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School of Curriculum

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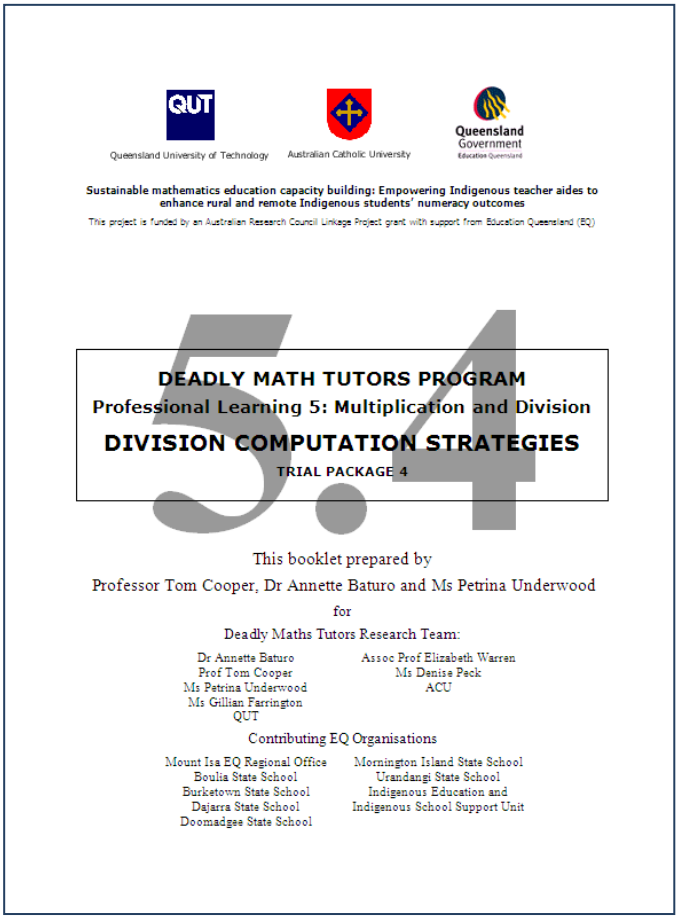
Professional Learning 5

Multiplication and Division

Booklet 5.4: Division Computation Strategies



Queensland University of Technology Australian Catholic University Queensland Government

Sustainable mathematics education capacity building: Empowering Indigenous teacher aides to enhance rural and remote Indigenous students' numeracy outcomes

This project is funded by an Australian Research Council Linkage Project grant with support from Education Queensland (EQ)

5.4

DEADLY MATH TUTORS PROGRAM
Professional Learning 5: Multiplication and Division
DIVISION COMPUTATION STRATEGIES
TRIAL PACKAGE 4

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Burketown State School
Dajarra State School
Doomadgee State School
Mornington Island State School
Urandangi State School
Indigenous Education and Indigenous School Support Unit

YuMi Deadly Maths
Past Project Resource

Acknowledgement

We acknowledge the traditional owners and custodians of the lands in which the mathematics ideas for this resource were developed, refined and presented in professional development sessions.

YuMi Deadly Centre

The YuMi Deadly Centre is a Research Centre within the Faculty of Education at Queensland University of Technology which aims to improve the mathematics learning, employment and life chances of Aboriginal and Torres Strait Islander and low socio-economic status students at early childhood, primary and secondary levels, in vocational education and training courses, and through a focus on community within schools and neighbourhoods. It grew out of a group that, at the time of this booklet, was called "Deadly Maths".

"YuMi" is a Torres Strait Islander word meaning "you and me" but is used here with permission from the Torres Strait Island Regional Educational Council to mean working together as a community for the betterment of education for all. "Deadly" is an Aboriginal word used widely across Australia to mean smart in terms of being the best one can be in learning and life.

YuMi Deadly Centre's motif was developed by Blacklines to depict learning, empowerment, and growth within country/community. The three key elements are the individual (represented by the inner seed), the community (represented by the leaf), and the journey/pathway of learning (represented by the curved line which winds around and up through the leaf). As such, the motif illustrates the YuMi Deadly Centre's vision: *Growing community through education*.

More information about the YuMi Deadly Centre can be found at http://ydc.qut.edu.au and staff can be contacted at ydc@qut.edu.au.

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Queensland University of Technology,
Australian Catholic University &
Education Queensland

Deadly Maths Tutor Program

PROFESSIONAL LEARNING 5: MULTIPLICATION AND DIVISION

BOOKLET 5.4

DIVISION COMPUTATION STRATEGIES

2008

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Dajarra State School	Indigenous Education and Training Alliance
Doomadgee State School	(IETA)

YuMi Deadly Centre

School of Mathematics, Science and Technology Education,
Faculty of Education, QUT

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OVERVIEW

PURPOSE

These materials were designed to be used in conjunction with a Professional Learning program for teacher aides. The objective of this Professional Learning was to empower teacher aides to enhance rural and remote Indigenous students' numeracy outcomes. This document contains the materials of the fourth of five different booklets on multiplication and division.

If your school would like to receive a YuMi Deadly Maths Professional Learning program please contact the YuMi Deadly Centre (YDC) on: 07 3138 0035 or ydc@qut.edu.au.

DIRECTIONS

(1) Interviewing the students:

Pick one or more students who appear to be having trouble understanding division. Interview these students using the interview schedule and the materials. Mark what they do and put their results on the Student Recording Sheet.

(2) Trialling the student activities:

Use the Recording Sheet to work out the activities the students need to do and trial these activities with the students (with each student one at a time or with a group of students). Keep a record of what happens and collect the students' work.

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INTERVIEW SCHEDULE

Materials:

Unifix cubes, deck of playing cards, washable felt pen, pen, paper

Materials within this booklet: interview questions, cards, number tracks, number lines

Student Recording Sheet

Directions:

1. Photocopy and laminate attached cards.
2. Gather other material (unifix, paper, pencils)
3. Place material in front of students. Give students pen and paper to write with.
4. Tell the students you are trying to find out what they know. Say they are not expected to know it and you will teach what is not known.
5. Give the student directions slowly – read problems. Do not give hints. If student cannot do a question, pass on to the next question, repeating that it is not important if they don't know how to do the question.
6. Allow students to use material and make drawings but only after they say they do not know how to do it with symbols alone.

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INTERVIEW MATERIALS
Interview Questions

DSA	***Show and read Card 1*** • Ask: *Can you use the top answer to answer the two underneath?* **Repeat this for Card 2**
DSB	**Show and read Card 3** • Ask: *Can you answer this division operation by showing hundreds tens and ones?* • If cannot do this, **show and read Card 4** and ask: *Can you answer this one?* • If still cannot do this, ask if they can solve it any way.
DSC	**Show and read Card 5** • Ask: *Can you answer this division operation by working out how many 4s in 512 – looking first at 100s of 4s and then 10s of 4s?* • If cannot do this, **show and read Card 6** and ask: *Can you answer this one?*
DSD	**Show and read Card 7** • Ask: *Can you answer this division operation by finding an easier operation and relating this one to anything.* Say: *Say the problem (have student say the problem).* • If cannot do this, **show and read Card 8** and ask: *Can you read this one?*

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Interview Cards

Card 1 $6 \div 2 = 3$ $60 \div 2 =$ _____ $600 \div 2 =$ _____	**Card 2** $18 \div 3 = 6$ $180 \div 3 =$ _____ $1800 \div 3 =$ _____
Card 3 $576 \div 4$ $4\overline{)576}$	**Card 4** $72 \div 4$ $4\overline{)\ 72}$
Card 5 $512 \div 4$ $4\overline{)512}$	**Card 6** $76 \div 4$ $4\overline{)\ 76}$
Card 7 $584 \div 4$ $4\overline{)584}$	**Card 8** $92 \div 4$ $4\overline{)\ 92}$

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STUDENT RECORDING SHEET

Name: _____

School/Class: _____

Interview item	Result (✓, ✗)	Comments	Activities to be completed if incorrect
DSA: Higher decade division facts			DS1
DSB: Separation strategy for division computation			DS2
DSC: Sequencing strategy for division computation			DS3
DSD: Compensation strategy for division computation			DS4

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INTRODUCTION

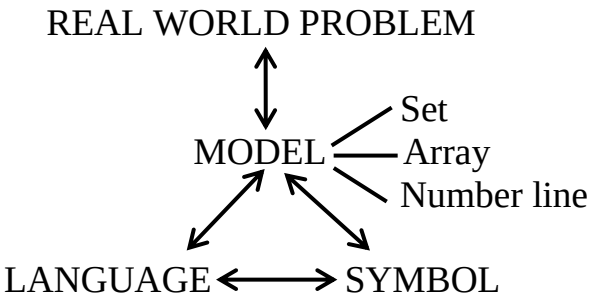
Contents

This package contains:

- four tutoring activities (DS1 to DS4) and their students materials (games and worksheets)

Pedagogy

The activities DS1 to DS4 are based on the Rathmell Triangle Relationship below, real world problems are related to set, array and number line models, language and symbols (and vice versa) to teach strategies for computation.

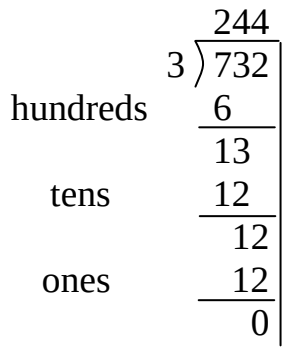


However, the focus of the activities is to develop a repertoire of strategies for computing such examples as 36÷6 and 255÷3. The activities are designed to allow you to tutor students who are having difficulties with division computation for 2- and 3-digit numbers ÷ 1-digit numbers. The activities are based on the belief that it is more important to use the algorithms to teach a variety of strategies than to get a correct answer. However, the activities also show how to get correct answers.

