Grade Level/Course:

4 and 5

Lesson/Unit Plan Name:

Problem Solving with Multiplication and Division

Rationale/Lesson Abstract:

A focus on key words and efficiency can lead to misinterpretations and errors when solving word problems. Understanding the situation described in a problem and recognizing the question being asked are critical to making good decisions.

Timeframe:

one period, ongoing

Common Core Standard(s):

4.OA.2

Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.

4.OA.3

Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for an unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

5.NF.6

Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

5.NF.7c

Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?*

Instructional Resources/Materials:

lesson plan, notebooks, pencils

blank problem pages and sentence frames (optional)

Overview: The students will **think**, **model**, **decide**, **solve**, **check**, and **conclude**.

Throughout the lesson you are modeling and encouraging the use of ***Standard 1 for Mathematical Practice – Making sense of problems and persevere in solving them.*** Promote student talk by having classmates Think-Pair-Share, compare their work and strategies with neighbors, or work in cooperative groups. Students and teachers can use the question stems below to engage in deeper math dialogue, discussion, and justification of work and process.

Think about the problem and the question being asked.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals.

- What do we need to find out?
- What is the question we have to answer?
- What is happening in this story?

Make a model.

They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt.

- What do we know?
- How can we show this?
- How can we draw this?

Decide what to do.

They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution.

- What type of problem is this?
- How can we translate this into math?
- How can we break this down?

Solve.

They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem.

- Can you explain why you…?
- Which methods will work well with this problem?
- What symbols did you use? What do they stand for?

Check.

Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?"

- How else can you solve this?
- What is another method for …?
- Can you clarify where you…?

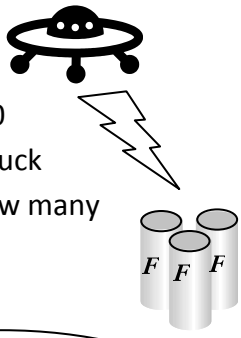
Conclude.

They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

- Who solved this another way?
- Compare your work with a neighbor.

Grade 4:

The Missing Chips:



Aliens love potato chips, especially *Fringles!* Fringles Chip Company packs 420 cans into each case they deliver to the grocery store. Peter Russet filled his truck with cases to deliver. When he got to the store, 3 cases had disappeared. How many cans did the aliens beam out of his delivery truck?

Think about the problem and the question being asked.

I need to find out the number of *cans* taken from Peter's truck. **I know** there are 420 cans in each case. **I know** the aliens took 3 cases.

Make a model.

Missing Cans

n		
420	420	420

Missing Cases

Decide what to do.

Multiply the cans (420) by the stolen cases (3) to find out how many cans were beamed out of the truck.

Solve. $3 \times 420 = n$

	400	20
3	1200	60

$$\begin{array}{r} 1{,}200 \\ +\ 60 \\ \hline 1{,}260 \end{array}$$

Check

$$\begin{array}{r} 420 \\ \times\ \ 3 \\ \hline 1{,}260 \end{array}$$

or

$$\begin{array}{rl} 420 & \\ \times\ \ 3 & \\ \hline 1200 & \leftarrow 3 \times 400 \\ 60 & \leftarrow 3 \times 20 \\ +\ \ 0 & \leftarrow 3 \times 0 \\ \hline 1{,}260 & \end{array}$$

Conclude.

The aliens beamed out 1,260 cans of *Fringles* from Peter's truck.

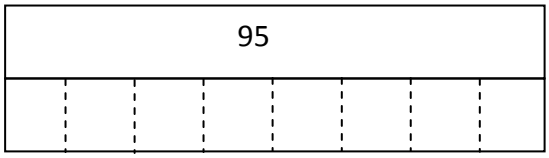
You Try:

Wilson Elementary School has 95 fourth graders. Tables in the cafeteria seat 8 students each. How many tables are needed when the fourth graders eat lunch?

Think about the problem and the question being asked.

I need to find out how many tables the 4th graders use. **I know** all of the kids need seats. There are 95 kids. 8 kids fit at each table.

Make a model.

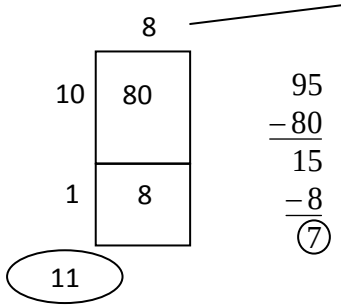


Decide what to do.

Divide 95 by 8. That will show how many tables are full. 95 isn't a multiple of 8, so I know there will be a remainder. The remainder stands for the kids who don't fill another table. They will need a table too, so the remainder is important in this problem.

