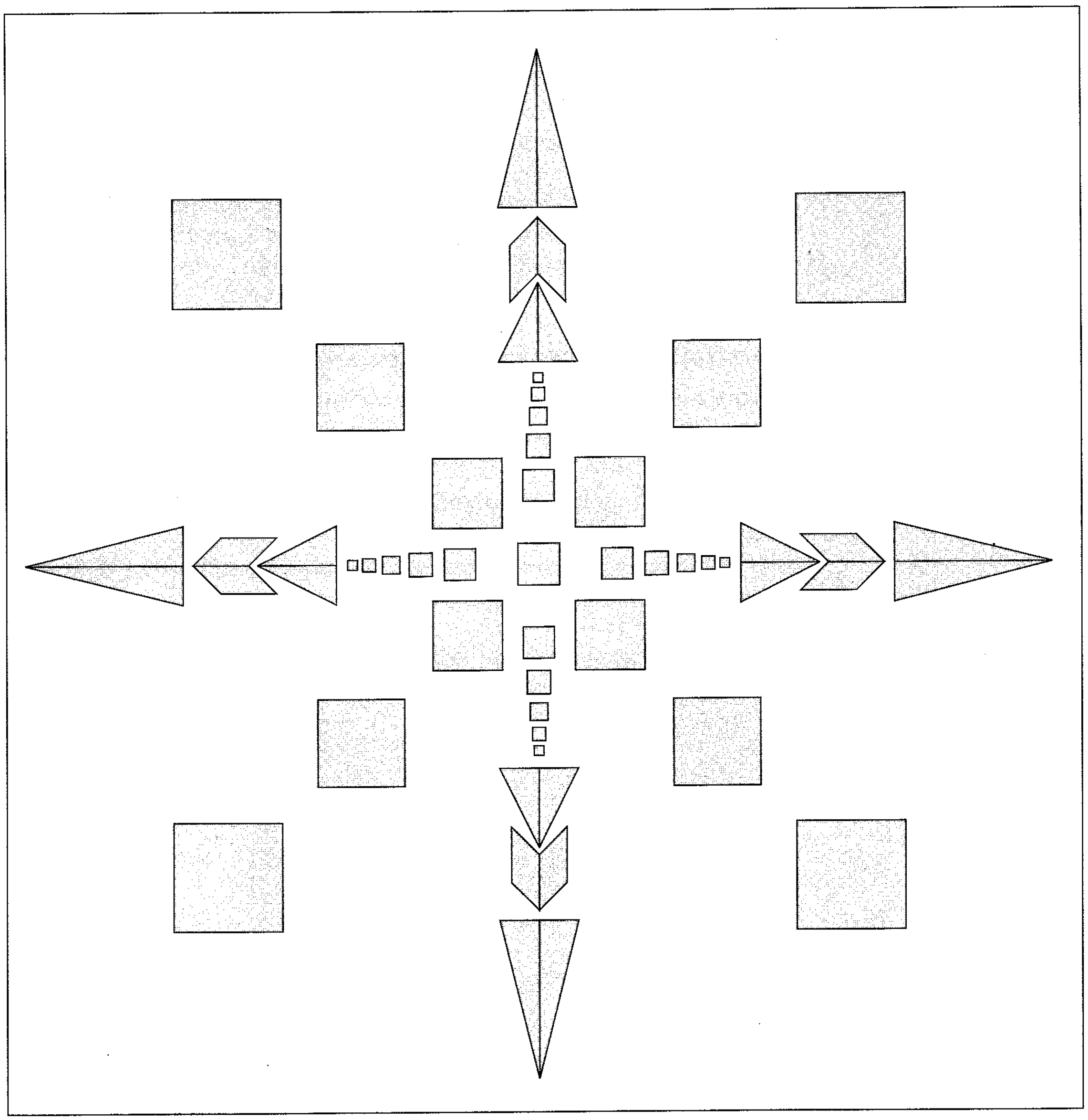
FRACTIONS

The activities that follow are organized roughly in order of difficulty. However, they may be used in the order you determine is best. The lessons are not intended to be an exhaustive study of the subject of teaching fractions. Rather, they are intended to demonstrate the range of possibilities that Power Blocks bring to the subject.



IDENTIFYING FRACTIONAL VALUES

Materials: Power Blocks
Unlined paper
Yarn loops

Purpose: To identify the fractional values within a mixed group of blocks

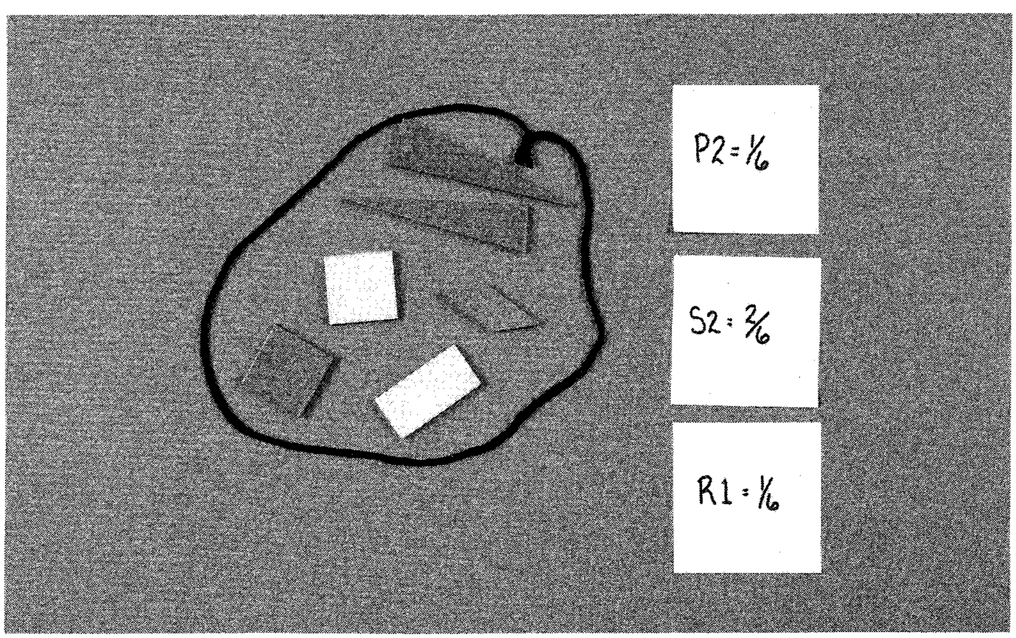
Activity: Teacher takes about six blocks at random, and places the blocks in a yarn loop.

Teacher: How many blocks are there in the loop?
Student: Six.
Teacher: How many of the blocks are S2s?
Student: Two.
Teacher: Six blocks altogether and two of the blocks are S2s. What fraction of the blocks are S2s?
Student: Two-sixths.
Teacher: Let's make a label. What fraction are P2s?
Student: Two-sixths.
Teacher: What fraction of the blocks are...

When students understand what is required, they work in pairs placing a number of blocks inside a yarn loop (limit the number of blocks to those that can be held in two hands). They label their work with slips of paper. Students may make a record of their work by tracing what they have done.

