MathLinks

FRACTIONS 2
STUDENT PACKET

FRACTION ADDITION AND SUBTRACTION

Parent (or Guardian) signature _____

MY WORD BANK

Explain the mathematical meaning of each word or phrase, using pictures and examples when possible. (See section 2.5.) Key mathematical vocabulary is underlined throughout the packet.

common denominator	difference
estimate	multiplication property of 1
lowest common denominator	equivalent fractions
sum	word of your choice: _____

THE SUPER MATH SQUAD

Like most super heroes, the Super Math Squad loves pizza. Their favorite pizza place, the Pi Palace, only makes whole pizzas and they are all the same size.

- The Reducer (she finds equivalent forms of fractions to meet any need)

  wants $\frac{1}{3}$ of a veggie pizza and $\frac{1}{6}$ of a pepperoni pizza.

- The Calculator (he conquers all multi-digit arithmetic in his head)

  wants $\frac{1}{3}$ of a veggie pizza and $\frac{3}{4}$ of a pepperoni pizza.

- The Estimator (she gets crazy close to the actual answer every time)

  wants $\frac{1}{6}$ of a veggie pizza and $\frac{1}{6}$ of a pepperoni pizza.

- The Solver (given a little time, there's not a problem he can't crack)

  wants $\frac{1}{2}$ of a veggie pizza and no pepperoni pizza.

How many of each pizza should they buy?

MENTAL MATH AND ESTIMATION

We will use pictures and mental math to add and subtract proper fractions and mixed numbers. We will use pictures and reasoning to help us estimate sums and differences of proper fractions and mixed numbers.

GETTING STARTED

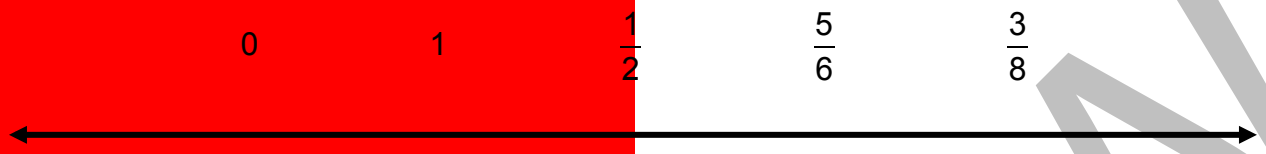
Here are four numbers. Describe why each one might not belong with the other three.

$\frac{4}{8}$ $\frac{5}{4}$ $\frac{3}{4}$ $\frac{1}{5}$

1. I'm $\frac{4}{8}$ and I don't belong because…	2. I'm $\frac{5}{4}$ and I don't belong because…
3. I'm $\frac{3}{4}$ and I don't belong because…	4. I'm $\frac{1}{5}$ and I don't belong because…

FRACTION CONCEPT REVIEW

1. Using section 2.5, write an explanation and example of the word estimate in My Word Bank. Then estimate the location of each number on the number line:



What numbers did you choose to put on the line first?

Explain how you located $\frac{3}{8}$ on the number line.

2. If 3 friends want to share 5 brownies so that each one gets the same amount, how much can each friend have? Show with a diagram. Write the result as an improper fraction and mixed number.

Use "the big 1" to complete each equivalence statement. Draw diagrams if needed.

3. $\frac{1}{3} \times \boxed{1} = \frac{\quad}{6}$	4. $\frac{3}{20} = \frac{\quad}{100}$	5. $\frac{9}{30} = \frac{3}{\quad}$

Write each fraction in simplest form. Show a "big 1" calculation.

6. $\frac{12}{16} \div \boxed{\frac{4}{4}} =$	7. $\frac{8}{12}$	8. $\frac{12}{21}$

Rewrite both fractions with a common denominator and circle the fraction with the greater value. Write an explanation and example in My Word Bank for this term.

9. $\frac{1}{2}$ and $\frac{5}{8}$	10. $\frac{4}{5}$ and $\frac{3}{4}$	11. $\frac{7}{10}$ and $\frac{5}{6}$

ADDING FRACTIONS USING MENTAL MATH

Follow your teacher's directions to find each sum for problems 1-3.Write an explanation of this term in My Word Bank. Use section 2.5 if needed.

(1)

a.	b.	c.	d.

(2)	(3)

Use mental math to add.

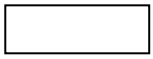
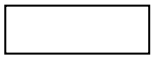
4. $1\frac{1}{2} + 2\frac{1}{2}$	5. $\frac{1}{6} + \frac{5}{6} + \frac{5}{6}$
6. $\frac{2}{7} + \frac{1}{5} + \frac{4}{5} + \frac{5}{7}$	7. $12\frac{2}{9} + 12\frac{7}{9}$
8. $6\frac{1}{3} + 2\frac{1}{4} + 4\frac{2}{3}$	9. $\frac{2}{5} + 10\frac{3}{5} + 14\frac{2}{7}$

10. Why would we probably not add $\frac{4}{11}$ and $\frac{7}{16}$ using mental math?

11. Use what you know about mental math and the sizes of fractions to confirm (or revise) your estimate for the number of pepperoni pizzas the Super Math Squad need to buy. Show your work.

ESTIMATING FRACTION SUMS

Follow your teacher's directions to estimate for problems 1-5.

Record and sketch (each rectangle represents one whole)	**Estimated sum** (picture only)	**Circle one number. The sum is closer to:**
(1) 		0 $\frac{1}{2}$ 1
(2) 		0 $\frac{1}{2}$ 1
(3) 		0 $\frac{1}{2}$ 1
(4) 	(5) 	

Without calculating, circle the phrase that represents the better estimate.

