Chapter 3 – Understanding Whole Number Operations

Types of Addition/Subtraction Problems

- Additive combination (add to, create, join, physically combine or conceptually, put together, etc.)
- Take away subtraction (physically take from, remove, eat, destroy, take apart, etc.)
- Additive comparison (compare two different quantities, usually conceptually)
- Missing addend/missing subtrahend (when in the above types an addend/sutrahend is missing)

Group Activity

With your group, discuss how a child might solve the following problems, then classify them using the types we talked about today. Is this problem an addition problem or subtraction problem?

- Chancho received $36 cash for his birthday. He has his eye on a new bicycle, which costs $109.99. His dad offered to pay him to make a concrete pathway. How much does he need to earn to buy the bike?

- Chancho also got 2 beef tacos and 3 chicken tacos at his party. How many tacos did he receive?

- There were 6 boys and 8 girls at his birthday party. How many more girls than boys were at his party?

- How many friends were at Chanco's party?

Define – Discrete Quantity ________________________, Continuous Quantity _________________________

Write Your Own Story Problems:

Can you write a story problem of each type that models addition? How about subtraction?

Group Activity – 3.2

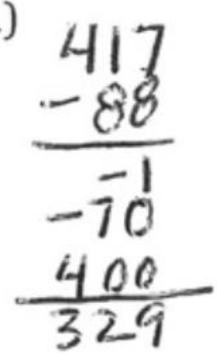
Suppose this is the work of several of your primary students, all solving 417 − 88 (in written form, without calculators or base-ten blocks). Identify the following:

A. which students clearly understand what they are doing

B. which students might understand what they are doing

C. which students do not understand what they are doing

(1)



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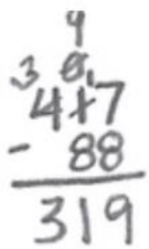

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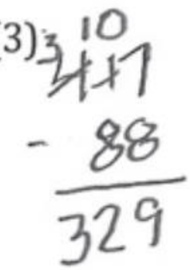

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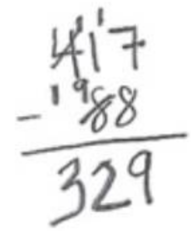

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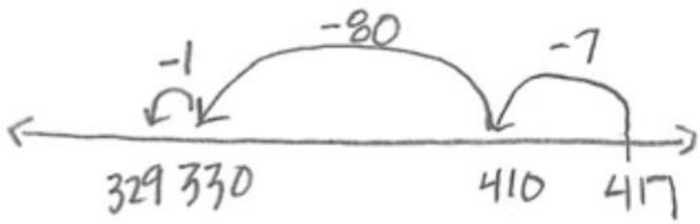
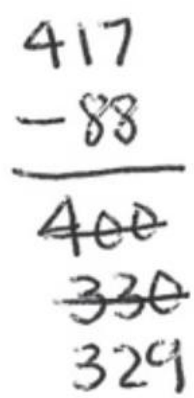


(6)

417 − 88 is the same as 419 − 90 and that is like 429 − 100 and that is 329.

(7)



3.3-3.4 – Ways of Thinking about Multiplication and Division

Review – Adding and subtracting using an empty number line and base blocks.

- 27 + 82
- 27 – 58
- 1,234 + 18 – 609
- 239 – 40

3.3 – Different Ways to Model Multiplication

When a whole number n of quantities, each with value q, are combined, the resulting quantity has a value of $q + q + q + \cdots$ (n addends), or $n \times q$. This is called the **repeated-addition view of multiplication.**

The **array (or area) model of multiplication** occurs in cases that can be modeled as a rectangle n units across and m units down. The **product** is $m \times n$.

The **fractional part-of-a-quantity model of multiplication** occurs when we need to find a fractional part of one of the two quantities. This is sometimes referred to as the **operator view of multiplication.**

In a case where two acts can be performed, if Act 1 can be performed in m ways, and Act 2 can be performed in n ways no matter how Act 1 turns out, then the sequence Act 1–Act 2 can be performed in $m \cdot n$ ways. This is the **fundamental counting principle** view of multiplication.

Try it yourself – In your closet at home, you have 7 pairs of shoes and 4 different colors of socks. How many different combinations do you have? What would a diagram representing this situation look like?

Check Yourself – Classify the following story problems.

- Joseph's bed is 9 feet long and 5 feet wide. What is its area?
- Joseph has eight colors of socks and four types of shoes. How many different possibilities does he have?
- Joseph gave ten dollars to each of his friends. Joseph has three friends. How much money did he give away?
- Joseph had two pizzas, and he ate ¾ of all the pizza. How much pizza did he eat?
- Joseph's bathtub is 6 feet by 4 feet by 3 feet. What is its volume?

3.4 – Different Ways of Modeling Division

In a division situation that can be described by $a \div b = q$, the a is called the **dividend,** b is called the **divisor,** and q is called the **quotient.** In a division situation in which b is not a factor of a, the situation can be described as $a \div b = q + \frac{r}{b}$, the quotient is $q + \frac{r}{b}$, and the quantity r is called the **remainder.** This situation is also written as $a \div b = q$ remainder r. Note that the divisor can never be 0.

36/9

38/9

$\frac{3}{4} \div \frac{1}{2}$

Another basic view of division is **sharing equally.** When one quantity (the dividend) is shared equally by a number of objects (the divisor), the quantity associated with each object is the quotient. This sharing notion of division is also called **partitive division.**

- 18/3

- 20/3

Check Yourself – Classify the following story problems.

Antonio Cromartie has fourteen children with eight separate women. He also has 1.6 million dollars.

