CANDY BARS: ADDING FRACTIONS

LESSON PLAN

For the sake of discussion, we will assume that the students are using green and red multi-link cubes (blocks).

1. Students should first represent the half of a candy bar. This would be a 2-block bar with one green and one red (shaded) block. Then they need to represent the one-third. The students will most likely create a 3-block bar with one block being red. However, the candy bars need to be the same size, so challenge the students to create two bars that have the same number of blocks, but are still one-half and one-third red, respectively. The students will easily create bars of six blocks each, 3 red and 2 red, respectively.

   When we then add the fractions, we need to combine the red blocks into one (or more) bars that are the same size as the original (6 blocks). We create one 6-block bar, with five of the six blocks being red.

   We then represent the problem arithmetically: $^1/_2 + {}^1/_3 = {}^3/_6 + {}^2/_6 = {}^5/_6$
   What is the rule for getting $^3/_6 + {}^2/_6 = {}^5/_6$?

2. The students will test out this rule on the next three problems in #2. Stress the importance of keeping all the candy bars within each problem the same size. This forces the students to find common denominators. They should then represent each problem arithmetically, and test their arithmetic rule to see if it generates the same solution as their geometric representation did.

Concepts
Adding fractions. Geometric and arithmetic representations.

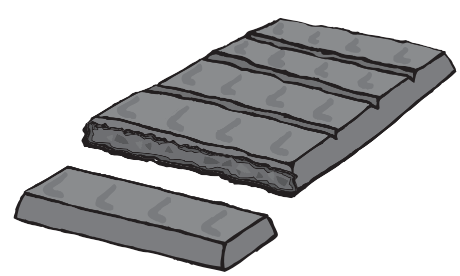
Time: 1-2 days

Materials
Multi-link cubes or colored blocks

Preparation
Each pair of students needs 20 cubes of one color, and 20 of another color.

SOLUTION DIAGRAMS (cubes & student sketches)

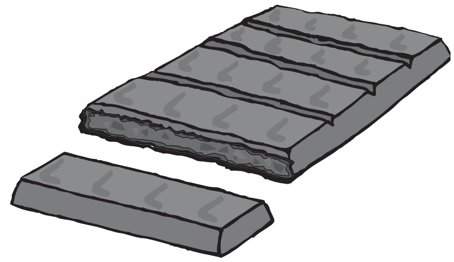
*In order to protect the integrity of these lessons in the classrooms, the solutions have been removed from this version of the project. For a copy of the entire project, including all of the solutions, order **MPJ's Ultimate Math Lessons** at http://www.mathprojects.com or call 1-800-247-6553 to order over the phone.*



CANDY BARS: ADDING FRACTIONS

Your friend shares a candy bar equally with you. Another friend shares the same kind of candy bar among three of you.

1. a) Show in the first bar below your portion of the first candy bar.
   b) Show in the second bar your portion.
   c) Show in the third bar, how much you have total.
   d) How much more do you need in order to eat a whole candy bar?



+ =

   e) Is there an easier way to figure this out, without drawing the diagrams? Show it.

2. Show how both methods above can be used to solve the following problems.

a) $\frac{2}{3}$ + $\frac{1}{6}$ =

+ =

b) $\frac{3}{5}$ + $\frac{1}{2}$ =

+ =

c) $1\frac{1}{4}$ + $1\frac{1}{2}$ =

+ =

3. Practice:

a) $\frac{2}{3}$ + $\frac{1}{2}$ =

b) $\frac{3}{2}$ + $\frac{2}{4}$ =

c) $2\frac{1}{4}$ + $1\frac{1}{3}$ =

4. Generalization:

$\frac{a}{b}$ + $\frac{c}{d}$ =

BROWNIES: MULTIPLYING FRACTIONS

LESSON PLAN

For the sake of discussion, we will assume that the students are using green and red multi-link cubes (blocks). The multi-link cubes may be used to represent multiplying fractions in two different ways. The first is in the context of the candy bars:

1. Have students represent one-half of a candy bar. Again they will most likely show 2 blocks with one block being red. Then on a second candy bar, show one-half of that one-half. Since the students cannot show half of a block, encourage them to go back and reconfigure their original candy bar. The students will easily create a 4-block bar with 2 red blocks. On the second bar they will also have 4 blocks, of which only 1 is red ($^1/_2$ of the $^1/_2$). Have them go through the same process for the next problem $^1/_2$ of $^3/_4$. (Note: They should create the $^3/_4$ candy bar first, then the one-half of the three-fourths.)