Solve.

$95 \div 8 =$



$$\begin{array}{r} 95 \\ -80 \\ \hline 15 \\ -8 \\ \hline (7) \end{array}$$

**This is an area model for division. The divisor is one dimension. You determine the quotient in stages as you build the area (dividend). Use subtraction to keep track of the remaining dividend and to find the remainder.*

$\therefore 95 \div 8 = 11\text{r}7$

Check.

$$\begin{array}{r} 11\text{r}7 \\ 8 \overline{)\,95} \\ \underline{-\,8}\downarrow \\ 15 \\ \underline{-\,8} \\ 7 \end{array}$$

or

$$\begin{aligned} &11 \times 8 + 7 \\ &= 88 + 7 \\ &= 95 \end{aligned}$$

Conclude.

The fourth graders at Wilson School will need 12 tables. 11 tables will be full, and one table will have an empty seat.

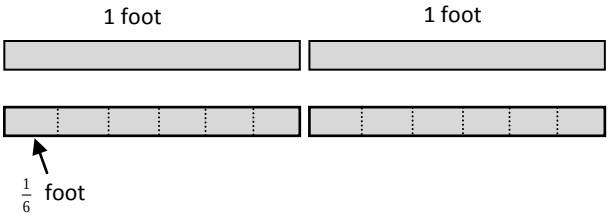
Grade 5:

Alexandra makes charms with wire and glass beads. She bought 2 feet of wire. For each charm, she needs $\frac{1}{6}$ of a foot of wire. How many charms can she make with her new wire?

Think about the problem and the question being asked.

I need to find out how many charms Alexandra can make. **I know** the wire she bought is 2 feet long. She cuts the wire into $\frac{1}{6}$ foot pieces. The number of pieces she can cut is the number of charms she can make.

Make a model.



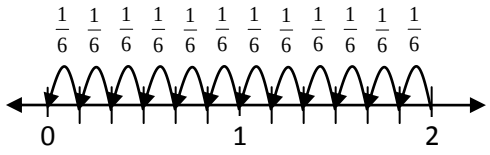
Decide what to do.

Divide 2 by $\frac{1}{6}$ to find out how many pieces of wire Alexandra can cut for charms.

Solve.

$$2 \div \frac{1}{6}$$
$$= \frac{2}{1} \div \frac{1}{6}$$
$$= \left(\frac{2}{1} \times \frac{6}{6}\right) \div \frac{1}{6}$$
$$= \frac{12}{6} \div \frac{1}{6}$$
$$= \frac{12}{1}$$
$$= 12$$

Check.



or

$$12 \times \frac{1}{6}$$
$$= \frac{12}{1} \times \frac{1}{6}$$
$$= \frac{3 \cdot 2 \cdot 2 \cdot 1}{3 \cdot 2 \cdot 1}$$
$$= \frac{2}{1}$$
$$= 2$$

Conclude.

Alexandra bought enough wire to make 12 charms.

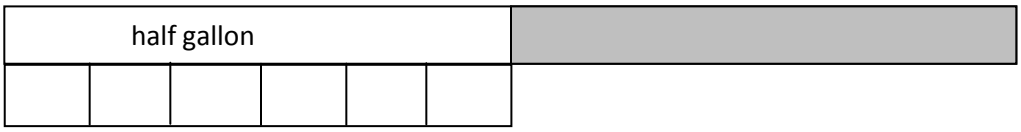
You Try:

Grandma is famous for her homemade lemonade. Five of my friends and I shared half a gallon of Grandma's Lemonade. How much did we each get?

Think about the problem and the question being asked.

I need to find out what part of a gallon each friend gets. **I know** $\frac{1}{2}$ gallon is being shared by 6 people.

Make a model.



Decide what to do.

Divide $\frac{1}{2}$ by 6 to find out what fraction of a gallon each friend gets.

Solve.

$$\frac{1}{2}\div 6$$
$$=\frac{1}{2}\div\frac{6}{1}$$
$$=\frac{1}{2}\div\frac{6}{1}\left(\frac{2}{2}\right)$$
$$=\frac{1\div 12}{2\div 2}$$
$$=\frac{1\div 12}{1}$$
$$=1\div 12$$
$$=\frac{1}{12}$$

Check.

$$\frac{1}{2}\div 6$$
$$=\frac{1}{2}\div\frac{6}{1}$$
$$=\frac{1}{2}\left(\frac{6}{6}\right)\div\frac{6}{1}$$
$$=\frac{6\div 6}{12\div 1}$$
$$=\frac{1}{12}$$

or

$$\frac{1}{12}\times 6$$
$$=\frac{1}{12}\times\frac{6}{1}$$
$$=\frac{2\cdot 3}{2\cdot 2\cdot 3}$$
$$=\frac{1}{2}$$

Conclude.