There are three strategies (or strategy groupings) associated with multiplication computation. These are:

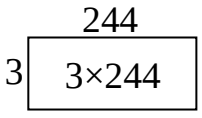
(1) Separation:

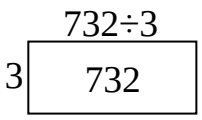
This is the traditional algorithm for long division, and it is based on sharing as can be seen in the following example 732÷3. This example is considered as 7 hundreds 3 tens and 2 ones shared amongst 3 people. By separating the number into its place values, it is possible to share each place value separately. It is easily seen to be more efficient to share large place values first. So 7 hundreds are shared between 3, 2 hundreds to each person, with 6 hundreds used and 1 hundred left over! This hundred makes 13 tens with the 3 tens and sharing continues until all ones are shared. This process works really well for money - $100 and $10 notes and $1 coins. The algorithm on the right symbolically acts out this sharing process.

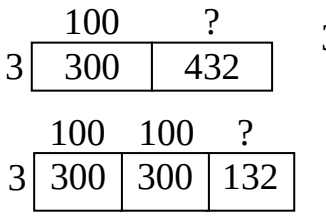


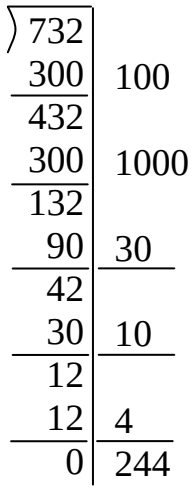
(2) Sequencing:

This is an alternative method/strategy. The number is not separated but broken into parts which become a sequence for the process of division. It is best seen in terms of arrays/area as on right. Multiplication of 244 by 3 is seen as the area of a 3×244 rectangle. Thus, division is seen as finding the long side of a 3 high rectangle with an area of 732. The idea is to start to think of what the long side could be. Is it over 10, over 100? Try 100. 100 multiplied by 3 is 300, leaving 432 as in figure on right. Try another 100 – yes, it works and leave 132 as on right. Then we can try 30 and 10 or 40 direct and finally 4 for the last 12.









This gives the algorithm on the right. It enables the division to be worked out with a sequence if parts – for example, the 244 is determined by 100, 100, 30, 10 and 4.

(3) Compensation:

This is the most efficient strategy. There is no breaking into parts by separating into place values or generating sequences. Numbers are left as they are but other examples are sought which are closer to the original division example but easy to divide. For the example 732÷3, an easy example would be 750÷3 which is 250, then the difference between the original and the easy example has to be compensated for. 750 is 18 too high, this is 6 threes, so subtract 6 from 250 = 244, which is the answer for 732÷3.

To recognise easier examples requires knowledge of (a) higher-decade division (e.g., 12÷4 = 3 so 120÷4 = 30 and 120÷40 = 3); and (b) when a division is the inverse of an easy multiplication (e.g., ×25 and ×50). Some examples of making division easy are as follows.

(1) 581÷7: An easy example is 560÷7 = 80, 581 is 21 more than 560 so need to add 21÷7 = 3 to 80, so answer is 83.

(2) 924÷6: An easy example is 900÷6 = 150, 924 is 24 more than 900, so need to add 24÷6 = 4 to 150, so answer is 154.

Note: There is another method for making examples easier and that is to use the fact that if, for example, 6 = 3x2 then 24÷6 = 24÷3÷2 = 8÷2 = 4.

This is particularly useful for divisors based on 2. For example, 544÷8 can be done by 54÷2÷2÷2 as 2×2×2 = 8. This is really halving, so answer half of half of half of 544 = half of half of 272 = half of 136 = 68.

It is also useful when dividing by 2 digit numbers, e.g. 888÷24 as 6×4 = 24, then answer is found by 888÷4 = 222 and 222÷6 = 37.

All the three strategies require knowledge of basic number facts (e.g., 6×8 = 48) and also higher-decade number facts (e.g., 6×80 = 480, 600×80 = 48 000).

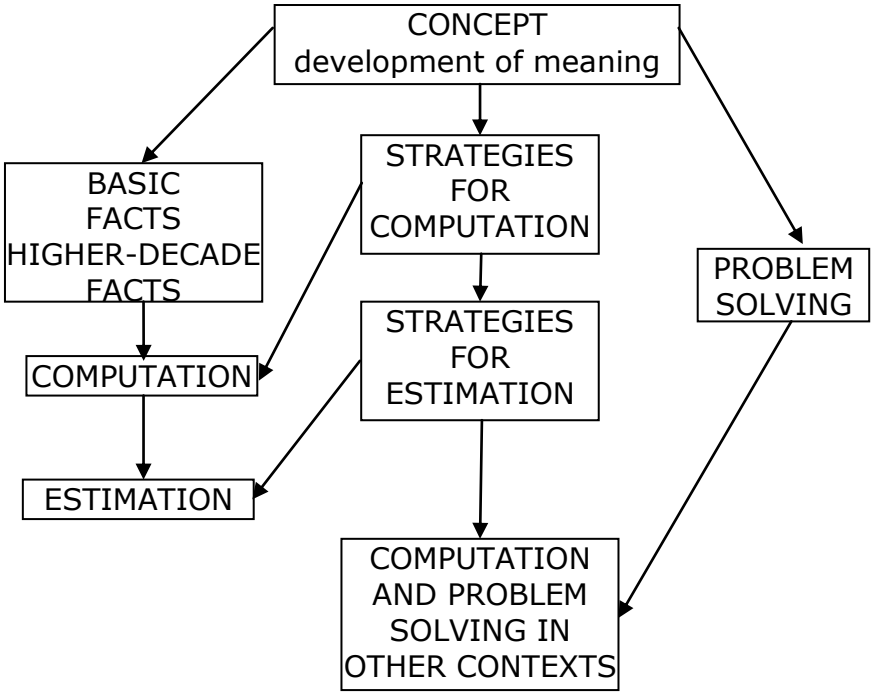
Thus, the four activities in this booklet are the higher-decade facts (Activity DS1), separation strategy (Activity DS2), sequencing strategy (Activity DS3), and compensation strategy (Activity DS4).

Approach

The four operations of addition, subtraction, multiplication and division are important in mathematics, as they reflect everyday important actions (of joining, separation, combining and partitioning) that happen in the lives of people and that are the basis of problems that need to be solved.

For larger numbers, procedures have been developed to achieve answers using basic facts and higher-decade facts. These are based on strategies that also can be used to teach multiplication and division for, for example, mixed numbers, measures, time, and algebra. In a world of calculators and computers, computation for answers has become less important than computation for learning strategies. However, strategies when learnt will enable answers to be acquired as well as the procedures to be understood.

Thus, the sequence for the development of any of the four operations with whole number is:



Therefore, in this booklet we will focus on strategies (leaving problem solving for booklet 5.5) so as to develop mathematics ideas that will pay off in later years in other contexts (e.g. decimals). For this reason, much of the activity in this booklet is learning a repertoire of strategies (not just one strategy to get answers).

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ACTIVITIES

ACTIVITY DS1

[Higher-decade division facts]

Materials: MAB, unifix cubes, pens, paper, calculators, attachments

Directions:

1. Consider 8÷4. Act this out by sharing 8 MAB units amongst 4 people. Ask: *How many does each person get?* [2] Now consider 80÷4. Act this out by sharing 8 tens amongst 4 people. Ask: *How many does each person get?* [2 tens or twenty] Repeat this for 800÷4.
2. Consider 15÷5. Act this out with unifix by making rows of 5. Ask: *How many rows?* [3] Consider 150÷5. Act this out by making rows of 5. Do it in your mind. Will 10 rows of 5 give 150, 20 rows of 5, 30 rows of 5 and so on. Ask: *How many rows?* [30] Repeat this thinking for 1500÷5.
3. Write down the results of 2 and 3. Use a calculator to work out the results of the examples under them.

8÷4 = 2	80÷4 = 20	800÷4 = 200
15÷5 = 3	150÷5 = 30	1500÷5 = 300
24÷6 =	240÷6 =	2400÷6 =
12÷3 =	120÷3 =	1200÷3 =

   Ask: *Can you write down a rule for dividing with tens and hundreds?* If difficulty, ask students to look at relationship of other columns to left hand column.

4. Use a calculator to work out the answers for these examples:

9÷3 =	90÷30 =	900÷300 =
8÷2 =	80÷2 =	800÷20 =
14÷7 =	140÷70 =	1400÷70 =
18÷6 =	180÷6 =	1800÷600 =
32÷8 =	3200÷80 =	3200÷800 =

   Ask: *Can anyone think of a rule for dividing these numbers?* If difficulty, ask: *Can you see how these* [point to 2 right hand columns] *relate to this* [point to left hand column]*?*

5. Complete Worksheet 1.1 and 1.2.
6. Complete game "Ride them equal".

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DS1 – Worksheet 1.1

1. Complete the following using a calculator:

6÷2 = _____	49÷7 = _____	28÷4 = _____
60÷2 = _____	490÷7 = _____	280÷4 = _____
600÷2 = _____	4900÷7 = _____	2800÷4 = _____
6000÷2 = _____	49 000÷7 = _____	28 000÷4 = _____
60÷2 = _____	490÷70 = _____	280÷40 = _____
600÷20 = _____	4900÷70 = _____	2800÷40 = _____
6000÷20 = _____	49 000÷70 = _____	28 000÷40 = _____
600÷200 = _____	4900÷70 = _____	2800÷400 = _____
6000÷200 = _____	49 000÷70 = _____	28 000÷400 = _____
6000÷2000 = _____	4900÷700 = _____	28 000÷4000 = _____

2. Complete these without a calculator:

48÷6 = 8	30÷5 = 6	72÷4 = 18
480÷6 = _____	300÷5 = _____	720÷4 = _____
4800÷6 = _____	3000÷5 = _____	7200÷4 = _____
48 000÷6 = _____	30 000÷5 = _____	72 000÷4 = _____
480÷60 = _____	300÷50 = _____	720÷40 = _____
4800÷60 = _____	3000÷50 = _____	7200÷40 = _____
48 000÷600 = _____	30 000÷50 = _____	72 000÷40 = _____
4800÷600 = _____	3000÷500 = _____	7200÷400 = _____
48 000÷600 = _____	30 000÷500 = _____	72 000÷400 = _____
48 000÷6000 = _____	30 000÷5000 = _____	72 000÷4000 = _____