2. Once they have completed these exercises and recorded their diagrams, have the students generate an arithmetic rule for multiplying fractions, and show it in #2. They instinctively multiply the denominators to determine the number of blocks in the stick. They are then to test this rule both geometrically and arithmetically in #3. Of course, they must generalize their rule algebraically as well in #4.

> ***Concepts***
> Multiplying fractions. Geometric and arithmetic representations
>
> ***Time:*** 1-2 days
>
> ***Materials***
> Multi-link cubes or colored blocks, student handout
>
> ***Preparation***
> Each pair of students needs 20 cubes for each of 2 colors.

SOLUTION DIAGRAMS (Candy Bar Method - cube models)

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3. In #5, first ask the students what multiplication is represented by the given scenario ($^2/_3$ of $^1/_3$). Challenge them then to make a brownie (rectangle) that can be portioned into halves horizontally, and thirds vertically. How many cubes does it take to make that brownie? Partition the diagram on the handout into the six parts. Make half of that brownie red and lightly shade half of the brownie (3 blocks). Go back to the original brownie and make two-thirds of it red and lightly shade two-thirds on the diagram. Darken the overlapping shaded region in the diagram; then represent that overlapping region with red blocks on the brownie. How much of the brownie is this? Does this model still support your arithmetic rule that you created earlier?

4. Have students practice both the geometric representation and the arithmetic rule for #6.

SOLUTION DIAGRAMS (Brownie Method - cubes & student sketches)

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BROWNIES: MULTIPLYING FRACTIONS

1. With multi-link cubes...
   a) Show $\frac{1}{2}$ b) Show $\frac{1}{2}$ of $\frac{1}{2}$ c) Show $\frac{3}{4}$ d) Show $\frac{1}{2}$ of $\frac{3}{4}$

2. Is there an easier way to represent this, without drawing the diagrams? Show this symbolic method.
   a) $\frac{1}{2} \bullet \frac{1}{2}$ b) $\frac{1}{2} \bullet \frac{3}{4}$

3. Show how both methods above can be used to solve the following problem:
   a) Show $\frac{5}{6}$ b) Show $\frac{2}{3}$ times $\frac{5}{6}$

4. What is the outcome of $\frac{a}{b} \bullet \frac{c}{d}$?

5. Your friend shares a brownie equally with you. You share your portion of the brownie among you and two friends (three portions). One of the friends says "No thank you," so you keep his portion.
   a) Show, horizontally, the first portion that you receive.
   b) Show, vertically, the portion of it that you keep.
   c) What operation with fractions does this represent.

6. Represent the solution to the following problems both geometrically and symbolically.
   a) $\frac{1}{3} \bullet \frac{1}{5}$ b) $\frac{1}{3} \bullet \frac{3}{5}$ c) $\frac{1}{4} \bullet \frac{4}{5}$ d) $\frac{2}{3} \bullet \frac{3}{4}$

BEEF JERKY: DIVIDING FRACTIONS

LESSON PLAN

For the sake of discussion, we will assume that the students are using yellow, green and red multi-link cubes (blocks).

Concepts
Dividing fractions. Geometric and arithmetic representations

Time: 2 days

Materials
Multi-link cubes or colored blocks

Preparation
Each pair of students needs 10 cubes of one color, 10 of a second color and 10 of a third.

1. Use the question in #1 to hook the students. Line up 5 single cubes and ask them if these are an appropriate model for the beef jerky. They likely will say no, because they cannot represent half of a cube. The students will probably offer 5 stacks, each having two cubes. Have them draw this model on the handout, and shade half of just one stick of jerky. (Make only one cube of one stack red.) This shading of the diagram helps students see the concept of "How many halves go into five wholes?" The students should then circle as many halves as possible (ten halves). Having them separate the 5 sticks into the 10 halves helps them better understand also.