Questions to explore with students:

- How many sixths are there in your group of blocks?
- If you had seven blocks in your group, how many sevenths did it take to make your group of blocks?
- If you had five blocks in your group, how many fifths did it take to make your group of blocks?
- Do you see a pattern that would enable you to predict the number of fractional parts it takes to make one whole group?



IDENTIFYING FRACTIONAL VALUES

Materials: Power Blocks
Unlined paper

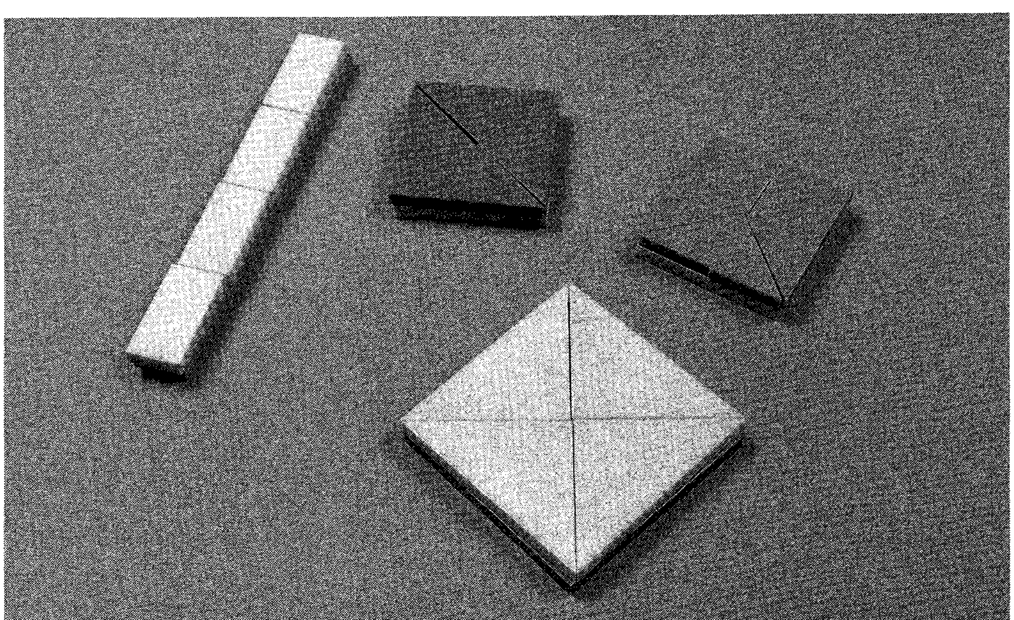
Purpose: To assign fractional values to specific Power Blocks

Activity: **Teacher**: Take out S5. S5 is one square unit of area. Are there two identical blocks that can exactly cover S5?
Student: Yes. Two R4s.
Teacher: Is there another way to cover S5 with two blocks?
Student: Yes. Two T5s.
Teacher: What fraction of S5 is R4?
Student: One-half.
Teacher: What fraction of S5 is T5?
Student: One-half.
Teacher: Pick any other block, and see how many different ways you can cover it with two identical blocks.

When students understand what is required, they may choose any block and investigate ways to cover it with four identical blocks. As students continue their explorations of ways to cover a larger block with smaller blocks that are identical, they may make a recording of their work by tracing the blocks. The drawings show how the smaller blocks cover the larger block. Students assign fractional values to the blocks covering the bottom block which is defined as one square unit of area.

Questions to explore with students:

- If T4 is one fourth, how many fourths make a one square unit of area?
- If R4 equals one square unit of area, how many halves did it take to cover it? How many fourths? How many eighths? How many sixteenths? If you knew the fractional value of one covering block, do you see a pattern that would help you predict the number of blocks it would take to cover R4?
- If you had blocks that were thirds, fifths, or sixths, could you predict how many it would take to cover one square unit of area?



NONCONGRUENT WHOLE UNITS OF AREA

Materials: Power Blocks
Unlined paper

Purpose: To make different shapes that have one square unit of area

Activity: **Teacher**: If T3 is one-half square unit of area, how would you make a shape that is one square unit of area?
Student: Use two T3s.
Teacher: See how many different ways you can make one square unit of area using T3s. Make sure the sides of the blocks are touching.

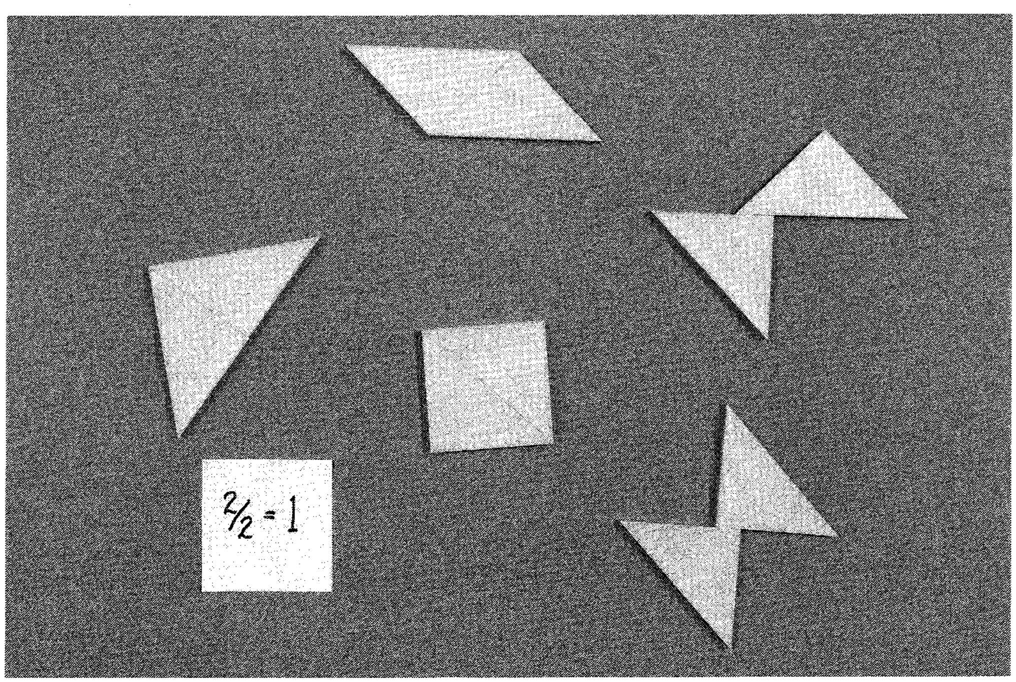
The teacher changes the definition of one-half square unit of area. Students repeat the activity until they are comfortable with the idea that shapes can have the same area and not look alike.

Teacher: If P4 is one-fourth of a square unit of area, see how many ways you can make shapes with one square unit of area.
Student: Can we use other blocks?
Teacher: What do you mean?
Student: Some blocks have the same area as P4, but are different shapes. Can we use them?
Teacher: Yes, as long as they are the same area as P4.

When students understand what is required, they may define any block in terms of a fraction with a numerator of one. They then see how many different ways they can make shapes of one square unit of area. They may make a record of what they have done by tracing their work.