6.	$2\frac{1}{8} + 4\frac{1}{9}$	Closer to 6 Closer to 7	7.	$4\frac{1}{12} + 5\frac{2}{21}$	Closer to 9 Closer to 10
8.	$1\frac{1}{2} + 2\frac{1}{11}$	Closer to 3 Closer to 4	9.	$10\frac{1}{5} + 10\frac{3}{7}$	Closer to 20 Closer to 21

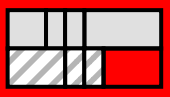
10. Use what you know about mental math and the sizes of fractions to confirm (or revise) your estimate for the number of veggie pizzas the Super Math Squad need to buy. Show your work.

PRACTICE 1

Match the following equations with an appropriate diagram below (area model or linear model). Not all diagrams have a match.

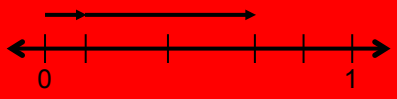
1. ____ $\frac{1}{5} + \frac{2}{5} = \frac{3}{5}$	2. ____ $\frac{4}{8} + \frac{3}{8} = \frac{7}{8}$

a.

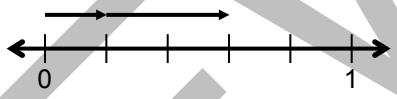


b.

c.



d.



3. Choose one diagram above that does not have a match and explain why.

Use the diagrams above for the following if helpful, or make your own sketch.

4. $\frac{3}{8} +$ ____ $= \frac{1}{2}$	5. Why is $\frac{5}{8}$ greater than $\frac{1}{2}$?

Use mental math to find the sum.

6. $\frac{3}{11} + 2\frac{7}{9} + 4\frac{2}{9}$	7. $\frac{4}{7} + 2\frac{1}{8} + 4\frac{7}{8} + \frac{3}{7}$
8. $1\frac{5}{13} + 4 + 5\frac{2}{13}$	9. $1\frac{3}{10} + 9\frac{1}{10} + 6\frac{3}{10}$

Estimate each sum.

10. $3\frac{1}{4} + 6\frac{2}{5}$	Less than 10 Greater than 10	11. $4\frac{3}{5} + 1\frac{2}{3}$	Less than 6 Greater than 6
12. $2\frac{3}{8} + 5\frac{9}{19}$	Less than 8 Greater than 8	13. $6\frac{1}{6} + 2\frac{8}{9}$	Less than 9 Greater than 9

SUBTRACTING FRACTIONS USING MENTAL MATH AND ESTIMATION

Draw diagrams and find the difference for problems 1-6. Write an explanation of this term in My Word Bank. Use section 2.5 if needed.

1. $\frac{3}{10} - \frac{1}{10}$	2. $\frac{5}{6} - \frac{1}{6}$	3. $1 - \frac{5}{8}$	4. $1 - \frac{5}{6}$
5. $4 - \frac{1}{3}$	6. $3 - 2\frac{2}{3}$	7. $2 - 1\frac{1}{4}$	8. $3 - 2\frac{1}{2}$

Use mental math to subtract.

9. $\frac{5}{9} - \frac{3}{9}$	10. $4\frac{9}{17} - \frac{1}{17}$	11. $1 - \frac{2}{3}$
12. $4 - \frac{1}{5}$	13. $4 - 1\frac{2}{3}$	14. $8 - 3\frac{7}{8}$

Without calculating, estimate each difference.

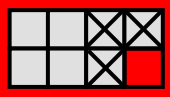
15. $10\frac{1}{16} - 5\frac{9}{10}$	Closer to 4 Closer to 5	16. $6\frac{1}{6} - 2\frac{1}{5}$	Closer to 3 Closer to 4
17. $7\frac{1}{9} - 1\frac{9}{10}$	Closer to 5 Closer to 6	18. $12\frac{5}{6} - 1\frac{1}{8}$	Closer to 11 Closer to 12

PRACTICE 2

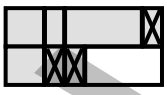
Match the following equations with an appropriate diagram below (area model or linear model). Not all diagrams have a match.

1. _____ $\frac{3}{5} - \frac{2}{5} = \frac{1}{5}$	2. _____ $\frac{7}{8} - \frac{3}{8} = \frac{4}{8}$

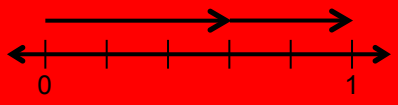
a.



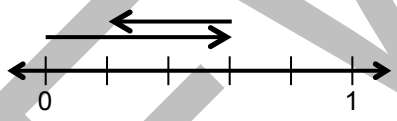
b.



c.



d.



3. Choose one picture above that does not have a match and explain why it doesn't.

Use mental math to subtract.

4. $\frac{7}{11} - \frac{2}{11}$	5. $6\frac{5}{9} - 2\frac{3}{9}$	6. $1 - \frac{4}{13}$
7. $4 - \frac{3}{5}$	8. $6 - 1\frac{5}{8}$	9. $6\frac{5}{9} - \frac{2}{9}$

Without calculating, estimate each difference.

10. $8\frac{1}{11} - 5\frac{7}{8}$ Closer to 2 Closer to 3	11. $8\frac{3}{4} - 7\frac{4}{5}$ Closer to 1 Closer to 2

12. Julio says he knows that $1 - \frac{14}{25}$ is $\frac{11}{25}$ because 11 + 14 = 25. What about Julio's strategy makes sense?

