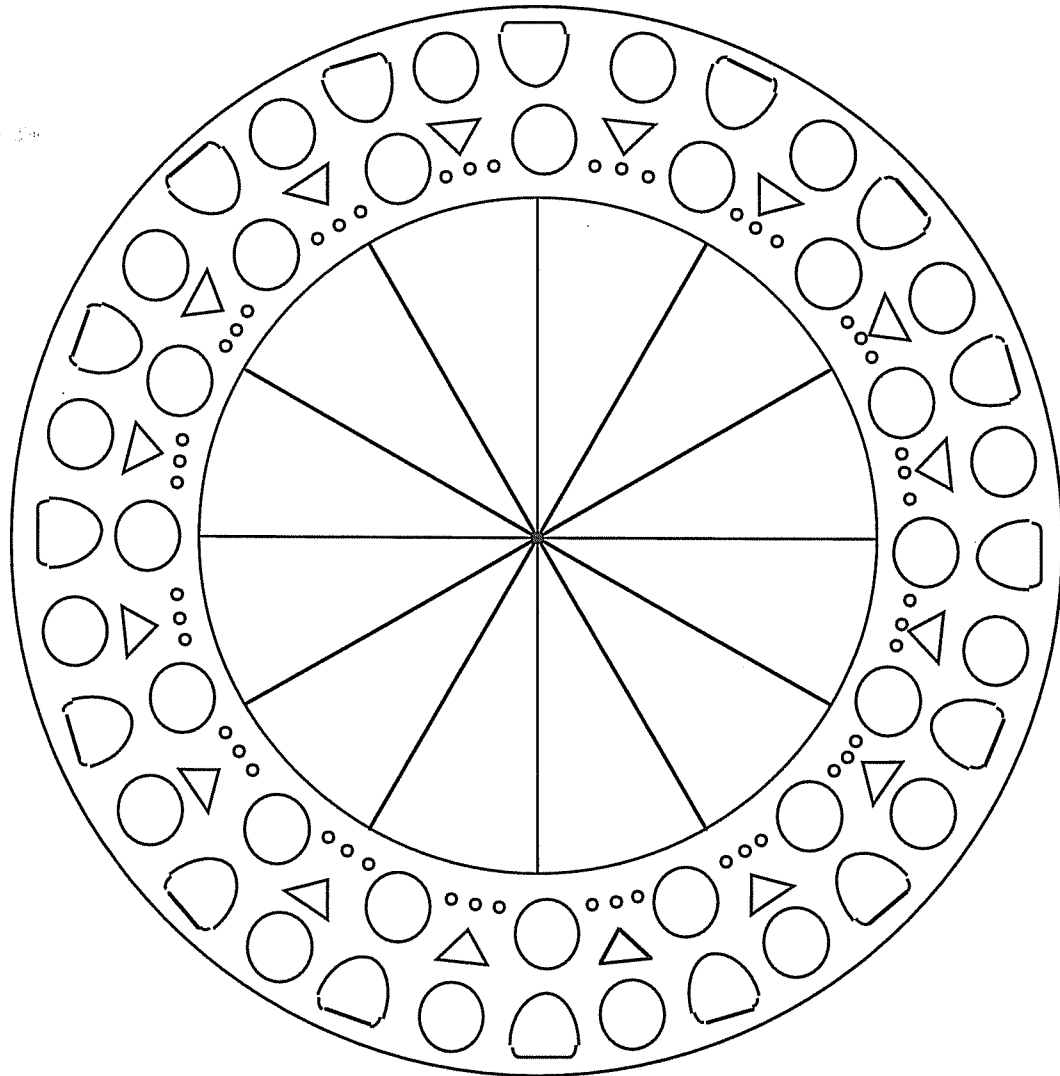


Patterns in Arithmetic
Fractions - Booklet 1 PDF
Basic Concepts
Parent/Teacher Guide



By Alysia Krafel, Suki Glenn, and Susan Carpenter

Illustrations by Karen Minns and Suki Glenn
Based on methods developed by Prof. Michael Butler at the
UCI Farm Elementary School
University of California, Irvine

Fractions: Booklet 1 - PDF - Basic Concepts

Contents

Assessment Guide	i	Pattern Block Games	19
Pre-Assessment	1	My Fractions Book: Pattern Blocks	20
In the Kitchen	5	Changing Wholes: Beginning	22
Free Exploration	6	Fractional Parts of Sets	25
My Fractions Book: Beginning	8	My Fractions Book: Number Lines	26
Numerators Greater Than One	10	My Fractions Book: Equivalence	27
Whole Numbers as Fractions	12	My Fractions Book: Equivalence - Number Lines ...	29
Fraction Card Game.....	13	Answer Key	30
Greater Than and Less Than	14		
Recording Fractions: Prism Set	15		
Sorting Fractions	17		

This booklet is dedicated to Susan Carpenter. Without her editing skills, mathematical knowledge, friendship, dedication, and support I could not have made or finished this math series. Suki Glenn

Acknowledgments

The knowledge, patience, and dedication of Professor Michael Butler made the UCI Farm Elementary School and this mathematics program possible. Special thanks go to Alysia Krafel and Susan Carpenter, who helped develop much of the math materials based on the teachings, ideas, and insights of Professor Butler.

For many years Farm School teachers, students, parents, and staff have shared their unfailing delight in learning. Thank you for your support and dedication.

The books would never have been completed if the students at Chrysalis Charter School in Redding, California, under the guidance of Alysia and Paul Krafel, hadn't needed them. Thank you for your patience through all of the draft copies.

Susan Carpenter edited, added her wise words, useful suggestions, and helped make the Answer Keys a reality. Karán Founds-Benton contributed her meticulous editing skill and knowledge. Diligent and thorough copy editing was done by Zephyr Alfanash and Jacqueline Logue.

The cover mandala and many delightful illustrations are by Karen Marie Christa Minns. Other illustrations are by Suki Glenn and ClickArt by T/Maker.

To all of the mathematicians, from antiquity to the present, who discovered the principles of mathematics goes our heartfelt appreciation for your dedication.

Fractions: Booklet 1 finished on 11/12/13

Patterns in Arithmetic: Fractions - Booklet 1 PDF

Parent/Teacher Guide

©2014 Pattern Press

Published by Pattern Press
P.O. Box 2737
Fallbrook, CA 92088
(760)728-3731

All rights reserved.

Practice worksheets may be duplicated.

Printed on recycled paper.



www.patternpress.com

E-mail: Patternpress1@gmail.com

ISBN 978-1-935559-57-3

Assessment Guide

Purpose The purpose of this guide is to assess the fundamental knowledge necessary for success in this booklet.

The Pre-Assessment is a preview of the new material presented in this booklet and is used to set the baseline for what the student already knows at the beginning of instruction.

The Post-Assessment is administered to determine if the student learned the material that was presented in this booklet. A comparison of the score on Pre-Assessment to the score on the Post-Assessment will give both you and your student a sense of growth. The Post-Assessment is the same as Pre-Assessment.

Prerequisites None

Materials Fractions: Booklet 1 - Pre-Assessment - Worksheets 1 - 4, pages 1 - 4
Score Sheets, pages v - viii in this booklet
Prism Fractions or Fraction Circles
Pattern blocks

Note If you do not have the pink or black pattern blocks in your set, make them with pattern blocks; directions are on page iv.

Instructions The student may use fraction circles or Prism Fractions Circles, and pattern blocks to complete the test. Give him at least fifteen minutes of free exploration time with the materials before the test.

Instruct the student to attempt all the problems. If the student does not know how to do a problem, he should put a question mark by it. This will let you know he looked at the item and decided he could not do it.

It is acceptable to read the items to a student. We are assessing math, not reading. But, do not explain any items to him. If he does not know what the question means, tell him to put a question mark on that item.

After scoring the assessment, use results with the Booklet Selection Guide to place your student. The answers are in the Answer Key.

Assessment Guide This Assessment Guide explains what concept each item on the test is assessing. The item numbers match the item numbers on the student test page. The title of the lesson and Booklet number tell you where the concept is taught. In the Assessment Guide, under each lesson title are several assessment criteria. Each criterion is labeled with capital letters 'A,' 'B,' etc. These criteria tell you what to look for in the student work. On the student test, sometimes multiple problems are used to test a concept. These multiple problems are labeled with small letters 'a,' 'b,' etc. Score sheets that match the Assessment Guide for both the Pre-Assessment and Post-Assessments follow.

**Assessment
Criteria**

All criteria are from Fractions: Booklet 1

Can the student:

1. My Fractions Book: Beginning
 - A. use a fraction manipulative to identify the one-third piece?
2. My Fractions Book: Beginning
 - A. use the fraction manipulative to identify the one-fourth piece?
 - B. indicate it takes four-fourths to make a whole?
3. My Fractions Book: Beginning
 - A. identify the one-sixth piece?
 - B. indicate it takes six-sixths to make a whole?
4. Sorting Fractions
 - A. demonstrate that he understands that the two halves must be of equal size by picking out the three designs that are cut into two equal parts?
5. My Fractions Book: Beginning
 - A. write the name of the fraction given in standard fraction notation?
6. Greater Than, Less Than
 - A. use a greater than, less than symbol to show that one-fourth is less than three-fourths?

The test is to see if he can use the manipulative to determine the relative sizes of the fractional units given.
7. Numerators Greater Than One
 - A. divide the rectangle into four roughly equal parts?
 - B. shade in three of the four parts?
8. Greater Than, Less Than
 - A. choose the larger fraction from a pair of two unlike fractions with ones in both numerators?
9. Greater Than, Less Than
 - A. choose the larger fraction from a pair of two unlike fractions with different numbers in the numerator?
 - B. Rubric for 'How do you know?'
 - 1 point: I measured and $\frac{4}{5}$ is bigger than $\frac{3}{5}$.
 - 2 points: Fifths are bigger than sixths and four is bigger than three so four-fifths must be larger than three-sixths.
10. Changing Wholes: Beginning
 - A. choose the correct whole given the size of the one-sixth block?

Give him pattern blocks to solve this problem. This item tests his understanding of the relationship between parts and wholes in fractions. He must choose the larger block that takes six greens to cover it.

11. Changing Wholes: Beginning

- A. use pattern blocks to find the value of the blue block if yellow equals one?
- B. find the value of the blue block if the yellow equals one-half?

12. Changing Wholes: Beginning

- A. shade in half of each pizza?

1 point - The wholes are not the same.

2 points - The size of the half is made by the size of the whole, or if the whole is bigger, then the half will be bigger too.

This is to test if he understands that the whole can be defined as anything you like. Once that definition is made, all other fractional units are established by their relationship to the whole.

13. My Fractions Book: Equivalence

- A. use the manipulative to match several smaller pieces to the size of the $\frac{1}{2}$ piece?
- B. list at least two of the four equal fractions possible?

Have him use fraction circles or Prism Fractions. This is to test if he understands that 'equal' means covering the same area. Can he match up a greater number of smaller pieces to cover the exact same area that the larger one-half piece covers?

14. My Fractions Book: Equivalence

- A. use the manipulative to match the nine-twelfths to the three-fourths?

15. My Fractions Book: Equivalence

- A. use the manipulative to match two-sixths to the one-third?

16. Equivalence: Recording

- A. use the manipulative to determine four halves would cover two wholes?
- B. extend the number pattern to fill in missing numbers?

17. My Fractions Book: Number Lines

- A. identify that the arrow points to one-third in the problem?

To interpret a number line, the student must first understand that the space between the zero and the one is the whole, and that the number of equal sections the space between zero and one is divided into determines the fractional part. Many students have difficulty with fractional number lines.

18. My Fractions Book: Number Lines

- A. identify that the arrow points to three-fifths?

19. Numerators Greater Than One: Number Lines

- A. identify that the arrow points to three-fourths?

If he gave the answer three-eighths, he counted the spaces on the whole number line, not just the spaces between the zero and the one. This is a very common error.

20. My Fractions Book: Number Lines

- A. use the number line to identify equal fractions by drawing a line from one number line to a second number line?

Make sure he does not use the fraction manipulative to answer this question. He must draw in the line.

Booklet Selection Guide based on results of the Pre-Assessment

21 points or more: Move to Fractions: Booklet 2. Remediate on number lines and equal fractions if either of those areas are marked with a No.

A score of 11 - 20 indicates beginner level understanding of basic fractions concepts. For a student of age nine or less, do the entire Fractions: Booklet 1.

A student who is age ten or more should do a modified Fractions: Booklet 1. You can skip items that he got correct on the Pre-Assessment. Focus on the My Fractions Book especially on the sections on equivalent fractions and number lines. You can skip the sections on Changing Wholes and Greater Than, Less Than, as these are strongly covered in Fractions: Booklet 2. Reassess and begin instruction in Fractions: Booklet 2.

A score of less than ten points indicates this booklet is the correct place to begin for a student of any age.

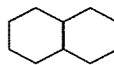
Whenever remediation is needed, repeat the following process, which is used throughout the *Patterns in Arithmetic* series to develop understanding of a concept.

1. Introduce the concept with a manipulative. Orally discuss it. Build it. Verify it. Practice it. Repeat the experience with a different manipulative (oral manipulative).
2. Use manipulatives to explore the concept again. This time record it with pictures (pictorial/representation). Practice it. Use worksheets.
3. Record the problem with numbers (abstract/symbolic). This links the pictorial with the abstract.
4. Practice fluency.
5. Practice for speed.

Ask questions or make statements, such as: “Are you sure?” or “Build it.” or “What gave you the clue?” or “Show me how you got that.” or “Prove it.” even when a student is correct. This is important to do often. Many students will ask an adult, “Am I right?” rather than answering definitively. Confidence in a student’s response must come from within. A student needs to self-check and have confidence in his or her ability and knowledge. Asking the student if he or she is right, even when correct, will encourage self-confidence and the ability to self-check.

Pattern block directions for pink or black blocks:

Pink: Glue two yellow hexagons together to make this shape.
Paint pink if you wish.



Black: Glue two blue rhombi together to make this shape.
Paint black if you wish.



Pre-Assessment Score Sheet

Name _____ Date _____

Can the student:

1. My Fractions Book: Beginning
Yes No A. identify the one-third piece?

2. My Fractions Book: Beginning
Yes No A. identify the one-fourth piece?
Yes No B. indicate that it takes four-fourths to make a whole?

3. My Fractions Book: Beginning
Yes No A. identify the one-sixth piece?
Yes No B. indicate that it takes six-sixths to make a whole?

4. Sorting Fractions
Yes No A. choose the three correct pictures of a figure divided into halves?

5. My Fractions Book: Beginning
Yes No A. write the name of the fraction, one-third?

6. Greater Than, Less Than
Yes No A. use a greater than, less than symbol to show that $\frac{1}{4} < \frac{3}{4}$?

7. Numerators Greater Than One
Yes No A. divide the rectangle into four roughly equal parts?
Yes No B. shade in three of the four parts?

8. Greater Than, Less Than
Yes No A. choose the larger fraction from a pair of two unlike fractions with ones in both numerators?

9. Greater Than, Less Than
Yes No A. choose the larger fraction from a pair of two unlike fractions with different numbers in the numerators?
1 pt. 2 pts. B. 'How do you know?'

10. Changing Wholes: Beginning
Yes No A. choose the correct whole given the size of the one-sixth block?

11. Changing Wholes: Beginning
Yes No A. find the value of the blue block if yellow equals one?
Yes No B. find the value of the blue block if the yellow equals one-half?

12. Changing Wholes: Beginning
Yes No A. shade in half of each pizza?
1 pt. 2 pts. B. Explain—use the rubric

13. My Fractions Book: Equivalence
 Yes No A. match several smaller pieces to the size of the one-half piece?
 Yes No B. list at least two of the four equal fractions possible?
14. My Fractions Book: Equivalence
 Yes No A. match nine-twelfths to the three-fourths?
15. My Fractions Book: Equivalence
 Yes No A. match two-sixths to the one-third?
16. Equivalence Recording
 Yes No A. determine four halves cover two wholes?
 Yes No B. extend the number pattern to fill in missing numbers?
17. My Fractions Book: Number Lines
 Yes No A. identify that the arrow points to one-third?
18. My Fractions Book: Number Lines
 Yes No A. identify that the arrow points to three-fifths?
19. Numerators Greater Than One: Number Lines
 Yes No A. identify that the arrow points to three-fourths?
20. My Fractions Book: Number Lines
 Yes No A. use the number line to identify equivalent fractions?

1 point per Yes

Items Correct = _____ = _____ %
 Items Possible = 30

For placement information see Booklet Selection Guide, page 4

Post-Assessment Score Sheet

Name _____ Date _____

Can the student:

1. My Fractions Book: Beginning
Yes No A. identify the one-third piece?
2. My Fractions Book: Beginning
Yes No A. identify the one-fourth piece?
Yes No B. indicate that it takes four-fourths to make a whole?
3. My Fractions Book: Beginning
Yes No A. identify the one-sixth piece?
Yes No B. indicate that it takes six-sixths to make a whole?
4. Sorting Fractions
Yes No A. choose the three correct pictures of a figure divided into halves?
5. My Fractions Book: Beginning
Yes No A. write the name of the fraction, one-third?
6. Greater Than, Less Than
Yes No A. use a greater than, less than symbol to show that $\frac{1}{4} < \frac{3}{4}$?
7. Numerators Greater Than One
Yes No A. divide the rectangle into four roughly equal parts?
Yes No B. shade in three of the four parts?
8. Greater Than, Less Than
Yes No A. choose the larger fraction from a pair of two unlike fractions with ones in both numerators?
9. Greater Than, Less Than
Yes No A. choose the larger fraction from a pair of two unlike fractions with different numbers in the numerators?
1 pt. 2 pts. B. 'How do you know?'
10. Changing Wholes: Beginning
Yes No A. choose the correct whole given the size of the one-sixth block?
11. Changing Wholes: Beginning
Yes No A. find the value of the blue block if yellow equals one?
Yes No B. find the value of the blue block if the yellow equals one-half?
12. Changing Wholes: Beginning
Yes No A. shade in half of each pizza?
1 pt. 2 pts. B. Explain—use the rubric

Assesses basic concept in:

- A. Fractional units using a manipulative
- B. Changing sizes of the whole
- C. Fractional units on a number line
- D. Equal fractions with a manipulative and number lines

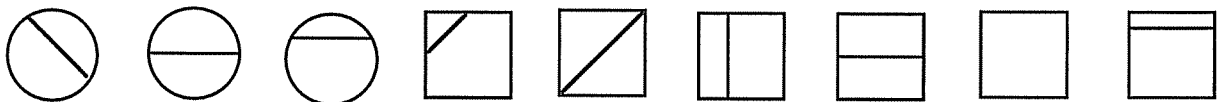
A familiar fraction manipulative, such as Fraction Circles or Prism Fractions and Pattern blocks, must be available to the student. The examiner must observe the student throughout the entire assessment. Give assistance only in reading. Note if the student uses the manipulative or not on each item.

