

# Learning & Teaching

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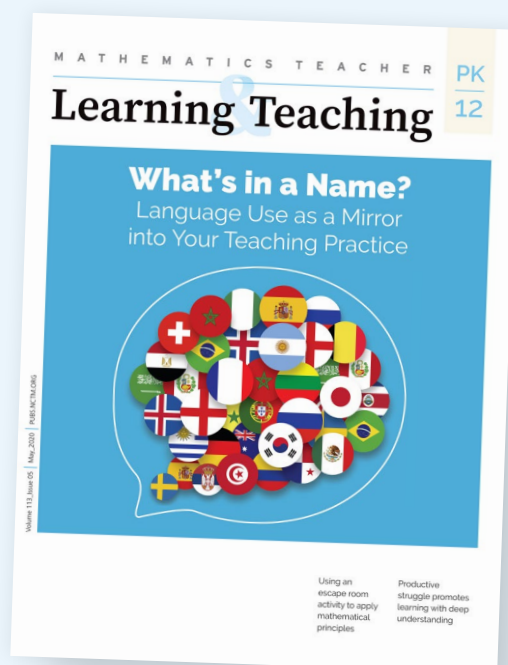
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# Playing with Fractions

Constraints for social distancing require teachers to find creative ways to engage students. Consider this fun strategy for exploring fraction equivalence, addition, and subtraction in a game environment where students use self-made or digital manipulatives.

Juli K. Dixon, Treshonda Rutledge, Jennifer C. Caton, and Edward C. Nolan

**Finding ways for students** to use manipulatives in a safe, yet collaborative, manner is a challenge the 2020–2021 school year introduced. Teachers scrambled to create a set of manipulatives for individual use on a budget so students could learn from home, in hybrid environments, or in socially distanced classrooms. What follows is a description of a budget-friendly manipulative for fraction instruction that does not compromise educational worth and transitions between remote and face-to-face instruction.

We have used the construction paper fraction kit for many years and have found it to be an excellent hands-on tool for representing fractions, finding equivalent fractions, and operating with fractions. How to create, introduce, and use the fraction kit are described in detail in *Making Sense of Mathematics for Teaching Grades 3–5* (Dixon et al. 2016). In this article, we share how to prepare the fraction kit and use it to play conceptually focused games in a socially distanced or remote classroom. To play the game, students need to be able to name fractions as part of a whole.

## CREATING THE CONSTRUCTION PAPER FRACTION KIT

Each kit consists of six colored pieces of 9-in. × 12-in. construction paper: two red (for the wholes), one blue (for halves), one orange (for fourths), one yellow (for eighths),

and one green (for sixteenths). The pieces should be folded parallel to the shorter sides of the paper (often referred to as “hamburger” or “taco” folds) and torn into equal-size pieces to represent the game pieces (see figure 1). If students do not have access to colored paper, they can use copy paper and write the color names on each piece.

This entire process typically requires 30 minutes of instructional time and should be punctuated by questions asking students to name the fractions with respect to different-size wholes. Students could be asked to determine what one green piece would be if the whole is one yellow piece ( $\frac{1}{2}$ ), or they could be asked what the whole would be if one yellow piece is  $\frac{1}{4}$  (the blue piece). Be sure to ask questions using the red piece as the whole to discuss equivalence relationships in preparation for the game. For example, you may ask, “What is a name for the fraction represented by two yellow pieces?” The response you are looking for is  $\frac{2}{8}$ . You could then ask students which other pieces could represent the same amount of the red whole, and students should say one orange piece, or  $\frac{1}{4}$ , and four green pieces, or  $\frac{4}{16}$ . Once the kits are created and discussed, students are ready to play.