   Show students the traditional model of inverting and multiplying; and ask them to analyze it. The first 10 represents the number of single cubes in our model. The 1 represents the number of single cubes in each portion that we wish to share.

2. Have the students then represent the problem in #2: $6 \div {}^{2}\!/_{3}$. They should have 6 stacks of 3 cubes. The first stack only should have 2 red cubes. When they circle as many two-thirds on their diagram as possible, also have them separate the six sticks of jerky into as many groups of 2 as possible. (There should be nine.) Parallel this with the traditional model of inverting and multiplying. The eighteen represents the number of single cubes in our model. The two represents the number of cubes in each portion that we want to share. The question of "How many times does two-thirds go into six?" has been changed to "How many times does two go into eighteen?" The students can SEE this!

3. Have the students practice with modeling division of fractions with the four problems provided. Parts c & d are a challenge because they will be dividing a fraction by another fraction. For part c, have the students form a stick with two colors. The students start getting savvy and anticipate the division by a third so they make a stick of 15 cubes, 12 of which are green (${}^{4}\!/_{5}$) and the remainder are yellow. Now they are to make one-third of the total jerky stick (5 cubes) red. This will be five cubes. How many sets of five cubes go into the 12 cubes? (Two with two-fifths left over!) For part d, the students will have a stick of six cubes, three of which are green (${}^{1}\!/_{2}$). They then need to shade two-thirds of the six (4 cubes), but they can't because they only have 3 cubes. So the answer must be less than one. Circling the four cubes in the diagram shows that they have ${}^{3}\!/_{4}$ of a single portion!

SOLUTION DIAGRAMS (Brownie Method - cubes & student sketches)

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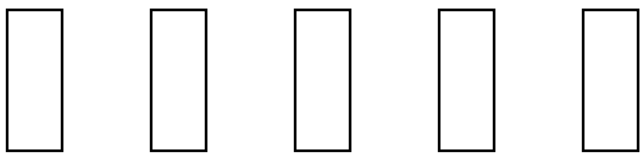
BEEF JERKY: DIVIDING FRACTIONS

1. You have 5 sticks of beef jerky. To how many friends can you give half of a stick of jerky?

   a) Use multi-link cubes to model the 5 beef jerky sticks. Record your multi-link models below.



   b) On only one stick of jerky in the diagram, shade the portion that you wish to share with each person.

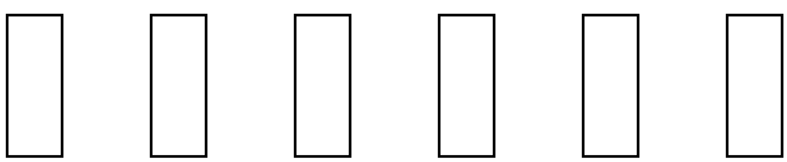
   c) Circle as many shares of that portion that you think the 5 sticks will yield. How many is that?

   d) This model is traditionally represented and solved in the following manner:

   $5 \div \frac{1}{2} = 5 \bullet \frac{2}{1} = \frac{10}{1} = 10$

   What does the first 10 represent? What does the 1 represent?

2. a) Represent the following division problem with the cubes and record that model below: $6 \div \frac{2}{3}$
   Be sure to shade the $\frac{2}{3}$ then circle as many of those $\frac{2}{3}$ portions as possible.



   b) This model is traditionally represented and solved in the following manner:

   $6 \div \frac{2}{3} = 6 \bullet \frac{3}{2} = \frac{18}{2} = 9$

   What does the 18 represent? What does the 2 represent?

3. Represent the following division problems with the cubes and record those models below. Be sure to shade the appropriate portions and circle as many of those portions as possible.

   a) $4 \div \frac{2}{5}$ b) $3 \div \frac{2}{5}$ c) $\frac{4}{5} \div \frac{1}{3}$ d) $\frac{1}{2} \div \frac{2}{3}$