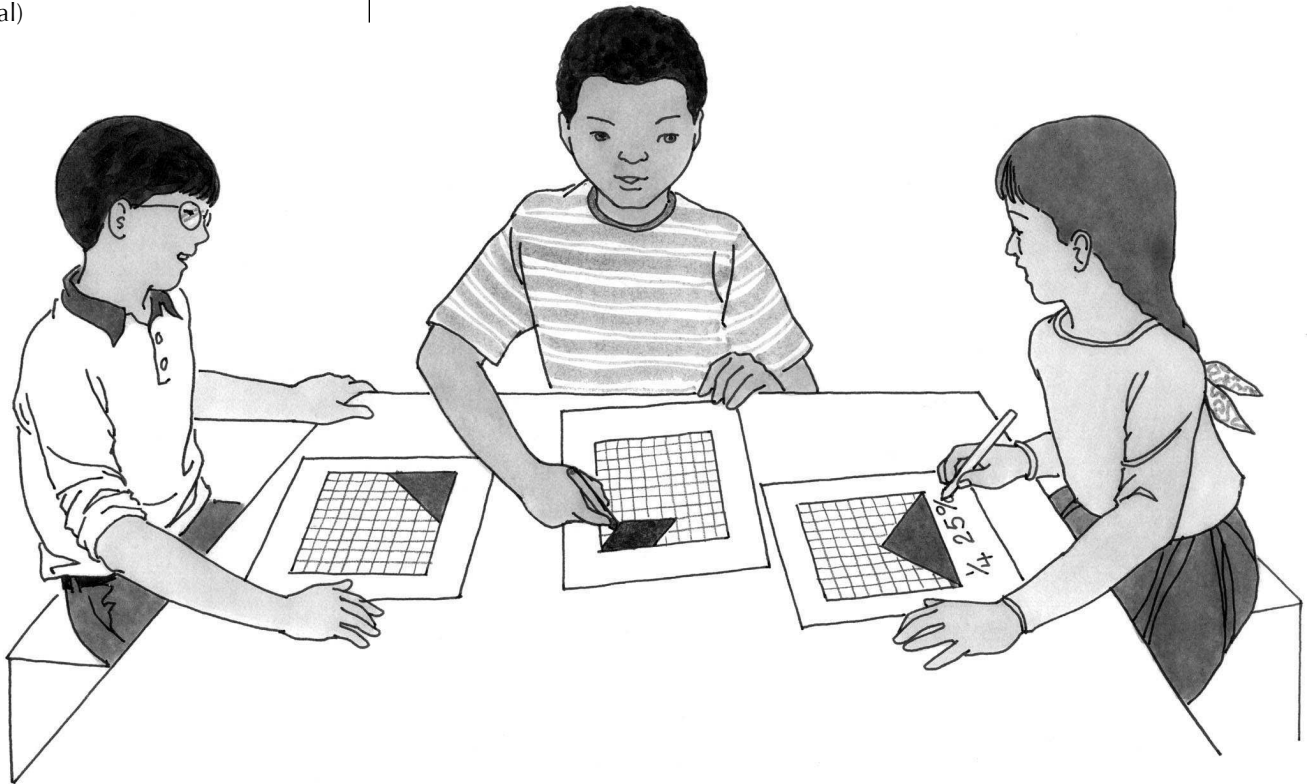
The Activity

Point out that % is used to designate percent. For example, in 30%, the % symbol tells us that 30 is only a part of a larger group of 100, and that 30% can be expressed as the fraction $\frac{30}{100}$.

In On Their Own*, it may be helpful to allow children to estimate some of their answers, since some placements of Tangram pieces don't fit the grid exactly.*

Introducing

◆ Have children give examples of situations where they have heard the term *percent* used. List their responses on the board. Examples: a 30% chance of rain, clothes on sale for 50% off, a test grade of 95%.

◆ Discuss what percent means in the examples children give.

◆ Give each child a *Cover-Up Squares Worksheet* and ask children how many square centimeters are on one grid. Have children fit one set of Tangram pieces in the square. Point out that the seven Tangram pieces cover all 100 squares or 100% of the grid.
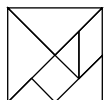
On Their Own

How can you find the percent of an entire area that shapes cover?

- Work in a group of 3 or 4. One person is the Percent Maker. The others are Percent Finders. The Percent Maker uses from 3 to 6 Tangram pieces to make a design that covers part of a 100-centimeter square grid.

- The Percent Finders copy the design on their grids. Then they count the squares to find the area covered by the pieces. For example, if the pieces cover an area of 25 of the 100 grid squares, then they cover 25 percent (25%) of the grid.

- When the Percent Finders agree on a percent, the Percent Maker traces the design and writes the percent on it. If the Percent Finders disagree on an exact answer, they may need to decide on an estimated answer.

- Repeat the activity until each person in the group has a chance to be the Percent Maker at least once.

- Be ready to explain how you figured out the percents for each design.

The Bigger Picture

Thinking and Sharing

Have groups post their designs, arranging them in order from the least percent to the greatest.

Use prompts such as these to promote class discussion:

- What do you notice about the posted designs and their percents?