Put a question mark next to anything you do not know yet.

1. What is the color of the $\frac{1}{3}$ piece in your set? _____
2. Cover the whole with fourths. How many fourths does it take to cover a whole?


3. Cover the whole with sixths. How many sixths does it take to cover a whole?

4. Circle all of the designs below which are cut in half.



5. Write the name of this fraction in words. $\frac{1}{3}$ _____

6. Write in the correct < or > sign. $\frac{1}{4}$ $\frac{3}{4}$

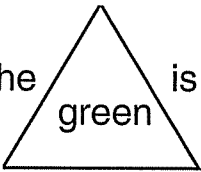
7. Shade in $\frac{3}{4}$ of this box. 

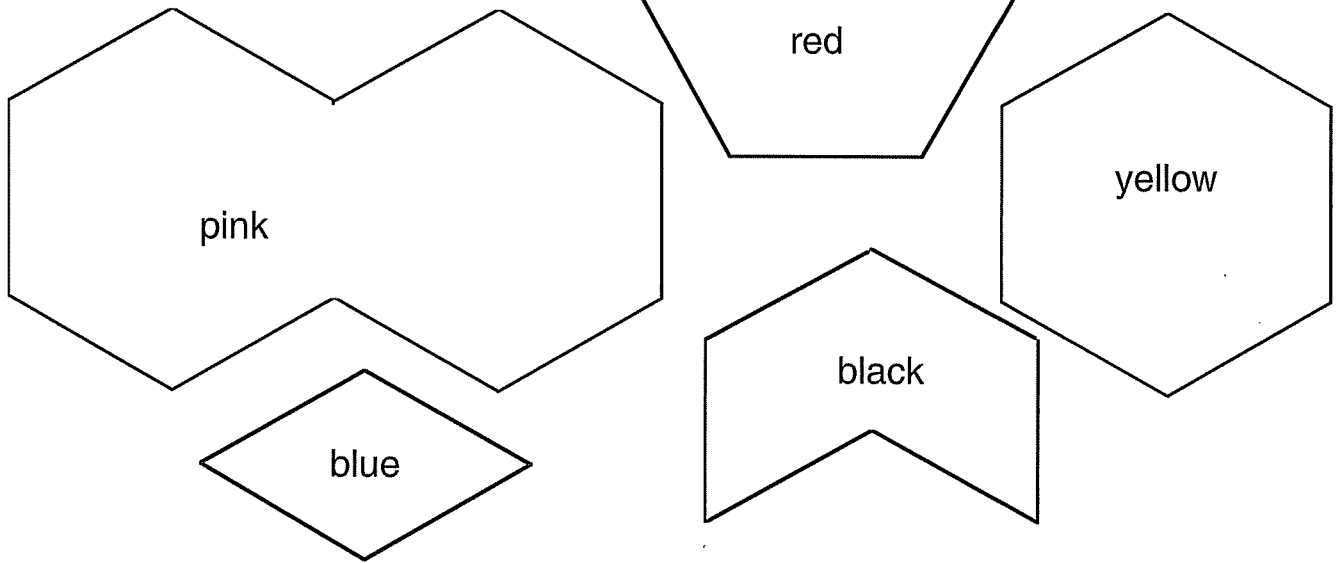
8. Circle the fraction which shows a larger amount. $\frac{1}{4}$ $\frac{1}{3}$

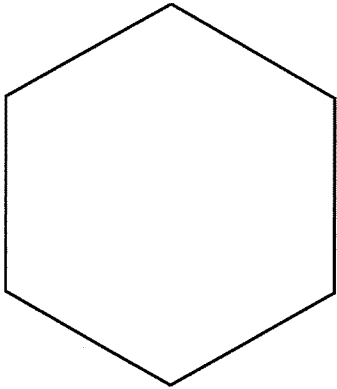
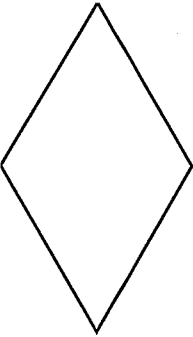
9. Which fraction shows a larger amount $\frac{4}{5}$ or $\frac{3}{6}$? _____

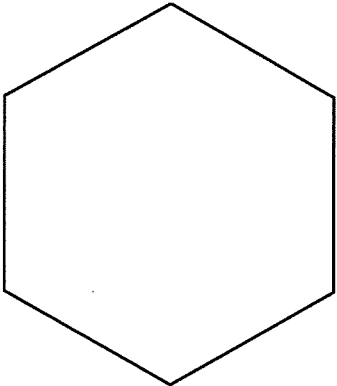
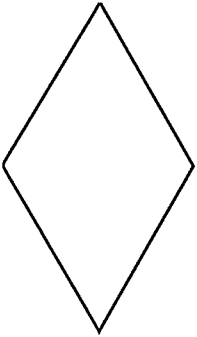
How do you know? _____

Put a question mark next to anything you do not know yet.

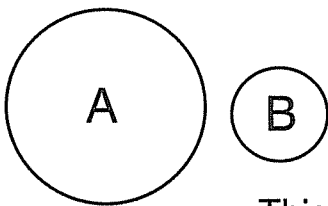
10. If the  is equal to $\frac{1}{6}$, which of these figures is equal to one whole? _____

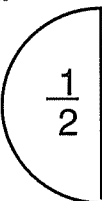
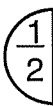


11. If  equals 1, then what does  equal? _____

If  equals $\frac{1}{2}$, then what does  equal? _____

Put a question mark next to anything you do not know yet.

12. Here are two pizzas.  Shade in half of each pizza.

This is half of pizza A.  This is half of pizza B. 

The pieces are both halves, but they are not the same size.

How can this be? _____

13. List all the fractions you can make with your set of fraction pieces that are equal to $\frac{1}{2}$. _____

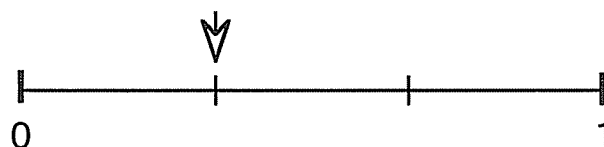
14. Trade three-fourths for twelfths with your fraction pieces. How many twelfths cover the same area as three-fourths? _____

15. How many sixths are needed to cover one-third? _____

16. Fill in the missing numbers in this pattern.

$$2 = \frac{\quad}{2} = \frac{\quad}{3} = \frac{\quad}{4} = \frac{\quad}{6} = \frac{\quad}{8}$$

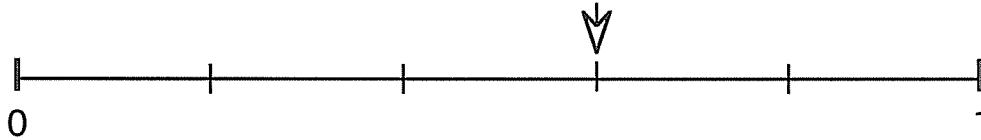
17. The arrow points to which fraction on the number line? _____



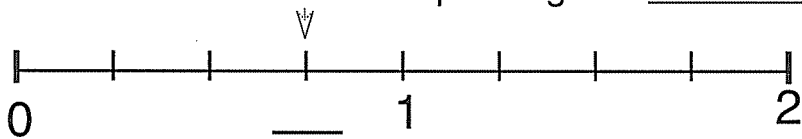
Pre-Assessment - Worksheet 4

Put a question mark next to anything you do not know yet.

18. The arrow points to which fraction on the number line? _____

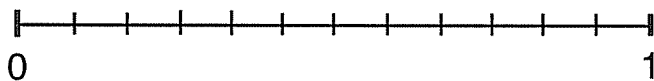
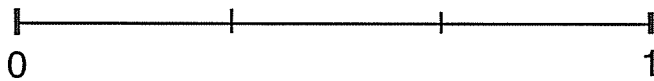


19. What fraction is the arrow pointing to? _____



20. How many twelfths are in two-thirds? _____

Draw a line on the number line to prove your answer.

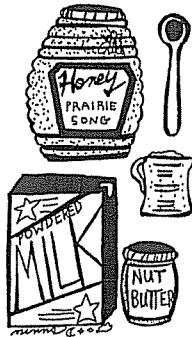


In the Kitchen

- Purpose** The purpose of this lesson is to explore fractions in the everyday world. To determine the concept that a fraction is part of a whole, is less than one, and that fractional pieces must be equal in size.
- Prerequisites** Exploration of the use of fractions in daily life. In cooking: halving and doubling recipes, dividing pies and pizza, sharing cookies, and recognizing the different fractional parts in chocolate bars, crackers, etc.
- Materials** Bread, Fig Newtons, or any other easily cut, square, or rectangular delectable
- Activities** Have a student help cut the food in half. Have one person cut and the other person choose the piece. Most students carefully cut equal size pieces.
- Halves** Model cutting one piece in two unequal pieces. Offer the small half to the student. She will usually protest that this is not fair. **"What's wrong with it?"** "They have to be cut to be equal sizes." **"When I cut the bread in half, how many pieces do I get?"** "Two." **"Are two halves larger, smaller, or the same size as the original piece of bread?"** "Smaller."
- Fourths** Have the student cut the bread into four 'fair' pieces to share with four people. **"Is one-fourth larger or smaller than a half a piece of bread?"** "Smaller."
- Repeat with other edibles that come in fourths, e.g., graham crackers and saltines. Give a blob of peanut or almond butter to divide into fourths to spread on top.

Cooking

Make Peanut Butter Balls together. Measuring with wholes and halves gives a concrete example of using fractions in the real world.¹ Almond butter can be substituted for those allergic to peanut butter.



Ingredients

- 1 cup peanut butter
- $\frac{1}{2}$ cup honey
- $\frac{1}{2}$ cup powdered milk

(Helen Miller)

Mix all of the ingredients together. Form into walnut sized balls. Chill until firm. When you eat the balls, continue exploring fractions. Flatten a ball like a pancake. Have the student cut the pancake into halves to share. Then cut it into fourths. Try eighths. Make a log shape for cutting into thirds. Share the cut pieces. Try sixths. Explore other shapes and easier ways to cut the shapes into fractions. Use play dough for a variation. Have fun!

Make pizza together as described in In the Kitchen - Worksheets 1 and 2.

- Worksheets** In the Kitchen - Worksheets 1 and 2, pages 5 and 6

¹Explore with sets of measuring cups in various sizes: 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{3}$, and measuring spoons: 1 tablespoon, 1 teaspoon, $\frac{1}{2}$ teaspoon, $\frac{1}{4}$ teaspoon.

About Free Exploration, or How Not To Be a Nag

by Alysia Krafel,

I recall an incident years ago when my six-year-old nephew was learning to set the table. Dinner was almost ready and there he was popping his fists down onto fork tines to flip them into the air. The stage was set for an unpleasant confrontation. I see now that the problem is one of time frames. We needed him to get the job done; he needed to explore. When we press a child to use a tool seriously and with skill before we have provided fiddle time, we set him up to be seen as a behavior problem and ourselves to be seen as nags. If a child can do his necessary playing and exploring with materials when he is not under pressure or expectations, before he needs to use them as we wish him to use them, not only will he learn the new skill faster and with more understanding, he will learn it with more delight (or at least with less complaining). The first association will be of joy and competence rather than frustration and forced anxiety.

Learning to use math manipulatives is like learning to use other tools. An adult will look at a screwdriver and use it to drive screws. A child will roll it on the floor, listening intently as the grooves in the plastic handle thump. She will roll it over her tongue, poke it into cracks, bang it on the table, spin it, or balance it on her finger. When finally satisfied with the investigation, she will watch you screw in the screws and then try it herself. And so it is with all of our doodads.

Play, unhindered exploration, is very important to children. At the Farm School, we came to realize that this self-directed learning style was not an impediment but a boon to our aims. We found that children who had enough time to fiddle with the plexiglass tiles came to their first fractions lessons knowing that the smaller the pieces there were, the more of them they had; that you could cover the black ($\frac{1}{2}$) tile¹ with the yellow ($\frac{1}{4}$) tile or orange ($\frac{1}{6}$) pieces, but you couldn't with the clear ones ($\frac{1}{3}$). When they began to Free Exploration

work with the formal fractions lessons, they brought into action all that their senses already knew about these tiles. As soon as the labels "halves" and "fourths" were attached to the colored tiles, they knew that $\frac{1}{2} = \frac{2}{4}$. They found the patterns very quickly and mastered the materials faster than the previous children who had not been allowed fiddle time.

The problem the teachers at the Farm School had encountered was that we wanted to teach x amount of material in a certain time frame. When the children needed three weeks of fiddle time with the fraction tiles, we experienced that as a delay, a delay that made us nervous. We just had to teach and have the children master fractions by the end of the school term. The solution was to introduce the materials long, long before (in many cases years before) we intended to use them as teaching tools. After ample free exploration time, not only did the children not resist the use of the materials in the specific way that the formal lessons demanded, they eagerly attended to the new way to interact with the now familiar materials. The new work was for them a continuation of the old play. The experience did not feel all that different to them. Since the struggle between teacher and child had been eased, the adversarial relationship became a co-worker relationship. The instruction then proceeded easily. The children and the teachers learned together to truly understand the world of numbers and enjoyed doing it.

My life suddenly changed when I had a baby. When giving her a bath one day, I had the idea to give her as a toy one thing she would later use as a tool, a cup. In the tub, she could pour, drink (or sputter), spill, bang, and splash to her heart's content without undoing whatever housework managed to get done. She would talk into the cup and put it on her head. Doing these things at the table with a cup filled with milk would have caused an uproar just as fiddling with colored tiles during a fractions lesson did. She had had the cup as a toy many months before we ever put milk into it for

¹ As used in *Fraction Tiles* by Lee Jenkins and Peggy McLean

her to drink at the table. Interestingly enough, when given milk in the cup at the table, she reacted in the same way as the children in the fractions lesson did. Since pouring liquid from the cup was old hat and drinking milk from it like Mommy and Daddy was new, she tried very hard to do it right because that's what she was ready to do, that was the new fun. She wouldn't pour milk out at the table and say "oh no" when she spilled it. Later, when she showed an interest, spoons and bowls were added to the toy shelf and to the bath set. While in the tub recently, she filled her bowl with water, bent down, and began to blow bubbles into it. She dumped out the water and put the bowl on her head and said, "Hat." I thought to myself, "I'm glad that was warm water on her naked body instead of hot tomato soup on her white sweater!"



An unintended side effect of all of this was that she became competent with a cup at fourteen months and with a spoon and bowl by sixteen.

Having done all of that, I was surprised recently to find myself remaking that same mistake of not allowing exploration as a parent as I had as a beginning teacher. When my daughter put eggs and Cheerios in her cup of milk, I said, "No put food in cup! No put eggs in milk!" I was expecting her to be like me, to use tools as tools, food as food, instead of tools and food as toys. Resisting my constant scolding, she persisted in this behavior. Obviously, she needed to explore how things, like scrambled eggs and Cherrios, would interact with milk in her cup. My choice

was either to press her to "act properly at the table," triggering tears and tantrums, or to allow her to explore with the knowledge (or at least great hope) that when she was satisfied, she would stop. This is always a difficult decision for me to make. One doesn't want to be so permissive as to develop a totally undisciplined child. On the other hand, one doesn't want to be a repressive nag either. Since food couldn't be a toy anywhere else but at the table, I gave in on unconventional mixing, squashing food through fingers, and food painting but drew the line on throwing. So with a certain amount of plaintive sighing, I watched her put my lovingly prepared, warm eggs into her milk, got out the dish towels, and added them to her toy box. To my delight, she ate the cold, milky eggs out of her cup with the spoon without as much mess as one would expect! My husband realized that the current fascination was food and liquid together. Now we put the liquid in the bowl with the food to begin with, and everyone is happy. She certainly is not like me.

I wonder how many things children must learn, like setting the table, feeding the cats, making the beds and so on, would move more easily if we parents allowed the child to play with the new materials long before we or society demanded that they use them properly and with skill.

Student Worksheets

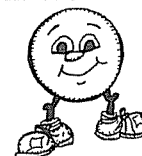
Free Exploration - Worksheets 1 and 2,
pages 7 and 8

My Fractions Book: Beginning

Purpose The purpose of this lesson is to concretely discover, understand, and represent basic fractions using a manipulative. The process will first be with Fraction Circles, page 9, then with pattern blocks, and, finally, with number lines, page 54.

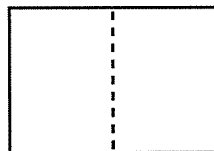
Prerequisites In the Kitchen lesson and Free Exploration with the Prism Fraction Circles Set, Prism Fractions Square Set, pattern blocks, and Cuisenaire Rods

Materials My Fractions Book: Beginning, page 9 - instructions are also in the Student Workbook
Eight sheets of 11 x 17 inch paper
Prism Fractions® Circle Set
Pencil



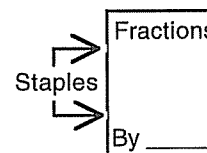
Directions Each student makes a book and learns the names of most common fractions, draws fractions, and writes fractions with numbers and words. Have her work on the book about twenty minutes per day. She needs to be neat and use a sharp pencil! This book will be used for at least a year.

Stack eight sheets of 11 x 17 inch paper.



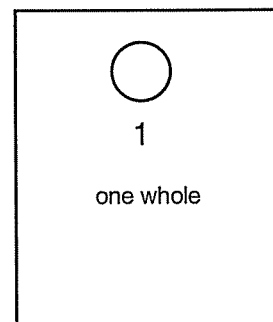
Fold in half to find the middle and then staple in the fold.