Each friend gets $\frac{1}{12}$ of a gallon of Grandma's lemonade.

Assessment:

4th

Flora uses 15 flowers in each of her bouquets. As of Tuesday she had received 43 orders for Friday. Flora knows that more orders could come in, so she bought extra flowers. Flora bought 900 flowers in all. How many extra flowers did she buy?

5th

A group of 5 students is running a relay race. The entire course is $\frac{1}{4}$ of a mile long. How far will each student run?

Additional Problems:

4th

Max has six times the number of comic books as Jonah. Max has 522 comic books. How many comics does Jonah have?

Ella, Liz, and Beth ran a 3 mile long race. Beth finished the race in 40 minutes. Liz was 10 minutes slower. Ella's time was half of the total time it took Liz and Beth to finish. How long did it take each girl to finish the race?

5th

Maria ate $\frac{3}{8}$ a box of crackers. Her dad ate $\frac{1}{5}$ of what was left. How much of the box did Maria's dad eat? How much of the box was left after both Maria and her dad ate their crackers?

Tyrone spends $\frac{7}{12}$ of his free time playing outside. When Tyrone plays outside, he spends $\frac{3}{7}$ of it swimming at the pool. How much his free time does Tyrone spend swimming?

4 points:

The student demonstrates a thorough understanding of the problem, calculates with precision, and completely answers the question.

- The student calculates 645 flowers needed for bouquets. The student subtracts 645 from 900 to find 255 extra flowers.
- The student used a second multiplication method or model to check the accuracy of the multiplication. The student used addition or a second subtraction method to check the subtraction.
- The student answered the question with a sentence.

3 points:

The student demonstrates a good understanding of the problem, calculates accurately, and answers the question.

- The student calculates 645 flowers needed for bouquets. The student subtracts 645 from 900 to find 255 extra flowers.
- The student answered the question with a sentence.
- The student **did not** check the accuracy of the calculations.

2 points:

The student demonstrates a partial understanding of the problem.

- The student multiplied correctly, but didn't subtract from 900. Or the student subtracted from 900, but had a calculation error while multiplying 43x15.
- The student wrote a sentence as part of the answer.

1 point:

The student misunderstood the problem.

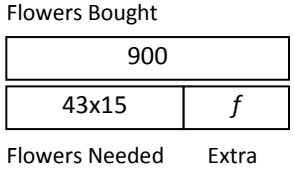
- The student used random operations with the values in the question.
- The student attempted to answer the question.

0 points:

The student did not attempt to answer the problem.

- The student wrote an answer with no work to support it.
- The question was left blank.

Model



Solve

$$43\times 15+f=900$$
$$(40\times 15)+(3\times 15)+f=900$$
$$600+45+f=900$$
$$645+f=900$$
$$645-645+f=900-645$$
$$f=255$$

Check

$$\begin{array}{r} 43 \\ \times 15 \\ \hline 15 \\ 200 \\ 30 \\ \hline 645 \end{array} \qquad \begin{array}{r} 645 \\ +255 \\ \hline 900 \end{array}$$

Conclude

Flora bought 255 extra flowers.

4 points:

The student demonstrates a thorough understanding of the problem, calculates with precision, and completely answers the question.

- The student calculates one fourth divided by 5 runners is one twentieth of a mile.
- The student used a second method or model to check the accuracy of the division.
- The student answered the question with a sentence.

3 points:

The student demonstrates a good understanding of the problem, calculates accurately, and answers the question.

- The student calculates one fourth divided by 5 runners is one twentieth of a mile.
- The student answered the question with a sentence.
- The student **did not** check the accuracy of the calculations.

2 points:

The student demonstrates a partial understanding of the problem.

- The student made an error calculating such as dividing 5 by one fourth or multiplying one fourth by 5.
- The student wrote a sentence as part of the answer.

1 point:

The student misunderstood the problem.

- The student used random operations with the values in the question.
- The student attempted to answer the question.

0 points:

The student did not attempt to answer the problem.