Questions to explore with students:

- Can different shapes have the same area?
- Is there a limit to the number of ways you can make shapes with the same area?



ASSIGNING RELATIVE FRACTIONAL VALUES

Materials: Power Blocks
Unlined paper
Table of Relative Areas (blackline master)

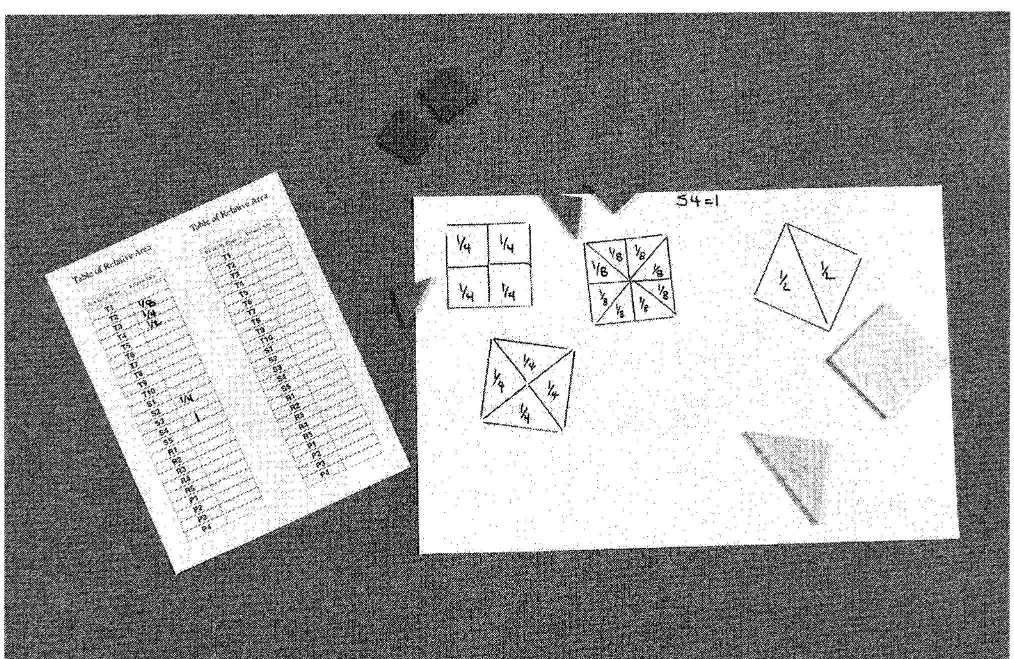
Purpose: To assign relative fractional values to the blocks

Activity: **Teacher:** Take out S5. Trace it on a piece of paper. S5 is one square unit of area. How many T3s does it take to exactly cover S5?
Student: Four.
Teacher: Correct. What fraction of S5 is T4?
Student: One-fourth.
Teacher: Make a tracing that shows how four T4s make S5, and record the fractional value of each T3 on your tracing. If S5 is one square unit of area, how much is T3?
Student: One eighth.
Teacher: See if you can determine the area of each of the different blocks.

Students may record their results by making tracings and writing the fractional values in a Table of Relative Areas. When they have determined the areas of the various blocks, change the definition of one square unit of area and repeat the process. One square unit of area can be defined in terms of any block or combination of blocks.

Questions to explore with students:

- If P3 equals one, what are the areas of the other blocks?
- If R4 equals one, what are the areas of the other blocks?
- If S5 equals 1/3, what are the areas of the other blocks?
- If S3 equals 3/7, what are the areas of the other blocks?
- Do you see a pattern that would help you predict what a block's area would be once you decide the area of one of the other blocks?



BUILDING FRACTIONAL AREAS

Materials: Power Blocks
Unlined paper
Table of Relative Areas (blackline master)

Purpose: To make shapes with fractional areas that have numerators larger than one

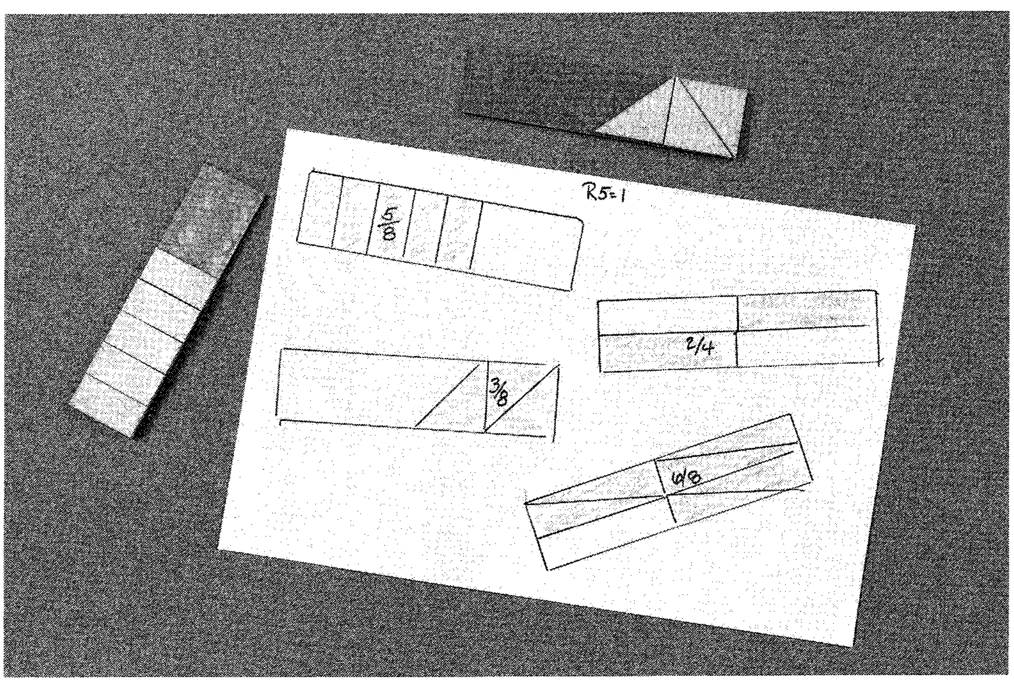
Activity: Students complete a Table of Relative Areas for R5 equal to one square unit of area.

Teacher: Take out R5 and trace it on a piece of paper. Cover part of R5 with five R1s. What fraction of R5 is covered by R1s?
Student: Five-eighths.
Teacher: Right. Trace the R1s on top of your tracing of the R5 to show how they cover five-eighths of R5. Color the five-eighths part of your tracing. Take out three T3s, and put them on top of the R5. What fraction of R5 is covered by T3s?
Student: Three-fourths.

When students understand what is required, they cover part of R5 as many different way as they can with smaller identical blocks. They record their results.

Questions to explore with students:

- Can you generate fractions with numerators larger than one, if R3 = 1?
- Choose any block and make it equal to one square unit of area. Can you generate fractions with numerators larger than one?