She writes her name and Fractions on the cover. Decorate.



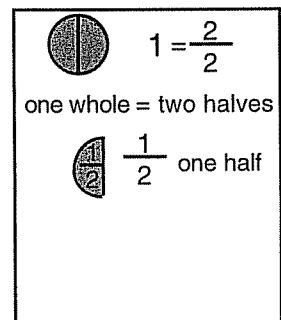
Page 1 Begin with fraction circles. Trace the whole piece. Label one whole and record the fraction in words and then in numerals.

Leave about one-fourth of the page blank on all of the pages.



Page 2 Trace the whole piece. Place two halves on the whole and draw on the whole what this looks like. Record one whole = how many halves in words and then in numerals.

Trace around one half piece and record the fraction in words and in numerals. Color the fraction drawings the same color as the fraction circle pieces.

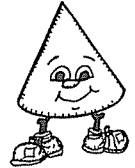
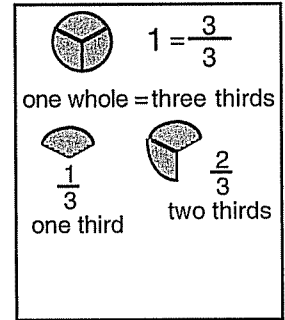


Page 3 Trace the whole piece. Place the thirds on the whole and draw on the whole what this looks like.

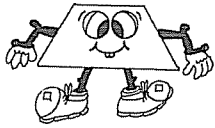
Record one whole = how many thirds in words and then in numerals.

Trace around one-third piece and record the fraction in words and in numerals.

Trace around two-thirds and record the fraction in words and in numerals. Color the fraction drawings the same color as the fraction circle pieces. You may need more than one page.



Repeat with fourths, fifths, sixths, eighths, tenths, and twelfths. Draw and label all of the fractions. For example, one-fourth, two-fourths, three-fourths.



Numerators Greater Than One

$$\frac{2}{3} \begin{array}{l} \text{numerator} \\ \text{denominator} \end{array}$$

Purpose

The purpose of this lesson is to introduce fractions with numerators (the top number) greater than one with a manipulative using the language 'two out of.'

Prerequisites

My Fractions Book: Fraction Circles, My Fractions Book: Pattern Blocks, What Fraction Is This? - Worksheets 1 - 3, pages 10 - 12, and Fraction Guessing Game, page 13

Materials

Numerators Greater Than One - Worksheet 1, page 14
Pattern blocks

Lesson

Give each student Numerators Greater Than One - Worksheet 1 and a set of pattern blocks. **"Cover the first hexagon with three equal pattern blocks. Color 'one out of three.'"** Notice that 'one out of three' is written in mathematical notation as $\frac{1}{3}$.

"Record on the lines provided." out of = $\frac{1}{3}$

"Color 'two out of three' blocks in the next picture."

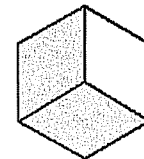
"How do you think this would be recorded?"

"Two out of three." out of = $\frac{2}{3}$

"Why?"

"Because two of the three blocks are colored."

"Record it as a fraction." $\frac{2}{3}$



"In the fraction two-thirds, what does the denominator, the bottom number, mean?" "There are three parts in the whole."

"What does the numerator, the top number, mean?" "Two. You have two parts of that whole."

Complete the worksheet independently, then give Numerators Greater Than One - Worksheet 2.


Worksheets

Numerators Greater Than One - Worksheets 2 and 3, pages 15 and 16
Shrinking Circles - Worksheets 1 and 2, pages 17 and 18

Here is a dialogue with a student who had studied fractions for several years but was still unclear about what the numbers in a fraction mean. We were working with pattern blocks.



Teacher:


"So the blue is...?" 

"What does the one mean and what does the three mean?"

"OK. And what does the one mean?"

"Three covers the whole. If you have one third, what does the one mean?"

"One out of how many? If you have one third, it means you have...?"

"If you have one of these (one blue block),  is this a whole?"

"How much of a whole is it?"

"Your whole is how many?"

"If you're using three, how many does it take to make the whole?"

"If you have two blues, how would you write that?"

"And what does the 'two' mean?"

"And the three means?" *(She is still unclear.)*



"If a cookie is divided into three pieces and I give you one piece, how much of the whole do you have if you have just one piece?"

"You have a third of it. One of three, three being the total. If you have two of them?"

"A blue block is...?"

"Does the one mean how many are in the whole?"

"What number means how many in the whole?"

"What does the one mean?"

"And the three means?"

Student:

"One third. Is that the way you write it?" $\frac{1}{3}$

"The three means there are three blocks."

"A whole." *(She is referring to the one in the numerator.)*


"One third."

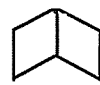
Silence

"No."


"Ah, it's a third."


"A whole is one." *(This is true but she is referring to the 1 in 1/3.)*

"Three." 

"Two-thirds." $\frac{2}{3}$ 

"Two means that there's two... Two in the whole. The whole is covered up by two-thirds." No reply.

 "A third of it."

"You have two of the thirds." 

"One-third."

"Uh, no."

"The three. One means a third of a whole."

"You have one of the whole."

"That there are three in the whole."

Whole Numbers as Fractions

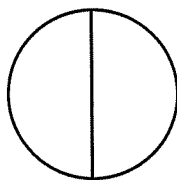
Purpose The purpose of this lesson is to learn how to represent whole numbers as fractions.

Prerequisites My Fractions Book: Fractions Circles

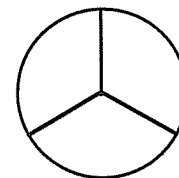
Materials My Fractions Book and Whole Numbers as Fractions - page 19
Prism Fractions Circle Set

Lesson Review all the pages that show the whole in the student's My Fractions Book. Have the student draw the wholes from each page on the worksheet.
Examples:

$1 = 2$ halves

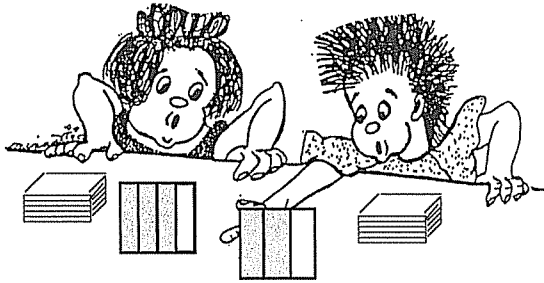


$1 = 3$ thirds



Worksheet Complete Whole Numbers as Fractions - page 19.

Fraction Card Game



This game asks students to compare fractions, which gets to the heart of a common misunderstanding. Does the question "Which is more?" refer to the number of pieces in a fraction or to the size of a portion? For instance, comparing one half to one-third. With one half there are two pieces in the whole. With one-third the whole is divided into three parts, which means there are more pieces but each piece is smaller than the one half pieces. It must be made clear that when asking to compare fractions, one is comparing the *size* of each piece, not the number of pieces.

Rules

1. A player deals out all the cards, an even amount to each player. Leftover cards are placed in the center of the table face-down.
2. Each player pulls the top card from his or her face-down stack and lays it on the table face up.
3. The fraction card with the larger fraction wins. The player who drew that card keeps all cards in that turn and puts them in a separate pile.
4. If both cards have equal fractions, each player deals out three cards face down and one card face up. The larger fraction wins all. If another tie occurs, the process is repeated.
5. When a player exhausts his original stack of cards, he picks up the pile of cards he has won and plays with these cards.
6. The person who has the most cards is the winner.

Variation

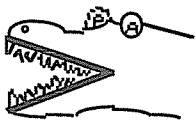
Play for the smaller fraction to win a hand.

If the players do not know which fraction is the largest, they must check with fraction pieces or blocks.

Materials

Fraction Card Game - Worksheets 1 - 4, pages 21 - 27

Glue the card game pages to file folders or a piece of light cardboard. Or duplicate the pages onto card stock. Cut the cards out. A paper cutter works best for cutting evenly.



Greater Than and Less Than



Purpose The purpose of this lesson is to compare and order fractions and to look for patterns.

Prerequisites Greater than and less than with whole numbers $4 > 3$, $5 < 7$, Recording Fractions: Prism Set, Fraction Card Game.

Materials Any fraction manipulative.

Lesson Have the student make predictions before comparing with fraction pieces.

"Which fraction is larger $\frac{1}{2}$ or $\frac{1}{3}$? Guess, then prove."

$\frac{1}{3}$ or $\frac{1}{4}$?

$\frac{1}{4}$ or $\frac{1}{8}$?

$\frac{1}{8}$ or $\frac{1}{12}$?

Looking for Patterns Recording the series after they are compared can help a student find patterns. **"What patterns do you notice?"** One pattern is the larger the bottom number, the smaller the piece. She may need more experience to figure out this pattern. If it is not obvious at this time, do more examples and check again. Think of good questions that stimulate comparisons.

Your student may find a different pattern also. One student found several patterns. She noticed that the second number was repeated in each set of numbers. "The one that is skinnier goes one more time before the other one." She likened the pattern to multiplication. Then she sang notes to each fraction. As the fractions became smaller, the notes got higher in logical increments! It was quite delightful to hear. After a few probing questions, she was able to show and state that the smallest piece had the highest denominator. The $\frac{1}{2}$ was the largest fraction and the $\frac{1}{12}$ was the smallest. (She had felt this intuitively in her singing, but it took some additional thinking for her to verbalize it.) By your asking questions and pushing for more and deeper thoughts, students will delight in thinking of new things. These lessons should be very open-ended. Allow and encourage spin-offs, and take the time to explore. With a series of pairs of numbers also ask, **"Which fraction is smaller?"**

Next, write two fractions and have her put in the $>$ and $<$ signs: $\frac{2}{3}$ $\frac{1}{2}$
 $\frac{2}{3} > \frac{1}{2}$

Practice with several combinations. Additional combinations to guess and then build with fraction pieces:

$\frac{1}{4}$ or $\frac{2}{4}$	$\frac{1}{4}$ or $\frac{3}{8}$	$\frac{2}{3}$ or $\frac{3}{4}$	$\frac{2}{3}$ or $\frac{4}{5}$
$\frac{1}{3}$ or $\frac{2}{3}$	$\frac{3}{8}$ or $\frac{3}{4}$	$\frac{1}{3}$ or $\frac{1}{2}$	$\frac{1}{6}$ or $\frac{1}{3}$
$\frac{2}{6}$ or $\frac{3}{6}$	$\frac{2}{5}$ or $\frac{3}{4}$	$\frac{3}{6}$ or $\frac{3}{4}$	$\frac{4}{12}$ or $\frac{3}{4}$

Worksheets Greater Than and Less Than - Worksheets 1 and 2, pages 29 and 30.

Recording Fractions: Prism Set

Purpose The purpose of this lesson is to review the written form of fractions and to link the physical manipulative to the symbolic form and to learn the function of the numerator and denominator. This also moves into $\frac{2}{4}$, $\frac{2}{3}$, etc.

Prerequisites Pattern Block Games, Pattern Block Fractions, and free exploration with the Prism Fractions set

Materials Recording Fractions: Prism Set, page 31
Prism Fractions Set - Circles or Squares



Lesson Start with one whole. Lay out each color and compare to the whole. The fractions can be folded so only the fractional part is visible. Or carefully cut up one set.

Session 1

$\frac{1}{3}$
numerator
denominator

"How many halves make a whole, how many thirds make a whole, etc.?" Use one half pieces and ask, **"What is this?"** "One half, or one of two." Take one of the thirds and ask, **"How much of the whole is this?"** "One-third, or one of three." Repeat with the fourths, fifths, etc.

"How do you write the fraction for one half?" $\frac{1}{2}$ **"One-third, one-fourth, etc.?"** If he doesn't remember, show him. **"What does the 'one' mean in one half?"** "The 'one' means how many parts you have." **"The top number is called the numerator."** **"What does the 'two' mean in one half?"** "The 'two' means how many equal parts make a whole." **"Yes, that's correct. And the denominator indicates the number of equal parts into which a whole is divided. The bottom number is the denominator."** A generalization is made from all of the previous experiences. He will say it in his own way. The important part is that the student understands what the numbers mean. He may develop language that makes sense to him. Fold the orange piece so two-thirds show and ask, **"What fraction is this?"** "Two-thirds or two of three." Make more examples with different fractions, e.g., three-fourths, three-thirds, five-sixths. Ask in reverse also. **"Find four-sixths, three-sixths."** Have the student make up some examples.

One student represented the models by drawing pictures of each fraction and then he wrote the symbolic fraction next to each picture.  $\frac{1}{2}$  $\frac{1}{3}$

Session 2 Make a chart of what each colored piece represents. Use the whole, place the fraction pieces on it, count, and record on Recording Fractions: Prism Set.

Make a Chart

Example: Start with the whole.  Compare the red piece with the whole. 
Or fold along the line so one half shows. 

The student records:






"One red piece is $\frac{1}{2}$ of the whole." After the chart is completed, ask, **"Two orange pieces are how much of the whole?"** "Two-thirds." $\frac{2}{3}$




Worksheets Recording Fractions: Prism Set, page 31

Here is a dialogue with two students who are sisters, Leah, age twelve, and Rebecca, nine. Leah has had several years of fractions but has the meaning of numerators and denominators mixed up. It is very important to have students understand this before proceeding with the lessons.


We start with a whole and each student takes out the half piece.

Teacher	whole		$1/2$		Students
	"If this is the whole, what is this?"				"It's a half." 
	"How do you know?"				"See, look." They place the half on top of the whole. "It's half of the whole." 
	"How do you write the fraction?"				" $1/2$ "
	"What do the numbers mean?"				"The top number means the whole thing, the bottom number means how many of the wholes." (Leah has this backwards.)
	"What happens if you have two halves?"				"You have a whole." (She builds it.) 
	"How many halves make a whole?"				"Two."
	"So the 'two' means?"				"Oh, OK. The bottom number tells you how many you have to have to make a whole."
	"What does the top number mean?"				"One out of how many to make the whole."

Yes, they appear to be getting to the heart of the matter. The next question tests this understanding.

"If two halves make a whole, how is that written?" Leah $1/1$  Rebecca $2/2$

Leah, the older student, does not seem to get it, but the younger Rebecca does. A side issue starts at this point, which will be addressed later.

To Leah: "How many pieces do you have?"	"Two." 
"Out of how many?"	"Two."
"So, how is the fraction written?"	"Oh, I see. Two out of two." $2/2$

We explore this further by making more examples and looking for patterns.

Back to the side issue. A little sibling rivalry starts with Rebecca smirking. The tables are turned and she is the one who understands first. This hasn't happened very often, and it feels so good for her to understand something her older sister doesn't. But now Leah feels like a dummy because her sister is making fun of her. How is the situation diffused so they both come out feeling good? At this point we stop and talk about how good it feels to comprehend something. Understanding is what we want. On the other hand, we need to be sensitive when another person doesn't grasp the concept yet. We talk about what can be said to the other person who hasn't gotten it yet so she doesn't feel bad. How does one make them feel good, too? "Na, na, na, na, na, na" certainly isn't the way. "Keep thinking, you'll get it soon," "This is what helped me," "It was hard for me, too," are more encouraging responses.

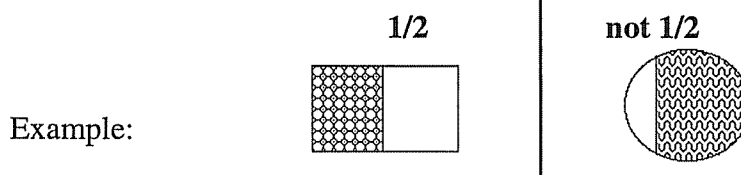
Sorting Fractions

Purpose The purpose of this lesson is to sort pictures of shapes that are divided into sections equally and unequally. Fractions must be divided equally.

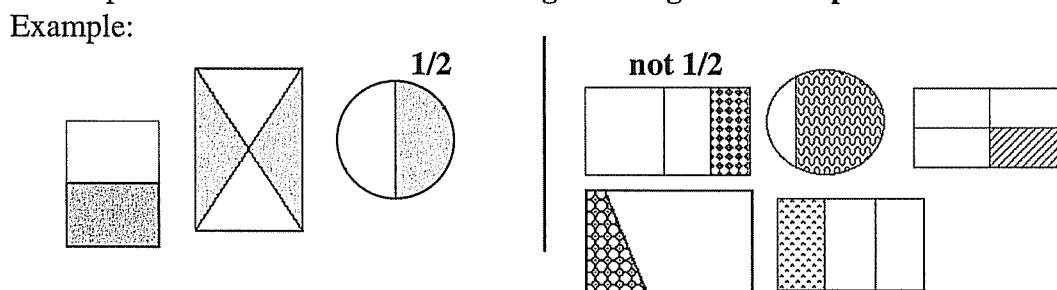
Materials Sorting Pictures (on the following page)
Sorting Fractions - Show You Know, page 32. Make more of your own or have the student draw her own.

Directions Cut out the pictures on the Sorting Pictures page. Have the student divide them into sets of pictures that have only two sections, three sections, and four sections.

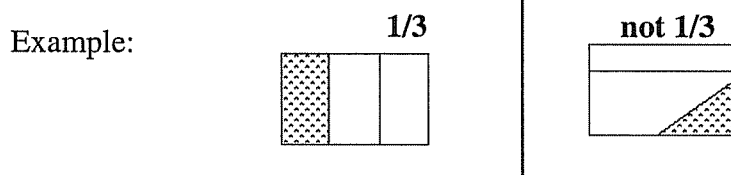
Halves "Use the pictures that have only two sections. Sort the pictures into halves and not halves."



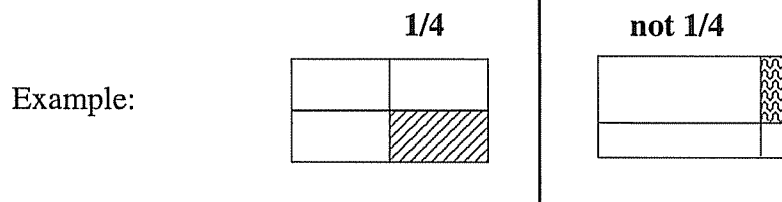
Use the pictures with all sections. "Sort again using all the shapes."



Thirds "Use the pictures that have only three sections. Sort the pictures into one-third and not one-third."