SUMS AND DIFFERENCES OF PROPER FRACTIONS

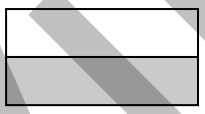
We will use pictures and procedures to add and subtract proper fractions.

GETTING STARTED

1. Look up multiplication property of 1 and equivalent fractions in section 2.5. Write an explanation and example of these terms in My Word Bank.

2. What is the "big 1"?

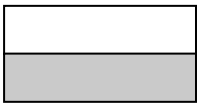
3. One half of this rectangle is shaded.



   a. Draw one vertical line to make fourths. This illustrates that $\frac{1}{2} = \frac{\quad}{4}$.

   b. Use the "big 1" to write an equivalence statement: $\frac{1}{2} \cdot \frac{1}{1} = \frac{\quad}{4}$

4. One half of this rectangle is shaded.



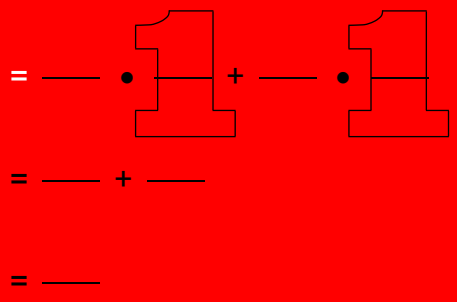
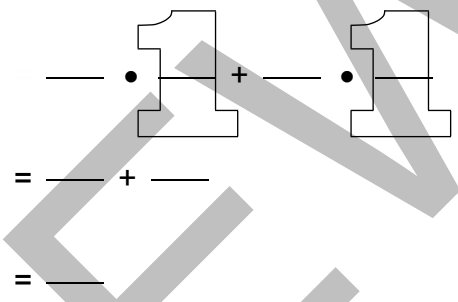
   a. Draw some vertical lines to make eighths. This illustrates that $\frac{1}{2} = \frac{\quad}{8}$.

   b. Use the "big 1" to write an equivalence statement: $\frac{1}{2} \cdot \frac{1}{1} = \frac{\quad}{8}$

5. Luiz says that since 5 and 8 are greater than 3 and 4, then $\frac{5}{8}$ must be greater than $\frac{3}{4}$. Explain why Luiz is mistaken using numbers and words.

ADDING PROPER FRACTIONS

Follow your teacher's directions to complete problems 1-4.

(1)	(2)
(3) 	(4) 

5. Why do we need common denominators when adding fractions?

6. Why do we usually prefer a lowest common denominator when adding fractions?

Write an explanation and example of lowest common denominator in My Word Bank.

For problems 7-8, draw pictures and write number sentences like in problems 3-4 above.

7. $\frac{1}{3} + \frac{1}{6}$	8. $\frac{3}{4} + \frac{1}{3}$

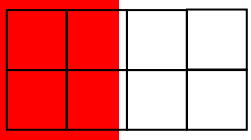
9. Ignatius added these proper fractions this way: $\frac{3}{4}+\frac{3}{5} = \frac{6}{9}$.

a. Explain why his result of $\frac{6}{9}$ does not make sense.

b. Find the correct sum. Show work.

SUBTRACTING PROPER FRACTIONS

Complete diagrams and record number sentences for each problem.

Words	Diagrams	Number Sentences
1. Ed has three-eighths of a stick of butter in his refrigerator. He uses one-fourth of a whole stick to make pancakes. How much of the stick is left?		
2. Jody buys two-thirds of a yard of fabric. She uses one-half yard to make a pillow. How much fabric is left?		

3. Why do we need common denominators when subtracting fractions?

Why do we usually prefer a lowest common denominator?

Draw pictures and write number sentences for each problem.

4. $\frac{1}{3} - \frac{1}{6}$	5. $\frac{3}{4} - \frac{1}{3}$

6. Apollo subtracted these proper fractions this way: $\frac{2}{3} - \frac{1}{2} = \frac{1}{1}$.

   a. Explain why his result of $\frac{1}{1}$ does not make sense.

   b. Find the correct difference. Show work.

PRACTICE 3

Draw pictures and write number sentences for each problem.

1. $\frac{2}{3} + \frac{5}{9}$	2. $\frac{3}{5} + \frac{1}{3}$
3. $\frac{3}{4} - \frac{3}{8}$	4. $\frac{4}{8} - \frac{1}{2}$

Find each sum or difference. Show work.

5. $\frac{1}{5} + \frac{3}{10}$	6. $\frac{5}{6} + \frac{7}{18}$	7. $\frac{1}{3} + \frac{2}{5}$	8. $\frac{5}{6} + \frac{7}{9}$
9. $\frac{9}{16} - \frac{1}{2}$	10. $\frac{5}{6} - \frac{5}{12}$	11. $\frac{2}{3} - \frac{1}{7}$	12. $\frac{5}{6} - \frac{3}{4}$

13. Dilma added these proper fractions this way: $\frac{4}{5} + \frac{3}{4} = \frac{7}{9}$.

a. Explain why her result of $\frac{7}{9}$ does not make sense.

b. Find the correct sum. Show work.

IT HAPPENED AT SCHOOL

1. Kendra took one-half of the colored pencils in a box. Then Myra took one-sixth of the total number of pencils. After that there were 12 pencils left. How many colored pencils were in the box to start with? Explain your thinking.

2. Yasra surveyed the students at school about their preferences in movies. Each student responded by naming the one type of movie that they like the best. One-half said comic book movies. One-fourth said action movies. One-eighth said comedy movies. The other 27 students said fantasy movies. How many students did Yasra survey? Explain your thinking.