BUILDING SHAPES WITH AREAS THAT ARE MIXED NUMBERS

Materials: Power Blocks
Unlined paper

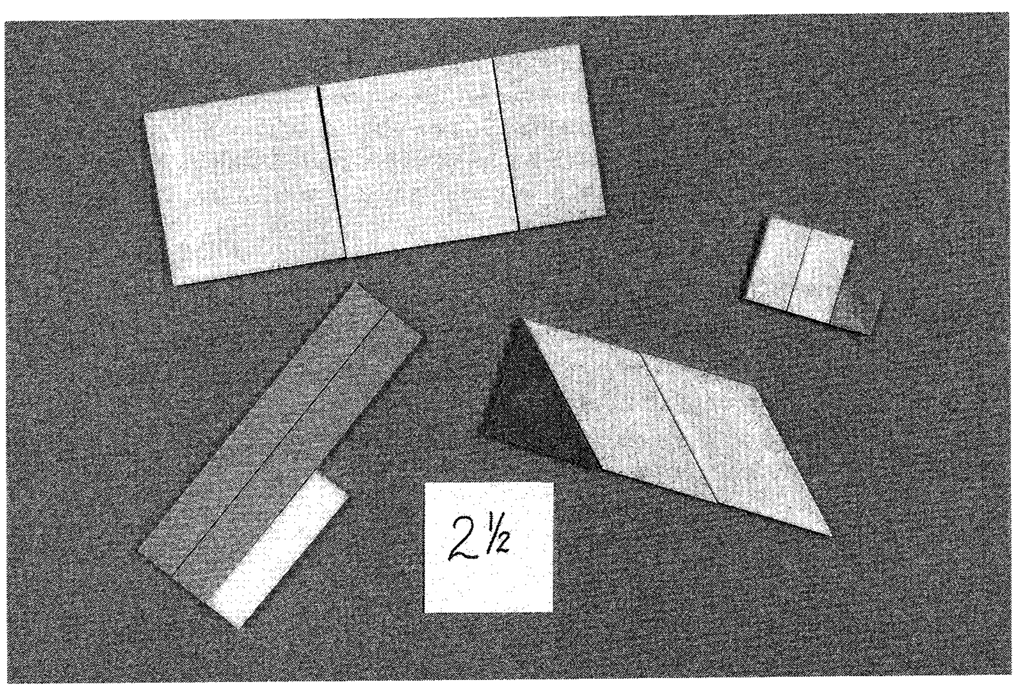
Purpose: To build shapes that have areas that are mixed numbers and to provide additional experience with the arbitrary nature of the definition of one whole unit

Activity: **Teacher**: Today we are going to make shapes that have areas that are mixed numbers. A mixed number is a number that is a whole number, like two, combined with a fraction, like one-half. Define one square unit of area with any block you want except T1.
Student: Any block?
Teacher: Yes. Now make a shape that has an area of two and one-half. What blocks did you use?
Student: Two S4s and one T4.
Teacher: Did anyone make two and one-half a different way?
Student: Yes, I did it with two P2s and one P1.
Teacher: Make two and one-half as many different ways as you can? You may choose any block to be one square unit.

When students understand what is expected, they work independently building specific mixed numbers generated by the class (for example 1 3/4). They may change the definition of one square unit as they deem necessary. Students may make labels on slips of paper to identify the various groups of blocks, or they may make a record of their work by tracing and labeling the blocks in their drawings.

Questions to explore with students:

- Make a mixed number. Ask a neighbor to determine "one".
- If your neighbor tells you the mixed number, could you determine what "one" was? If so how?



EQUIVALENT FRACTIONS

Materials: Power Blocks
Graph Paper (blackline master)
Table of Relative Areas (blackline master)

Purpose: To create a list of equivalent fractions

Activity: Students complete a Table of Relative Areas for S5 equal to one square unit of area.

Teacher: Take out P3. What is the area of P3? Use your Table of Relative Areas to get the answer.
Student: One-fourth.
Teacher: Is it possible to cover P3 with two triangles?
Student: Yes. Two T3s.
Teacher: What is the area of T3? Use your table to get the answer.
Student: One-eighth.
Teacher: Right. How many eighths did it take to cover P3?
Student: Two.
Teacher: I want you to record your results like this on the graph paper:

P3= 1/4= 2/8

How many T2s does it take to cover P3?
Student: Four.
Teacher: What is the area of T2?
Student: One-sixteenth.
Teacher: Record your results like this:

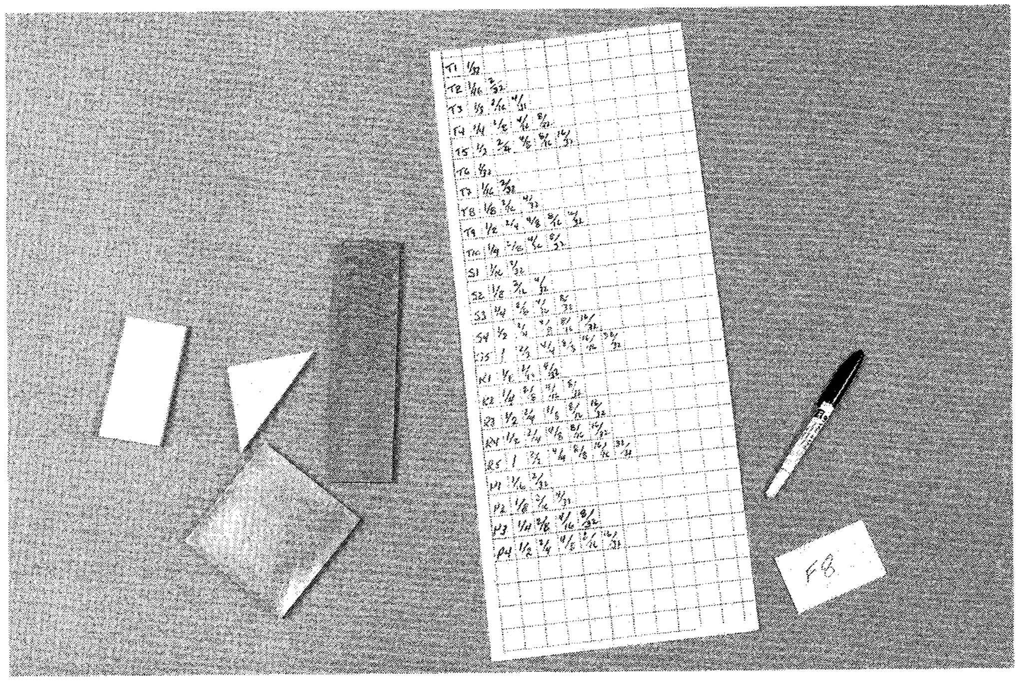
P3 = 1/4= 2/8= 4/16

Teacher: Are there any other ways to cover P3 with triangles?

Students choose another block and explore it in the same way. This exploration continues for each block in the set. Students are always to look for the number of smaller blocks that make larger blocks. The teacher saves the results of student explorations and consolidates them into a table. When students understand what is required, they collect the data and create their own tables for any definition of one square unit of area.

