Division Mistake Detectives

Fourth Graders Come to the Rescue!

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Oh man!!!

Ben just doesn't understand why two of his quotients are not correct. Can you help Ben?

$$\begin{array}{r} 147 \checkmark \\ 5)\overline{785} \\ -5 \\ \hline 28 \\ -25 \\ \hline 35 \\ -35 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 507 \checkmark \\ 4)\overline{2528} \\ -25 \\ \hline 028 \\ -28 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 811 \\ 8)\overline{6488} \\ -64 \\ \hline 08 \\ -8 \\ \hline 0 \end{array}$$

How can we help Ben???

147 ✓ 5)785 -5 28 -25 35 -35 0	507 ✓ 4)2528 -25 028 - 28 0	811 8)6488 -25 028 - 28 0

- What is his mistake?
- When does he make it?
- Why is one answer correct?
- How will you show him the correct way to divide?

Today we will

- Analyze error patterns that students may make when they are using the division algorithm without understanding it.

- Explain how error patterns can be corrected by using
  - Estimation
  - Repeated subtraction
  - Partial quotients
  - Concrete models or drawings

- Demonstrate the meaning of the division algorithm.

Mistake Detectives' Vocabulary

- Error Pattern: When a student makes the same mistake over and over again.

- Decomposing: Separating the values of numbers to make groups of tens, hundreds, thousands, etc. (273 = 200 + 70 + 3)

- Division Algorithm: The usual way of solving an division problem <u>without</u> using drawings or models.

- Division Problem:

$$\text{Dividend} \div \text{Divisor} = \text{Quotient} \quad \underline{or} \quad \text{Divisor}\overline{)\text{Dividend}}^{\text{Quotient}}$$

- Remainder: The amount left over after the dividend has been divided equally.

- Place Value:

Hundreds	Tens	Ones
3	2	6

Mistake Detectives' Vocabulary

$$811 \; R \; 1$$

$$8 \overline{)6489}$$

-64
08
- 8
09
- 8
1

Remainder:
The amount left over after the dividend has been divided equally.

This remainder can be interpreted as
$6489 \div 8 = 811$ with 1 left over
or
$6489 = 811(8) + 1$

Solve the following problems:

$6)\overline{789}$	$2)\overline{684}$	$5)\overline{5995}$

Did you get the correct quotients?

```
  131 R 3          342            1199
6)789            2)684          5)5995
 -6               -6             -5
  18               08             09
 -18              - 8            - 5
   09               04             49
   - 6             - 4           - 45
     3               0             45
                                 -45
                                   0
```

(131 with 3 left over)

Yikes !!!

Zoe solved the problems and got two of them wrong. What mistake did she make?

$\begin{array}{r} 111 \\ 6\overline{)789} \end{array}$ ✓	$\begin{array}{r} 342 \\ 2\overline{)684} \end{array}$	$\begin{array}{r} 1111 \\ 5\overline{)5995} \end{array}$ ✓

Step 1: Describe the error pattern.

$\dfrac{111}{6)789}$ ✓	$\dfrac{342}{2)684}$	$\dfrac{1111}{5)5995}$ ✓

- What is her mistake?
- When does she make it?
- Why is one answer correct?
- Do you see an error pattern?

Step 1: Describe the error pattern.

$\frac{111}{6)789}$ ✓	$\frac{342}{2)684}$	$\frac{1111}{5)5995}$ ✓

Zoe has totally forgotten about place value. She is dividing each digit of the dividend separately without subtracting and decomposing. The middle problem is correct because no decomposing was necessary.

Step 2: Help Zoe correct her error pattern.

111 ✓ 6)789	342 2)684	1111 ✓ 5)5995

- Estimation
- Repeated subtraction
- Partial quotients
- Concrete models or drawings

Estimation

111 ✓ $5\overline{)975}$	$2\overline{)3698}$	$8\overline{)8423}$	$3\overline{)9275}$

Estimation	Algorithm
975 is about 1,000. 1,000 ÷ 5 ≈ 200. My quotient will be about 200.	195 $5\overline{)975}$ -5 47 -45 25 -25 0

Repeated Subtraction: 45 ÷ 9 = 5

Repeated Subtraction	Concrete Model (Take away groups of 9)
45 – 9 = 36 36 – 9 = 37 27 – 9 = 18 18 – 9 = 9 9 – 9 = 0 **How many groups of 9 are there? Are any ones left over?**	