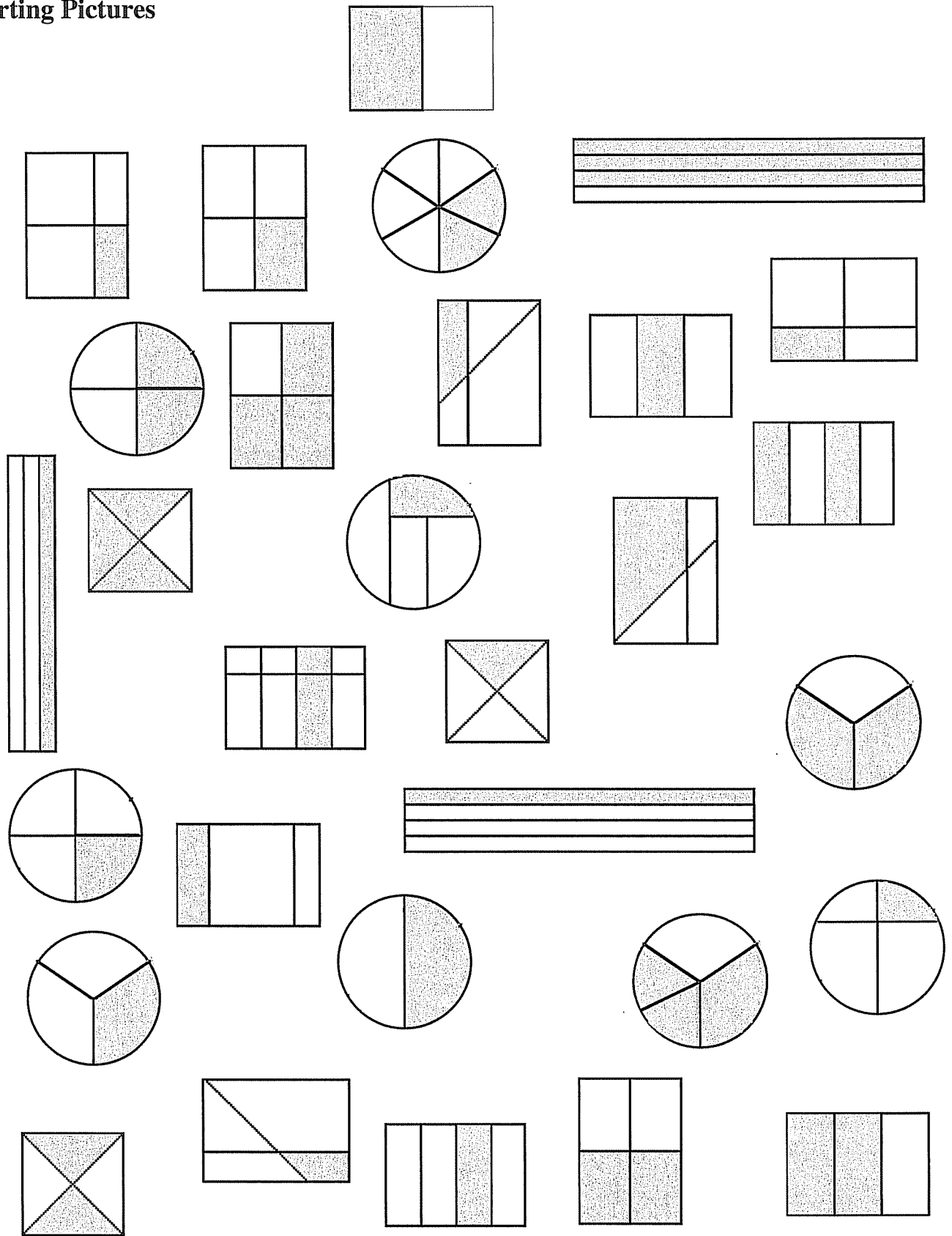


Fourths Use the pictures with four sections. "Sort the pictures into one-fourth and not one-fourth."



Worksheet Sorting Fractions - Show You Know, page 32

Sorting Pictures



Pattern Block Games

Purpose

The purpose of this lesson is to compose and decompose two dimensional shapes with pattern blocks to develop foundations for understanding fractions. To begin the concept of $\frac{1}{6}$, and to introduce equivalent fractions.

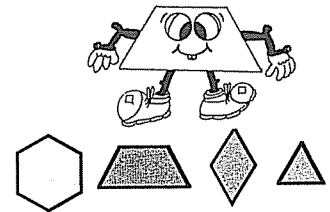
Prerequisites

Free exploration with pattern blocks, Beginning Fraction Activities, and Trading Game

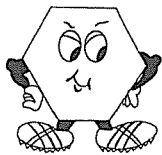
Materials

Pattern Block Games: Lion Game and Flower Power, pages 35 and 36

Pattern blocks	yellow hexagons	1 whole
	red trapezoids	$\frac{1}{2}$
	blue parallelograms	$\frac{1}{3}$
	green triangles	$\frac{1}{6}$
	One die or spinner	



Pattern Block Game¹



The object of the game is to get five yellow hexagons.

Roll the die. In turn, each player takes that number of green triangles and exchanges them for equivalent larger blocks. Example: A five is rolled on the die. The player takes five green triangles and exchanges them for a red trapezoid and a blue parallelogram. Rule: You must always have the fewest number of pieces possible.

After playing a while, ask: "How many reds equal a yellow?" "Two."

"What fraction of a yellow is a red?" "One-half."

"How many blues equal a yellow?" "Three."

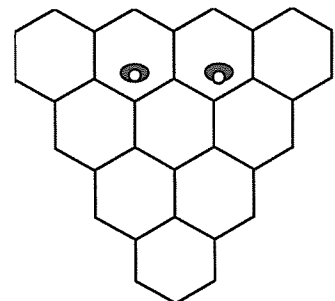
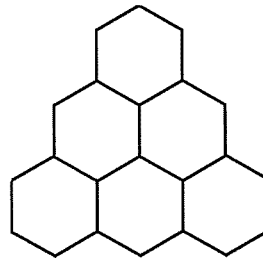
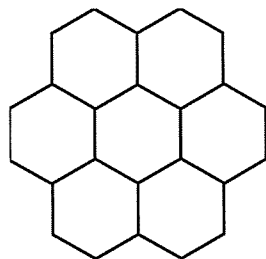
"What fraction of a yellow is a blue?" "One-third."

"How many greens equal a yellow?" "Six."

"What fraction of a yellow is a green?" "One-sixth."

Make a Shape

Play the game as above but each person makes a predetermined shape. Some shapes we have made are: a flower with seven hexagons, a rocket ship with six hexagons, and a lion face with ten. Sometimes we just play the game and build a free-style shape with the hexagons until we're tired of playing.



Backwards Trading Game

Play the Trading Game backwards. Start with five yellow hexagons and play until there are no blocks left. Each player must always have the fewest possible amount of blocks. The first player without any blocks is the winner. A variation is to go out with the exact number of pieces.

Pattern Block Games: Lion Game and Flower Power, pages 35 and 36

¹Adapted with permission from *Fractions with Pattern Blocks* ©1975 Creative Publications

My Fractions Book: Pattern Blocks

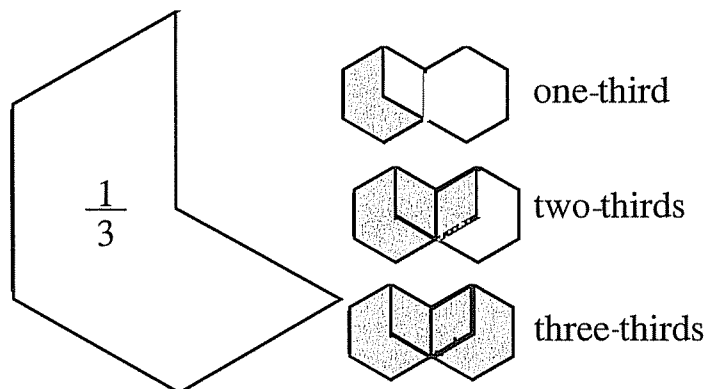
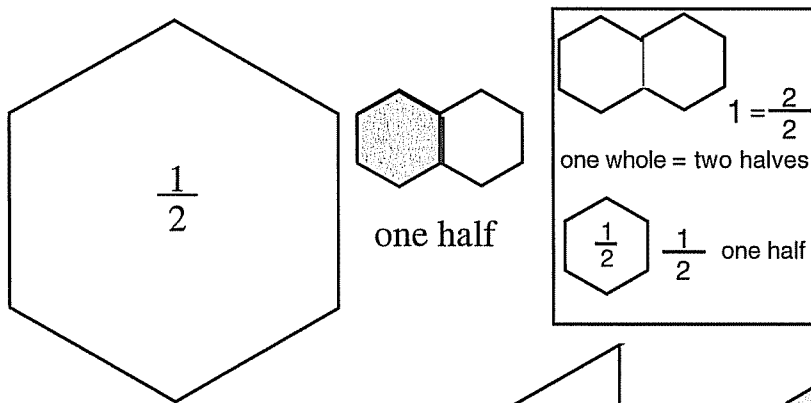
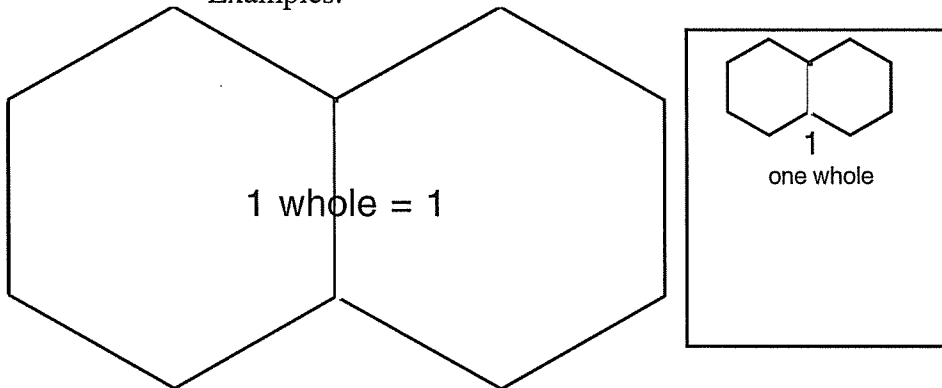
Purpose The purpose of this lesson is to reinforce basic understanding of fractions using a different manipulative.

Prerequisites My Fractions Book with Fraction Circles

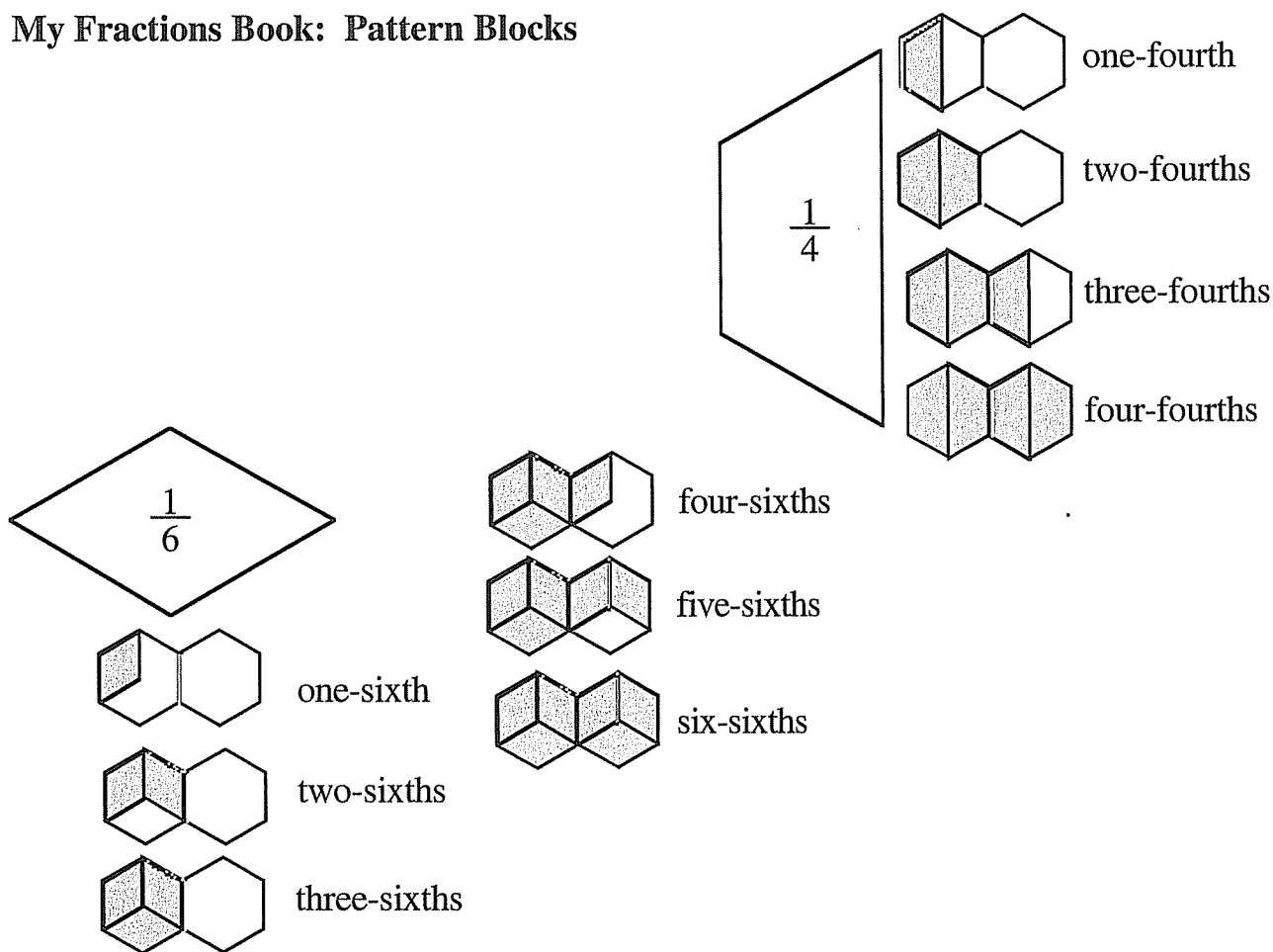
Materials My Fractions Book: Pattern Blocks, page 37
Eight sheets of 11 x 17 inch paper
Pattern blocks and sharp pencil

Directions Join two yellow pattern blocks to equal a whole and tape together two blue rhombi to make thirds. There is also a set of commercially produced pattern blocks in which the double yellow hexagon is pink and the double set of blue rhombi is black.

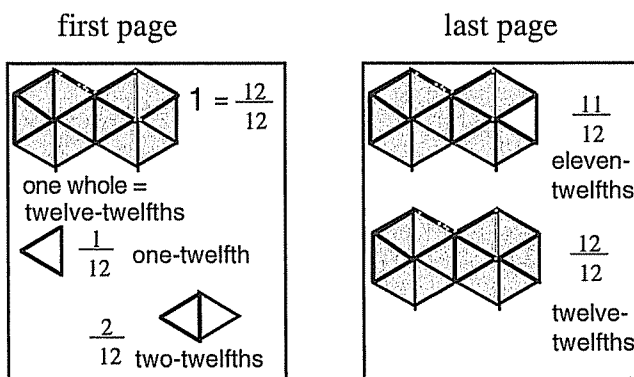
Repeat the process used with the fraction circles to show each size fraction.
Examples:



My Fractions Book: Pattern Blocks



Samples of the twelfths pages:



Worksheet Give Pattern Blocks Fractions - Worksheet 4, page 41.

Changing Wholes: Beginning

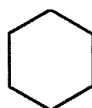
Purpose The purpose of this lesson is to develop the understanding that the size of a fractional part is relative to the size of the whole. This lays the foundation for understanding multiplication and division of fractions. Fractional pieces are defined in relationship to the whole, but wholes come in different sizes. For example, with pattern blocks: If the yellow hexagon is defined as the whole, then the red trapezoid piece is $\frac{1}{2}$, the green triangle is $\frac{1}{6}$. But if the definition of the whole is changed to two hexagon blocks, then the $\frac{1}{2}$ is one hexagon, the red trapezoid becomes $\frac{1}{4}$ and the green triangle is $\frac{1}{12}$.

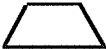
Prerequisites My Fractions Book, Numerators Greater Than One, Recording Fractions, Greater Than and Less Than, and Pattern Block Fractions

Materials Pattern blocks
Cuisenaire Rods

Lesson 1 Pattern Blocks

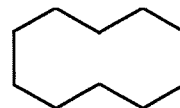
Start with one yellow hexagon.



"If the hexagon is one (whole), how many red blocks do you need to cover the whole?" "Two." "What is one red trapezoid?"  "One-half."

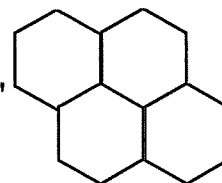
"One blue rhombus?" "One-third."  "One green triangle?" "One-sixth."
"Prove it." The student covers the hexagon with six triangles. 

"Now build a whole equal to two yellow hexagons."



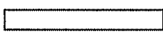
"What is the value of one red trapezoid?" "One-fourth." "How do you know?" "It takes four to cover it and this is one of four." "The blue rhombus?" "One-sixth." "The green triangle?" "One-twelfth." "Two green triangles?" "Two-twelfths."
This can be repeated with three hexagons.

"If this yellow hexagon is one-fourth, build the whole."

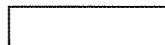


Repeat with any fraction manipulative you are using.

Worksheets Changing Wholes - Worksheets 1 - 4, pages 43 - 46

Lesson 2 Here is an example using Cuisenaire Rods.
Cuisenaire Start with the six rod. 
Rods "If this is one, then the light green rod is ____." "One-half."
"The red rod is ____." "One-third." "The tan rod is ____." "One-sixth."

Change to two six rods.



"If this is one, now the dark green rod is ____." "One-half."
"The light green is ____." "One-fourth." "The red rod is ____." "One-sixth."
"The tan rod is ____." "One-twelfth."

Changing Wholes with Fraction Pieces - A dialogue with Kirstin and Laura.

Two white pieces are now one whole. Each student has two sets of fraction pieces.

Teacher 

Students

"Two of these are the whole. How many of these (red pieces) do you need to cover the new whole?"