Questions to explore with students:

- Look at the table I have made from data you have given me. Do you see a pattern?
- If you knew the area of a block, could you predict the equivalent fractions that could be made with other blocks?
- Do you see a pattern that would enable you to make a list of equivalent fractions for any fraction?



EQUIVALENT FRACTIONS - TRADING DOWN

Materials: Power Blocks
Table of Relative Areas (blackline master)
Unlined paper

Purpose: To identify specific equivalent fractions by trading larger blocks for smaller blocks

Activity: Students complete a Table of Relative Areas for S5 equal to one square unit of area.

Teacher: Make a shape that has an area of 3/4 of a square unit. How did you do it?
Student: I used three R2s.
Teacher: Did anyone do it a different way?
Student: I use three P3s.
Teacher: Are there any other ways to make 3/4?
Student: I did it with three T3s and three T10s.
Teacher: Can you trade the blocks in your 3/4 for smaller blocks with the same shape and still have the same total area?
Student: I can trade my three R2s for six R1s.
Teacher: How much is one R1?
Student: One-eighth.
Teacher: How many eighths did it take to make 3/4?
Student: Six.
Teacher: Did anyone do it a different way?
Student: I traded three T3s for six T2s.
Teacher: Record it by tracing what you have done and writing the results like this:

3 T3s = 3/4 = 6/8 =

or

3 P3s = 3/4 = 6/8 =

or

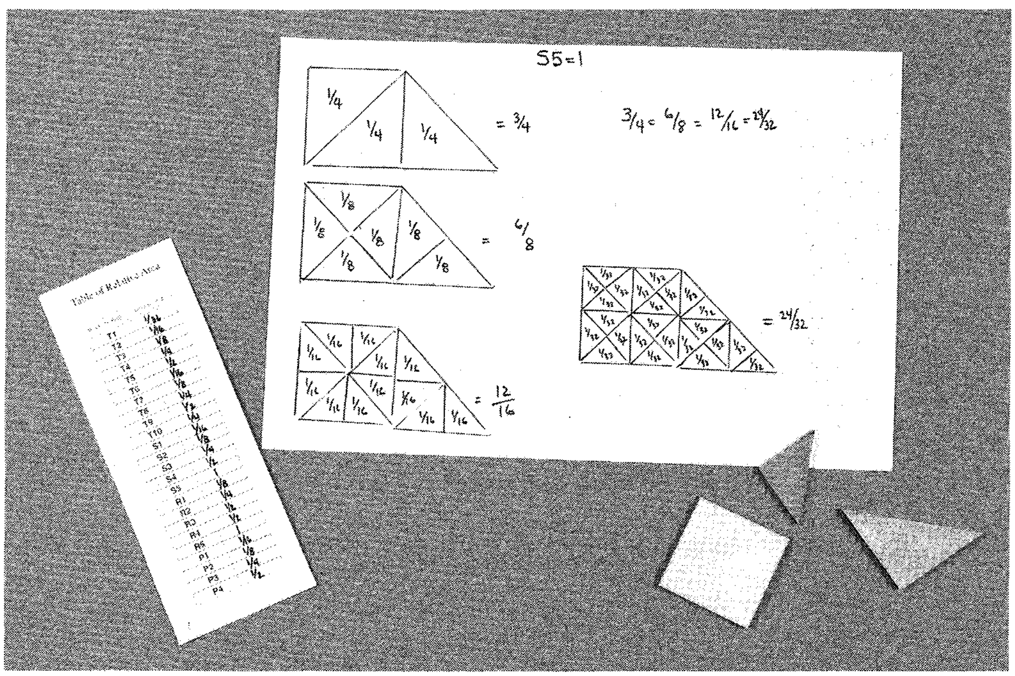
3 R3s = 3/4 = 6/8 =

Are there other identical smaller blocks that are equivalent to 6/8?

When students understand the process of trading down to smaller blocks that have the same total area as the starting area, the teacher and the class generate a series of fractions for the class to explore (for example: 3/8, 5/8, 3/16, 5/16, 7/16).

Questions to explore with students:

- Do you see a pattern that would enable you to make a list of equivalent fractions for any starting fraction?



EQUIVALENT FRACTIONS - TRADING UP

Materials: Power Blocks
Lined paper
Table of Relative Areas

Purpose: To trade groups of identical smaller blocks for larger blocks

Activity: Students complete a Table of Relative Area for S5 equal to one square unit of area.

Teacher: You need seven T2s. How many T2s does it take to make a T3?
Student: Two.
Teacher: Trade as many of your seven T2s for as many T3s as you can? How many T3s did you get?
Student: Three.
Teacher: Did you have any blocks left over?
Student: Yes. One T2.
Teacher: Look at your Table of Relative Areas, what is the area of T2?
Student: One-sixteenth.
Teacher: How many sixteenths did we start with?
Student: Seven.
Teacher: What is the area of T3?
Student: One-eighth.
Teacher: How many eighths did you have when you finished trading?
Student: Three.
Teacher: How many sixteenths did you have when you finished trading?
Student: One.
Teacher: Here is how to make a record of what you have done:

7 T2s = 7/16 = 3/8 + 1/16

When students understand the process of trading smaller blocks up for larger blocks, they create there own problems by taking arbitrary amounts of identical smaller blocks and trading until they can trade no more. For example if they started with nine T1s, they would go through the following series of trades:

9 T1s = 9/32 = 4/16 + 1/32

9 T1s = 9/32 = 2/8 + 1/32

9 T1s = 9/32 = 1/4 + 1/32

Questions to explore with students:

- If R4 = 1, can you create addition problems in the same way you did for the previous problems?
- Were there any situations in which you could not trade up?
- If you knew the fractions on the right side of the equations, could you use the blocks to determine what the starting fraction may have been?

EQUIVALENT FRACTIONS - TRADING UP (SIMPLIFYING)

Materials: Power Blocks
Unlined paper
Table of Relative Areas (blackline master)

Purpose: To identify equivalent fractions by trading smaller blocks for larger blocks (simplifying)

Activity: Students complete a Table of Relative Area for S5 equal to one square unit of area.