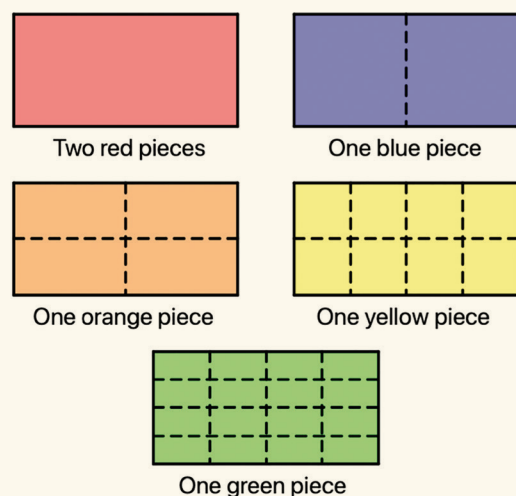
## FRACTION KIT GAMES

Fraction kit games offer an excellent opportunity for students to collaborate while maintaining social distance.

These games are played with two or three players. Players can use their own fraction kit and game cube. The game cube can be created by labeling a wooden or plastic cube found at most craft stores or by cutting and folding a paper net of a cube like the example in figure 2.

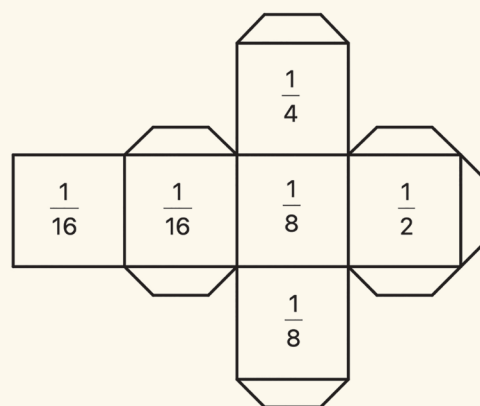
The game board consists of one red piece of paper (one of the two pieces in the kit), which represents the whole when naming fractions during the games.

**Fig. 1**



*The fraction kit is composed of six pieces of construction paper.*

**Fig. 2**



*The net can be used to create a game cube.*

Students take turns rolling their game cube. The fraction rolled indicates which piece they should place on or remove from the game board.

### Make One

In this version of the game, the goal is to complete the whole by exactly covering the game board. Students record their turns on their own game sheet (see figure 3).

To start each turn, the student records the fraction represented on the game board. Then the student rolls the game cube and records the fraction to be added to

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the board. For example, in figure 4, the students begin with  $1/16$  of their board covered. One student rolls  $1/16$ , adds that piece to the board, and records this “move” on the game sheet.

This turn would be initially recorded as  $1/16 + 1/16 = 2/16$ . However, as part of the game, students need to represent their board with the fewest number of same-size fraction pieces possible before ending their turn. If a student ends the turn with the board looking like the one in figure 4, the student loses the turn and must remove the  $1/16$  just added.

Prior to ending this turn, the student would need to say that the  $2/16$  can be exchanged for  $1/8$ . The student would record this “move” on the game sheet like this:  $1/16 + 1/16 = 2/16 = 1/8$ . Figure 5 shows the resulting game board and game sheet.

**Fig. 3**

Make One Take One Game Sheet

Name:

|         |  |
|---------|--|
| Turn 1  |  |
| Turn 2  |  |
| Turn 3  |  |
| Turn 4  |  |
| Turn 5  |  |
| Turn 6  |  |
| Turn 7  |  |
| Turn 8  |  |
| Turn 9  |  |
| Turn 10 |  |

The game sheet provides a way for students to record their actions in the game.

**Fig. 4**



|        |                      |
|--------|----------------------|
| Turn 1 | $1/16$               |
| Turn 2 | $1/16 + 1/16 = 2/16$ |

This is how the game could look for a player during turn two.

With some turns, students need to exchange pieces on their board for smaller pieces. For example, if, on the next turn, this student rolled  $1/16$ , the student would initially record  $1/8 + 1/16$ . The student would then need to say that the  $1/8$  was exchanged for  $2/16$  so that  $3/16$  of the board was covered. Figure 6 provides an example of the way the game board may be changed during this turn.

The game is won when a player is able to exchange the pieces on that player's board for the red whole so that the game board is covered by the second red piece of construction paper. If a player's roll results in more than one whole being covered, then the player loses that turn.