3. The gym teacher, Mrs. Silverberg, brought 96 oranges from her backyard tree to school one day, and several of her students wanted one. One-third of the oranges were eaten before school started. Two-sixths of them were eaten during snack break. One-sixth of them were eaten during lunch. Thirteen of them were eaten after school. How many oranges are left, if any?

SUMS AND DIFFERENCES OF MIXED NUMBERS

We will use pictures and procedures to add and subtract mixed numbers.

GETTING STARTED

Change to a mixed number.

1. $\frac{9}{7}$	2. $\frac{19}{5}$

Change to an improper fraction.

3. $1\frac{4}{5}$	4. $5\frac{1}{4}$

5. When might mixed numbers be preferable to improper fractions?

6. When might improper fractions be preferable to mixed numbers?

Use mental math to calculate.

7. $\frac{3}{10} + 6\frac{1}{5} + 3\frac{4}{5} + 2\frac{7}{10}$	8. $2\frac{1}{7} + 3\frac{2}{9} + 4\frac{6}{7}$

Compute. Show work.

9. $\frac{5}{8} + \frac{2}{3}$	10. $\frac{3}{4} - \frac{2}{5}$

FRACTION ADDITION

Follow your teacher's directions to find each sum for problems 1-2.

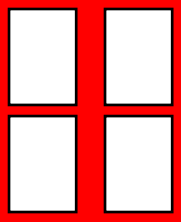
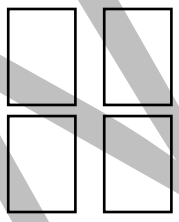
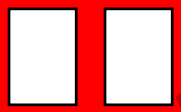
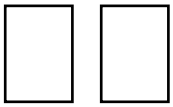
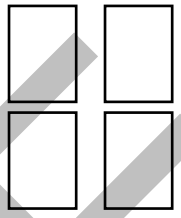
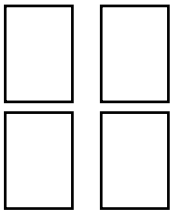
Mixed Numbers	Improper Fractions
(1a)	(1b)
(2a)	(2b)

Use either mixed numbers or improper fractions to add.

3. $4\frac{1}{6} + 2\frac{2}{3}$	4. $4\frac{2}{5} + 5\frac{1}{4}$	5. $10\frac{1}{2} + 5\frac{1}{3}$
6. $1\frac{3}{8} + 6\frac{3}{4}$	7. $4\frac{3}{5} + 7\frac{2}{3}$	8. $10\frac{1}{2} + 8\frac{6}{7}$

FRACTION SUBTRACTION

Follow your teacher's directions to find each difference for problems 1-3.

Mixed Numbers	Improper Fractions
(1a) 	(1b) 
(2a) 	(2b) 
(3a) 	(3b) 

Use either mixed numbers or improper fractions to subtract.

4. $3\frac{2}{5} - \frac{1}{4}$	5. $4\frac{2}{3} - 2\frac{1}{6}$	6. $6\frac{1}{3} - 5\frac{1}{2}$

PRACTICE 4

Look at each problem before deciding which method to use to add or subtract. If mental math is used, write "MM" next to the answer. Otherwise, choose the mixed number method or the improper fraction method and show work.

1. $10\frac{3}{8} + 20\frac{5}{8}$	2. $7\frac{1}{5} + 3\frac{7}{10}$	3. $2\frac{3}{4} + 1\frac{2}{3}$
4. $4\frac{1}{6} + 2\frac{5}{6} + 6\frac{1}{2}$	5. $8\frac{1}{4} + 7\frac{2}{5}$	6. $9\frac{5}{6} - 4\frac{5}{12}$
7. $8\frac{3}{10} - \frac{2}{5}$	8. $5\frac{2}{3} - 4\frac{1}{4}$	9. $8\frac{1}{6} - 6\frac{3}{8}$

10. Ping says that subtracting $2 - 1\frac{1}{3}$ yields the same result as computing $2 - 1 + \frac{1}{3}$. Quon disagrees. He thinks it's the same result as computing $2 - 1 - \frac{1}{3}$. Is either correct? Explain.

11. You determined in the Opening Problem on page 1 that the Math Squad ordered 2 veggie pizzas and 2 pepperoni pizzas. How much of each pizza was left over?

HELPING AT THE FOOD BANK

1. Tiffany works 5 hours each week at the food bank. On Monday, she worked $1\frac{1}{4}$ hours. On Wednesday, she worked $2\frac{1}{6}$ hours.

   a. How many more hours does Tiffany have to work at the food bank this week?

   b. Tiffany plans to go to the food bank on Friday and Saturday. Suggest two different ways she might complete her hours.

2. The Math Club and the Art Club collected canned food for the food bank. They packed the cans in crates that were all the same size, and every week they dropped off their donations. Each club recorded the number of crates they filled for four weeks.

Week Number	1	2	3	4
Crates packed by the Math Club	$1\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{2}{5}$	$\frac{3}{5}$
Crates packed by the Art Club	$1\frac{4}{5}$	$2\frac{1}{4}$	$3\frac{1}{2}$	$\frac{3}{10}$

Which club collected the most crates? How many more?

REVIEW

MEASURING CUPS

Guy is cooking and has three measuring cups. They are $\frac{1}{2}$ cup, $\frac{1}{3}$ cup, and $\frac{1}{4}$ cup. Show work to clearly describe how he can use these cups to find the following measures.

