

EXPLORING FRACTIONS

Kids and Cookies Guide for Parents and Teachers



Make to Learn

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Exploring Fractions: Kids and Cookies Guide for Parents and Teachers

Kids and Cookies is an interactive game designed to teach fractions to young children with the assistance of a parent or a teacher.

The game originated through interactions between a mathematics educator, Joe Garofalo, and his daughter, Leah, when she was four years old. Joe posed questions such as, “How can three kids share four cookies fairly.” Leah is now an adult who works as an engineer, an aptitude fostered by an early exposure to numbers.

The game has been implemented in a number of incarnations based on the technology of the time. It originally was distributed to parents of Leah’s friends on a CD-ROM, but now is available on the web as one of the tools available on the *Make to Learn* site:

<https://www.maketolearn.org/tool/fractions>

The game is designed to enable children to explore fractions with support from a parent or a teacher. The following guide provides information that may be helpful in supporting such explorations.

Game Credits

- Game Created by Leah Garofalo
- Game Developed by Joe Garofalo and Brian Sharp
- Graphic Design by Starrie Williamson
- Program Implemented by Gina Bull

Overview of *Kids and Cookies*

Kids and Cookies is a program designed to build upon children’s informal concepts of rational numbers. The problem-solving context of the game is familiar to all children, “How can cookies be shared fairly among friends?” This context allows for the connection of fraction concepts (e.g., partitioning, equivalence classes, and unit) and authentic problem-solving situations.

The design of *Kids and Cookies* makes the program versatile enough to accommodate differing ability levels. By manipulating features of the program, parents and teachers can gain insights into student thought processes and methods for solving tasks. The program also incorporates multiple representations of fractions into the problem-solving tasks. Area models, numerical symbols, and voice cues are all a part of the program. Players can control the types of representations displayed through option menus.

Tour of *Kids and Cookies*

Kids and Cookies has four main screens and a menu bar. The four screens are:

1. A Launch Screen
2. An Opening Menu
3. Cookie Selection Screen
4. Snack Table Screen

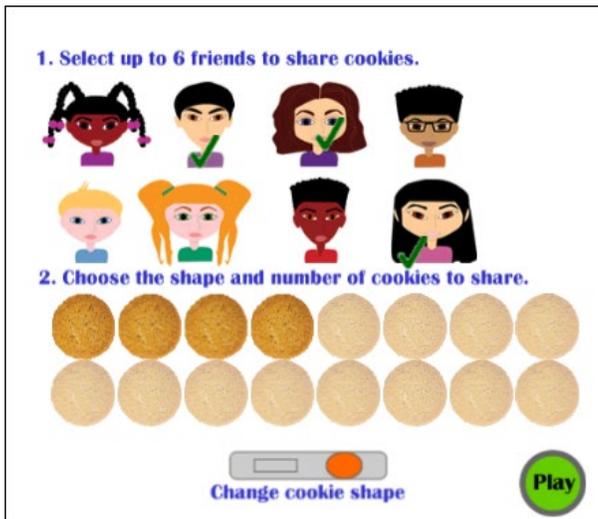
The *Launch Screen* appears when the program is accessed via a web link. A green flag in the center of the screen is clicked to launch the program.



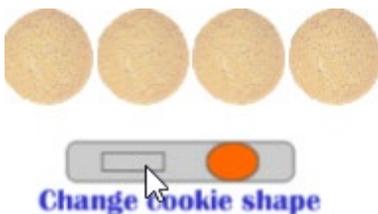
An *Opening Menu* appears after the program is launched. A menu bar includes options to turn the sound on or off, turn fraction symbols on or off, and access the program credits.



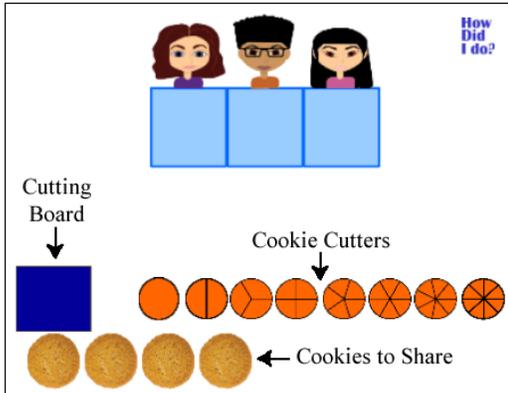
The *Play* option on the menu bar is clicked to begin the game. A *Cookie Selection* screen appears with options to select up to six friends to share cookies. The type and number of cookies to share can also be selected on this screen.



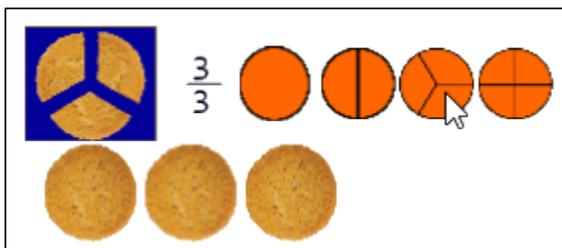
The cookie selection area allows the player to select from one to sixteen cookies to share among kids seated at the snack table. Cookies are wafers (rectangular) or oatmeal (circular). A toggle buttons below the cookies controls the type of cookie.