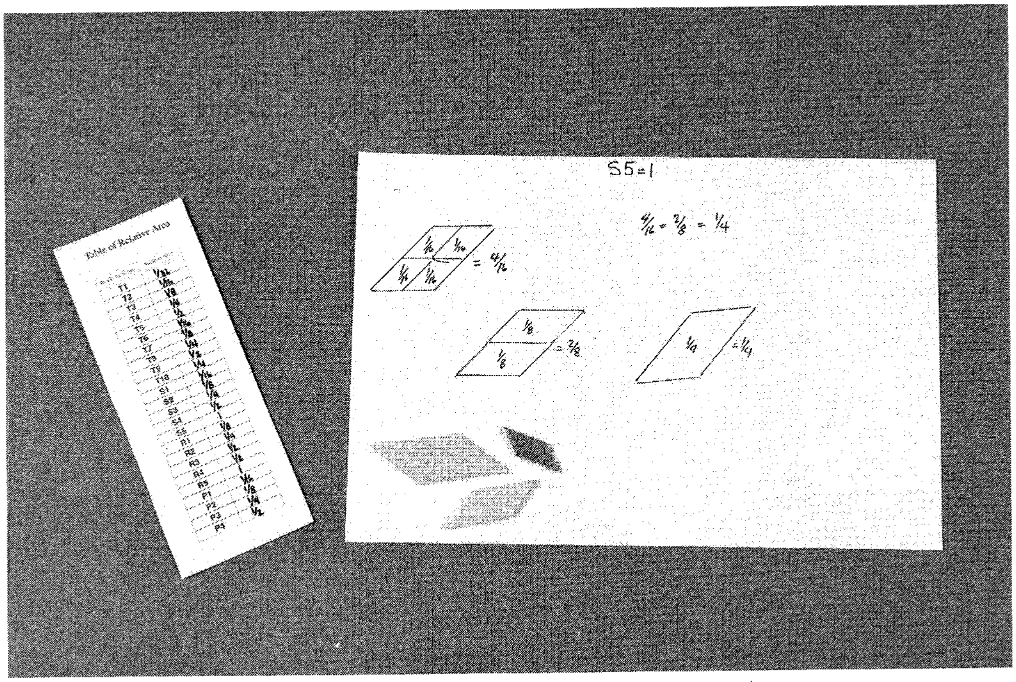
Teacher: Yesterday when we were trading up, you could trade some of your blocks or all of your blocks. Today, we can only make trades if we can trade all of our blocks. This is called simplifying. Take out four R1s. What is the combined area of four R1s?
Student: Four-sixteenths.
Teacher: Can you trade the 4/16s for identical larger blocks?
Student: Yes. I can trade two R1s for an R2.
Teacher: How many R2s did you use to make trades?
Student: Two.
Teacher: How would you write two R2s as a fraction?
Student: Two-eighths.
Teacher: Can you trade the R2s for larger blocks.
Student: Yes, one R4.
Teacher: Did anyone do it a different way?
Student: Yes, I did it with one R3.
Teacher: What are the areas of R3 and R4?
Student: They are both 1/4.
Teacher: Record by tracing what you have done and writing the results like this:

4 R1s = 4/16 = 2/8 = 1/4

When students understand the process of trading all their smaller blocks up to larger blocks that have the same total area as the area of the blocks they started with, the teacher and class generate a list of fractions to explore (for example: 2/16, 6/16, 8/16, 12/16, 2/8, 4/8, 6/8, 2/4).

Questions to explore with students:

- If R4 = 1, create fractions of your choice. Which of your fractions can be simplified? Which ones cannot be simplified?
- Do you see a pattern that would enable you to predict fractions that can be simplified and those that cannot be simplified?



ADDITION - SAME DENOMINATORS

Materials: ______ Power Blocks
Table of Relative Areas (blackline master)
Unlined paper

Purpose: ______ To add the areas of congruent blocks

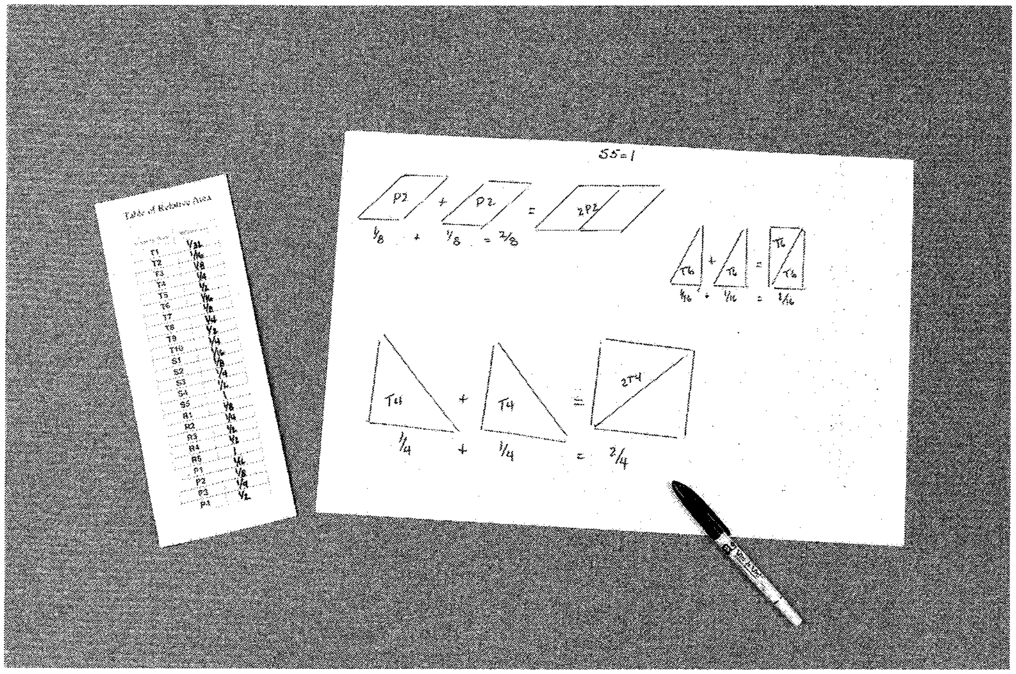
Activity: ______ Students complete a Table of Relative Area for S5 equal to one square unit of area.

Teacher: Take out two T4s. What is the area of one T4?
Student: One-fourth.
Teacher: What is the area of the two T4s if we combine them into one shape?
Student: Two-fourths.
Teacher: Can you simplify your answer by trading the two T4s for another block?
Student: Yes, I traded it for one T5.

When students understand what is required, they generate their own addition problems by combining congruent blocks into a single shape. The teacher can control the difficulty of the problems by limiting the number of blocks students can use in a given problem. They may record their work by tracing the blocks and writing equations. They may simplify their solutions by trading up if they wish.

Questions to explore with students:

- If you changed the definition of one square unit of area, could you generate different problems?
- Do you see a pattern that would enable you to predict the solution to addition problems in which the denominators are the same?



SUBTRACTION - SAME DENOMINATORS

Materials: Power Blocks
Table of Relative Areas
Unlined paper

Purpose: To create and subtract shapes using congruent blocks

Activity: Students complete a Table of Relative Area for S5 equal to one square unit of area.