### Take One

The Take One version of the game is played similarly to how the Make One game is played; however, with this version, each player starts with the second red piece covering the game board. The player removes the fraction of the game board indicated by what the player

**Fig. 5**



|        |                            |
|--------|----------------------------|
| Turn 1 | $1/16$                     |
| Turn 2 | $1/16 + 1/16 = 2/16 = 1/8$ |

This is how the game could look at the end of turn two after the player makes exchanges.

**Fig. 6**



|        |                                   |
|--------|-----------------------------------|
| Turn 1 | $1/16$                            |
| Turn 2 | $1/16 + 1/16 = 2/16 = 1/8$        |
| Turn 3 | $1/8 + 1/16 = 2/16 + 1/16 = 3/16$ |

This is how the game could look for the player at the end of turn three.



rolls on each turn. The first turn will always involve exchanging the red whole covering the game board for other pieces. For example, if a player rolls  $\frac{1}{4}$  for the first turn, the player would say, “I need to exchange my one whole for 4 fourth-size pieces so I can take away  $\frac{1}{4}$ . Now I have  $\frac{3}{4}$  of my board covered.” The game sheet would show  $1 - \frac{1}{4} = \frac{4}{4} - \frac{1}{4} = \frac{3}{4}$ . Verbalizing the process helps students make sense of the actions of the game and connect to what will become procedures used for adding and subtracting fractions with like and unlike denominators.

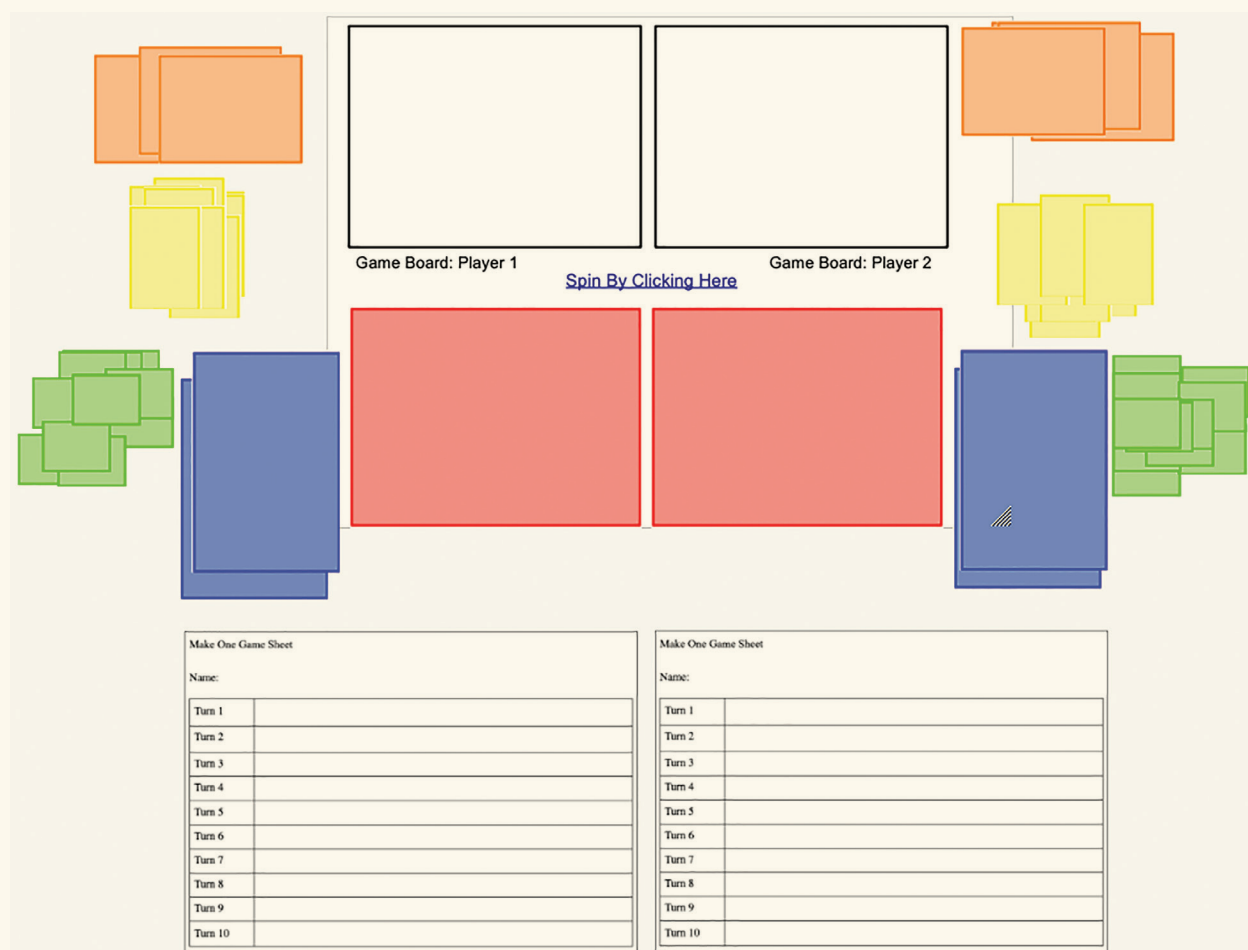
The fraction kit is designed so game pieces are multiples of other game pieces; by this we mean that each game piece beyond the smallest is the same size as duplicates of another game piece. The purpose of this is so that pieces can be “exchanged” directly. We are often