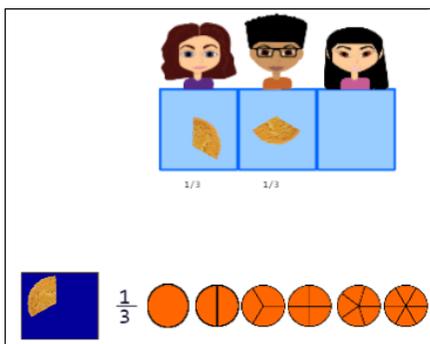
The snack table screen is the main interface of *Kids and Cookies*. This is the place where players partition and distribute cookies to the kids. The cookies to share are shown at the bottom of the screen. A cutting board consisting of a blue square is provided in the lower left-hand corner of the screen. Orange cookie cutters to the right of the cutting board can be used to cut a cookie placed on the cutting board into different shapes.



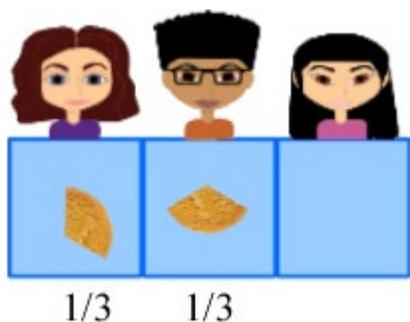
When a player places a cookie on the cutting board, the player can then click on the desired cookie cutter which separates the cookie into pieces.



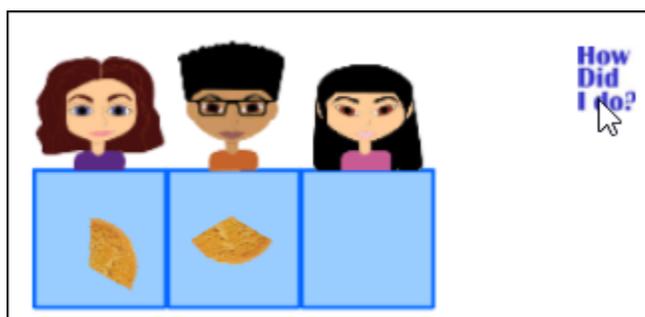
The player can then drag the pieces of the cookie on the snack table, choosing the number of pieces that each child receives.



When the symbol option is enabled, fractions are displayed below the cookie pieces on the snack table.



Once all the cookies are distributed, the “How Did I Do?” option can be used to determine whether the cookies were shared fairly. The player then has the option of returning to the current game, starting a new game, or quitting the program.



Types of Cookie Sharing Tasks

Kids and Cookies was designed so that parents and teachers could engage their students in fair sharing tasks. There are other ways that *Kids and Cookies* can help develop division and fraction knowledge.

Fair Sharing Tasks

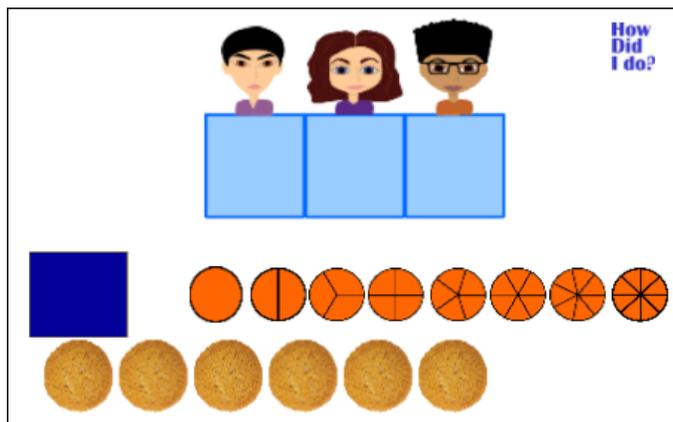
Children solving various ‘fair sharing’ tasks were examined in a pilot study during development of *Kids and Cookies*. (See the table on the next page for an overview of the types of tasks.) When children solve fair sharing tasks, it is important for them to experience as many different types of tasks as possible. Facilitators should encourage children to solve tasks using several methods and talk about the strengths and weaknesses of each method.

For example, if the task is to share one cookie among three kids, a strategy that children might use to solve the task is to cut the cookie into three pieces and distribute one-third cookie to each kid. Another method that children might use to solve the task is to cut the cookie into six pieces and distribute two-sixths cookie to each kid. Children might prefer one strategy over another

based on the size of the cookie pieces, the amount of time it takes to distribute the pieces, or other reasons.