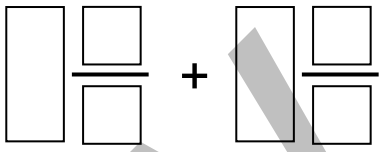
1. $\frac{3}{4}$ cup using two of the cups	2. $\frac{5}{6}$ using two of the cups
3. $\frac{1}{6}$ cup using two of the cups	4. $\frac{5}{12}$ cup using all three of the cups

Create a problem to match the following with the same cup options as above.

5. A different amount from above using any two of the cups.	6. A different amount from above using all three of the cups.

MIXED NUMBER TARGETS

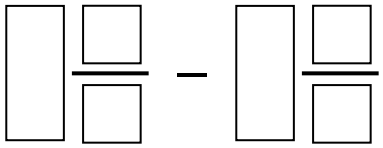
For problems 1-3, use the expression structure to the right and six of the digits 1 – 9, no more than one each.



1. Find any sum.	2. Find a sum greater than 10. Make at least two attempts.	

3. Find the greatest possible sum. Make at least three attempts.		

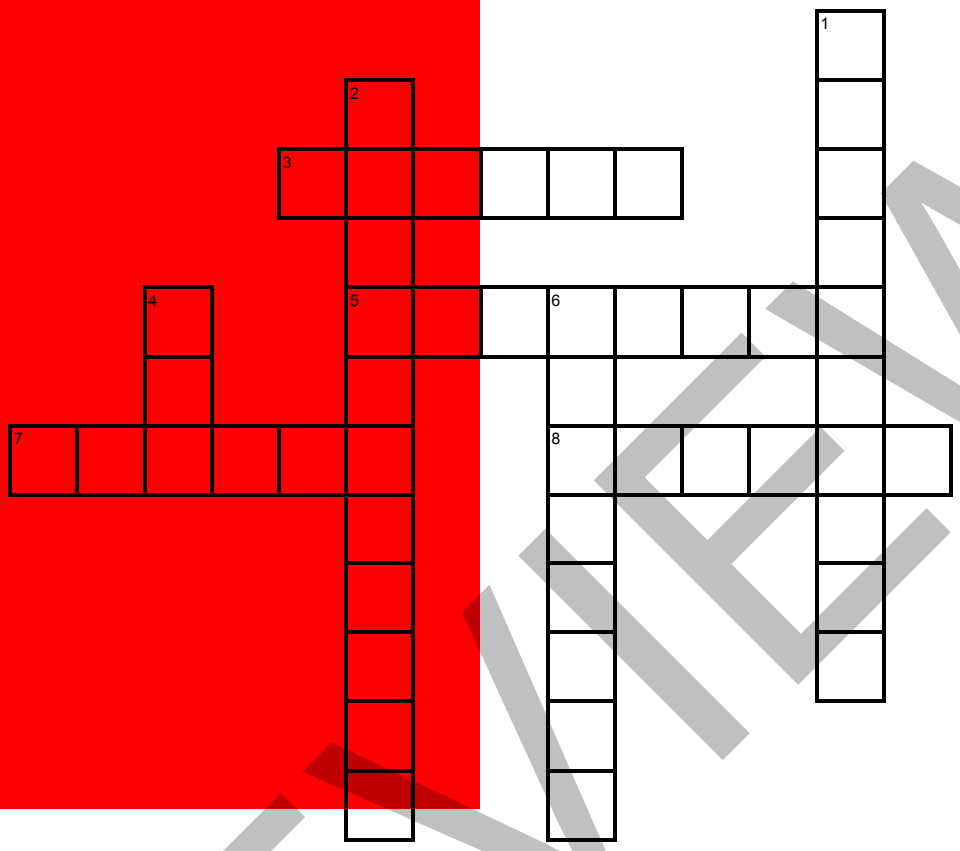
For problems 4-6, use the expression structure to the right and six of the digits 1-9, no more than one each.



4. Find any difference.	5. Find a difference greater than 5. Make at least two attempts.	

6. Find the greatest possible difference. Make at least three attempts.		

VOCABULARY REVIEW



Across

3 The lowest common denominator when adding halves and thirds.

5 A calculation to get close to the actual answer, often done mentally.

7 A number that is divisible by each of the fractions' denominators is a ___ denominator.

8 A(n) ___ fraction is between 0 and 1.

Down

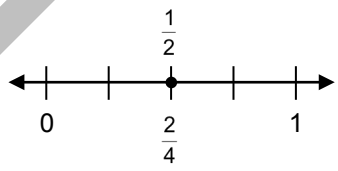
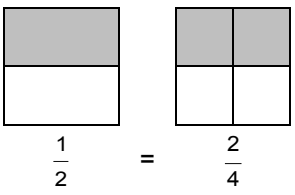
1 The result of subtraction.

