

TWO-THIRDS BLUE

NUMBER • PROBABILITY/STATISTICS

- Fractions
- Ratios
- Experimental probability
- Theoretical probability

Getting Ready

What You'll Need

Color Tiles, about 100 per group
Small paper bags, 1 per group

Overview

Children use Color Tiles to represent a fractional part of a whole and to investigate probability. In this activity, children have the opportunity to:

- ◆ reinforce the understanding that the value of a fractional part is determined by the whole from which it comes
- ◆ gain experience with experimental probability
- ◆ collect and analyze data
- ◆ begin to realize the difference between mathematical probability and experimental probability



The Activity

Children should recognize that even though theoretically one half of the tiles drawn should be red, experimentally this may not be exactly what happens.

Introducing

- ◆ Place four Color Tiles in a bag—two red, one blue, and one yellow.
- ◆ List the contents of the bag on the chalkboard.
- ◆ Ask children what fractional part of all the tiles in the bag are red tiles. Confirm that the answer is one half.
- ◆ Have children discuss whether, if you drew one tile from the bag without looking, you would be as likely to pick a blue or a yellow as a red tile.
- ◆ Establish that since one half of all the tiles are red, the theoretical probability of reaching into the bag and pulling out a red tile is one out of two, or one half.
- ◆ Tell children to imagine that they drew tiles from the bag, one at a time, replacing each after it was drawn. Ask children if they think that after ten or twenty draws, one half of the tiles they drew would be red.

On Their Own

If you sample tiles from a bag of Color Tiles in which $\frac{2}{3}$ of the tiles are blue, should you expect that $\frac{2}{3}$ of the tiles you sample will be blue?

- Work with your group to assemble an assortment of Color Tiles that is $\frac{2}{3}$ blue.
- Put your tiles into a paper bag and write the names of the people in your group on the outside of the bag.
- Exchange bags with another group.
- Without looking, draw a tile from the bag, record its color, and return it to the bag. Shake the bag to mix the tiles for the next draw. Do this several times.
- Continue sampling tiles until you have enough data to be sure that the number of blue tiles either is or is not $\frac{2}{3}$ of the total number of tiles in the bag.
- Now open the bag and check its contents. Discuss how your data relates to the actual contents of the bag.
- Exchange bags with a different group and repeat the experiment.
- Be ready to talk about your results.

The Bigger Picture

Thinking and Sharing

Have children return their bags to the groups that filled them and discuss their findings with those groups.

Use prompts like these to promote class discussion:

- ◆ What are some examples of a set of tiles in which two thirds are blue?
- ◆ After you had drawn several tiles from the bag, did you expect any particular results? Explain your answer.
- ◆ How did your sampling experiments help you to know whether or not two thirds of the tiles in a bag were blue?
- ◆ Did you discover a relationship between the fractional part of the tiles in the bag that were blue and the fractional part of the total number of samples that were blue? How would you explain this?
- ◆ Might a bigger sampling have changed your results? Explain why you think so.

Writing

Have children describe how to assemble a set of tiles two thirds of which are blue.

Extending the Activity

1. Have children prepare a bag of Color Tiles in which the probability of drawing any one of the four colors is one fourth. Have them design an experiment in which they use sampling to compare the theoretical probability with the experimental probability.

Teacher Talk

Where's the Mathematics?

In the first part of this activity, children must assemble an assortment of Color Tiles that is two-thirds blue. Some children may puzzle over this at first, since the total number of tiles to be used is not given; children must determine that number for themselves. Some may select a number of tiles at random to be the total and then try to determine how many of the tiles should be blue. In some cases, the number they select may not be workable—two thirds of that number may not result in a whole number of tiles. This may lead children to think about choosing a number that can be divided evenly into thirds, such as 6, 9, 12, 15, and so forth. They can then separate this number of tiles into three equal piles, using blue tiles for two of the piles and other colors for the third pile.

Some children may make groups of three tiles in which two tiles are blue. They may then fill their bag with several of these groups of tiles. Other children may make three stacks of equal numbers of tiles, making two of the stacks using blue tiles and the third stack using other colors. Children should come to see that the total number of tiles in the bag could be many different numbers. Some children may even recognize that the ratio formed by comparing the number of blue tiles to the total number of tiles in the bag will be equivalent to two thirds in every case.

2. Have children prepare a bag of Color Tiles in which the probability of drawing a blue tile is 0 percent (or 0). Then have them prepare another bag in which the probability of drawing a blue tile is 100 percent (or 1). Tell them to compare their bags with others who have done this problem. Ask them to explain why there may correctly be different numbers of tiles in the various bags.

As children sample tiles from their bags, they compare experimental probability with theoretical probability. If the bag was properly prepared, then theoretically two thirds of the tiles sampled should be blue. As they experiment, however, this may not be the case. In fact, it is likely that after sampling a number of tiles and analyzing their results, children may begin to wonder whether the bag was prepared incorrectly. For example, it is not unlikely that from a bag of Color Tiles in which twenty are blue and ten are red, the first five draws are red. Children may even want to peek into the bag to see if it contains any blue tiles at all! Children should find, however, that the more tiles they sample in their experiment, the more closely their results will resemble the proportions of colors of the tiles in the bag.

Some groups may not be convinced that two thirds of the tiles in their bag are blue if their data does not show that exactly two thirds of their samples produced blue tiles. Their expectation of what should happen may prevent them from allowing for the element of chance involved in experimental probability. Children should recognize that it is likely that their data will not show a ratio that is exactly two-thirds blue, even if the bag of tiles was prepared correctly. However, they should also recognize that the more samples they take, the closer the experimental and theoretical ratios will be.