3. Write down a rule that these examples follows:

_____

_____

_____

4. Show how your rule can explain why if 65÷5 = 13 then 6500÷50 = 130:

_____

_____

_____

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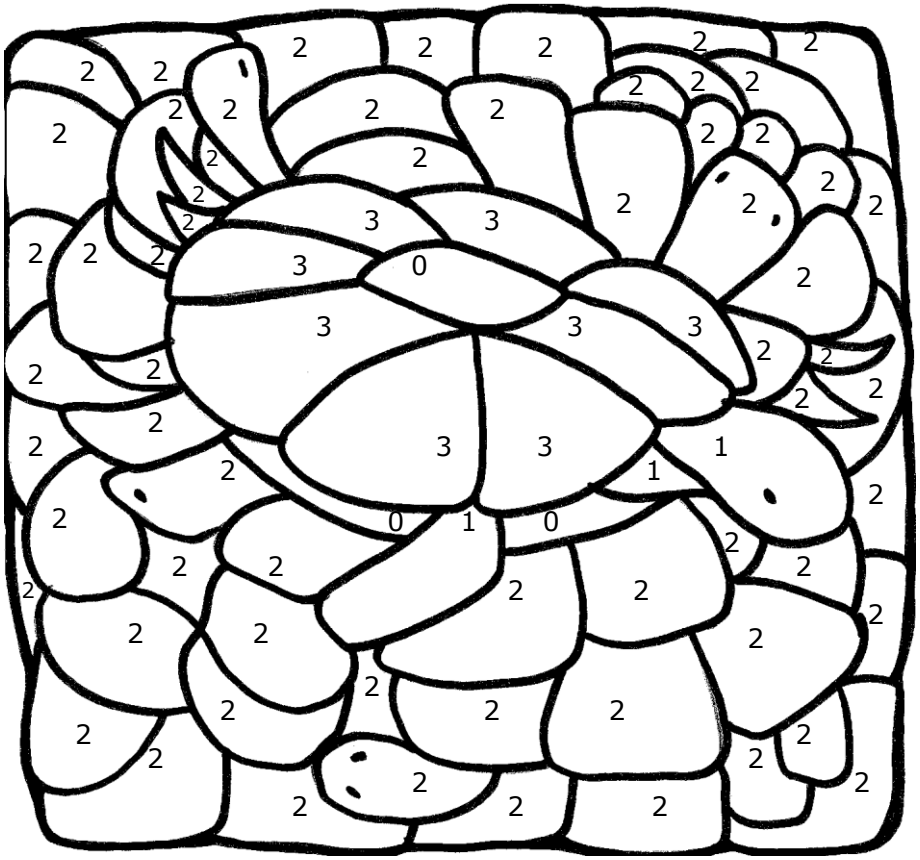
DS1 – Worksheet 1.2

6 ÷ 3 = 2

How many zeroes in the answers?

For each question, determine the number of zeros and colour one area with the colour given by the number of zeroes - 0 – green; 1 – brown; 2 – blue; 3 – yellow. When you are finished, colour all other areas. What have you got?

(1) 600 ÷ 20	(2) 6000 ÷ 2	(3) 60 000 ÷ 200
(4) 6 ÷ 2	(5) 6 000 000 ÷ 200 000	(6) 600 ÷ 200
(7) 60 000 000 ÷ 2000	(8) 6 000 000 ÷ 20 000	(9) 6000 000 ÷ 200 000
(10) 600 ÷ 2	(11) 60 000 ÷ 2000	(12) 600 000 000 ÷ 200 000
(13) 600 000 ÷ 20 000	(14) 60 000 ÷ 20	(15) 60 ÷ 20
(16) 60 000 000 ÷ 200 000	(17) 600 000 ÷ 2000	(18) 6000 ÷ 2000
(19) 60 ÷ 2	(20) 6 000 000 ÷ 2000	(21) 6000 ÷ 20
(22) 6000 ÷ 200	(23) 600 000 ÷ 200	(24) 60 000 ÷ 20 000



It keeps on paddling?

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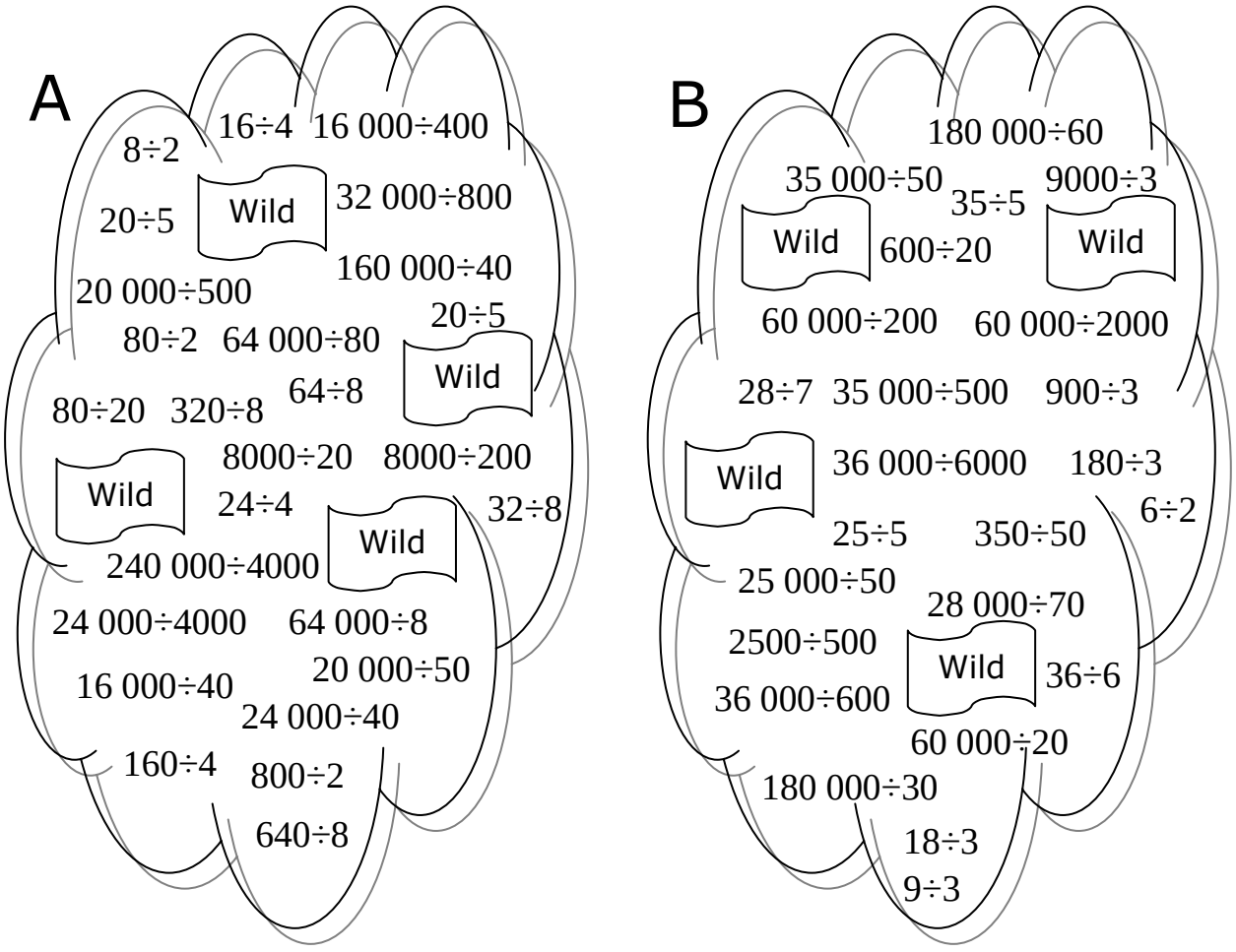
DS1 – Game: "Ride Them Equal"

Materials: A marker (coloured unifix) for each player (start at "START"), calculator, pen.

Number of players: 2

Directions:

1) Pick on exercise from each cloud. Cross out the examples chosen.
2) Use a calculator to work out the answers.
3) If the number of zeros are the same, move marker one step towards finish line.
4) Wild can be used to make your own problem.
5) First to finish wins.



START						**FINISH**
START						**FINISH**

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DS1 Activity Feedback Sheet

1. How the student found the activity (put a cross on lines)

NAME	STUDENTS' REACTIONS
	Boring ——— Interesting Difficult ——— Easy Not learning ——— Learning
	Boring ——— Interesting Difficult ——— Easy Not learning ——— Learning

2. How did you feel about trialling the activity?

   Mark the line with an X: Unconfident ——— Very confident

3. Do you think the student was engaged in the activity? Explain.

   _____

4. What do you think the student learnt from the activity?

   _____

5. Do you think the student has gained an understanding of the concept being taught? Explain.

   _____

6. What do you think of the activity?

   _____

7. What are your suggestions for improving the activity?

   _____

   _____

8. What else do you suggest could be done to help students who have trouble with this activity?

   _____

   _____

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ACTIVITY DS2

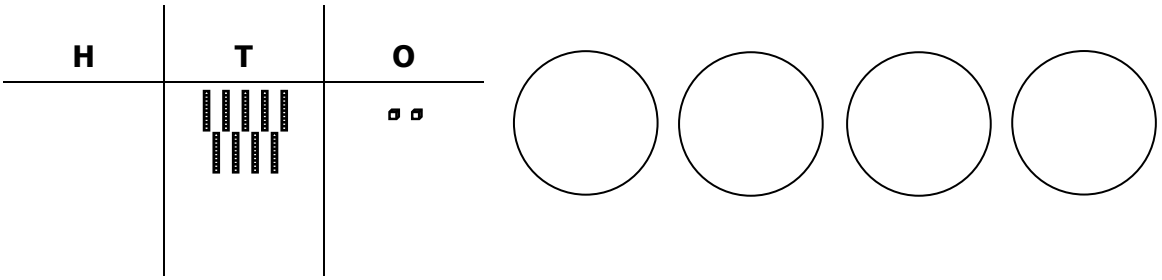
[Separation strategy for division computation]

Materials: MAB (for 100, for 10, for 1), plates, place value chart (100, 10, 1), pen, paper, attachments