$\frac{1}{2}$

K & L "Four."

"So the reds are now...?"

K & L "Fourths."

"You can do it in your head."

K "The oranges are going to be sixths." (She is making a prediction.) I already know what it is." $\frac{1}{3}$

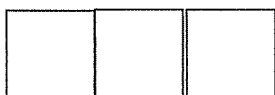
"So the yellows are...?"

K "Uh, huh." (yes)

L "Eighths."

They continue with each piece. They double the amount of each one without any problem.

"Now, three of these are the whole."



K "Then this would be eighths." $\frac{1}{2}$

"How many does it take to cover all three?"

K "Eight. So you have four, plus two."

"Would it take eight to cover all three?"

K "No, it would be six."

"The next would be?"

L "Sixths."

L "Ninths." (She is correct.)

Both are having difficulty figuring out the next one with the 1/4 piece.

$\frac{1}{4}$

"How are you figuring it out? What did you do to figure out the halves?"

K "I timesed it."

Laura builds, and Kirstin calculates and then checks with the pieces.

"OK, twelfths."

L & K "Twelfths." (They each figured it out.)

"What did you do to figure it out?"

K "Four, times four, times four..."

"Timesed it by what?"

K "I first got these out, four yellows. Four yellow on one square. Then I timesed... it's like fours (times table): four, eight, twelve, and I've got twelve."

"So you were multiplying by what each time?"

K "Four goes four three times. I was multiplying by two, no, one, four."

"Four, eight, twelve. How many times did you do that?"

K "Three."

"So you multiplied by...?"

K "Three."

"You're multiplying by three. Will that work for the next one? How did you do it, Laura?"

L "And then I figured that four plus four equals eight, plus another four, equals twelve."

L "It's fifteen. 'Cause five, ten, fifteen."

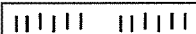
"Laura, what is the next one?" (*Fifths*).

She builds it.

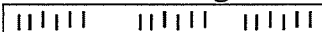
"How did you get the next one, Kirstin?"

K "So, they go another fifth time. Because five times three. There are three wholes, so times these by three and then you get the number."

"How did you get the next one, Laura?"

L "Six plus six is twelve, then you count, make lines for a six again." 

"Do you want to draw a picture of it?"

"OK." 

Purpose The purpose of this lesson is to have a different representation of changing wholes and fractions. This may appeal to students with a visual learning style.

Prerequisites Changing Wholes: Beginning, Lessons 1 and 2

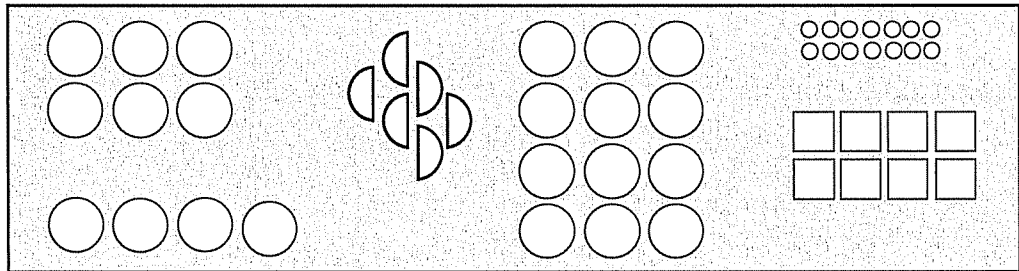
Materials
 Colored scratch paper
 White stickers
 Paper punch holes
 Paper glue for punch holes

Lesson 3 Make up several sheets with sets of objects. Use white stickers, or glue paper-punched holes onto the colored paper. Write the directions: "Color $\frac{1}{2}$ of each set." (Example below.) Also make pages for $\frac{1}{3}$, $\frac{1}{4}$. Change the directions appropriately.

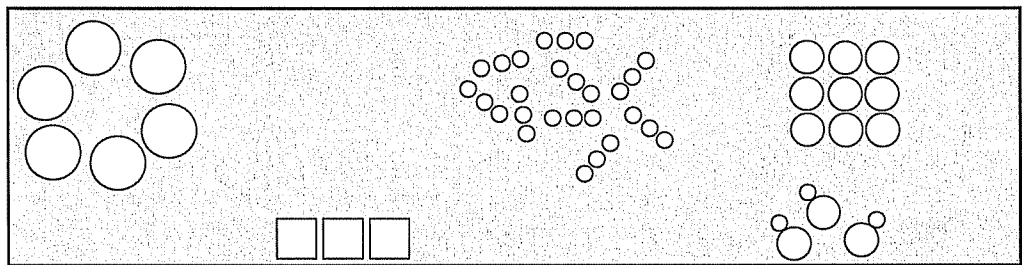
Have your student make up one page for each fractional part. **"Why is one-half equal to three in this set and equal to only two in this set?"** "The size of the first set is six and in the second set the size of the set is only four."

The bigger the set, the _____ the half. The smaller the set, the _____ the half.

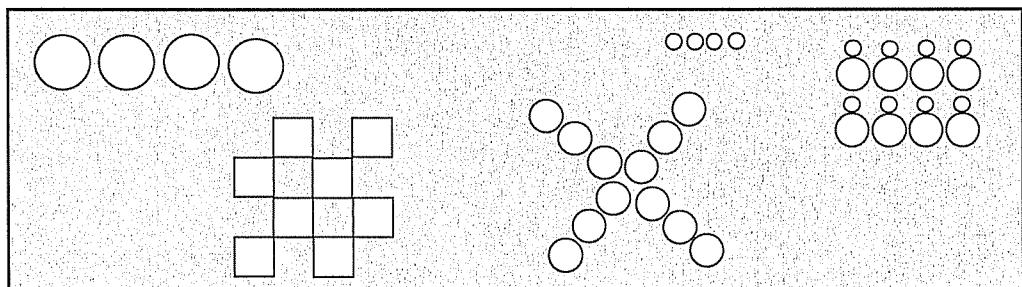
Color $\frac{1}{2}$ of each set.



Color $\frac{1}{3}$ of each set.



Color $\frac{1}{4}$ of each set.



Fractional Parts of Sets

Purpose The purpose of this lesson is to develop an understanding of fractional parts of a set. When fractions describe parts of a set of objects, only the number of objects is regarded, not the size of the objects. This is in contrast to one whole divided into fractional parts where each piece has to be equal in size.

Prerequisites Sorting, Changing Wholes: Beginning

Materials Groups or sets of objects that are not equal in size, e.g., a pencil cup holding writing tools, stuffed animals, silverware, pieces of clothing such as socks, or family members

Lesson Review sorting a group of objects in different ways and naming the groups, e.g., pencil cup sort into pencils, pens, scissors, erasers, markers; long shapes, short shapes, black objects, non black objects.

Initially use more and less in the comparison of the sorted groups. Are there more black objects or non black ones? Then, return to a concrete set, sort, and discuss it.

"How many objects are in the whole group?" "Sixteen in the pencil cup."

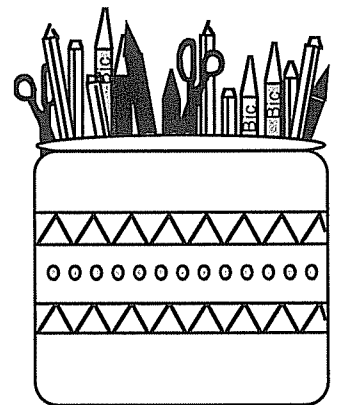
"Are they all of equal size?" "No."

"How many of the whole group are pencils?" "Eight."

"What part of the whole are pencils?" "Eight out of sixteen or $\frac{8}{16}$."

"What part of the whole are not pencils?" "Eight out of sixteen or $\frac{8}{16}$."

"What part of the whole are black?" "Six out of sixteen or $\frac{6}{16}$."



Sort many groups and ask these types of questions. For example:

"How many people are in the whole group?" "Eight."

"How many are adults?" "Four."

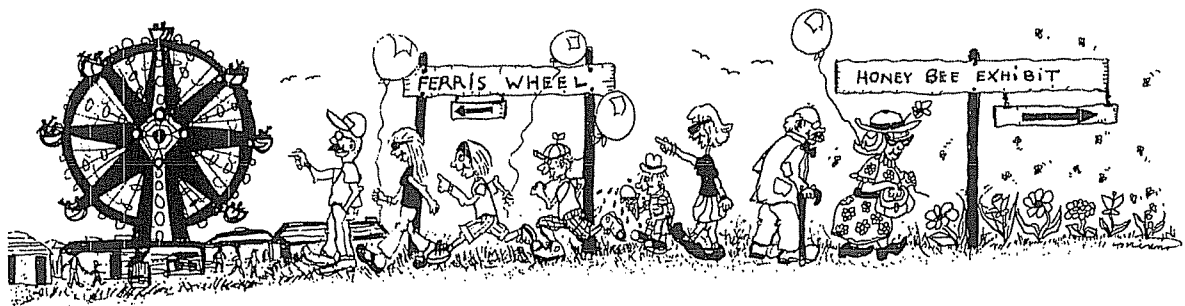
"How many are children?" "Four."

"What part of the whole are adults?" "Four out of eight or $\frac{4}{8}$."

"What part of the whole are children?" "Four out of eight or $\frac{4}{8}$."

"What part of the whole are walking to the honey bee exhibit?"

"Two out of eight or $\frac{2}{8}$."



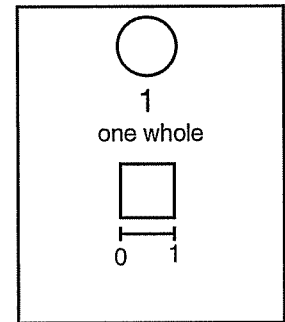
My Fractions Book: Number Lines

Purpose The purpose of this lesson is to represent fractions by points or distance on a number line.

Prerequisites Free exploration with Prism Fractions Square Set, string, tape measure, or rope. Rulers as Number Lines - Worksheets 1 - 4, pages 50 - 53

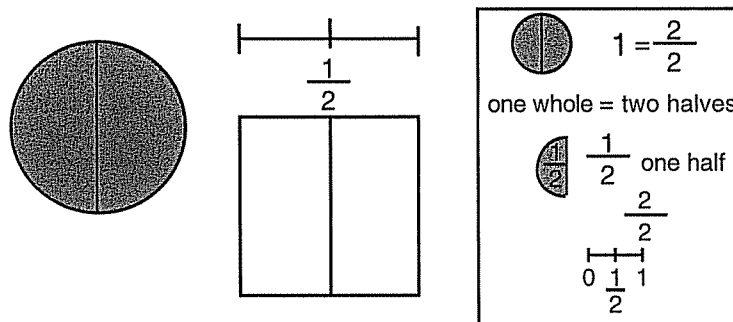
Materials Student's My Fractions Book or blank sheets of paper
Prism Fractions Square Set

Lesson First, find the page in My Fractions Book that shows the 1 = one whole circle fraction. Find the square that represents one whole and place it on the page. Trace the top edge of the square. Remove the square. Draw an end bar on each end of this line segment. This line will now equal one. Label under the left end bar the numeral 0. Label under the right end bar the numeral 1.



Draw a number line in your My Fractions Book at the bottom of each whole number page.

Find the Prism Fractions square that shows halves. Check the edge of it against the line segment equal to one whole. **"Is it the same in length?"** Now go to the page of halves in My Fractions Book. Place the square on the page and trace the top edge of it and mark the middle point. Remove the square. Make it into a line segment with end bars. Label zero and one with numerals. **"What fraction describes the distance from zero to the middle point? Label it underneath the point."**



Note The space between zero and the point of one-half is equal to one-half of the distance of the whole. Start at zero and say, **"Zero."** Trace the distance (space) on the line with your finger. As you reach each number say, **"One-half, two-halves."**

Label $\frac{2}{2}$ above the end bar marked 1. Students frequently confuse the spaces with the points and label the end of the space. Throughout these number line exercises, focus on the spaces created by the division of the whole.

Continue this process of creating number lines for each set of fractions in My Fractions Book. The square Prism Fractions pieces will keep the length of an edge equal to one and have equal spacing for the fractional parts.

My Fractions Book: Equivalence

Purpose The purpose of this lesson is to concretely discover and represent equivalent fractions. To record the picture symbolically.

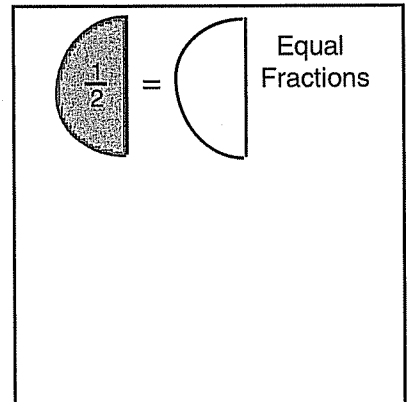
Prerequisites Free exploration with fraction circle pieces. My Fractions Book: Circles, My Fractions Book: Pattern Blocks and My Fractions Book: Number Lines

Materials My Fractions Book: Fraction Circles
Prism Fractions Circle Set

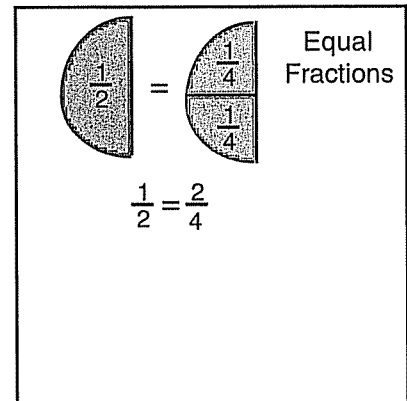
Lesson Find the last page made in My Fractions Book and label the next section Equal Fractions.

At the top of the page trace the $\frac{1}{2}$ piece. Write an equal sign and trace another $\frac{1}{2}$ piece next to it.

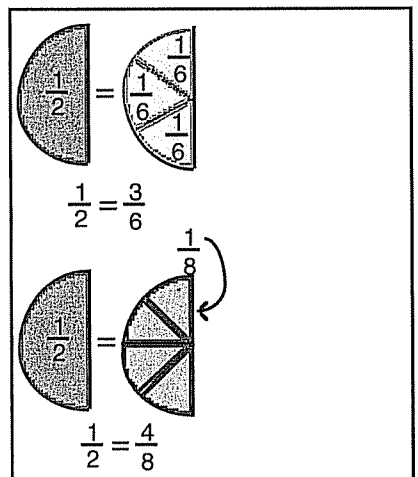
Example:



Place fourths on the second $\frac{1}{2}$ piece and trace around them. Record the fractions on the pieces. Use a crayon to outline the color of the fraction piece. Color lightly inside the fraction piece. Write the equivalent fraction. Example:

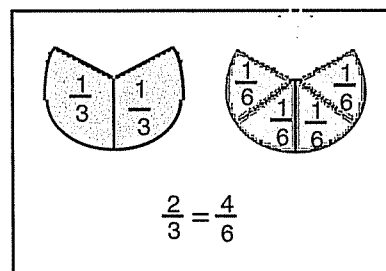
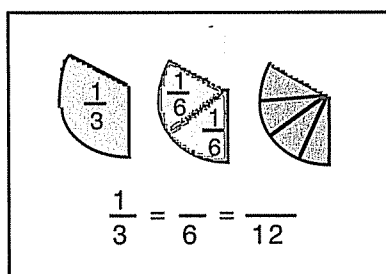
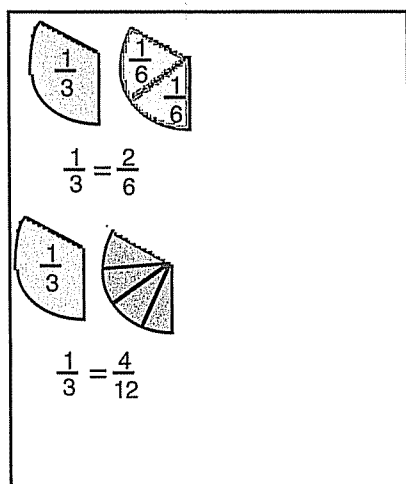


Make all of the equivalent fractions possible for one half. Put two different fractions per page.



My Fractions Book: Equivalence

On the following pages repeat this process with the third, fourth, fifth, and sixth fraction pieces.



On the next pages in your booklet repeat this process with numerators greater than one for the thirds, fourths, fifths, and sixths fraction pieces.

Record equations in this format also.

$$\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{5}{10} = \frac{6}{12}$$

Challenge! $\frac{2}{3} = \frac{4}{6} = \frac{8}{12} = \frac{10}{15}$

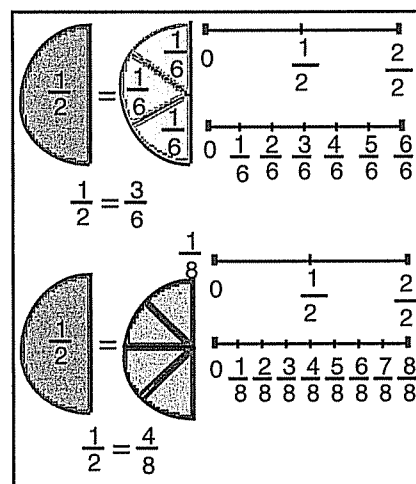
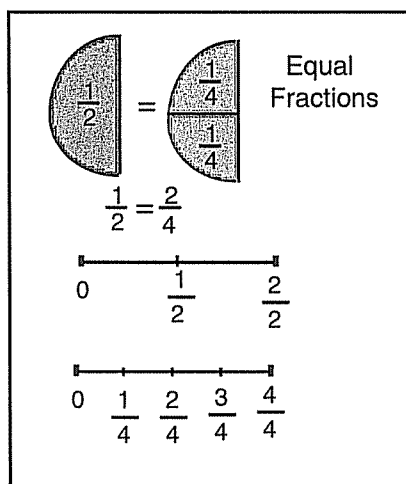
My Fractions Book: Equivalence - Number Lines

Purpose The purpose of this lesson is to record the number lines on equivalent fraction pages.