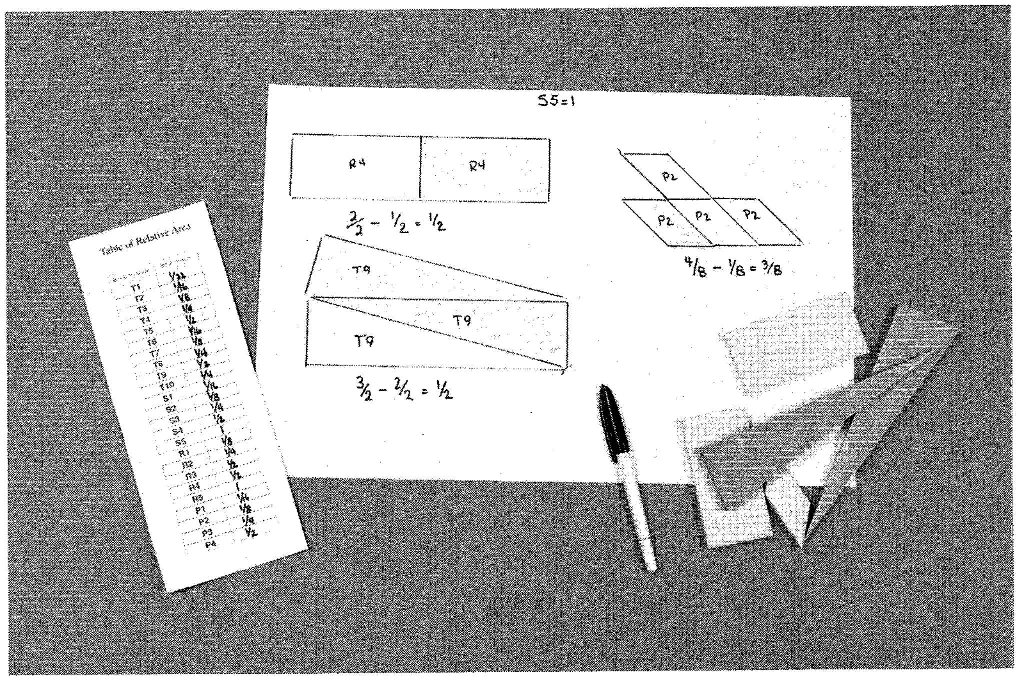
Teacher: Make a shape using four P2s, and record what you have done by tracing it.
Student: Do we just trace the outline, or do we show each little shape that makes the big shape?
Teacher: Show the little shapes. What is the area of the shape you have made?
Student: Four-eighths.
Teacher: Now take away one of the P2s. What is the area of the shape that remains?
Student: Three-eighths.
Teacher: Record what you have done by shading the blocks that you took away. Then write the equation like this:

$$4/8 - 1/8 = 3/8$$

When students understand what is expected, they independently create their own shapes and subtract congruent blocks of their choice from the larger shape.

Questions to explore with students:

- If you changed the definition of one square unit of area, could you generate different problems?
- Do you see a pattern that would enable you to predict the solution to subtraction problems in which the denominators are the same?



ADDITION - DIFFERENT DENOMINATORS

Materials: Power Blocks
Unlined paper
Table of Relative Areas (blackline master)

Purpose: To have students generate addition problems using blocks

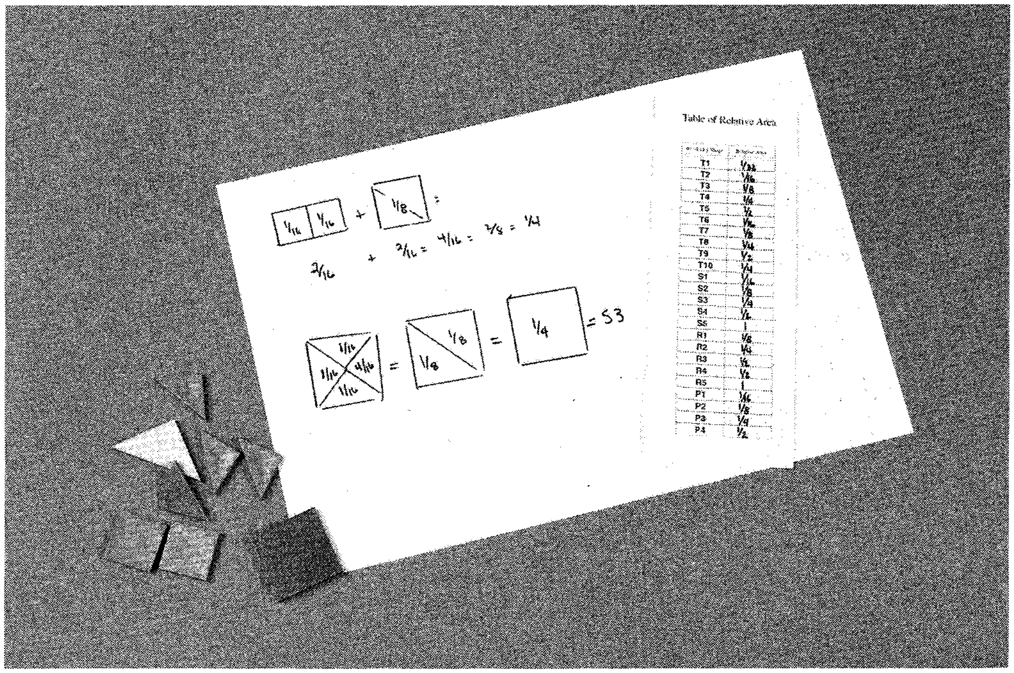
Activity: Students complete a Table of Relative Area for S5 equal to one square unit of area.

Teacher: Take out T5 and T4. Make a shape using the two blocks. What is the area of T5?
Student: One-half.
Teacher: What is the area of T4?
Student: One-fourth.
Teacher: Trace T5 on your piece of paper. Put a plus sign after it. Trace T4 next to the plus sign. Put an equals sign after the T4. Then trace the combined shape after the equals sign. Write the shapes' areas beneath each tracing. The two fractions have different denominators. What could you do to get the denominators the same?
Student: Trade T5 down for two T4s.
Teacher: If we do that, what is the area of the shape we combined from T5 and T4?
Student: Three-fourths.
Teacher: Record your work as an equation.

When students understand what is expected they independently create their own addition problems by taking blocks at random and combining them to make a single shape. They record their work by tracing what they have done, and writing an equation. The difficulty of the shapes students choose to build may be controlled by limiting the number of blocks they may use.

Questions to explore with students:

- If you changed the definition of one square unit of area, could you generate different problems?
- Do you see a pattern that would enable you to predict the common denominator for any problem you create?



SUBTRACTION - DIFFERENT DENOMINATORS

Materials: Power Blocks
Unlined paper
Table of Relative Areas (blackline master)

Purpose: To have students generate their own subtraction problems.

Activity: Students complete a Table of Relative Area for S5 equal to one square unit of area.