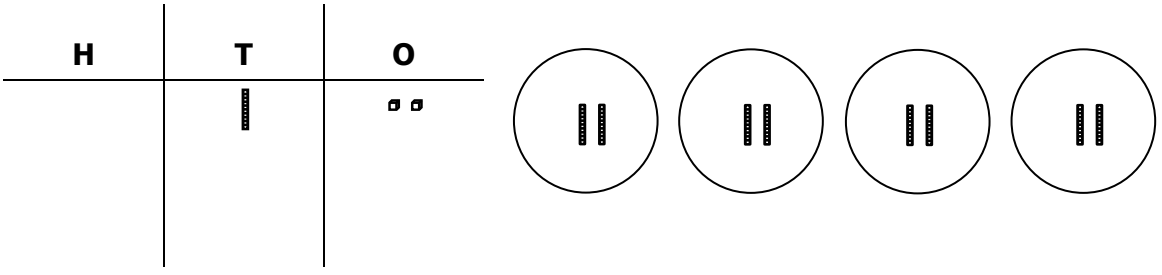
Directions:

1. Consider the division example 92÷4. From booklet 5.2, this can be considered as "92 shared amongst 4" or "how many groups of 4 in 92". Discuss this with students. Ask: *How can we think about 92÷4? What does 92÷4 mean?* Also ask: *Is there another way to write it?* Lead students to remember that 92÷4 can also be written as $4\overline{)92}$. State: *For computation we use this second way!* [point to $4\overline{)92}$]

2. State: The *first strategy is based on separating the number being divided* [quotient] *into place values and sharing!* Ask: *How many tens in 92?* [9] *How many ones left over?* [2] State: *Show this with MAB.* [put out 9 tens and 2 ones on place value chart] *Show the 4 to share amongst.* [put out 4 plates]



Ask: *What shall we share first?* [let students discuss but encourage them to see that in real life it is easier to share the larger notes first – the tens] State: *Share the tens.* ["a ten to you, a ten to you" and so on] Ask: *How many tens did each plate get?* [2] *How many tens used all together?* [8] *How many tens left over?* [1]



Ask: *What can we do with the left over 10 to keep sharing?* [discuss but encourage students to see need to break/trade it for ones] Ask: *How many ones does this give us?* [12] State: *Share these ones.*

Ask: *How many ones does each plate get?* [3] *How many ones are used?* [12] *How many ones are left over?* [0] *What is the answer?* [2 tens and 3 ones – 23]

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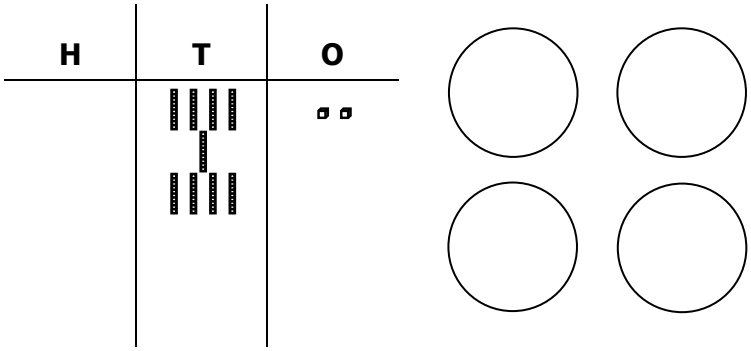
3. Repeat direction 2 but record with a pen and paper as go

Step 1 Setting up the sharing.

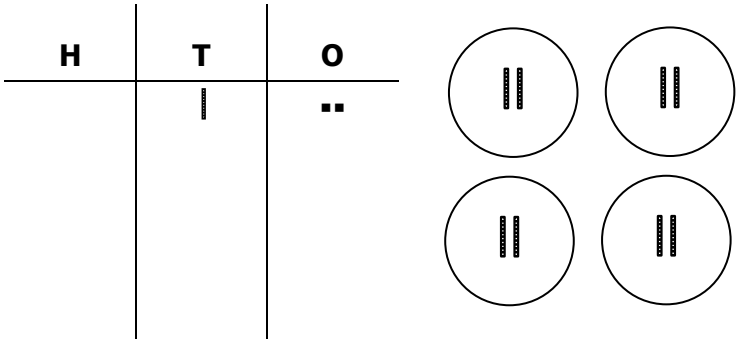


How many to share amongst?

$4\overline{)92}$

How much do we have?

Step 2 Sharing the larger place value – the tens.



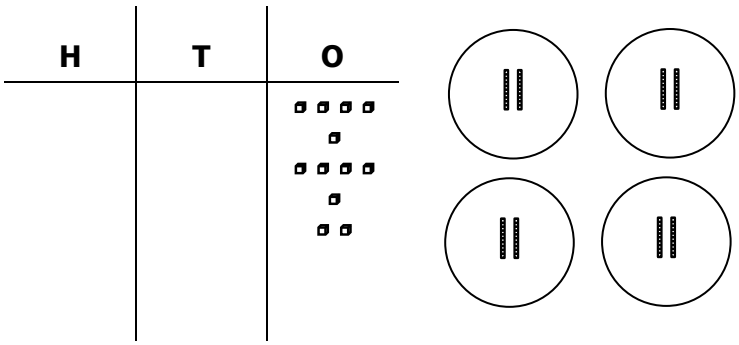
How many tens to each plate?

$$4\overline{)92}\quad \begin{array}{r} 2 \\ 8 \\ \hline 1 \end{array}$$

How many used?

How many left over?

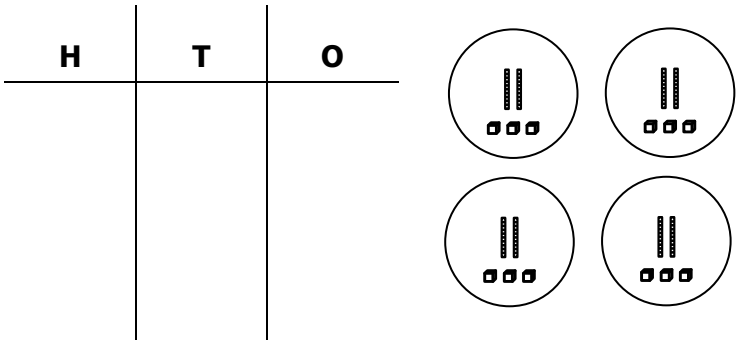
Step 3 Regrouping.



$$4\overline{)92}\quad \begin{array}{r} 2 \\ 8 \\ \hline 12 \end{array}$$

How many ones?

Step 4 Sharing the ones.



How many ones to each plate?

$$4\overline{)92}\quad \begin{array}{r} 23 \\ 8 \\ \hline 12 \\ 12 \\ \hline 0 \end{array}$$

How many ones used?

How many left over?

Step 5 State the answer. [23]

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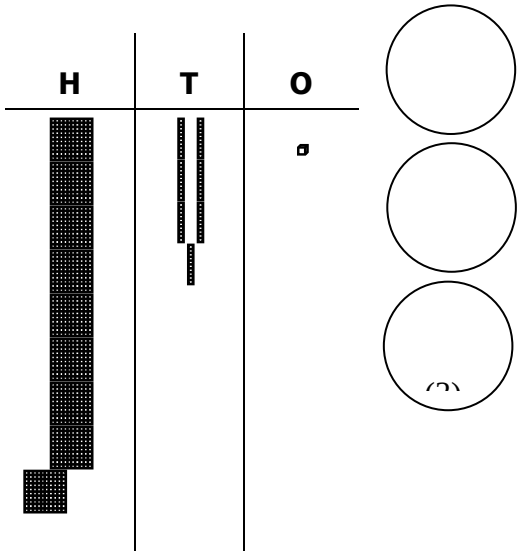
4. Repeat for 771÷3. State: *Act this out with MAB and 3 plates.* State: *Point at numbers and material as you ask the questions.*

<u>Step 1</u> Set up.



$3\overline{)771}$

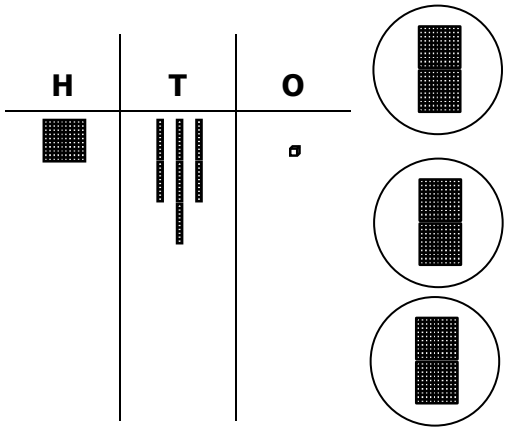
How many hundreds?

How many tens left over?

How many ones left over?

How many to share amongst?

<u>Step 2</u> Sharing the hundreds.



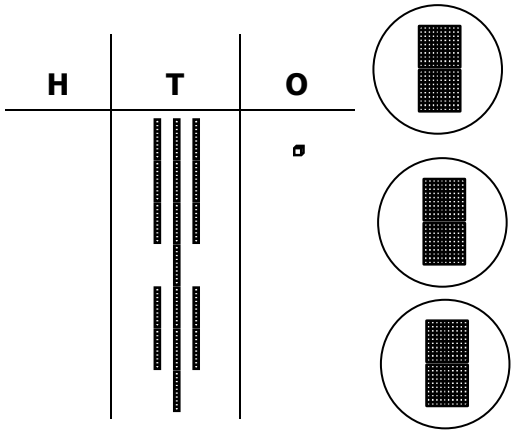
$$\begin{array}{r} 2 \\ 3\overline{)771} \\ \underline{6} \\ 1 \end{array}$$

How many hundreds to each plate?

How many hundreds used?

How many hundreds left over?

<u>Step 3</u> Regrouping 100s → 10s.



$$\begin{array}{r} 2 \\ 3\overline{)771} \\ \underline{6} \\ 17 \end{array}$$

How many tens now?