Prerequisites My Fractions Book: Number Lines

Materials My Fractions Book
Prism Fractions Circle Set
Prism Fractions Square Set

Lesson On the Equal Fractions pages add number lines to the pairs of equivalent fractions using Prism Fractions Squares. The square Prism Fractions pieces will keep the length of an edge equal to one and have equal spacing for the fractional parts.
Examples:



Worksheets Equivalence: Manipulative, page 62
Equivalence: Recording - Worksheets 1 and 2, pages 63 and 64

Patterns in Arithmetic

**Fractions: Booklet 1
Basic Concepts**

**Answer Key
for the
Student Workbook**

By Suki Glenn and Susan Carpenter

Answer Key Legend

AWV = answer(s) will vary
BUWV = break up will vary
OWV = order will vary

Pattern Blocks

r = red trapezoid
g = green triangle
y = yellow hexagon
o = orange square
b = blue parallelogram
t = tan rhombus

Cuisenaire Rods

1 w = white
2 r = red
3 lg = light green
4 p = purple
5 y = yellow
6 dg = dark green
7 bk = black
8 bn = brown
9 bl = blue
10 o = orange

Note: Some items and pages are left out of the answer key.

- 1) Some pages in which the answers are open-ended or will vary.
- 2) Make your own problems. Since students create their own problems and solutions, these sections give valuable information about the level of confidence and competence. It can be a useful source of curriculum for other students.
- 3) Practice pages.
- 4) Workboards.
- 5) The answers are in the Parent/Teacher Guide.

Patterns in Arithmetic: Fractions - Booklet 1
Parent/Teacher Guide
Answer Key for the Student Workbook
©2012 Pattern Press

All rights reserved.

Published by Pattern Press
P.O. Box 2737
Fallbrook, CA 92088

Printed on recycled paper.



ISBN 978-1-935559-25-2

Fractions - Booklet 1

Pre-Assessment - Worksheet 1

Assesses basic concept in:

- A. Fractional units using a manipulative
- B. Changing sizes of the whole
- C. Fractional units on a number line
- D. Equal fractions with a manipulative and number lines,

A familiar fraction manipulative, such as, circle fractions or Prism Fractions and Pattern Blocks must be available to the student. The examiner must observe the student throughout the entire assessment. Give assistance only in reading. Note if the student uses the manipulative or not on each item.

1. What is the color of the $\frac{1}{3}$ piece in your set? orange
2. Cover the whole with fourths. How many fourths does it take to cover a whole?
4
3. Cover the whole with sixths. How many sixths does it take to cover a whole?
6

4. Circle all of the designs below which are cut in half.
-

5. Write the name of this fraction in words. $\frac{1}{3}$ one-third

6. Write in the correct $<$ $>$ sign. $\frac{1}{4} < \frac{3}{4}$

7. Shade in $\frac{3}{4}$ of this box.

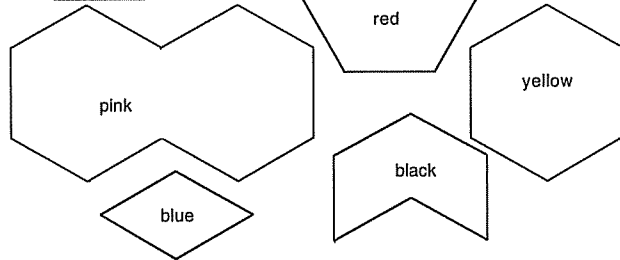
8. Circle the fraction that shows a larger amount. $\frac{1}{4}$ $\frac{1}{3}$
9. Which fraction shows a larger amount $\frac{4}{5}$ or $\frac{3}{6}$? $\frac{4}{5}$
How do you know? Fifths are larger than sixths.

$$\frac{3}{6} = \frac{1}{2} \quad \frac{4}{5} \text{ is larger than } \frac{1}{2}.$$

1

Pre-Assessment - Worksheet 2

10. If the is equal to $\frac{1}{6}$, which of these figures is equal to one whole? yellow hexagon



11. If equals 1, then what does equal? $\frac{1}{3}$

- If equals $\frac{1}{2}$, then what does equal? $\frac{1}{6}$

2

Pre-Assessment - Worksheet 3

12. Here are two pizzas. Shade in half of each pizza.

This is half of pizza A. This is half of pizza

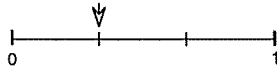
The pieces are both halves, but they are not the same size.
How can this be? If the whole is bigger, then the half is bigger.

13. List all the fractions you can make with your set of fraction pieces that are equal to $\frac{1}{2}$. $\frac{4}{8}$, $\frac{6}{12}$, $\frac{8}{16}$, $\frac{10}{20}$, $\frac{12}{24}$
14. Trade three-fourths for twelfths with your fraction pieces. How many twelfths cover the same area as three-fourths? 9
15. How many sixths are needed to cover one-third? 2

16. Fill in the missing numbers in this pattern.

$$2 = \frac{4}{2} = \frac{6}{3} = \frac{8}{4} = \frac{12}{6} = \frac{16}{8}$$

17. The arrow points to which fraction on the number line. $\frac{1}{3}$



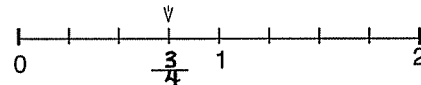
3

Pre-Assessment - Worksheet 4

18. The arrow points to which fraction on the number line? $\frac{3}{5}$

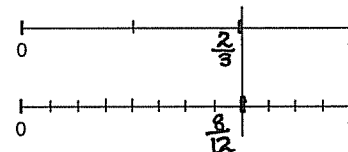


19. What fraction is the arrow pointing to? $\frac{3}{4}$



20. How many twelfths are in two-thirds? 8

Draw a line on the number line to prove your answer.



4

In the Kitchen - Worksheet 1

How many fourths are in one cup? 4 How many tablespoons are in a cup? 16
How many tablespoons are in a fourth of a cup? 4

Here's a piece of bread spread with your very favorite jam. You share it with a friend. He cuts it in two and gives you this piece for your 'half' and keeps the other part for himself.

How do you feel about the sharing? Unhappy

How would you want the bread cut? Draw it here.



How does the bread have to be cut to be fair? Exactly in half.

When the bread is cut exactly in half, how many pieces do you get? 2
Are two halves together larger, smaller, or the same size as the original piece of bread?

The same.

Draw, then cut the bread into four 'fair' pieces to share with four people.





4

In the Kitchen - Worksheet 2

Cut the English muffins in half and toast them. Spread 1 tablespoon of sauce on each muffin. Spread $\frac{1}{4}$ cup cheese on top of the sauce. Place the desired toppings on top of the sauce. Cook in a preheated oven at 400° until the cheese melts, about five minutes. Cut the pizzas into different fractional amounts.

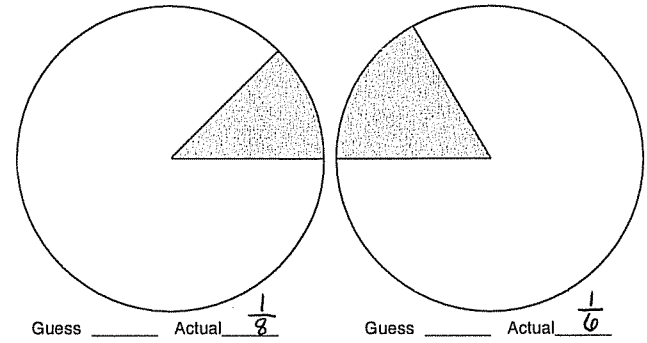
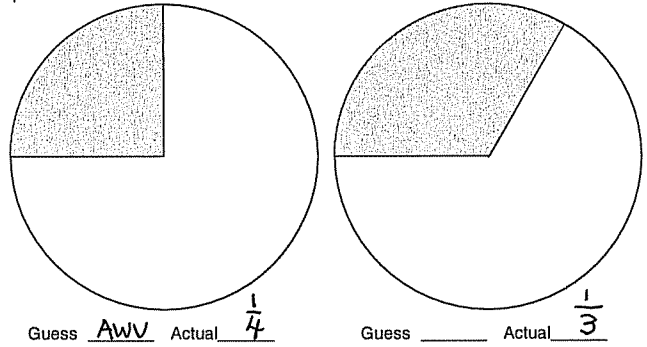
Word problems that go with the pizzas.

- You have five pizzas. Your friend eats two pizzas, and you eat two pizzas. How many left? 1 pizza
If you shared the left over pizza, how much would you get? $\frac{1}{2}$
- A pizza is sliced into four pieces. You eat two pieces. How much of the pizza did you eat? $\frac{1}{2}$ How much is left? $\frac{1}{2}$ Draw a picture. 
or 2 pieces
- You have three pizzas, and five friends come for a party. How would you divide the pizzas so each person has an equal amount? cut in 6ths Draw a picture. 
How much does each person get? 3 pieces or $\frac{3}{6}$
- How many tablespoons are in a fourth of a cup? 4
You have half of a cup of pizza sauce. Each pizza uses one tablespoon of sauce. How many pizzas can you make? 8 pizzas
- There are six English muffins in a bag. Each English muffin makes two pizzas. How many pizzas can be made from one bag? 12 pizzas
- You are going to have some friends over to share the pizza. If each person eats three pizzas, how many people will one bag of English muffins feed? 4 people
- If each person eats two pizzas, how many people can you have over? 6 people
- Figure out how many cups of cheese and sauce you will need if each pizza uses 3 tablespoons of cheese and 1 tablespoon of sauce. Figure out the amount of toppings (olives, mushrooms, etc.) to buy.
3 cups cheese
12 T sauce 12 T = $\frac{3}{4}$ cup

6

What Fraction Is This? - Worksheet 1

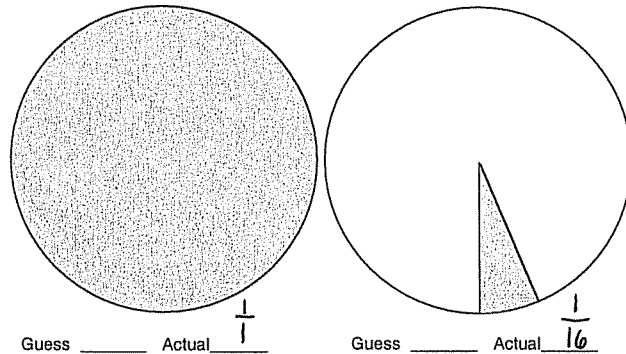
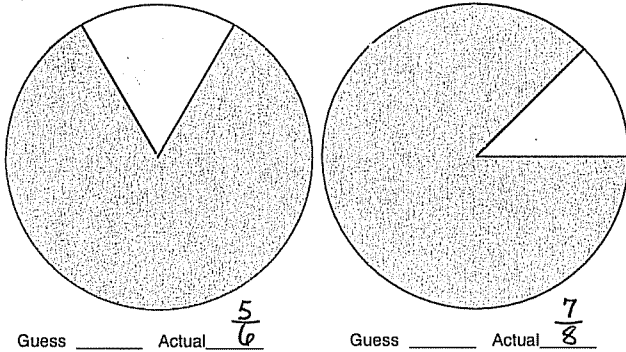
What fraction of the circle is shaded? Guess first. Then use your fraction pieces to measure.



10

What Fraction Is This? - Worksheet 2

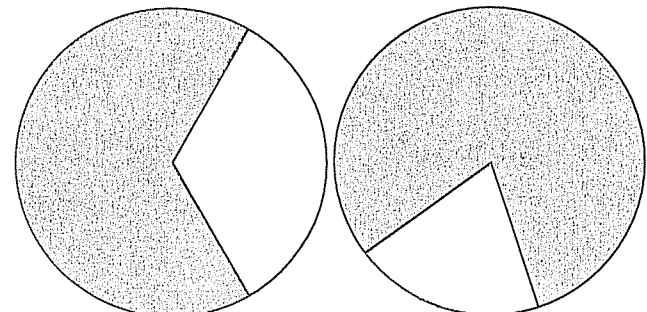
What fraction of the circle is shaded? Guess first. Then use your fraction pieces to measure.



11

What Fraction Is This? - Worksheet 3

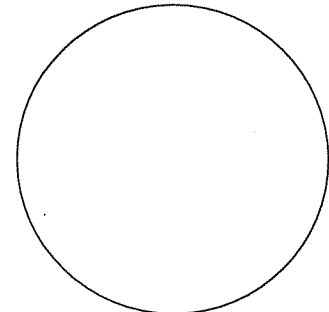
What fraction of the circle is shaded? Challenge! These will take more than one piece. There is more than one correct answer



There are 3 correct answers.
 $\frac{2}{3}$ or $\frac{4}{6}$ or $\frac{8}{12}$

There are 2 correct answers.
 $\frac{4}{5}$ or $\frac{8}{10}$

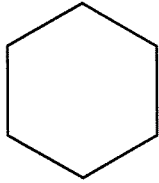
Challenge!
What fraction of the circle is shaded? 0



12

Numerators Greater Than One - Worksheet 1

Cover with three equal pattern blocks.



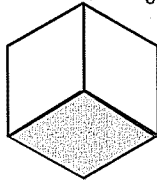
$$\frac{1}{3} \text{ out of } = \frac{1}{3}$$

Each block is one of three equal parts of the shape. $\frac{1}{3}$

Color one block.

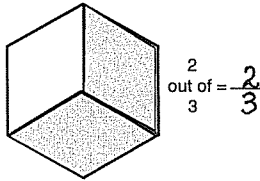
How many parts are colored? $\frac{3}{3}$

$$\frac{1}{3} \text{ out of } = \frac{1}{3}$$



Color two blocks.

How many parts are colored? $\frac{2}{3}$

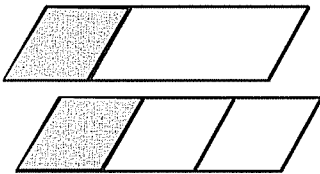
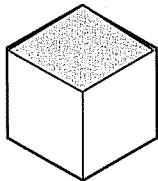
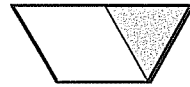
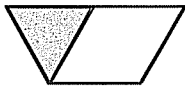


$$\frac{2}{3} \text{ out of } = \frac{2}{3}$$



Cover with three pattern blocks.

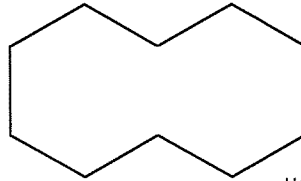
Color $\frac{1}{3}$ one color and $\frac{2}{3}$ another color.



14

Numerators Greater Than One - Worksheet 2

Cover with four equal pattern blocks.



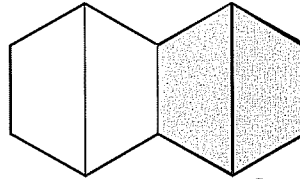
$$\frac{1}{4} \text{ out of } = \frac{1}{4}$$

Each block is one of four equal parts of the shape. Color one $\frac{1}{4}$



How many parts are colored? $\frac{1}{4}$ out of $\frac{4}{4}$

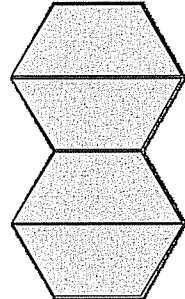
Color two parts.



$$\frac{2}{4} \text{ out of } = \frac{2}{4}$$

$$\frac{1}{4} \text{ out of } = \frac{1}{4}$$

Color four parts.

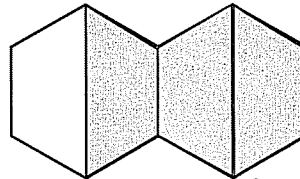


How many parts are colored? $\frac{4}{4}$ out of $\frac{4}{4}$

$$\frac{4}{4} \text{ out of } = \frac{4}{4}$$

How many parts are colored? $\frac{2}{4}$ out of $\frac{4}{4}$

Color three parts.



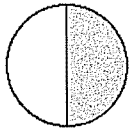
$$\frac{3}{4} \text{ out of } = \frac{3}{4}$$

How many parts are colored? $\frac{3}{4}$ out of $\frac{4}{4}$

15

Numerators Greater Than One - Worksheet 3

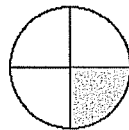
Wholely Cow
One fraction is mixed up.



"My name is $\frac{1}{2}$."



"My name is $\frac{2}{3}$."



"My name is $\frac{1}{4}$."



"My name is $\frac{6}{6}$."



"My name is $\frac{4}{8}$."

Will the real one please stand up? $\frac{6}{6}$



2. Draw $\frac{3}{4}$.



3. Draw $\frac{3}{6}$.



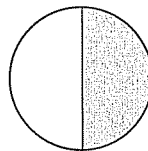
4. Draw $\frac{4}{4}$.



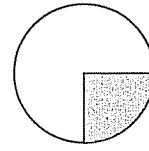
1. Which fraction above is mixed up?
 $\frac{4}{8}$

16

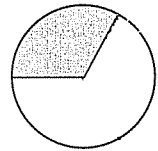
Shrinking Circles - Worksheet 1



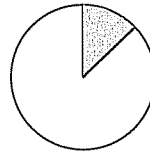
Shade in $\frac{1}{2}$.



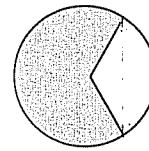
Shade in $\frac{1}{4}$.



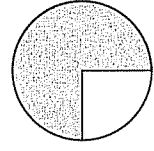
Shade in $\frac{1}{3}$.



Shade in $\frac{1}{8}$.

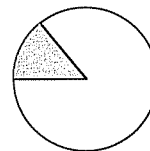


Shade in $\frac{2}{3}$.

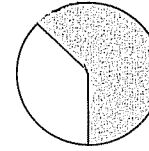


Shade in $\frac{3}{4}$.

Challenge!



Shade in $\frac{1}{6}$.