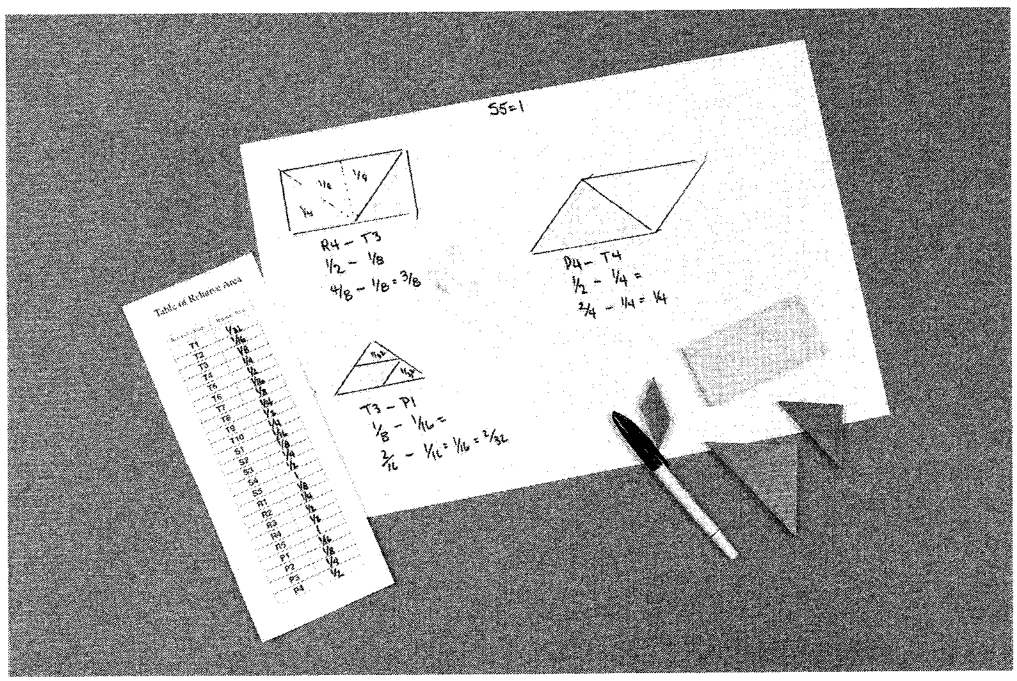
Teacher: Take out P4. Trace it. What is the area of P4?
Student: One-half.
Teacher: Take out T4. What is the area of T4?
Student: One-fourth.
Teacher: Cover part of P4 with T4. Trace what you have done. Shade the part of the drawing that is covered by T4. This is the way I want you to show the part of P4 we are subtracting. How could we show what we have done with numbers?
Student: Write: one-half minus one-fourth.
Teacher: Suppose we wanted both fractions to have the same denominators. What could we do?
Student: Trade P4 for two T4s. Then all the blocks would have the same denominators.

Teacher: How could we write that?
Student: Two-fourths minus one-fourth.
Teacher: What is left after we subtract the one-fourth?
Student: One-fourth.

When the students understand the process, they generate their own subtraction problems. They select a block and place a smaller block on top of it. They record their work with drawings and equations.

Questions to explore with students:

- If you changed the definition of one square unit of area, could you generate different problems?
- Do you see a pattern that would enable you to predict the common denominator for any problem you create?



MULTIPLICATION OF FRACTIONS

Materials: Power Blocks
Lined paper
Table of Relative Areas

Purpose: To have students find the answers to problems like, "What is 1/2 of 1/4?"

Activity: Students complete a Table of Relative Area for S5 equal to one square unit of area.

Teacher: Take out S5. What is the area of S5?
Student: One.
Teacher: What is one-half of S5?
Student: T5.
Teacher: What is the area of T5?
Student: One-half.
Teacher: I want you to record your results like this:

1/2 of 1 = 1/2

Take out P1. What is the area of P1?
Student: One-sixteenth.
Teacher: What is one-half of P1?
Student: T1.
Teacher: What is the area of T1?
Student: One-thirty-second.
Teacher: Add this information to your table.

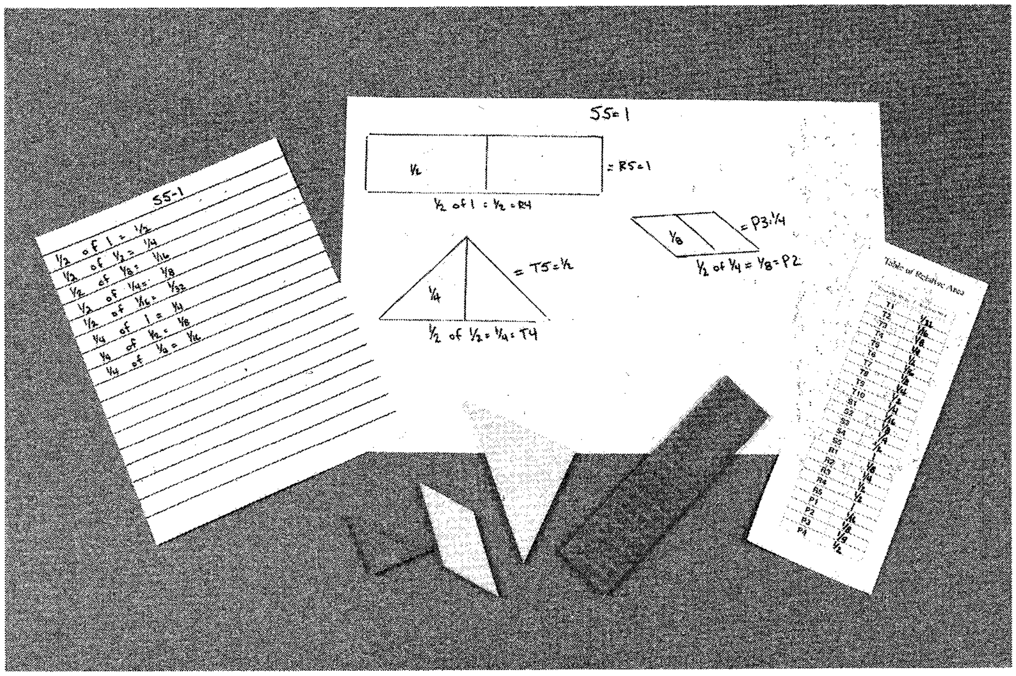
1/2 of 1 = 1/2
1/2 of 1/16 = 1/32

When the class understands the process, they are asked to find 1/2 of the area for as many blocks as they can. When they have done this, they are asked to find 1/4 of the area for as many blocks in the set as they can. They do the same thing for 1/8s and 1/16s. The data is added to their list.

The teacher carefully selects other problems for the class to explore because not all problems can be done with the blocks. Examples of other problems to explore are: What is 3/8 of R4, 3/4 of P4, 5/8 of T4?

Questions to explore with students:

- Do you see a pattern that you could use to predict the answer to questions like, "What is three-eighths of one-fourth"?



DIVISION OF FRACTIONS

Materials: Power Blocks
Lined paper
Table of Relative Areas (blackline master)

Purpose: To have students determine how many blocks of a specified area are in another block

Activity: Students complete a Table of Relative Area for S5 equal to one square unit of area.

Teacher: Here is how I want you to record what we are about to do. Make three columns on your paper. Write your headings like this:

Large piece	Small piece	Number

Take out S5. What is the area of S5?
Student: One.
Teacher: Record it like this:

Large piece	Small piece	Number
1		

Take out T5. What is the area of T5?

Student: One-half.
Teacher: Record it like this:

Large piece	Small piece	Number
1	1/2	

How many T5s are in the S5?
Student: Two.
Teacher: Record it like this:

Large piece	Small piece	Number
1	1/2	2

Take out T4. What is the area of T4?
Student: One-fourth.
Teacher: How many T4s are in S5?
Student: Four.
Teacher: Record it like this:

Large piece	Small piece	Number
1	1/2	2
1	1/4	4

When the class understands the process, they are asked to create problems in which they find the number of smaller blocks in a larger block. They add the information to their table.

Questions to explore with students:

- Do you see a pattern that will enable you to predict the number of times a block will go into another block?