- If he had to give each of his children an equal amount of his money, how much money would he give each child?
- If instead he had to give each mother an equal amount of money, how much money would he give each mother?
- If he had to pay $160,000 to the NFL for flagrant fouls each week, how many weeks would it take him to go broke?
- If he's had two kids per year on average, how long did it take him to have his kids?
- If he had 70 diapers and he wanted to share them with his kids in a fair way, how many diapers should he give each child?
- If his children are spread out across five states, how many children per state does he have on average?

A more general way of thinking about division is the **missing-factor view of division** in which a question is asked about a missing factor that, when multiplied by the divisor, would result in the dividend. That factor is the quotient.

- 77/11 →
- 83/11 →
- 36/9 →
- 38/9 →
- $\frac{3}{4} \div \frac{1}{2}$ →

3.5 – Children do Multiplication and Division Story Problems

In a third grade classrooms, children will already know that multiplication can be thought of as repeated addition. They worked on the following problem.

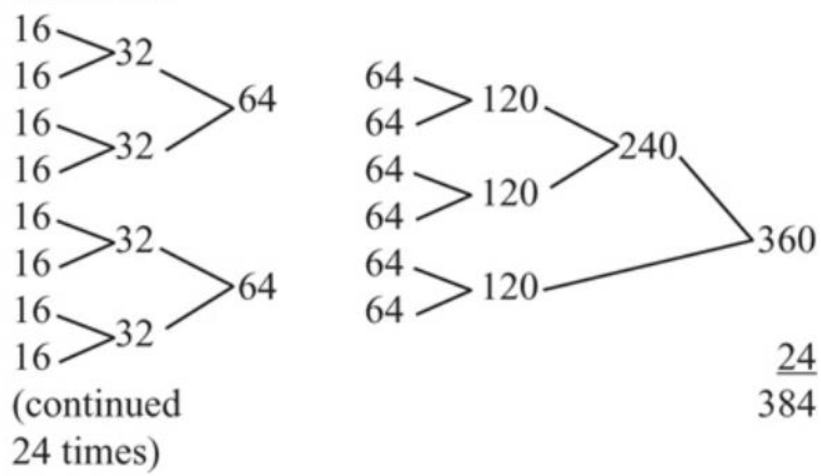
> Every Christmas my father gets big boxes of fruit, like Indian River oranges, from his company. We get so many pieces of fruit that we have to give some away. This year we ended up making 24 grocery bags of fruit, with 16 pieces in each bag. How many pieces did we bag altogether?

Take a minute to think and discuss with your group how you think the student solved it.

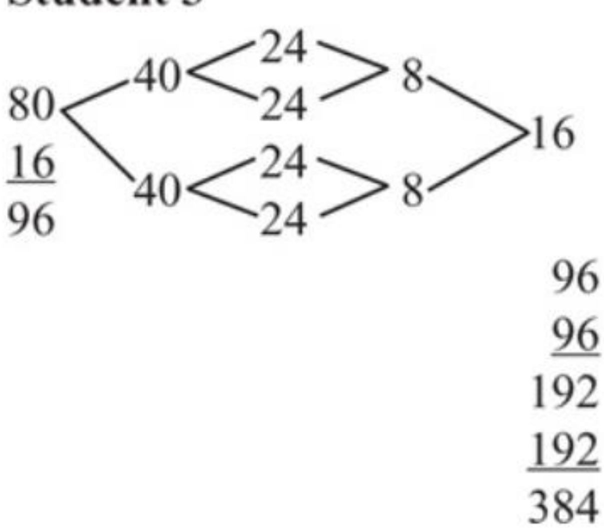
Student 1

$$\begin{array}{r} 20 \times 10 = 200 \\ 20 \times 6 = \underline{120} \\ 320 \\ 4 \times 10 = 40 \\ 4 \times 6 = \underline{24} \\ 64 \\ \underline{320} \\ 384 \end{array}$$

Student 2



Student 3



Student 4

$$\begin{array}{r} 16 \times 12 = 10 \times 12 = 120 \\ 6 \times 12 = \underline{72} \\ 192 \\ \underline{192} \\ 384 \end{array}$$

The following shows students solving different division problems. Take a minute to think and discuss with your group how you think the student solved it.

Student 1

How many cups containing 160 mL are in 2200 mL?

$10 \times 160 = 1600$

$13 \times 160 = 2080$

$14 \times 160 = 2240$

So, 13 cups, 120 mL left over.

Student 2

What is 78 divided by 3?

$20 + 20 + 20 = 60$

$8 \div 3 = 2$ R 2

$10 \div 3 = 3$ R 1

$2 + 1 = 3$

$3 \div 3 = 1$

So, $78 \div 3 = 26$.

Student 3

$280 \div 35$

280
−70
210
−70
140
−70
70
−70
0

So, four 70s is eight 35s.

Student 4

$27\overline{)3247}$

2700	100
547	
270	10
277	
270	10
7	120

So, $3247 \div 27 = 120$ R 7. (*Note:* The fourth way is the Greenwood or "scaffold" algorithm, dating back to the seventeenth century.)

Claire's Strategy

Claire said, "When I see a division problem like 120 ÷ 40, I change it to 12 ÷ 4 because I can do it in my head. Or, if it is like 900 ÷ 180, I change it to 300 ÷ 60, and that's easy—5! So, 900 divided by 180 is 5."

- Describe Claire's strategy. When can Claire use her strategy? Why does Claire's strategy work?

- Can you solve the following using Claire's strategy?

$1500 \div 150 =$ $840 \div 30 =$ $1530 \div 255 =$

Which solutions show good "number sense?"