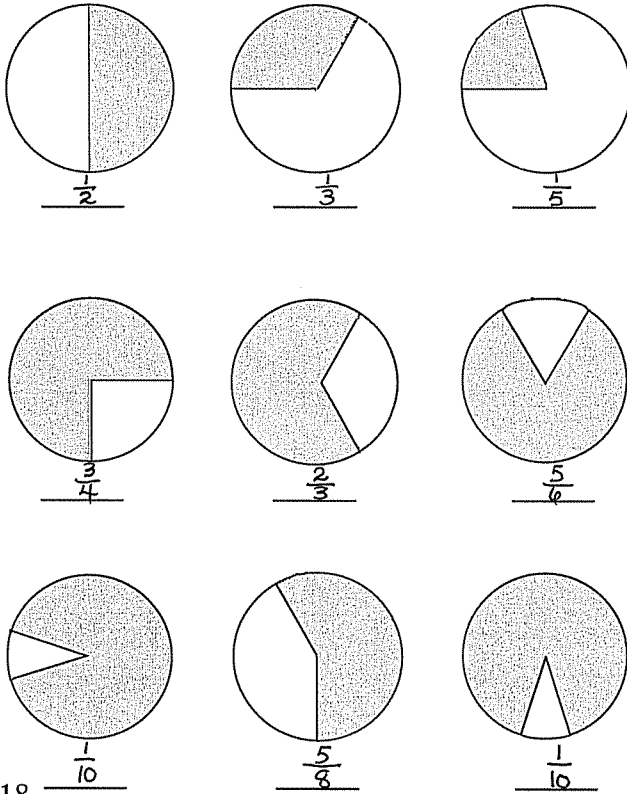


Shade in $\frac{5}{8}$.

17

Shrinking Circles - Worksheet 2

Estimate which fraction each shaded part of the circle



18

Whole Numbers as Fractions

Use fraction circles and My Fractions Book. Review all the pages that show the whole. Fill out this worksheet. Draw the pieces which make the wholes from each page here.

Example:
 $1 = 2$



$1 =$ fifths



$1 =$ 3 thirds



$1 =$ 6 sixths



$1 =$ 4 fourths



$1 =$ 8 eighths



What patterns do you notice? The number of pieces in each whole is equal to the denominator. They all have = 1. Several of the fractional words end in th.

Use your pattern to fill in the missing numbers.

$$1 = \frac{4}{4}$$

$$1 = \frac{3}{3}$$

$$\frac{6}{6} = 1$$

$$1 = \frac{5}{5}$$

$$1 = \frac{8}{8}$$

$$\frac{12}{12} = 1$$

19

Greater Than, Less Than - Worksheet 1

$1 > \frac{1}{2}$ $\frac{1}{3} < 1$

Show the relationship by putting in $<$ or $>$ signs.

Use fraction pieces to prove your answers.

$$\frac{1}{2} < 1$$

$$\frac{1}{3} < 1$$

$$\frac{1}{4} < 1$$

$$\frac{1}{2} > \frac{1}{3}$$

$$\frac{1}{4} > \frac{1}{8}$$

$$\frac{1}{4} < \frac{1}{2}$$

$$\frac{1}{6} < \frac{1}{4}$$

$$\frac{1}{3} > \frac{1}{4}$$

$$\frac{1}{8} > \frac{1}{12}$$

$$\frac{1}{2} > \frac{1}{6}$$

$$\frac{1}{3} > \frac{1}{6}$$

$$\frac{1}{3} < \frac{1}{2}$$

$$\frac{2}{3} > \frac{1}{2}$$

$$\frac{2}{3} > \frac{3}{8}$$

$$\frac{3}{4} > \frac{3}{8}$$

29

Greater Than, Less Than - Worksheet 2

$>$ $<$

Put fractions into the blanks to make the number sentences true.

$$\frac{1}{2} > \frac{1}{3} \quad \frac{1}{2} > \frac{1}{4} \quad 1 > \frac{1}{2} \quad 1 > \frac{1}{3}$$

AWV Example:

$$\frac{1}{6} > \frac{1}{8} \quad \frac{1}{5} > \underline{\quad} \quad \underline{\quad} > \frac{1}{3} \quad \underline{\quad} > \frac{1}{4}$$

$$\underline{\quad} > \underline{\quad} \quad \underline{\quad} > \underline{\quad} \quad \underline{\quad} > \underline{\quad} \quad \underline{\quad} > \underline{\quad}$$

Do the same with these number sentences.

$$\frac{1}{2} < \frac{2}{2} \quad \frac{1}{2} < 1 \quad \frac{1}{3} < \frac{1}{2} \quad 0 < \frac{1}{2}$$

AWV

$$\frac{1}{5} < \underline{\quad} \quad \frac{1}{8} < \underline{\quad} \quad \underline{\quad} < 1 \quad \underline{\quad} < \frac{1}{6}$$

$$\underline{\quad} < \underline{\quad} \quad \underline{\quad} < \underline{\quad} \quad \underline{\quad} < \underline{\quad} \quad \underline{\quad} < \underline{\quad}$$

Put the symbol in the box to show the relationship.

$$\frac{1}{4} \boxed{>} \frac{1}{6}$$

$$\frac{1}{3} \boxed{>} \frac{1}{4}$$

$$\frac{1}{4} \boxed{<} \frac{1}{2}$$

$$\frac{1}{3} \boxed{<} \frac{1}{2}$$

$$\frac{2}{6} \boxed{<} \frac{3}{6}$$

$$\frac{1}{2} \boxed{>} \frac{1}{6}$$

30

Recording Fractions - Show You Know Prism Fractions Set

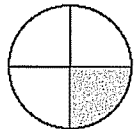
1 white is 1 whole,
 1 red piece is $\frac{1}{2}$ of the whole.
 1 orange piece is $\frac{1}{3}$ of the whole.
 1 yellow piece is $\frac{1}{4}$ of the whole.
 1 green piece is $\frac{1}{5}$ of the whole.
 1 blue piece is $\frac{1}{6}$ of the whole.
 1 indigo piece is $\frac{1}{8}$ of the whole.
 1 violet piece is $\frac{1}{10}$ of the whole.
 1 black piece is $\frac{1}{12}$ of the whole.

numerator
denominator

Mathematicians call the top number of a fraction the **numerator**. It tells how many parts of a whole you have. With a pencil, circle the numerators in each fraction above.

The bottom number of a fraction is called a **denominator**. It means how many equal parts make a whole, or how many equal parts into which a whole is divided. Write a capital D on each denominator above.

Draw a whole.
Shade in $\frac{1}{4}$.



The numerator is 1

The denominator is 4 and indicates that the whole is divided equally into 4

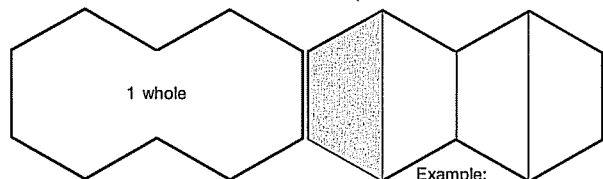
31

Pattern Block Fractions - Worksheet 1



Cover with four equal pattern blocks.

Each block is one of four equal parts or $\frac{1}{4}$ of the shape.

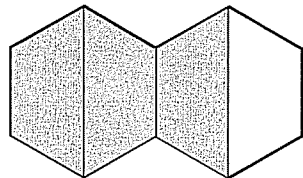


1 whole

Example:

How many parts are colored? 1 out of 4

$$\frac{1}{4} \text{ out of } = \frac{1}{4}$$



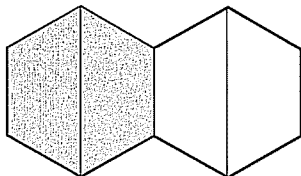
$$\frac{3}{4} \text{ out of } = \frac{3}{4}$$

How many parts are colored? 3 out of 4

Shade this one.

2 out of 4

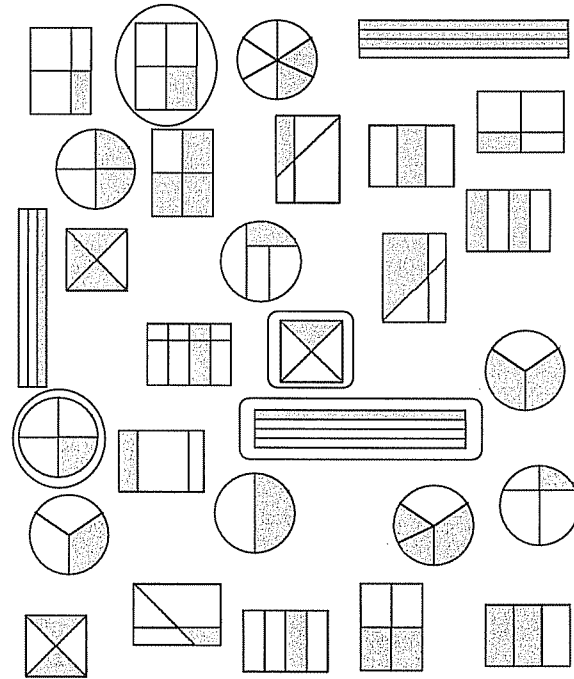
$$\frac{2}{4} \text{ out of } = \frac{2}{4}$$



38

Sorting Fractions - Show You Know

Decide which pictures are divided into fourths and show one fourth shaded. The shaded section is the fractional part. Circle the pictures in which one fourth is shaded. You may want to copy this page, cut the pictures out, and then sort.



32

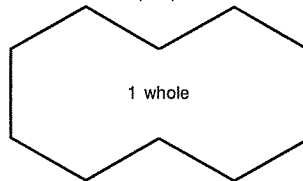
Pattern Block Fractions - Worksheet 2



Cover with six equal pattern blocks.

Each block is one of six equal parts

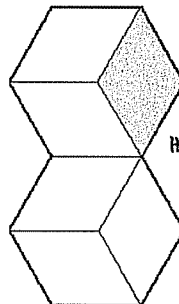
or $\frac{1}{6}$ of the shape.



1 whole

How many parts are colored? 3 out of 6.

$$\frac{3}{6} \text{ out of } = \frac{3}{6}$$



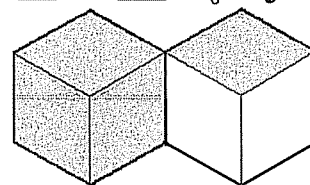
How many parts are colored? 1 out of 6

$$\frac{1}{6} \text{ out of } = \frac{1}{6}$$

Shade this one.

4 out of 6

$$\frac{4}{6} \text{ out of } = \frac{4}{6}$$



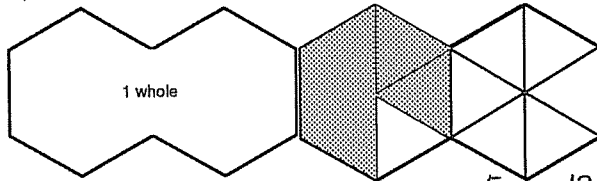
39

Pattern Block Fractions - Worksheet 3



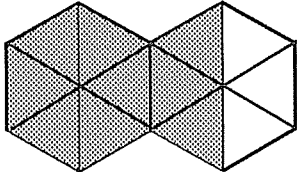
Cover with twelve equal pattern blocks.

Each block is one of twelve equal parts or $\frac{1}{12}$ of the shape.



How many parts are colored? 5 out of 12

How many parts are colored? 9 out of 12



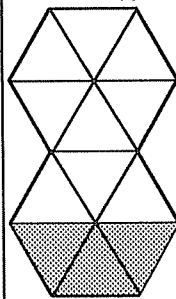
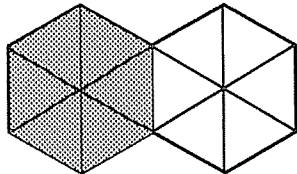
$\frac{9}{12}$
out of = $\frac{9}{12}$

How many parts are colored? 3 out of 12

out of = $\frac{3}{12}$

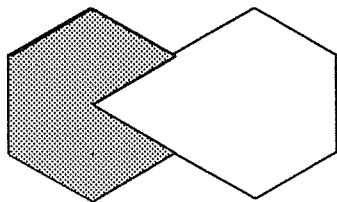
Shade this one.

6 out of 12 = $\frac{6}{12}$

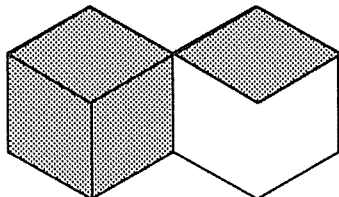


40

Pattern Block Fractions - Worksheet 5 Show You Know



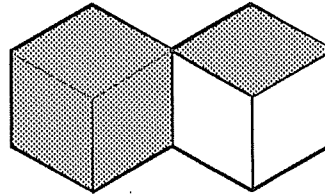
What fraction is shaded? $\frac{5}{12}$



What fraction is shaded? $\frac{4}{6}$

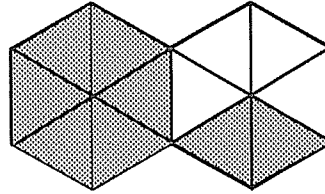
42

Pattern Block Fractions - Worksheet 4 Show You Know



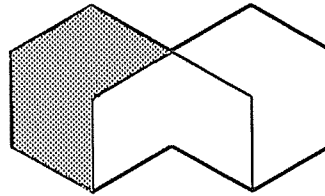
What fraction is colored?

$\frac{4}{6}$ out of $\frac{4}{6}$
out of = $\frac{4}{6}$



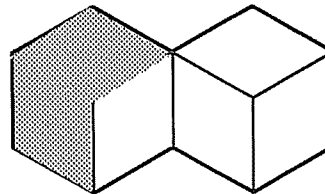
What fraction is colored?

$\frac{8}{12}$ out of $\frac{8}{12}$
out of = $\frac{8}{12}$



What fraction is colored?

$\frac{1}{3}$ out of $\frac{1}{3}$
out of = $\frac{1}{3}$

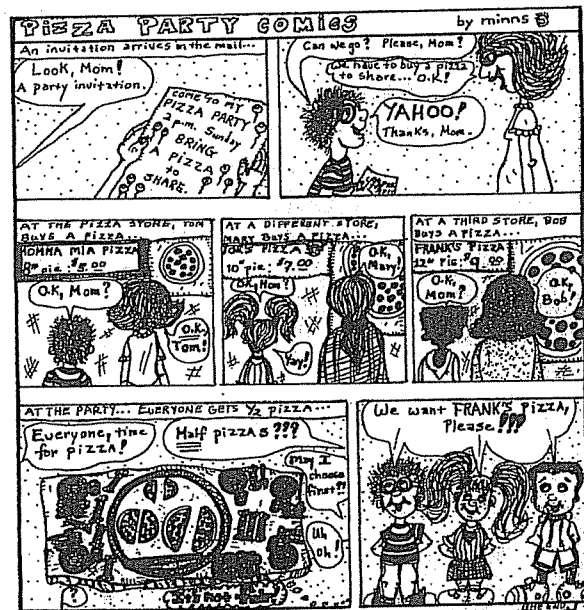


Shade this one.

$\frac{2}{6}$ out of $\frac{2}{6}$
out of = $\frac{2}{6}$

41

Changing Wholes: Beginning - Worksheet 1



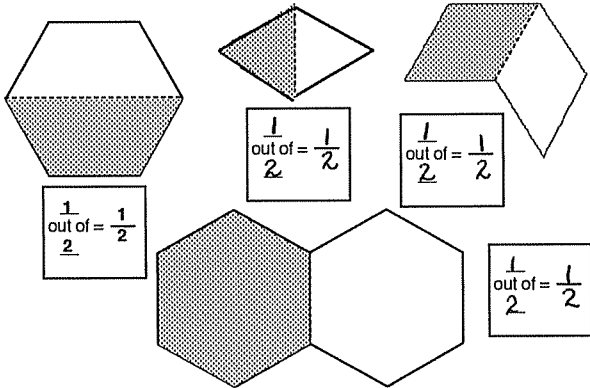
Why do they want half of Frank's pizza? Frank's pizza is the largest.

How can they share the pizzas fairly? Cut each in half again and then divide them.

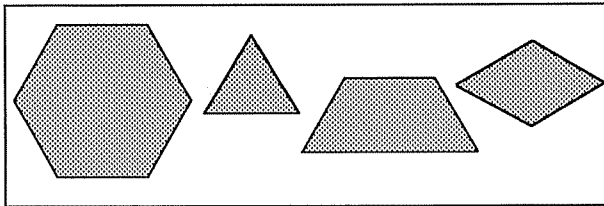
43

Changing Wholes: Beginning - Worksheet 2

Cover the first figure with two equal pattern blocks. Remove one of the blocks. Trace the remaining block. Color the empty section the same color as the block. Write the fraction of the colored amount in the rectangle. Leave the other block on the figure. Repeat with all of the figures.



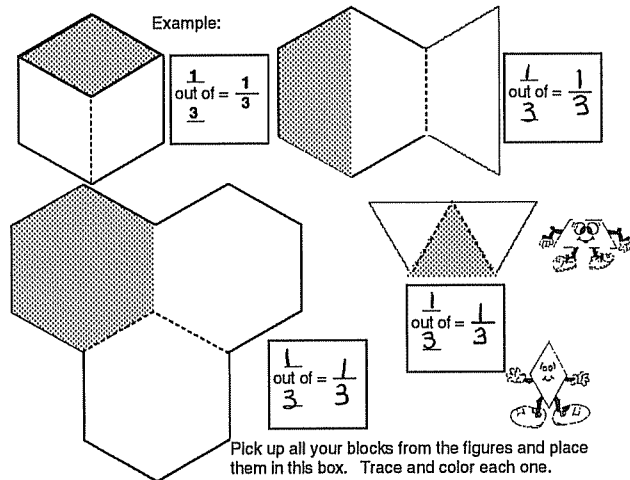
Pick up all the $\frac{1}{2}$ blocks from the figures and place them in this box. Trace and color each one.



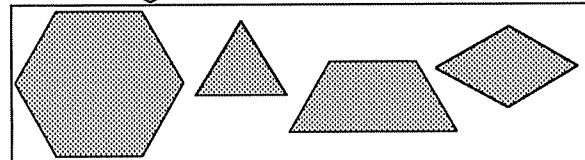
You labeled each of these blocks one half. Are the sizes the same? no
 How can this be? It is still one-half even if the sizes are different. They are all 1 out of 2.

Changing Wholes: Beginning - Worksheet 3

Cover the first figure with three equal pattern blocks. Remove one block. Trace the empty space. Color the empty space the same color as the block. Write the fraction your colored space represents in the rectangle. Remove one more block. Leave the last block on the figure. Repeat with all of the figures.