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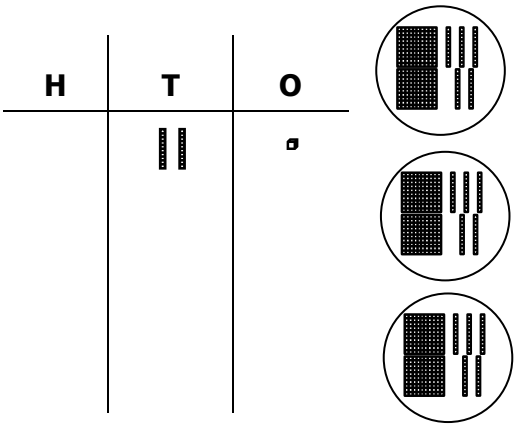
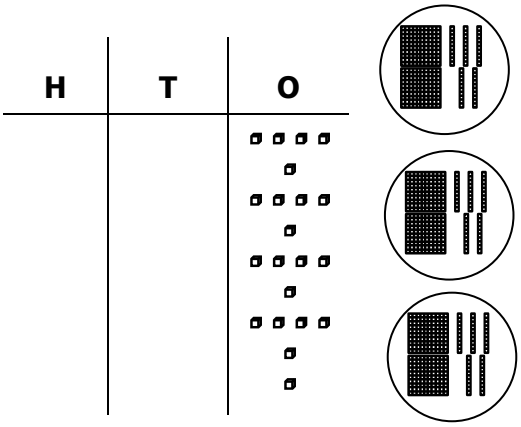
Step 4 Sharing the tens.



$$\begin{array}{r} 25 \\ 3\overline{)771} \\ 6 \\ \hline 17 \\ 15 \\ \hline 2 \end{array}$$

How many tens to each plate?
How many tens used?
How many tens left over?

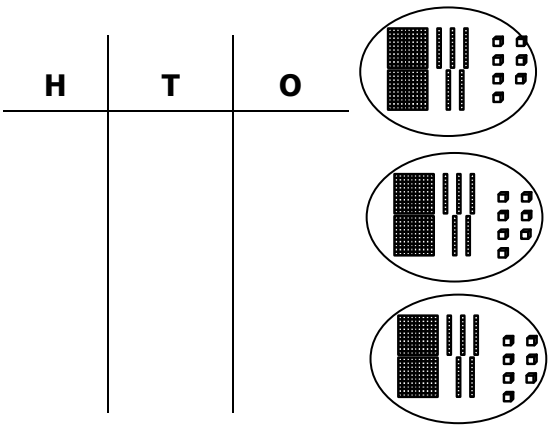
Step 5 Regrouping 10s → 1s.



$$\begin{array}{r} 25 \\ 3\overline{)771} \\ 6 \\ \hline 17 \\ 15 \\ \hline 21 \end{array}$$

How many ones now?

Step 6 Sharing the ones.



$$\begin{array}{r} 257 \\ 3\overline{)771} \\ 6 \\ \hline 17 \\ 15 \\ \hline 21 \\ 21 \\ \hline 0 \end{array}$$

How many to each plate?
How many used?
How many ones left over?

Step 7 State the answer. [257]

5. Complete worksheet 2.1.

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6. Go through separation strategy without material for example 936÷4. Point to numbers as ask questions.

   Step 1 Set up.

   $4\overline{)936}$

   How many to share?
   Write this down.
   How many to share amongst?
   Write this down.
   Draw $\overline{)}$ *to show division.*

   Step 2 Divide the 100s.

   $$\begin{array}{r} 2 \\ 4\overline{)936} \\ \underline{8} \\ 1 \end{array}$$

   How many 100s to divide? [9]
   How many 100s to each group? [9÷4 gives 2 to each group]
   How many 100s left? [1]

   Step 3 Regroup and divide the 10s.

   $$\begin{array}{r} 23 \\ 4\overline{)936} \\ \underline{8} \\ 13 \\ \underline{12} \\ 1 \end{array}$$

   Change the 100s to 10s.
   How many 10s to divide? [13]
   How many 10s to each group? [13÷4 gives 3 to each group and 1 left over]
   How many 10s left? [1]

   Step 4 Regroup, divide the 1s and state answer.

   $$\begin{array}{r} 234 \\ 4\overline{)936} \\ \underline{8} \\ 13 \\ \underline{12} \\ 16 \\ \underline{16} \\ 0 \end{array}$$

   Change the 10s to 1s
   How many 1s to divide? [16]
   How many 1s to each group? [4]
   How many 1s left? [0]
   What is the answer? [234]

7. Repeat direction 6 for $4\overline{)828}$. Discuss the zero for tens.
8. Complete Worksheet 2.2.
9. Play games: “Separation Division Snap”, “Separation Division Rummy”, “Separation Division Concentration”, “Separation Division Cover-the-board”, “Separation Division Mix-and-Match” and “Separation Division Bingo”.

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DS2 – Place Value Chart

	HUNDREDS
	TENS
	ONES

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DS2 – Worksheet 2.1

Use MAB and Place Value Chart to complete the following. (Put letters on top of answers in the box below).

(1)	$3\overline{)81}$	G	(2)	$4\overline{)96}$	N	(3)	$6\overline{)78}$	D
(4)	$5\overline{)85}$	M	(5)	$7\overline{)98}$	O	(6)	$3\overline{)96}$	L
(7)	$3\overline{)627}$	I	(8)	$4\overline{)784}$	T	(9)	$6\overline{)804}$	A
(10)	$5\overline{)940}$	R	(11)	$4\overline{)912}$	S			

What am I?

228	14	32	209	13	,	228	17	134	188	196
134	24	13		228	196	188	14	24	27	

Complete without MAB. (Put letters on top of answers in the box below).

(1)	$6\overline{)864}$	E	(2)	$7\overline{)994}$	R	(3)	$3\overline{)921}$	L
(4)	$3\overline{)867}$	U	(5)	$5\overline{)865}$	N	(6)	$7\overline{)812}$	Y
(7)	$6\overline{)624}$	P	(8)	$3\overline{)621}$	O	(9)	$7\overline{)735}$	A
(10)	$4\overline{)836}$	D						

How do I act?

104	272	207	289	209		105	173	209
209	144	105	209	307	116			

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DS2 Games

Snap, Rummy and Concentration

Materials: Four pages of pictures following these instructions (equations, algorithms, array, partitioned array).

Number of players: 2-4

Directions:

1. Print the four pages in 4 different colours, laminate and cut each page into 12 cards (making 48 cards of 4 different colours). Shuffle the cards. Follow instructions for these games:
2. **Snap**: Two players, cards divided equally between players. Together, the two players play the top card of their deck face up in front of them. First to call snap when two cards who the same number wins a point. The player with the most points wins when all cards played.
3. **Rummy**: Two to four players, deal out 7 cards to each player. Remaining cards face down in middle with one card face-up beside deck. Players put out any doubles or triples. Players in turn pick up a card (either the top face-up card or face-down card) and place a card face-up on the face-up pile. Doubles and triples are put out as they are formed. The winner is the first player to put out all their cards as doubles and triples.
4. **Concentration**: Place all cards face down on table. Players take turns selecting 2 cards. If they are the same, keep the pair and take another turn. The winner is the player with the most pairs when all cards used.

Cover-the-Board Game

Materials: Same materials as for card games except the symbols page is kept as a base board, while the other 3 pages are cut into 12 picture cards.

Number of players: 2-4

Directions:

1. Print the four pages from the card games, each on different colour paper or light card (laminate if possible).
2. Use the symbols as a base board.
3. Cut the other pages into 12 cards each.
4. Each player gets a set of cards.
5. In turn, each player places a card correctly on base board (card and board have to display same number) or on top of another card already placed.
6. At the end, the player with most cards on top wins.

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DS2 Games Continued

Mix-and-Match Cards

Materials: 12 mix and match cards (two per page).

Number of players: 1 (though can be a group)

Directions:

1. Print all cards in same colour.
2. Cut cards along lines into pieces.
3. Mix pieces together.
4. Students put pieces back together to form cards.

Bingo

Materials: 7 pages of material – one set of symbol flash cards and six bingo base boards, unifix cubes.

Number of players: 2-6

Directions:

1. Print the flash cards (symbols) on white paper or card, cut out and laminate if possible.
2. Print the six bingo base boards, each on different coloured paper or card (laminate if possible).
3. One player (caller) takes the flash cards and shuffles them, the rest take a base board and unifix cubes.
4. Caller shows cards one at a time.
5. Players cover same operation on their board with unifix cube.
6. First player to get 3 in a row (across, down or diagonal) is the winner (calls "bingo") and becomes caller in next game.

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DS2 – Separation Division Snap, Rummy, Concentration and Cover-the-Board Cards/Board

196 ÷ 7 = 28	128 ÷ 2 = 64	693 ÷ 9 = 77
432 ÷ 6 = 72	85 ÷ 5 = 17	464 ÷ 8 = 58
124 ÷ 4 = 31	752 ÷ 8 = 94	441 ÷ 7 = 63
215 ÷ 5 = 43	201 ÷ 3 = 67	768 ÷ 8 = 96

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DS2 – Separation Division Snap, Rummy, Concentration and Cover-the-Board Cards/Board Continued

$\begin{array}{r} 28 \\ 7\overline{)196} \\ 14 \\ \hline 56 \\ 56 \\ \hline 0 \end{array}$	$\begin{array}{r} 64 \\ 2\overline{)128} \\ 12 \\ \hline 08 \\ 8 \\ \hline 0 \end{array}$	$\begin{array}{r} 77 \\ 9\overline{)693} \\ 63 \\ \hline 63 \\ 63 \\ \hline 0 \end{array}$
$\begin{array}{r} 72 \\ 6\overline{)432} \\ 42 \\ \hline 12 \\ 12 \\ \hline 0 \end{array}$	$\begin{array}{r} 17 \\ 5\overline{)85} \\ 5 \\ \hline 35 \\ 35 \\ \hline 0 \end{array}$	$\begin{array}{r} 58 \\ 8\overline{)464} \\ 40 \\ \hline 64 \\ 64 \\ \hline 0 \end{array}$
$\begin{array}{r} 31 \\ 4\overline{)124} \\ 12 \\ \hline 04 \\ 4 \\ \hline 0 \end{array}$	$\begin{array}{r} 94 \\ 8\overline{)752} \\ 72 \\ \hline 32 \\ 32 \\ \hline 0 \end{array}$	$\begin{array}{r} 63 \\ 7\overline{)441} \\ 42 \\ \hline 21 \\ 21 \\ \hline 0 \end{array}$
$\begin{array}{r} 43 \\ 5\overline{)215} \\ 20 \\ \hline 15 \\ 15 \\ \hline 0 \end{array}$	$\begin{array}{r} 67 \\ 3\overline{)201} \\ 18 \\ \hline 21 \\ 21 \\ \hline 0 \end{array}$	$\begin{array}{r} 96 \\ 8\overline{)768} \\ 72 \\ \hline 48 \\ 48 \\ \hline 0 \end{array}$