9)45
- 9
36
-9
27
-9
18
-9
9
- 9
0
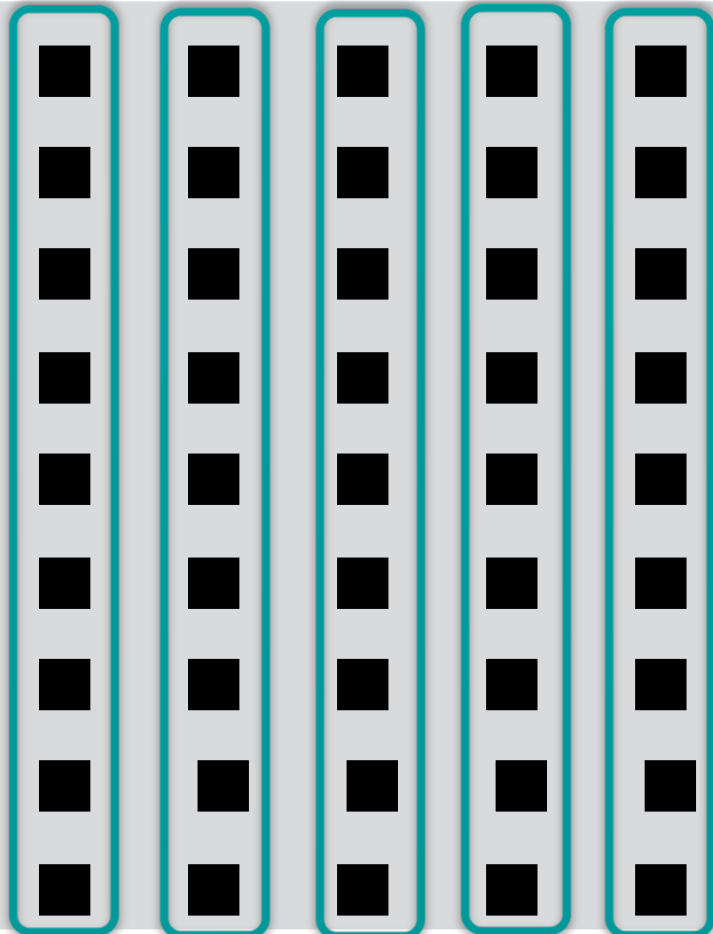
Repeated Subtraction – your turn!

Quotient

Divisor)Dividend

- Write a division problem in you math journal.

- Solve by using repeated subtraction.

- Then solve by using the algorithm.

- When could you use repeated subtraction?

- When would another approach be better?

Partial Quotients
This method involves estimation!

OR

6)789
-600
189
-120
69
-60
9
-6
3

100 x 6 = 600

20 x 6 = 120

10 x 6 = 60

+ 1 x 6 = 6
131 with 3
left over

6)789
-600
189
-180
9
-6
3

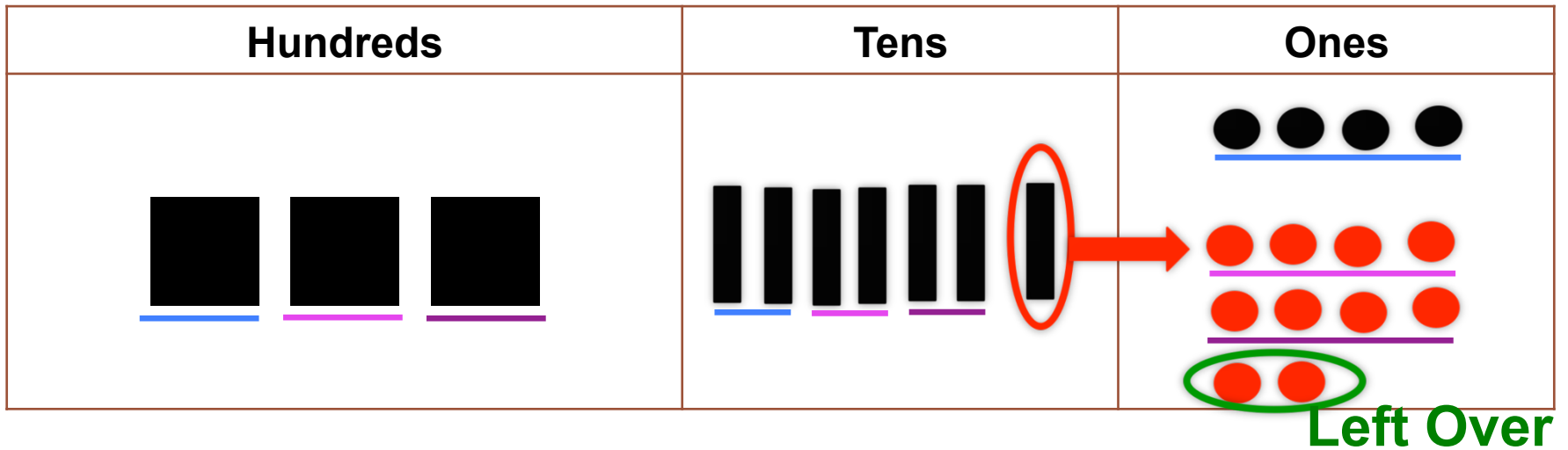100 x 6 = 600

30 x 6 = 180

+ 1 x 6 = 6
131 with 3
left over

OR??