2 The combination of a whole number and a fraction. (2 words)

4 The result of addition.

6 A(n) ___ fraction is greater than or equal to 1.

DEFINITIONS, EXPLANATIONS, AND EXAMPLES

Word or Phrase	Definition
common denominator	A common denominator of two or more fractions is a number that is divisible by each of the denominators of the fractions. A common denominator of the fractions $\frac{1}{6}$ and $\frac{3}{4}$ is 24, since 24 is divisible by both 6 and 4. Another common denominator of these fractions is 36. The lowest common denominator of these fractions is 12.
difference	In a subtraction problem, the difference is the result of subtraction. The minuend is the number from which another number is being subtracted, and the subtrahend is the number that is being subtracted. $\underset{\text{Minuend}}{12} - \underset{\text{subtrahend}}{4} = \underset{\text{difference}}{8}$
estimate	An estimate is an educated guess. One stack of paper is about $\frac{7}{8}$ inches high and another stack is about $1\frac{1}{4}$ inches high. If one stack is placed on top of the other, the total height may be estimated at about 2 inches.
equivalent fractions	The fractions $\frac{a}{b}$ and $\frac{c}{d}$ are equivalent if they represent the same point on the number line. This occurs if the results of the division problems $a \div b$ and $c \div d$ are equal. Since $\frac{1}{2} = 1 \div 2 = 0.5$ and $\frac{2}{4} = 2 \div 4 = 0.5$, the fractions $\frac{1}{2}$ and $\frac{2}{4}$ are equivalent. Pictorially:  
improper fraction	An improper fraction is a fraction of the form $\frac{m}{n}$, where $m \geq n$ and $n > 0$. The fractions $\frac{3}{2}$, $\frac{17}{4}$, $\frac{9}{9}$ and $\frac{32}{16}$ are improper fractions.

Word or Phrase	Definition
least common multiple	The least common multiple (LCM) of two numbers is the least number that is a multiple of both numbers. The multiples of 8 are 8, 16, 24, 32, 40, ... The multiples of 12 are 12, 24, 36, 48, … . Therefore the LCM of 8 and 12 is 24.
lowest common denominator	The lowest common denominator of two fractions is the least common multiple of their denominators. The lowest common denominator of $\frac{3}{8}$ and $\frac{5}{12}$ is 24.
mixed number	A mixed number is an expression of the form $n\frac{p}{q}$, which is a shorthand for $n + \frac{p}{q}$, where n, p, and q are positive whole numbers. The mixed number $4\frac{1}{4}$ ("four and one fourth") is shorthand for $4 + \frac{1}{4}$. It should not be confused with the product $4 \bullet \frac{1}{4} = 1$.
multiplication property of 1	The multiplication property of 1 states that $a \bullet 1 = 1 \bullet a = a$ for all numbers a. In other words, 1 is a multiplicative identity. The multiplication property of 1 is sometimes called the multiplicative identity property. $4 \bullet 1 = 4$, $1 \bullet (25) = 25$ $\frac{1}{2} \bullet \boxed{\frac{4}{4}} = \frac{4}{8}$. In this equation, $\frac{4}{4}$ is referred to as "the big 1."
proper fraction	A proper fraction is a fraction of the form $\frac{m}{n}$, where $1 \le m < n$. The fractions $\frac{1}{2}$ and $\frac{5}{6}$ are proper fractions.
sum	A sum is the result of addition. In an addition problem, the numbers to be added are addends. 7 + 5 = 12 addend addend sum

Mental Math Addition: Adding "Friendly" Fractions

Adding fractions requires that the fractions have common denominators. Sometimes it is easy to add expressions with fractions without converting to a form with common denominators. All of the work shown below is intended to be done mentally.

Example: $6\frac{1}{3} + 2\frac{1}{4} + 4\frac{2}{3}$

$$6\frac{1}{3} + 2\frac{1}{4} + 4\frac{2}{3} = \left(6 + \frac{1}{3}\right) + \left(2 + \frac{1}{4}\right) + \left(4 + \frac{2}{3}\right)$$

$$= (6 + 2 + 4) + \left(\frac{1}{3} + \frac{1}{4} + \frac{2}{3}\right)$$

$$= 12 + \left(\frac{1}{3} + \frac{1}{4} + \frac{2}{3}\right)$$

$$= 12 + \left(1 + \frac{1}{4}\right)$$

$$= 13\frac{1}{4}$$

To make calculations simpler, add the whole numbers first.

Then look for mental math opportunities with the fractions.

In this case, $\frac{1}{3} + \frac{2}{3} = 1$.

Mental Math Subtraction: Subtracting From a Whole Number

Here is a simple way to subtract a fraction or mixed number from a whole number, illustrated with diagrams and numbers. All of the work shown below is intended to be done mentally.

Example 1: $1 - \frac{1}{5}$

Start with 1 whole. Then remove $\frac{1}{5}$.

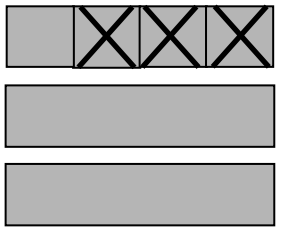
$1 - \frac{1}{5} = \frac{4}{5}$

Example 2: $3 - \frac{3}{4}$

Start with 3 wholes. Divide one whole into fourths.

Then remove $\frac{3}{4}$ from this whole.

$3 - \frac{3}{4} = 2\frac{1}{4}$



Example 3: $3 - 1\frac{3}{4}$

Remember that $1\frac{3}{4} = 1 + \frac{3}{4}$.

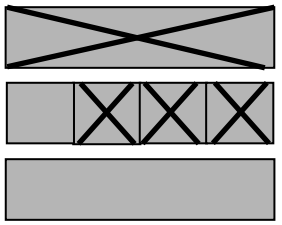
Therefore, subtracting $1\frac{3}{4}$ means to subtract 1 and also to subtract $\frac{3}{4}$.

Start with 3 wholes.

Divide one whole into fourths.

Remove 1 whole and then another $\frac{3}{4}$ of a whole.

1 whole and $\frac{1}{4}$ remain. Therefore, $3 - 1\frac{3}{4} = 1\frac{1}{4}$.



Fraction Addition with Diagrams

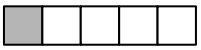
The standard procedure for adding fractions requires that the fractions have common denominators. An area model supports why this is reasonable.

Example 1: $\frac{1}{5} + \frac{3}{5}$

Already has a common denominator.