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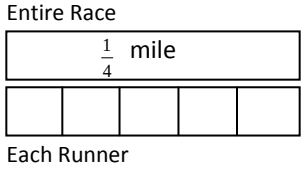
Model



Solve

$$\frac{1}{4} \div 5$$
$$= \frac{1}{4} \div \frac{5}{1}$$
$$= \frac{1}{4} \div \frac{5}{1}\left(\frac{4}{4}\right)$$
$$= \frac{1 \div 20}{4 \div 4}$$
$$= 1 \div 20$$
$$= \frac{1}{20}$$

Check

$$\frac{1}{4} \div 5$$
$$= \frac{1}{4} \div \frac{5}{1}$$
$$= \frac{1}{4}\left(\frac{5}{5}\right) \div \frac{5}{1}$$
$$= \frac{5 \div 5}{20 \div 1}$$
$$= \frac{1}{20}$$

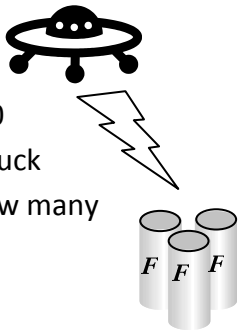
or

$$\frac{1}{20} \times 5$$
$$= \frac{1}{20} \times \frac{5}{1}$$
$$= \frac{1 \times 5}{2 \times 2 \times 5}$$
$$= \frac{1}{4}$$

Conclude

Each runner will run $\frac{1}{20}$ of a mile.

The Missing Chips:



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Think about the problem and the question being asked.

Make a model.

Decide what to do.

Solve.

Check **or**

Conclude.

Wilson Elementary School has 95 fourth graders. Tables in the cafeteria seat 8 students each. How many tables are needed when the fourth graders eat lunch?

Think about the problem and the question being asked.

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Solve.

Check. **or**

Conclude.

Alexandra makes charms with wire and glass beads. She bought 2 feet of wire. For each charm, she needs $\frac{1}{6}$ of a foot of wire. How many charms can she make with her new wire?

Think about the problem and the question being asked.

Make a model.

Decide what to do.

Solve.

Check. **or**

Conclude.

Grandma is famous for her homemade lemonade. Five of my friends and I shared half a gallon of Grandma's Lemonade. How much did we each get?

Think about the problem and the question being asked.

Make a model.

Decide what to do.

Solve.

Check. **or**

Conclude.

I need to find out

_____

_____

_____

I know

_____

_____

_____

_____

_____

_____

Think about the problem and the question being asked.

Make a model.

Decide what to do.

Solve.

Check. **or**

Conclude.

Warm Up

4.NBT.6

Find the quotient. Check your work using a second method.

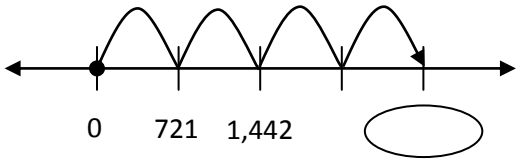
264 ÷ 6

4.NBT.5

Find the factors and product for each model. Record the equation.

	80	6
30	2400	180
5	400	30

____ x ____ = ____



____ x ____ = ____

5.NF.6

Find each quotient. Write a paragraph about the patterns you notice and the connections you see.

$2400 \div 50 =$

$2400 \div 10 =$

$2400 \div 5 =$

$2400 \div 1 =$

$2400 \div \frac{1}{2} =$

$2400 \div \frac{1}{10} =$

Warm Up Key

4.NBT.6

Find the quotient. Check your work using a second method.

$264 \div 6$

6	264	
	-120	20
	144	
	-120	20
	24	
	-24	4
	0	

264					
132			120+12		
44	44	44	40+4	40+4	40+4

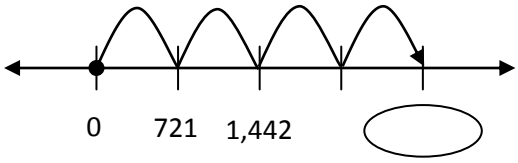
$\therefore 264 \div 6 = 44$

4.NBT.5

Find the factors and product for each model. Record the equation.

	80	6
30	2400	180
5	400	30

86 x 35 = 3,010



721 x 4 = 2,884

5.NF.6

Find each quotient. Write a paragraph about the patterns you notice and the connections you see.

$2400 \div 50 = 48$

$2400 \div 10 = 240$

$2400 \div 5 = 480$

$2400 \div 1 = 2400$

$2400 \div \frac{1}{2} = 4800$

$2400 \div \frac{1}{10} = 24000$

Sample:

The dividend is the same for all of these examples. The quotient alternates between 48 and 24, but the place values increase: 48 ones, 24 tens, 48 tens, 24 hundreds. The divisor keeps getting smaller. Every time the divisor gets smaller, the quotient gets larger, and that makes sense. If a fixed amount is being broken into fewer groups, each group will have more in it. Once the divisor became a fraction, the quotient ended up larger than the dividend.