asked why we do not include thirds and sixths with this kit. If thirds were included and a student with  $\frac{1}{3}$  of the game board covered rolled  $\frac{1}{4}$ , there would be a need for twelfths. This level of complication makes the game less helpful for early exploration of fraction equivalence with the purpose of adding and subtracting fractions with unlike denominators.

### PLAYING IN A REMOTE SETTING

We have been exploring ways to adapt this game to a remote or hybrid setting. Students are able to take their fraction kits home with them. However, a problem occurs when the goal is to maintain the collaborative nature of the game and students cannot see one another’s game boards.

**Fig. 7**

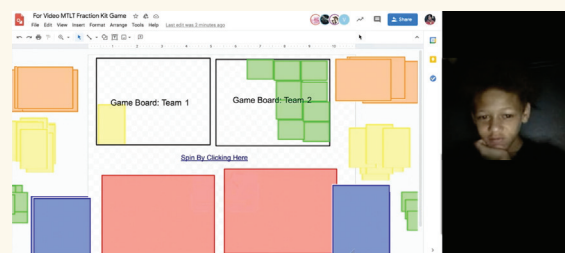


*The digital game board can be used to play the game in remote settings.*

We have had success using a digital version of the fraction kit (see the *MTLT* Fraction Kit Game in the supplementary files). Students play using an online meeting platform. They can use the embedded digital spinner or a game cube from home to determine their moves, using the honor system. Students can play using their physical game board and replicate it on the digital board or play directly on the digital board. The digital game board is an outline of a whole instead of using the red piece of paper because we found this made the game easier to use. The digital game is designed for two players or teams (see figure 7). If three players are in a group, the third player checks the turns for each player and indicates when a player loses a turn for neglecting to make appropriate exchanges.

In video 1, one of the authors is facilitating four fifth-grade students in teams of two to play the game. Notice how she supports students to make sense of equivalent fractions and use fraction names to describe their game boards. Because this is their first time playing, she does not require simplified fractions after each turn.

### Video 1 Playing the Digital Fraction Kit Game in a Remote Setting



[Watch the full video online.](#)

With the current pressures of teaching, keeping the importance of play and the need for hands-on experiences in mind can be challenging. We hope you enjoy this resource as a way to play with fractions. —

#### REFERENCE

Dixon, Juli, Nolan Edward, Adams Thomasenia, Tobias Jennifer, and Guy Barmoha. 2016. *Making Sense of Mathematics for Teaching Grades 3-5*. Bloomington, IN: Solution Tree.

#### ACKNOWLEDGMENTS

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