$\frac{1}{5} + \frac{3}{5} = \frac{4}{5}$.

$\frac{1}{5}$



$\frac{3}{5}$

$\frac{1}{5} + \frac{3}{5}$

Example 2: $\frac{1}{2} + \frac{1}{3}$

Find a common denominator.

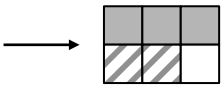
$\frac{1}{2} + \frac{1}{3} = \frac{1}{2} \cdot \boxed{\frac{3}{3}} + \frac{1}{3} \cdot \boxed{\frac{2}{2}}$

$= \frac{3}{6} + \frac{2}{6}$

$= \frac{5}{6}$

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

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

$\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$ 

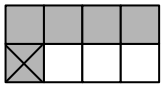
Fraction Subtraction with Diagrams

The standard procedure for subtracting fractions requires that the fractions have common denominators. An area model supports why this is reasonable.

Example 1: $\frac{5}{8} - \frac{1}{8}$

Already has a common denominator.

$\frac{5}{8} - \frac{1}{8} = \frac{4}{8}$.



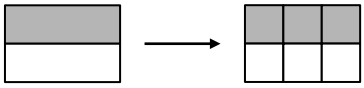
Example 2: $\frac{1}{2} - \frac{1}{3}$

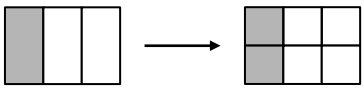
Find a common denominator.

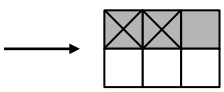
$\frac{1}{2} - \frac{1}{3} = \frac{1}{2} \cdot \boxed{\frac{3}{3}} - \frac{1}{3} \cdot \boxed{\frac{2}{2}}$

$= \frac{3}{6} - \frac{2}{6}$

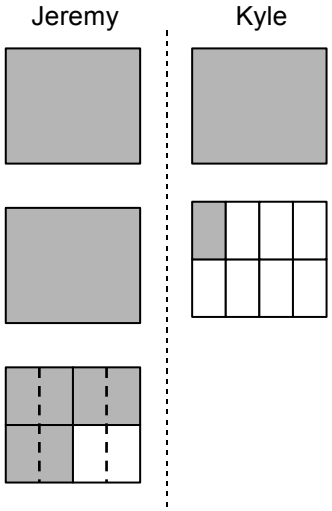
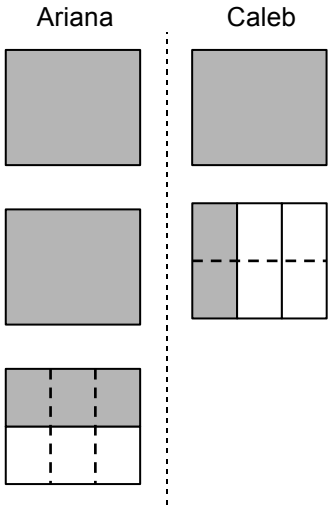
$= \frac{1}{6}$

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

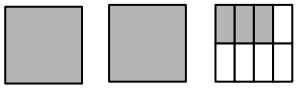
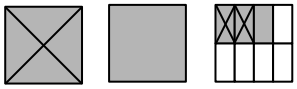
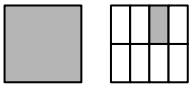
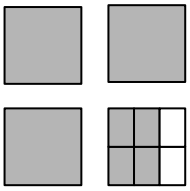
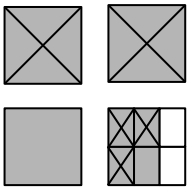
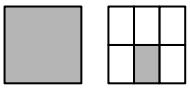
$\frac{1}{3} = \frac{2}{6}$ 

$\frac{3}{6} - \frac{2}{6} = \frac{1}{6}$ 

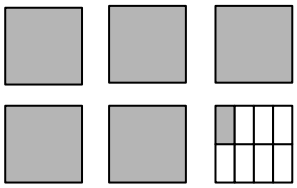
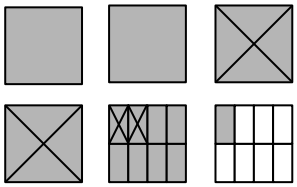
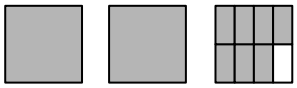
Examples: Adding Mixed Numbers

Words	Diagrams	Mixed Numbers	Improper Fractions
Jeremy has two and three-fourths waffles. Kyle has one and one-eighth waffles. How many waffles do they have together?	 Think: A common multiple of 4 and 8 is 8. 8 is a common denominator. (It is also the LCM.)	$2\frac{3}{4} + 1\frac{1}{8}$ $= \left(2 + \frac{3}{4}\right) + \left(1 + \frac{1}{8}\right)$ $= (2 + 1) + \left(\frac{3}{4} + \frac{1}{8}\right)$ $= (3) + \left(\frac{6}{8} + \frac{1}{8}\right)$ $= 3 + \frac{7}{8}$ $= 3\frac{7}{8}$	$2\frac{3}{4} + 1\frac{1}{8}$ $= \frac{11}{4} + \frac{9}{8}$ $= \frac{22}{8} + \frac{9}{8}$ $= \frac{31}{8}$ $= 3\frac{7}{8}$
Ariana has two and one-half waffles. Caleb has one and one-third waffles. How many waffles are there in all?	 Think: A common multiple of 2 and 3 is 6. 6 is a common denominator.	$2\frac{1}{2} + 1\frac{1}{3}$ $= \left(2 + \frac{1}{2}\right) + \left(1 + \frac{1}{3}\right)$ $= (2 + 1) + \left(\frac{1}{2} + \frac{1}{3}\right)$ $= (3) + \left(\frac{3}{6} + \frac{2}{6}\right)$ $= 3 + \frac{5}{6}$ $= 3\frac{5}{6}$	$2\frac{1}{2} + 1\frac{1}{3}$ $= \frac{5}{2} + \frac{4}{3}$ $= \frac{15}{6} + \frac{8}{6}$ $= \frac{23}{6}$ $= 3\frac{5}{6}$