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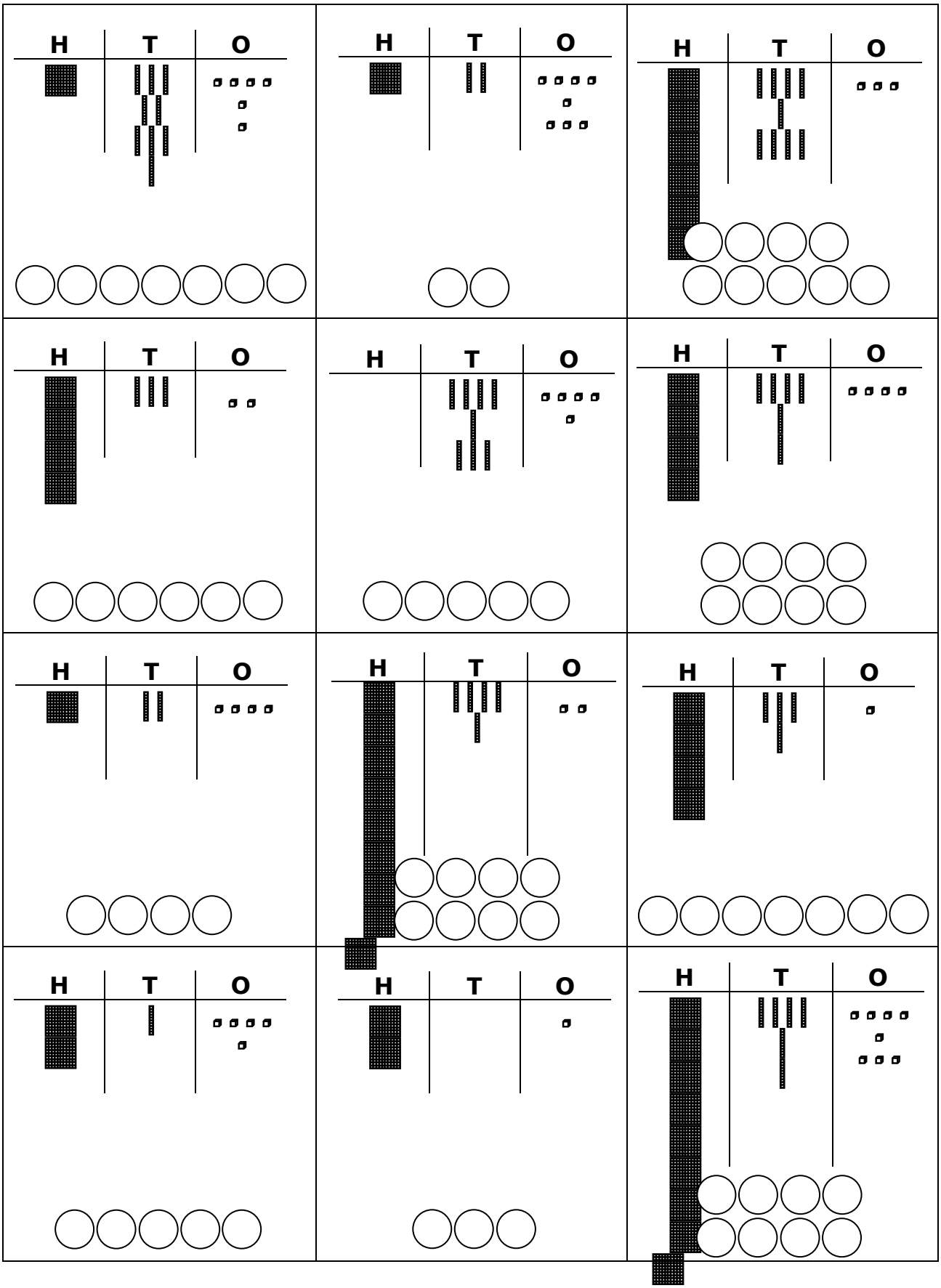
DS2 – Separation Division Snap, Rummy, Concentration and Cover-the-Board Cards/Board Continued



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DS2 – Separation Division Snap, Rummy, Concentration and Cover-the-Board Cards/Board Continued

One hundred and ninety-six divided by seven	One hundred and twenty-eight divided by two	Six hundred and ninety three divided by nine
Four hundred and thirty-two divided by six	Eighty-five divided by five	Four hundred and sixty-four divided by eight
One hundred and twenty-four divided by four	Seven hundred and fifty-two divided by eight	Four hundred and forty-one divided by seven
Two hundred and fifteen divided by five	Two hundred and one divided by three	Seven hundred and sixty-eight divided by eight

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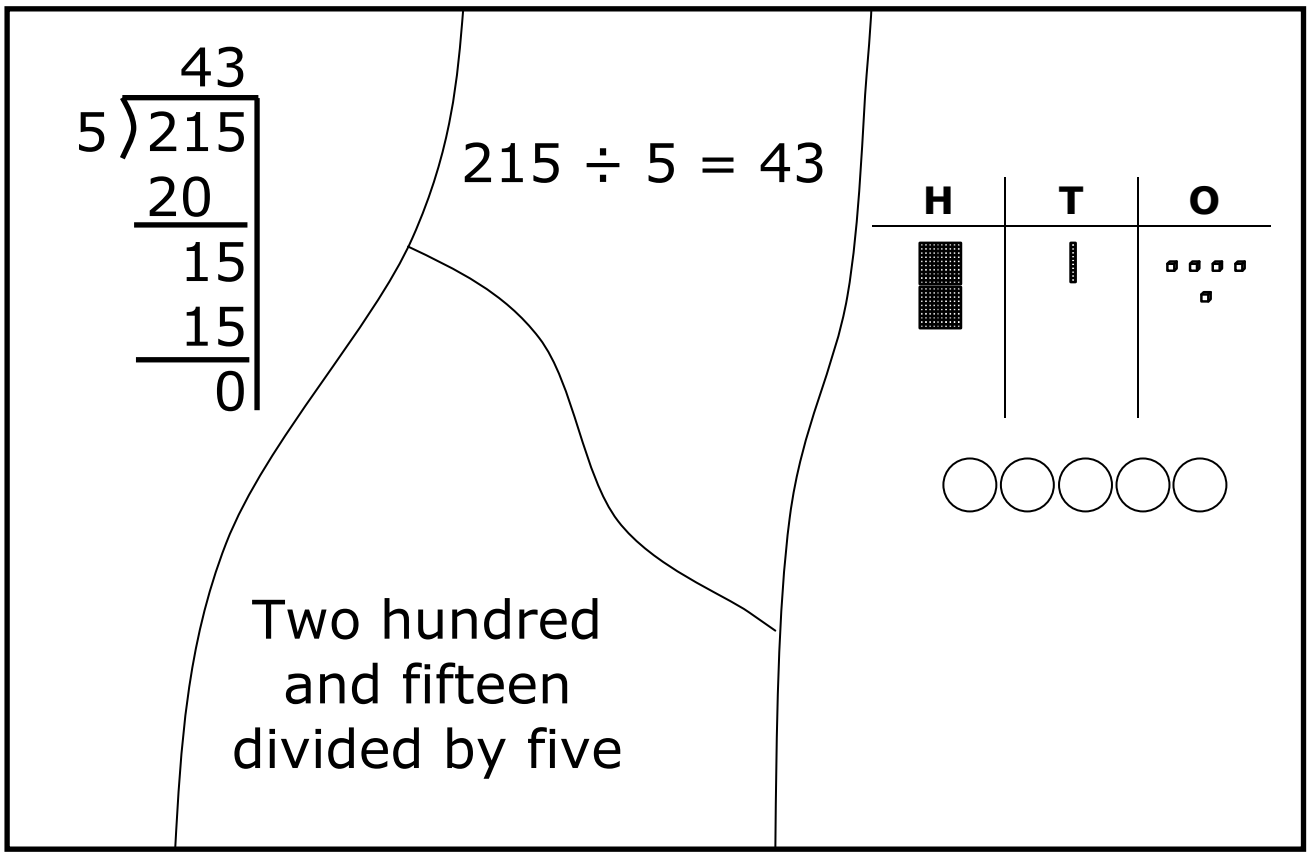
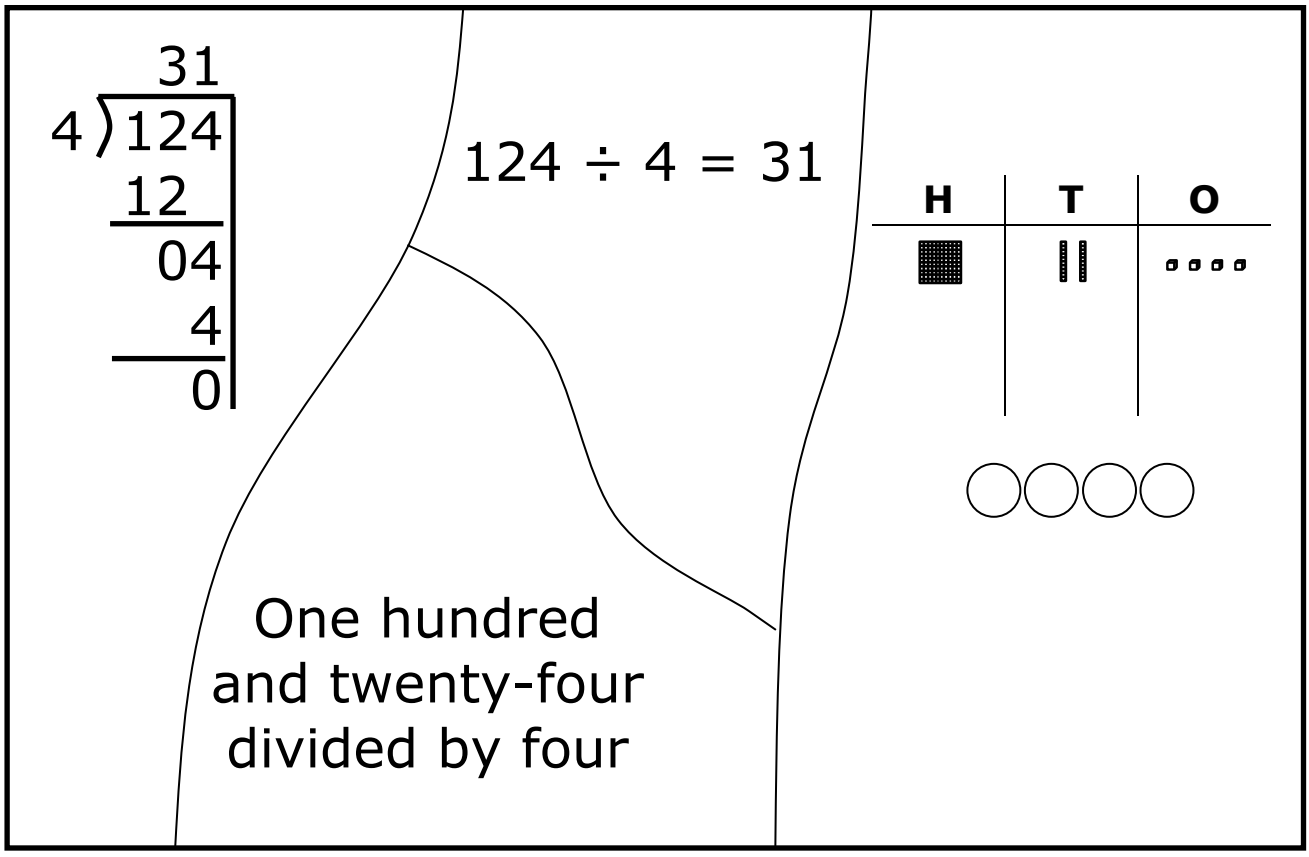
DS2 – Separation Division Mix-and-Match Cards





