CLOSEST TO 1

NUMBER • PROBABILITY

- Decimals
- Addition
- Subtraction
- Game strategies

Getting Ready

What You'll Need

Base Ten Blocks, 2 sets per group

Number cubes marked 1–6, 2 per group

Closest to 1 Score Sheet, 3 per child, page 90

Overhead Base Ten Blocks and/or Base Ten Block Grid Paper transparency (optional)

Overview

In this game for two or three players, children use Base Ten Blocks to represent decimal amounts according to the roll of two number cubes. They add or subtract these amounts in an effort to be the one whose final score is closest to 1 in value. In this activity, children have the opportunity to:

- compare the relative values of wholes, tenths, and hundredths
- determine whether to add or subtract a decimal amount
- use written notation to represent decimal amounts
- develop strategic thinking skills

The Activity

Introducing

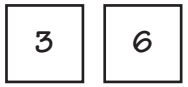
- Display one flat and have children do the same. Tell them to think of their flat as having the value of one whole, or 1.
- Write a decimal amount, such as 0.49, on the board.
- Ask children to use their flat, along with other Base Ten Blocks, to model the sum of 1 and 0.49.
- Confirm that 1 flat, 4 longs, and 9 units can be used to model 1 plus 4 tenths and 9 hundredths, or 1 plus 49 hundredths. Record the sum, 1.49, on the board.
- Now ask children to use the blocks to show how to subtract 0.49 from 1.
- Confirm that no flats, 5 longs, and 1 unit (or 51 units) model the difference of 1 minus 0.49. Record the difference, 0.51, on the board.
- Invite two volunteers, one at a time, to write a decimal amount on the board and have the rest of the class decide whether to add or subtract each amount from the blocks in front of them.
- Compare and discuss results.

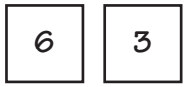
On Their Own

Play *Closest to 1!*

Here are the rules.

1. This is a game for 2 or 3 players. The object is to have the decimal score closest to 1 when the game ends.
2. Players each begin with 1 flat. (A flat is worth 1 whole.) They decide who will go first.
3. On each turn, a player:
   - rolls 2 number cubes.
   - decides how to arrange the digits rolled as a decimal amount less than 1. For example, a player who rolls 3 and 6 can decide to use 0.36 or 0.63.
   - uses Base 10 Blocks to show how to add or subtract that decimal amount from his or her flat or block collection, trading if necessary.
   - records the action on a score sheet like this:





Roll	Numbers Rolled	Decimal Chosen	Add or Subtract
1st			

4. After each turn, all players check the trading and the recording.
5. Play continues for a total of 10 rounds.
6. At any time during the game, a player may decide to skip 1 turn (and only 1 turn), even after rolling the number cubes!

- Play 3 games of *Closest to 1*.
- Be ready to talk about how your decisions affected the outcome of each game.

The Bigger Picture

Thinking and Sharing

List the winning scores within each group. Then determine which child had the score that came closest to 1 for the entire class.

Use prompts like these to promote class discussion:

- Which was harder, adding decimals or subtracting them? Why?
- What strategies helped you to get closer to 1?
- Was it better to roll certain numbers than others? Was it good to roll doubles? Explain.
- Did you ever decide to skip a turn? If so, what made you decide this?
- Are some numbers impossible to roll? How does this affect a game?
- After any turn, were you ever sorry about your choice of decimal or your choice of addition or subtraction? Explain.

Extending the Activity

1. Have children play *Closest to 1* by having each player start with 5 flats.

Teacher Talk

Where's the Mathematics?

Children with many different levels of understanding about decimals can successfully participate in this activity. Two different ways of handling the blocks reflect the two different levels of children's thinking. Some will work abstractly, not necessarily going through the motions of trading blocks on every turn. Assume, for example, that the number cubes are rolled and 5 and 1 come up. One child may immediately work out mentally that 1 minus 0.15 leaves 0.85 and simply replace a flat with 8 longs and 5 units. Another child may first trade the flat for 10 longs, trade one of the longs for 10 units, and then remove 1 long and 5 units to arrive at the difference of 0.85.

Most children will immediately see that it makes sense to add to a score that is less than 1 and to subtract from a score that is greater than 1. Deciding whether 0.36, for example, is better to use than 0.63 means asking oneself, "Which operation and which number will put my score closer to 1 than it is now?" Children who can work abstractly are likely to say that they see little difference in difficulty between adding and subtracting, but other children will say that subtracting is harder because it involves more trading.

Although winning depends mostly on chance, children must make judgments and must develop strategies in the course of play in order to be successful. On each roll they must arrange the number cubes to represent the decimal that best suits their purpose at that stage of the game. They must decide whether to add or to subtract. They must also determine when, if ever, to skip a turn.

It may be difficult for some children to decide what to do about the skipping option. After playing a few games most children will realize that skipping is usually most useful when used late in the game. It works best, of course, if a player's ninth roll produces a score of 1 (or close to 1), in which case the player can exercise the skipping option for the last turn.

Children who notice that 0.11 is the least number possible to roll are also likely to see that 0.66 is the greatest. Most will realize, too, that it is impossible to roll a 7, 8, 9, or 0 in this game. Not being able to roll a 0 means that a player will never be able to add or subtract longs alone since it is impossible to form any decimal that is a multiple of one tenth on any single turn.

2. Have children play the game using a 0–5 number cube and a 5–10 number cube. Afterward, have children explain how this version of the game was like the original game and how it was different from it.

A few children may figure out that there are 21 possible rolls of two number cubes. This allows for 36 different unique arrangements of the cubes. (Theoretically, there should be 42, assuming that there are two possible arrangements of digits for each roll. But a roll of a "double," of course, can be read in only one way!)

Those children who have some experience in thinking about probability may see that each of the 21 possible outcomes is equally likely to be rolled. Consideration of the possible arrangements requires a different level of thinking, however. If children understand that there are only 36 different arrangements, and not 42, they will realize that doubles have twice the probability of being rolled as each of the other numbers. Though few children may come to this realization, many will decide that they don't like rolling doubles, particularly the higher ones, since doubles can be arranged in only one way.

POSSIBLE ROLLS OF TWO NUMBER CUBES					
1,1					
1,2	2,2				
1,3	2,3	3,3			
1,4	2,4	3,4	4,4		
1,5	2,5	3,5	4,5	5,5	
1,6	2,6	3,6	4,6	5,6	6,6

After playing the game several times, most children will see that keeping one's score consistently close to 1 depends—in many cases—on a combination of these three factors:

- always arranging the digits rolled to create the smaller possible decimal (0.12 rather than 0.21, for example)
- always choosing the right operation (addition or subtraction)
- the luck of rolling low numbers