- What strategies did you use to find the percent of a design? Which strategy worked best for you?

- In what cases did you estimate your answer?

- What is the greatest percent that can be covered with each number of pieces? What is the least percent?

- How could you use similar strategies to find the fractional part of the grid that is covered by a design?

- What arrangements of pieces did you find that covered the same percent of the grid?

- How are percents and fractions related? Give an example.

- How can you find the percent of an uncovered part of the grid?

Extending the Activity

1. Have children make a design with from three to seven Tangram pieces, trace it on the square grid, and give it to a partner. The partner should *estimate* the fraction and the percent of the grid covered. Then have the pair work together to find the exact answer and compare it to the estimates.

2. Have children repeat the activity using one Tangram set made up from two different colors. Tell them to write the percent that represents each of the areas. Then have them confirm that the three percents add up to 100%.

3. Ask children to repeat the activity using a grid that measures 14 cm on a side and can hold up to two sets of Tangrams. Point out that the new, larger square now equals 100%.

14 cm

14 cm
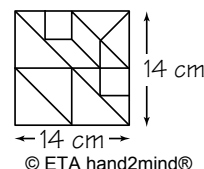
Where's the Mathematics?

Square Cover-Up gives children a visual model of how percents and fractions are related. Since the area of the square grid is 100 square centimeters (100 cm²) children can relate the area covered to a percent of the entire grid. As children measure area in square centimeters they begin to see, for example, that 50% of the grid means 50 of 100 squares and thus is also represented by the fraction $^{50}/_{100}$, or ½.

Each of the samples below represents a different way that children may use Tangram pieces to cover a part of the grid. Yet, after studying these samples, children may be surprised to find that in each case the pieces cover one half, or 50%, of the grid.
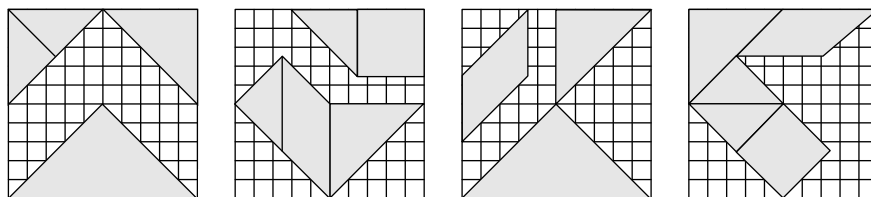
Thus, by sharing their completed designs, children see that there are many different ways to use Tangram pieces to represent the same percentage of the grid's area. They may also develop benchmarks for recognizing areas that represent specific percents such as 25%, 50%, and 75%.

As they realize that the number of squares covered is equal to the percent of the entire grid covered, children may use different strategies for finding the area covered by each Tangram piece. They may simply calculate the area of the entire grid by multiplying the length of the grid (10 cm) by the width (10 cm) and then use the knowledge that four large triangles make up the entire grid. Then, by dividing the entire area, 100 cm², by four, they find that the large triangle has an area of 25 cm².
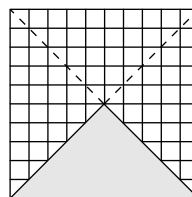
1 large triangle covers 25% of the grid

Children may also develop strategies for counting the grid squares. Some children may estimate a total. Other children may observe that partial squares often represent half of a grid square, and so may count each partial square as 1 and then divide by two to convert them into whole squares.

For example:
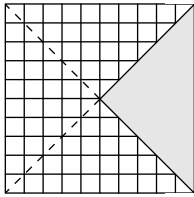
20 whole squares + 10 half squares

$$20 + \frac{10}{2}$$

20 + 5 = 25 whole squares,
or 25% of the grid

Children may also use what they know about the fractional relationship of Tangram pieces to find the percent of the square grid that each piece, or grouping of pieces, must cover. For example, since the Tangram set covers the entire square grid (100 cm²) and is made up of the equivalent of 16 small Tangram triangles, then the area covered by one small triangle is ¹⁄₁₆ of 100 or 6¼ cm².
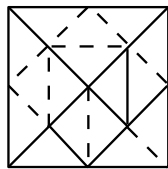
Thus, the medium triangle, the parallelogram, and the square, which can all be covered by two small triangles, each have an area of 6¼ x 2, or 12½ cm², and the large triangle, which can be covered by four small triangles, has an area of 6¼ x 4 or 25 cm².

Knowing that a Tangram piece covers 6¼%, 12½%, or 25% of the square grid enables children to use addition to find the percent of any combination of pieces and subtraction to find the percent of any uncovered area.
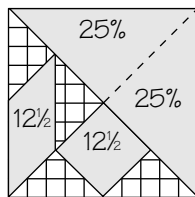
Since 75% of the grid is covered,
25% is uncovered.

Depending on their understanding of the concept of percent, you may wish to let children estimate and/or even "guesstimate" rather than allow them to become frustrated in their attempts to find exact percentages. In this activity, the methodology and the exactness of the solutions is secondary to the understanding that the Percent Makers and the Percent Finders are developing regarding the relationship of areas, fractions, and percents.

COVER-UP SQUARES