Cookie Sharing Tasks	
<i>Types of Sharing Tasks</i>	<i>Examples</i>
The number of cookies, C , is a multiple, n , of the number of kids, K . $C = nK$	<ul style="list-style-type: none"> • 6 cookies and 3 kids • 8 cookies and 4 kids • 4 cookies and 2 kids
The number of cookies exceeds the number of kids by one. $C = K+1$	<ul style="list-style-type: none"> • 5 cookies and 4 kids • 3 cookies and 2 kids • 7 cookies and 6 kids
The number of cookies exceeds the number of kids by more than one. $C > K+1$	<ul style="list-style-type: none"> • 5 cookies and 3 kids • 9 cookies and 6 kids • 7 cookies and 5 kids
The number of cookies is less than the number of kids. $C < K$	<ul style="list-style-type: none"> • 1 cookie and 3 kids • 4 cookies and 6 kids • 2 cookies and 5 kids
Eliminate the cutter that cuts a cookie into K pieces.	<ul style="list-style-type: none"> • 1 cookie and 3 kids (no thirds cutter) • 4 cookies and 6 kids (no sixths cutter) • 2 cookies and 4 kids (no fourths cutter)

A good starting point for introduction of *Kids and Cookies* is to ask students to solve tasks where the number of cookies is an integral multiple of the number of kids. For example, in the illustration below, three kids are asked to share six cookies fairly. All of the children participating in the pilot study, including four year-old children, could solve this type of task.



The children used two different strategies to distribute cookies. Some children dealt out cookies one at a time to each kid in rotation until they exhausted the cookie supply. Other children determined the number of cookies that each kid should receive beforehand and then distributed the pieces.

In another type of sharing task, children are asked to share one cookie among a group of friends. This gives children experience working with unit fractions. When solving tasks of this nature, most children will count the number of kids at the snack table and then start counting pieces in each cutter until they find the cutter that contains the same number of pieces as kids. The technique might be described as the “number of kids equals the number of pieces” strategy.

One child in the pilot study preferred using cutters that yielded more pieces than the number of kids at the snack table. He reasoned that if a kid had more pieces of the cookie, the kid could eat some cookie pieces now and save some pieces to eat later. This could be thought of as the “many pieces” strategy.

Children should work with tasks where the number of cookies is larger than the number of kids (e.g., five cookies and three kids) to give them experience working with fractions larger than one. Some children will distribute whole cookies first, and then divide the remaining cookies into pieces. Some children enjoy cutting cookies and may choose to cut more cookies than necessary to solve the tasks (e. g., cutting all cookies when some whole cookies could be distributed).

One of the hardest types of tasks for children to solve involves tasks where the number of cookies is less than the number of kids and the cutter that yielded the same number of cookie pieces as the number of kids was eliminated (e.g., four cookies and six kids with no sixths cutter available). Tasks of this type force children to consider strategies besides the “number of kids equals the number of pieces” strategy. Some children use number facts like $3 + 3 = 6$ to help them solve tasks of this type. They reason that since they could not cut one cookie to yield six pieces (the number of kids), then they need to cut two cookies to yield six pieces. They know that $3 + 3 = 6$, so they cut each cookie into thirds and distributed one-third cookie to each kid. The process is repeated for the remaining two cookies.

Did I Share Fairly?

In these tasks, the facilitator distributes cookies before the children are allowed to see the snack table. Children are then asked to determine if the solution is fair. Tasks of this type force children to use the shape of the cookie pieces in formulating their answers. After children decide on their answer, they can check the correctness of their answer by selecting the “How Did I Do?” button.

How Many Cookies Were in the Bin?

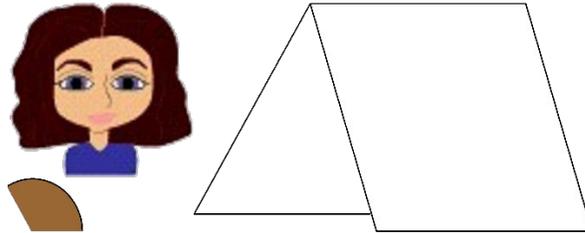
In another type of task, the facilitator can ask children how many cookies were originally in the cookie bin.

Paper Cutout Task

Paper shapes of the kids and cookies allow facilitators to give children tasks that might be called “tent tasks.” The following is a typical tent task scenario.

Leah and some of her friends went camping. During the night the campers decided that they needed a snack. Leah remembered that she had a large cookie in her bag outside the tent. She decided to share the cookie with her friends.

Assuming that Leah shared the cookie fairly, look at the illustration and decide how many friends were in the tent?



Children sometimes recognize the size of the cookie piece as they are solving a tent task. This means that they know which iconic representations match up to which fractions. For example, a child may recognize that the cookie piece matches up with the iconic representation of one third when presented with the illustration above.

Other children may solve a tent task by rotating the cookie piece around its center. Children using this method try to see how many copies of the piece are required to complete a full circle.