Partial Quotients – your turn!

5)729

1. Work with a partner. How many ways can you solve this problem using partial quotients?

2. Then solve the problem using the division algorithm.

Concrete Models or Drawings
374 ÷ 3 = 124 with 2 left over

Hundreds	Tens	Ones

Divide into 3 equal groups:

Your turn!

Choose a problem. Solve with concrete models or drawings and then by algorithm.

$\frac{111}{5)575}$ ✔	$\overline{2)698}$	$\overline{4)433}$	$\overline{3)275}$

Are there other ways to help Zoe?

$$\begin{array}{r} 111 \\ 6\overline{)789} \end{array} ✓ \qquad \begin{array}{r} 342 \\ 2\overline{)684} \end{array} \qquad \begin{array}{r} 1111 \\ 5\overline{)5995} \end{array} ✓$$

- Estimation
- Repeated subtraction
- Partial quotients

- Concrete models or drawings
- Other ideas?

Explain two ways that you will use to help Zoe.

$\begin{array}{r} 111 \\ 6\overline{)789} \end{array}$ ✓	$\begin{array}{r} 342 \\ 2\overline{)684} \end{array}$	$\begin{array}{r} 1111 \\ 5\overline{)5995} \end{array}$ ✓

Zoe made so many mistakes because _____.
I will demonstrate the correct way by _____ and
_____. I chose these two methods because _____.
I will then show her how to divide using the
algorithm.

Solve the following problems:

$3\overline{)6067}$	$5\overline{)7950}$	$2\overline{)4862}$

Did you get the correct quotients?

2022 $_R$ 1	1590	2431
3)6067	5)7950	2)4862
-6	-5	-4
006	29	08
-6	-25	-8
07	45	06
-6	-45	-6
1	00	02
		-2
		0

(2022 with 1 left over)

RATS!!!
Jack solved these problems and got two of them wrong. What is his error pattern?

222 R 1 ✓

3)6067

  -6

  006

    -6

    07

     -6

     1

159 ✓

5)7950

  -5

  29

  -25

   45

   -45

   00

2431

2)4862

  -4

  08

  -8

  06

  -6

  02

  -2

  0

Step 1: Describe the error pattern.

222 *R* 1 ✓	159 ✓	2431
3)6067	5)7950	2)4862
-6	-5	-4
006	29	08
-6	-25	-8
07	45	06
-6	-45	-6
1	00	02
		-2
		0

- What is his mistake?
- When does he make it?

- Why is one answer correct?
- Do you see an error pattern?

Step 2: Explain two ways that you will use to help Jack.

```
    222 R 1  ✓
3)6067
 -6
  006
   -6
   07
    -6
    1
```

```
    159  ✓
5)7950
 -5
  29
 -25
   45
  -45
   00
```

```
    2431
2)4862
 -4
  08
 -8
  06
  -6
  02
  -2
   0
```

- Estimation
- Repeated subtraction
- Partial quotients
- Concrete models or drawings
- Other ideas?

Step 2: Explain two ways that you will use to help Jack.

```
      222 R 1  ✓
   3)6067
    -6
     006
     -6
      07
      -6
       1
```

```
      159  ✓
   5)7950
    -5
     29
    -25
      45
     -45
      00
```

```
     2431
   2)4862
    -4
     08
    -8
     06
     -6
      02
     -2
      0
```

Jack made mistakes because _____. I will demonstrate the correct way by _____ and _____. I chose these two methods because _____. I will then show him _____.

What kinds of division errors have you made?

Be a Mistake Detective!

- Write five division problems with quotients that have an error pattern. Be sure to include one or two problems that have the correct answer.

- Describe the error pattern.

- Explain how you will help the student correct the mistake.   Use writing, symbols, and pictures in your explanation.

- Write the five division problems again using the correct algorithm and with the correct quotients.

- Share your work.

Mistake Detective Rubric

4	3	2	1
Fully accomplishes the purposes of the task:	**Substantially accomplishes the purposes of the task:**	**Partially accomplishes the purposes of the task:**	**Little or no progress toward accomplishing the purposes of the task:**
• Shows full grasp and use of the central mathematical ideas. • Recorded work communicates thinking clearly using some combination of written, symbolic, or visual means. • Computational work using the algorithm is correct.	• Shows essential grasp of the central mathematical ideas. • Recorded work in large part communicates thinking using some combination of written, symbolic, or visual means. • Computational work using the algorithm is correct.	• Shows partial but limited grasp of the central mathematical ideas. • Recorded work may be incomplete, misdirected, or not clearly presented • There are mistakes in the computational work that uses the algorithm.	• Shows little or no grasp of the central mathematical ideas. • Recorded work is barely (if at all) comprehensible. • There are mistakes in the computational work that uses the algorithm.

Rubric adapted from CLAS Mathematics, California Department of Education