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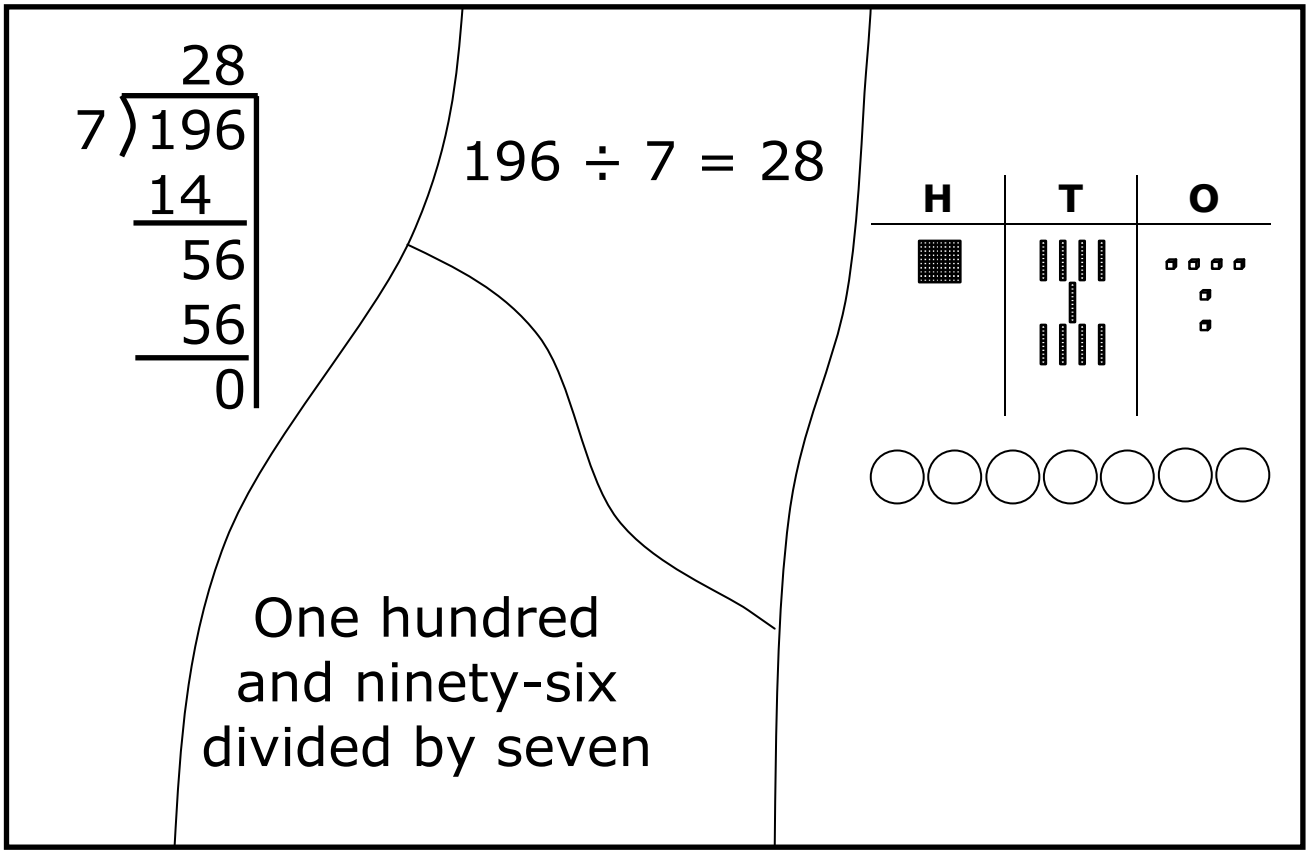
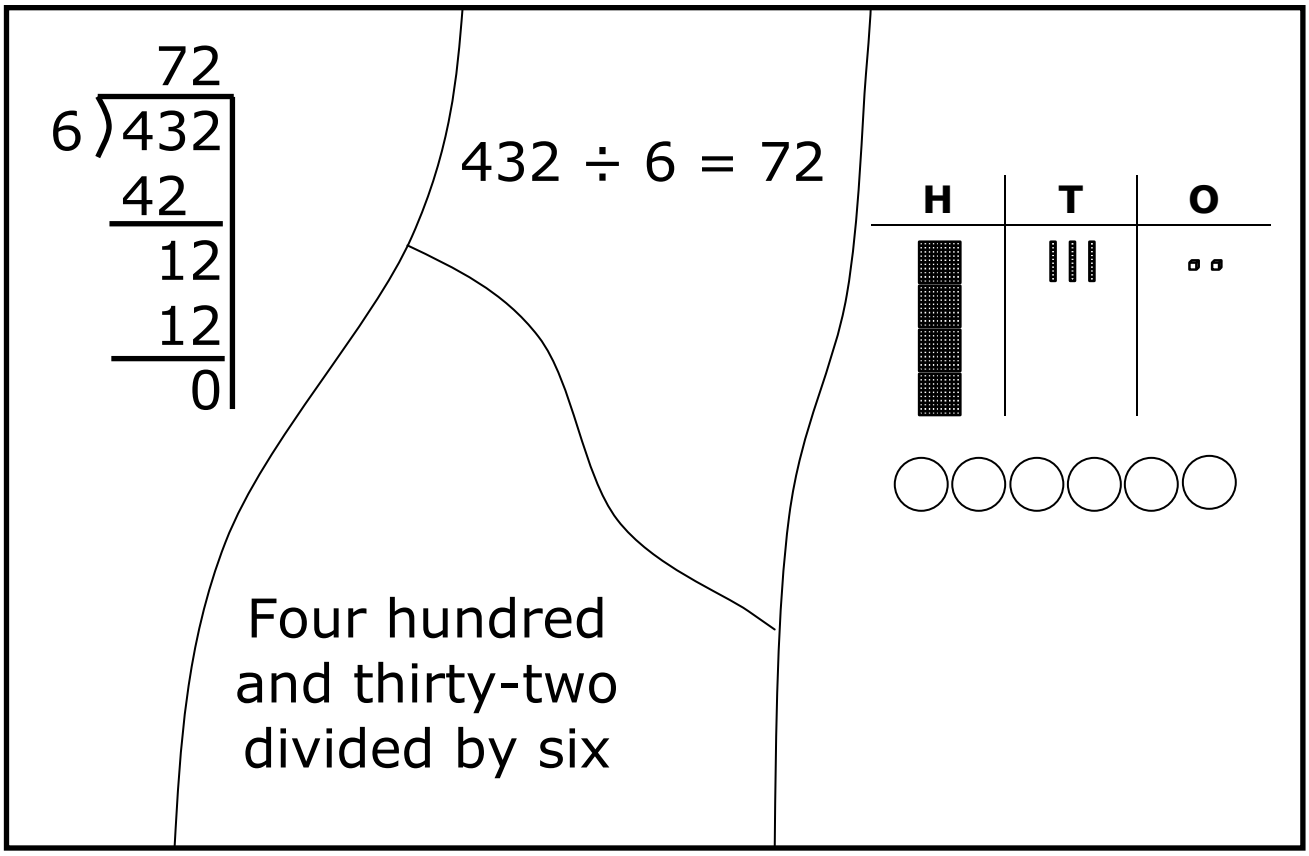
DS2 – Separation Division Mix-and-Match Cards Continued