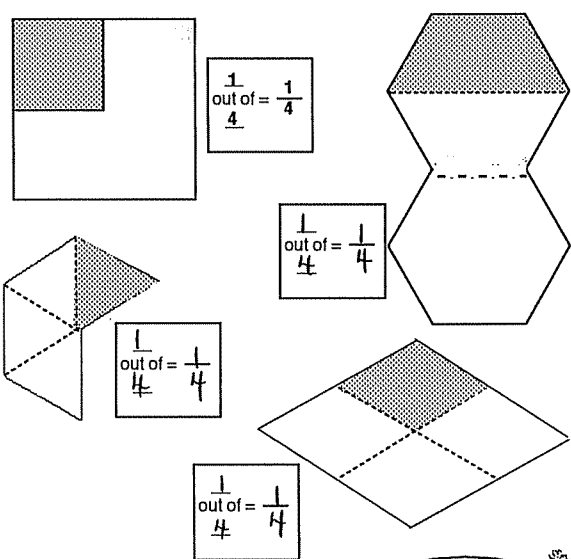
Pick up all your blocks from the figures and place them in this box. Trace and color each one.



You labeled each of these blocks one-third. Are the sizes the same? no
 How can this be? Fractions are ratios.

Changing Wholes: Beginning - Worksheet 4

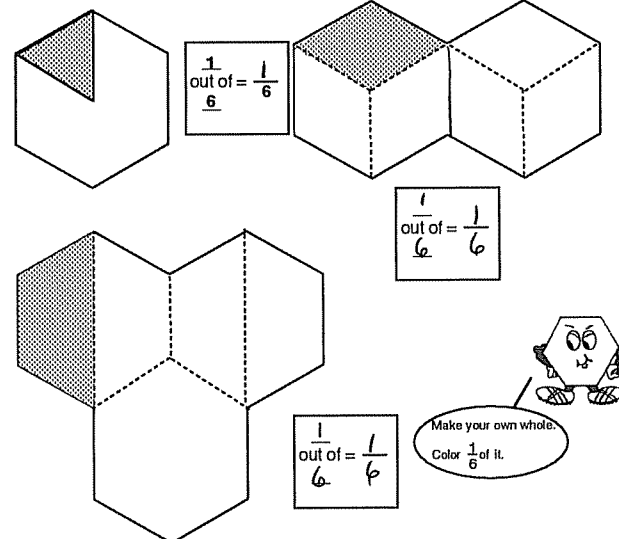
Cover the first figure with four equal pattern blocks. Remove one of the blocks. Trace the empty space. Color the empty space the same color as the block. Write the fraction of the colored amount in the rectangle. Remove two more blocks. Leave the last block on the figure. Repeat with all of the figures.



Are all of the fourths of equal size? no
 Make your own whole.

Changing Wholes: Beginning - Worksheet 5

Cover the first figure with six equal pattern blocks. Remove one of the blocks. Trace the empty space. Color the empty space the same color as the block. Write the fraction of the colored amount in the rectangle. Remove four more blocks. Leave the last block on the figure. Repeat with all of the figures.



Are the colored one-sixths all the same size? no

The smaller the $\frac{1}{6}$, the smaller the whole.

Pattern Block Designs - Worksheet 1

Build part of a design with pattern blocks. Have another person build the missing part. Trace or draw a picture. Trade off building parts of the design and building the missing part.
Example:

If this is half, what is the whole?



Build it here. Draw or trace your whole.



If this is half, what is the whole?



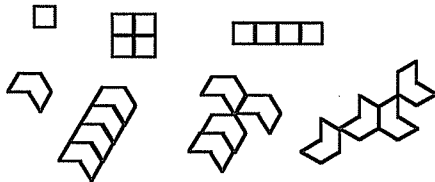
If this is a third, what is the whole?



If this is a third, what is the whole?



If this is a fourth, what is the whole?



48

Rulers as Number Lines - Worksheet 3

The whole is defined as one centimeter. $\underline{\hspace{1cm}}$

Measure these lines in centimeters.

15

6

13

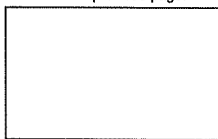
10

14

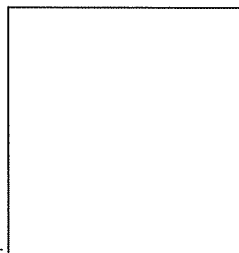
8

Rulers as Number Lines - Worksheet 4

Number lines can be used to measure the perimeter of rectangles. Measure the perimeter of each rectangle in centimeters with the number line ruler at bottom of the previous page.



perimeter 26



perimeter 34



perimeter 38

53

Rulers as Number Lines - Worksheet 1

Cut out and use the ruler at the bottom of the page.

The whole is defined as one inch. $\underline{\hspace{1in}}$

Measure these lines in inches.

6 inches

2 inches

5 inches

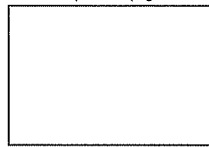
4 inches

7 inches

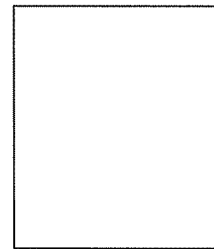
50

Rulers as Number Lines - Worksheet 2

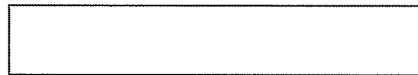
Number lines can be used to measure the perimeter of rectangles. Measure the perimeter of each rectangle in inches with the number line ruler at the bottom of the previous page.



perimeter 10



perimeter 12



perimeter 14

51

Rulers as Number Lines - Worksheet 3

The whole is defined as one centimeter. $\underline{\hspace{1cm}}$

Measure these lines in centimeters.

15

6

13

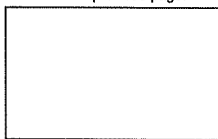
10

14

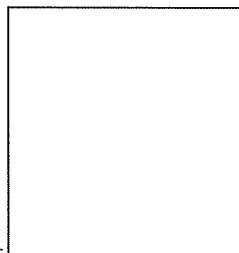
8

Rulers as Number Lines - Worksheet 4

Number lines can be used to measure the perimeter of rectangles. Measure the perimeter of each rectangle in centimeters with the number line ruler at bottom of the previous page.



perimeter 26



perimeter 34

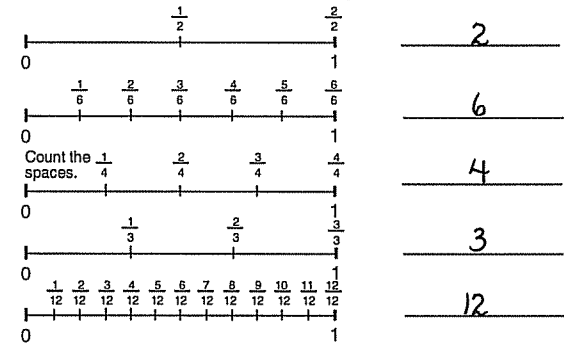


perimeter 38

53

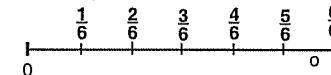
Whole Numbers as Fractions: Number Lines

The line segment is divided into how many sections?



What fraction describes the distance along each line segment?

Write it in place on all the above line segments. For example:



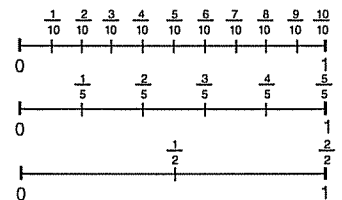
The line segment is divided into how many sections?

10

5

2

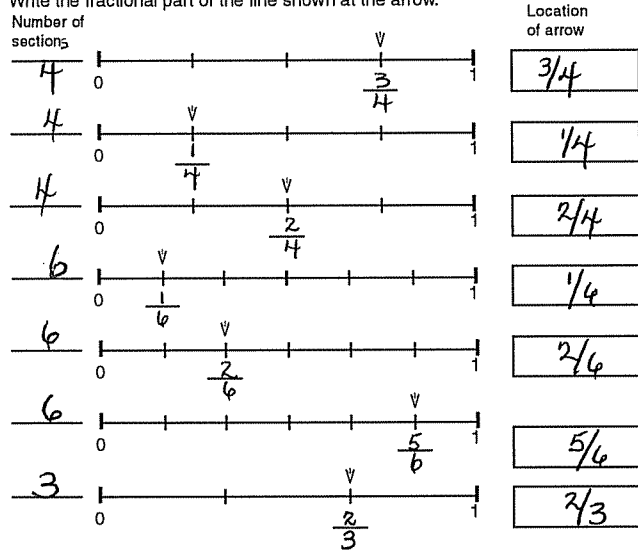
Write the fraction that describes each point.



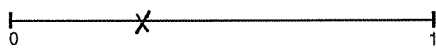
55

Numerators Greater Than One: Number Lines Worksheet 1

Write the fraction that describes the distance each point is along the number line.
Write the fractional part of the line shown at the arrow.



Draw an X where $\frac{1}{3}$ is on the number line.



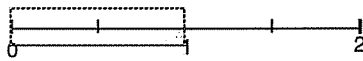
Draw a ★ where $\frac{1}{2}$ is on the number line.



56

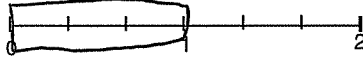
Numerators Greater Than One: Number Lines Worksheet 3

Draw a box around the whole. Example:



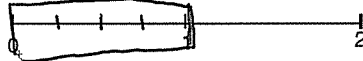
The number line is divided into 4.
a) thirds
b) halves
c) fourths

Draw a box around the whole.

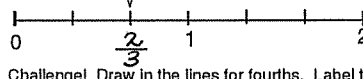
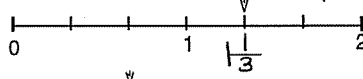
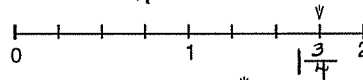
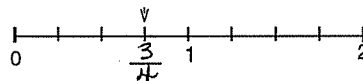


The number line is divided into 6.
a) thirds
b) halves
c) sixths

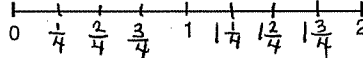
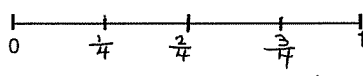
Divide this number line into fourths. Draw a box around the whole.



What fraction is the arrow pointing to? Write it on the line under the number line.



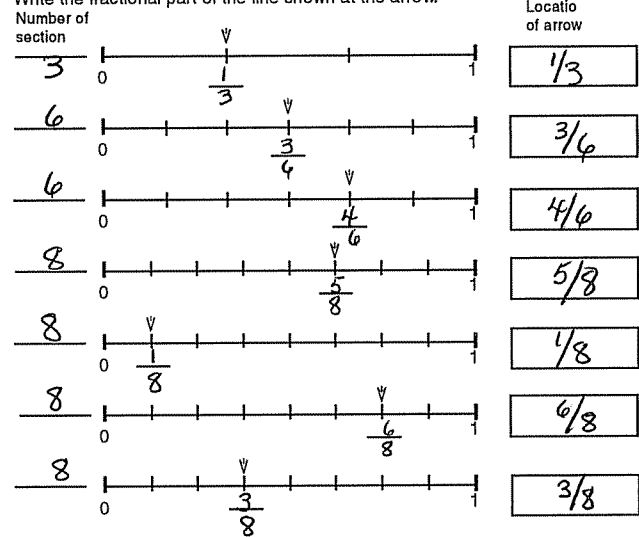
Challenge! Draw in the lines for fourths. Label the fractions.



58

Numerators Greater Than One: Number Lines Worksheet 2

Write the fraction that describes the distance each point is along the number line.
Write the fractional part of the line shown at the arrow.



Draw an X where $\frac{3}{4}$ is on the number line.



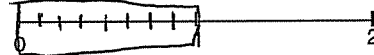
Draw a ★ where $\frac{7}{8}$ is on the number line.



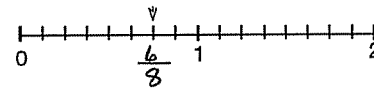
57

Numerators Greater Than One: Number Lines Worksheet 4

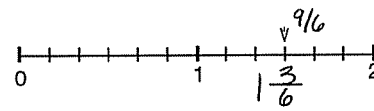
Divide this number line into eighths. Draw a box around the whole.



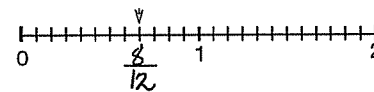
What fraction is the arrow pointing to? Write it on the line under the number line.



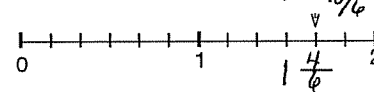
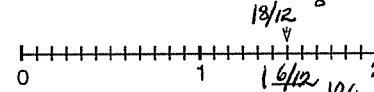
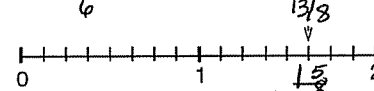
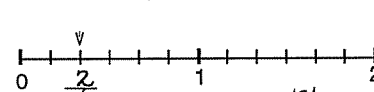
The number line is divided into 8.
a) sixths
b) twelfths
c) eighths



The number line is divided into 6.
a) sixths
b) twelfths
c) eighths



The number line is divided into 12.
a) sixths
b) twelfths
c) eighths

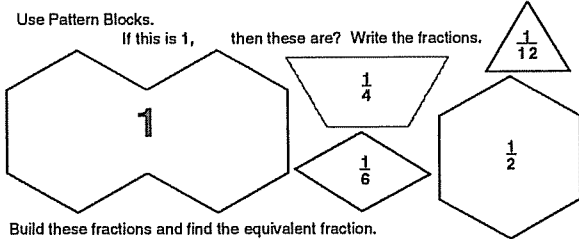


59

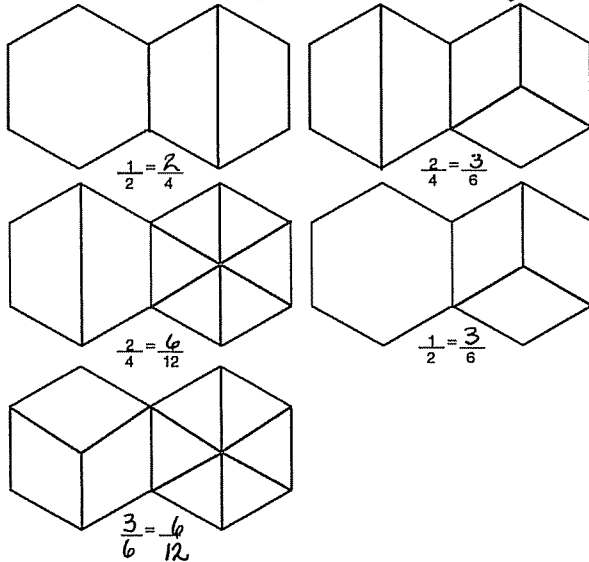
Equivalence: Manipulative - Worksheet 1

Use Pattern Blocks.

If this is 1, then these are? Write the fractions.



Build these fractions and find the equivalent fraction.



62

Equivalence: Recording - Worksheet 2

Whole Numbers

Use a fraction manipulative to find the answers.

$$1 = \frac{2}{2} = \frac{3}{3} = \frac{4}{4} = \frac{5}{5} = \frac{6}{6}$$

$$2 = \frac{4}{2} = \frac{6}{3} = \frac{8}{4} = \frac{10}{5} = \frac{12}{6}$$

$$4 = \frac{8}{2} = \frac{12}{3} = \frac{16}{4} = \frac{20}{5} = \frac{24}{6}$$

Make your own.

$$= \frac{\square}{2} = \frac{\square}{3} = \frac{\square}{4} = \frac{\square}{5} = \frac{\square}{6}$$



What patterns do you see? $1 =$ numerators increase by one. $2 =$ numerators increase by twos. $4 =$ numerators are the four times table.

64

Equivalence: Recording - Worksheet 1

Use a different manipulative to find the answers.

$$1 = \frac{2}{2} = \frac{3}{3} = \frac{4}{4} = \frac{5}{5} = \frac{6}{6}$$

$$2 = \frac{4}{2} = \frac{6}{3} = \frac{8}{4} = \frac{10}{5} = \frac{12}{6}$$

$$3 = \frac{6}{2} = \frac{9}{3} = \frac{12}{4} = \frac{15}{5} = \frac{18}{6}$$

$$\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{6}{12}$$

$$\frac{1}{4} = \frac{2}{8} = \frac{3}{12} = \frac{4}{16}$$

$$\frac{2}{4} = \frac{4}{8} = \frac{6}{12}$$

$$\frac{1}{3} = \frac{2}{6} = \frac{4}{12}$$

$$\frac{3}{4} = \frac{6}{8} = \frac{9}{12}$$

$$\frac{2}{3} = \frac{4}{6} = \frac{8}{12}$$

$$\frac{4}{4} = \frac{8}{8} = \frac{12}{12}$$

$$\frac{3}{3} = \frac{6}{6} = \frac{12}{12}$$

What patterns do you see?

Whole numbers go up by the multiple of the number, e.g., $1 = \frac{2}{2}, \frac{3}{3}, \frac{4}{4}, \frac{5}{5}, \frac{6}{6}$. Pattern repeats with fractions, e.g., $\frac{1}{2} = \frac{2}{4}, \frac{3}{6}, \frac{4}{8}, \frac{6}{12}$. $\frac{2}{4} = \frac{4}{8}, \frac{6}{12}$. $\frac{3}{4} = \frac{6}{8}, \frac{9}{12}$. $\frac{4}{4} = \frac{8}{8}, \frac{12}{12}$.

Word Problems



Dad Nana's Cafe Grandpa Grandma Drew Joey Jackie Cadence Kyle Ryan Mom

The whole family went to the county fair.

How many tickets did they buy to get into the fair? $\frac{12}{4/12}$

What fraction of the people are holding balloons? $\frac{4}{12}$

How many children are there? 8

How many adults are there? 4

What fraction of the whole family are children? $\frac{8}{12}$

What fraction of the whole family are adults? $\frac{4}{12}$

Challenge.

$$\frac{8}{12} = \frac{2}{3}$$

$$\frac{4}{12} = \frac{1}{3}$$

Consider only the children. What fraction of the children are girls? $\frac{4}{8}$

Make two problems of your own.

The Post-Assessment is the same as the Pre-Assessment.

65

Patterns in Arithmetic: Fractions - Booklet 1 PDF
Parent/Teacher Guide
Basic Concepts

ISBN 978-1-935559-57-3

ISBN 978-1-935559-57-3



9 781935 559573