Examples: Subtracting Mixed Numbers

Words	Diagrams	Mixed Numbers	Improper Fractions
Chris has two and three-eighths bars. He gives one and one-fourth bar away to Leonid. How much bar is left?	Start with $2\frac{3}{8}$ (shaded)  Remove $1\frac{1}{4}$ (crossed out)  Count what's left  Think: A common multiple of 4 and 8 is 8. 8 is a common denominator.	$2\frac{3}{8} - 1\frac{1}{4}$ $= 2 + \frac{3}{8} - 1 - \frac{1}{4}$ $= (2 - 1) + \left(\frac{3}{8} - \frac{1}{4}\right)$ $= 1 + \left(\frac{3}{8} - \frac{1}{4}\right)$ $= 1 + \left(\frac{3}{8} - \frac{2}{8}\right)$ $= 1 + \frac{1}{8}$ $= 1\frac{1}{8}$	$2\frac{3}{8} - 1\frac{1}{4}$ $= \frac{19}{8} - \frac{5}{4}$ $= \frac{19}{8} - \frac{10}{8}$ $= \frac{9}{8}$ $= 1\frac{1}{8}$
Denali has three and two-thirds sandwiches. She gives two and one-half to Jenya. How much remains?	Start with $3\frac{2}{3}$ (shaded)  Remove $2\frac{1}{2}$ (crossed out)  Count what's left  Think: A common multiple of 3 and 2 is 6. 6 is a common denominator.	$3\frac{2}{3} - 2\frac{1}{2}$ $= 3 + \frac{2}{3} - 2 - \frac{1}{2}$ $= (3 - 2) + \left(\frac{2}{3} - \frac{1}{2}\right)$ $= 1 + \left(\frac{4}{6} - \frac{3}{6}\right)$ $= 1 + \frac{1}{6}$ $= 1\frac{1}{6}$	$3\frac{2}{3} - 2\frac{1}{2}$ $= \frac{11}{3} - \frac{5}{2}$ $= \frac{22}{6} - \frac{15}{6}$ $= \frac{7}{6}$ $= 1\frac{1}{6}$

Examples: Subtracting Mixed Numbers (Continued)

Words	Diagrams	Mixed Numbers	Improper Fractions
Ted has five and one-eighths granola bars. He gives away two and one-fourth bars to Helen. How much is left?	Start with $5\frac{1}{8}$ (shaded)  Remove $2\frac{1}{4}$ (crossed out)  Count what's left  Think: A common multiple of 4 and 8 is 8. 8 is a common denominator.	$5\frac{1}{8} - 2\frac{1}{4}$ $= \left(5 - 2 - \frac{1}{4}\right) + \frac{1}{8}$ $= \left(3 - \frac{1}{4}\right) + \frac{1}{8}$ $= 2\frac{3}{4} + \frac{1}{8}$ $= 2 + \frac{6}{8} + \frac{1}{8}$ $= 2 + \frac{7}{8}$ $= 2\frac{7}{8}$	$5\frac{1}{8} - 2\frac{1}{4}$ $= \frac{41}{8} - \frac{9}{4}$ $= \frac{41}{8} - \frac{18}{8}$ $= \frac{23}{8}$ $= 2\frac{7}{8}$

Why Do We Add and Subtract Fractions Horizontally?

In previous grades, you may have been taught to add and subtract fractions vertically. In this program, we encourage you to record steps horizontally because it makes equivalent expressions more evident.

Consider the problem: $3\frac{1}{2} + 2\frac{2}{3}$. Your work might look like this:

$3\frac{1}{2} + 2\frac{2}{3}$	$= 3 + \frac{1}{2} + 2 + \frac{2}{3}$	meaning of mixed fraction addition
	$= (3 + 2) + \left(\frac{1}{2} + \frac{2}{3}\right)$	combine whole numbers and fractions
	$= 5 + \left(\frac{1}{2} \bullet \frac{3}{3}\right) + \left(\frac{2}{3} \bullet \frac{2}{2}\right)$	multiplication property of 1
	$= 5 + \frac{3}{6} + \frac{4}{6} = 5\frac{7}{6}$ $= 6\frac{1}{6}$	finish the computation

Consider the problem: $3\frac{1}{2} - 2\frac{2}{3}$. The work might look like this:

$3\frac{1}{2} - 2\frac{2}{3}$	$= 3 + \frac{1}{2} - 2 - \frac{2}{3}$	meaning of the mixed fraction subtraction
	$= (3 - 2) + \frac{1}{2} - \frac{2}{3}$	group whole numbers together
	$= \left(1 - \frac{2}{3}\right) + \frac{1}{2}$ $= \frac{1}{3} + \frac{1}{2}$	subtract the fraction from the whole number to create an addition problem
	$= \left(\frac{1}{3} \bullet \frac{2}{2}\right) + \left(\frac{1}{2} \bullet \frac{3}{3}\right)$	multiplication property of 1
	$= \frac{2}{6} + \frac{3}{6}$ $= \frac{5}{6}$	finish the computation

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