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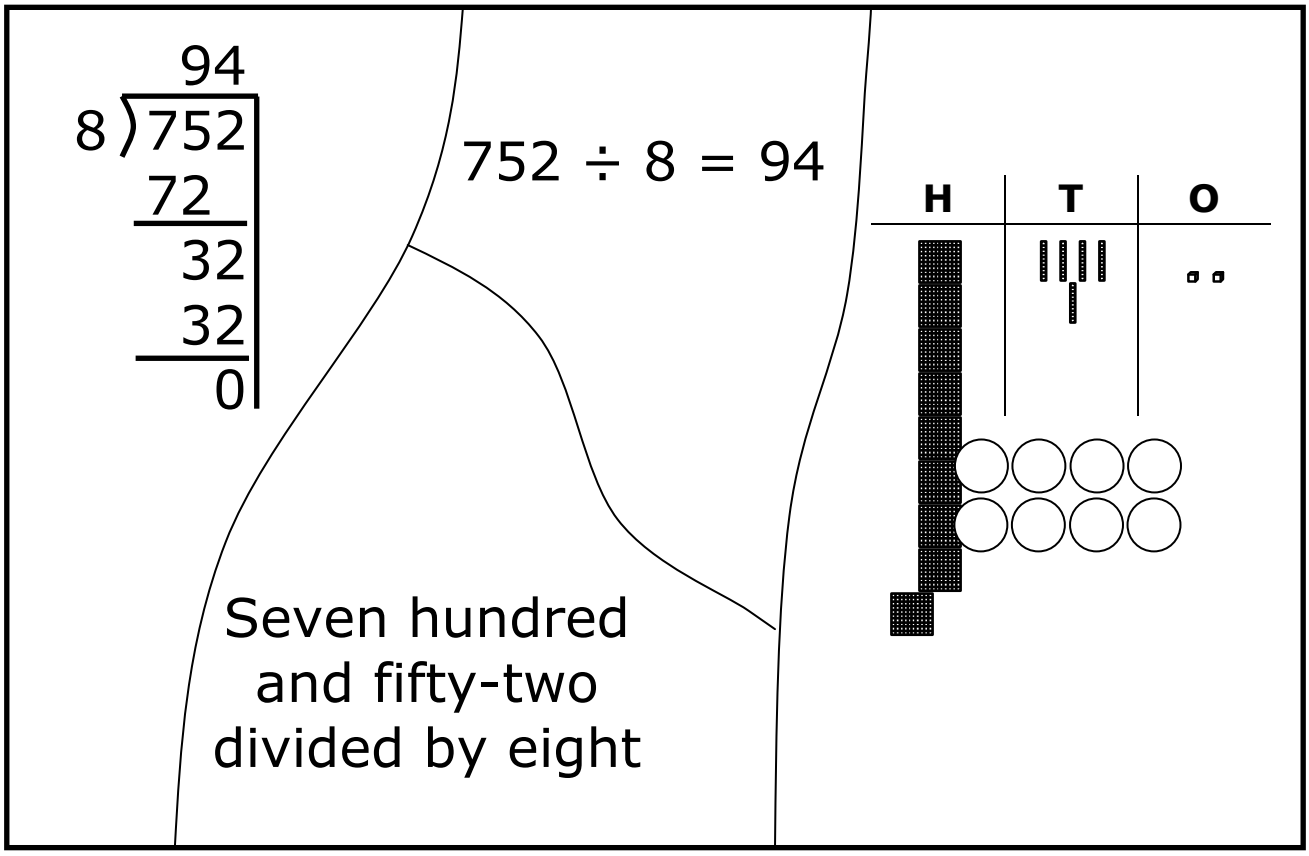
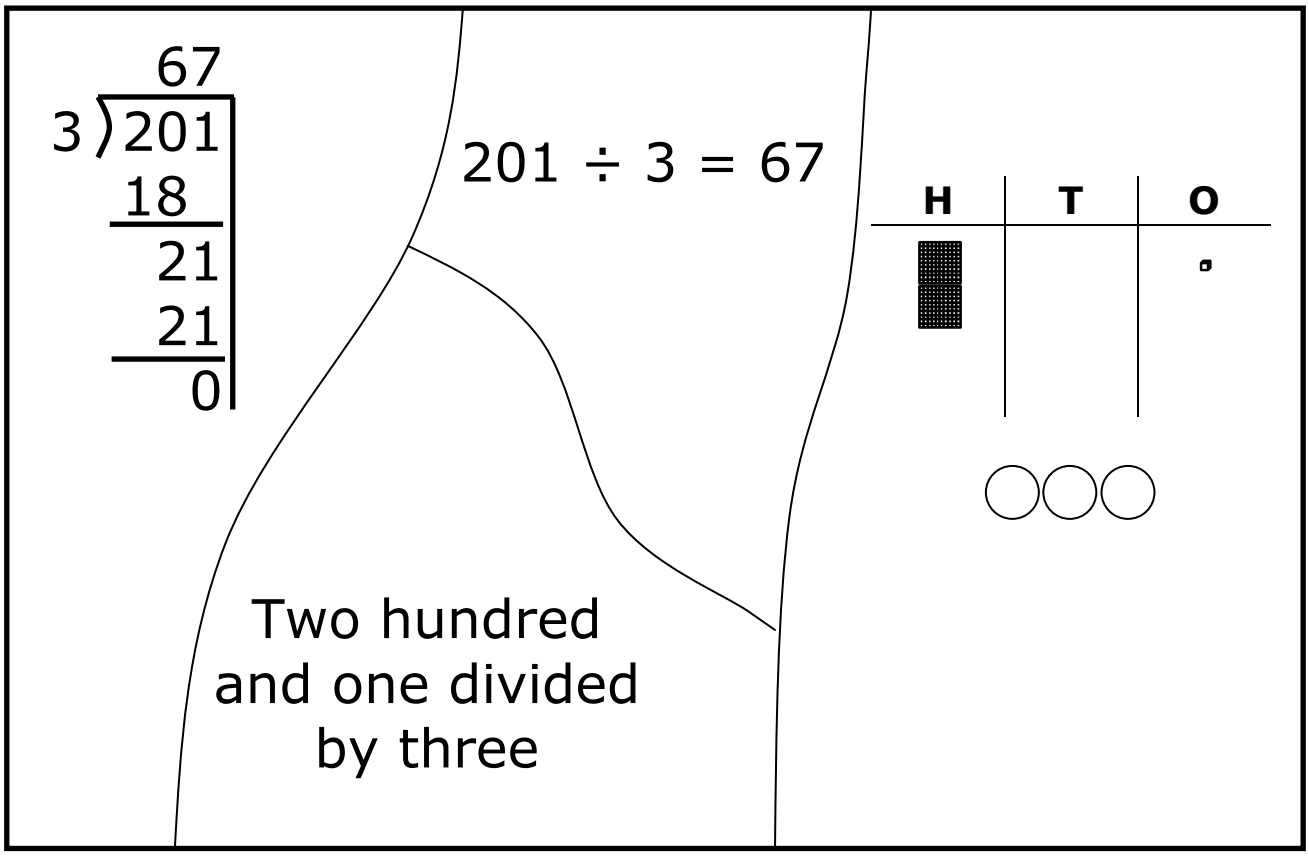
DS2 – Separation Division Mix-and-Match Cards Continued





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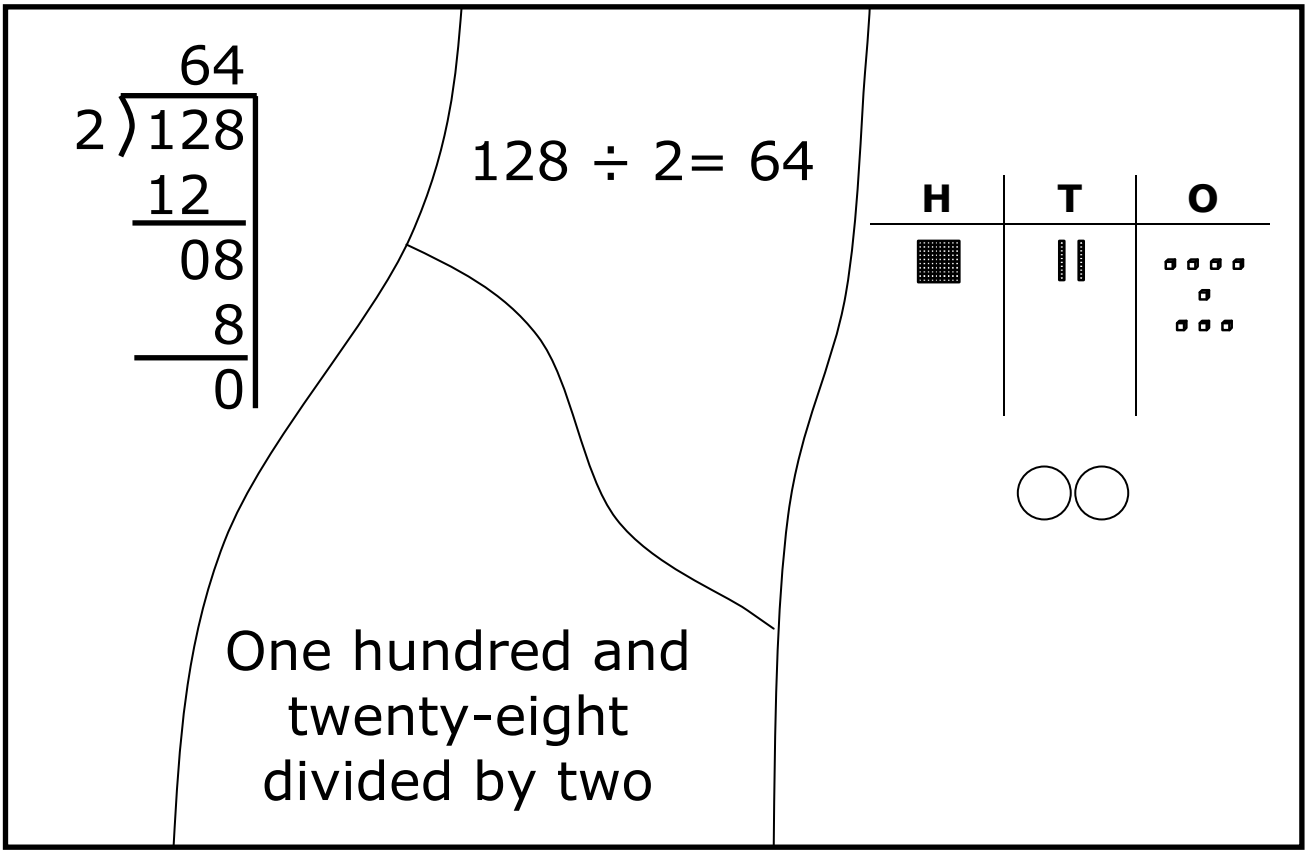
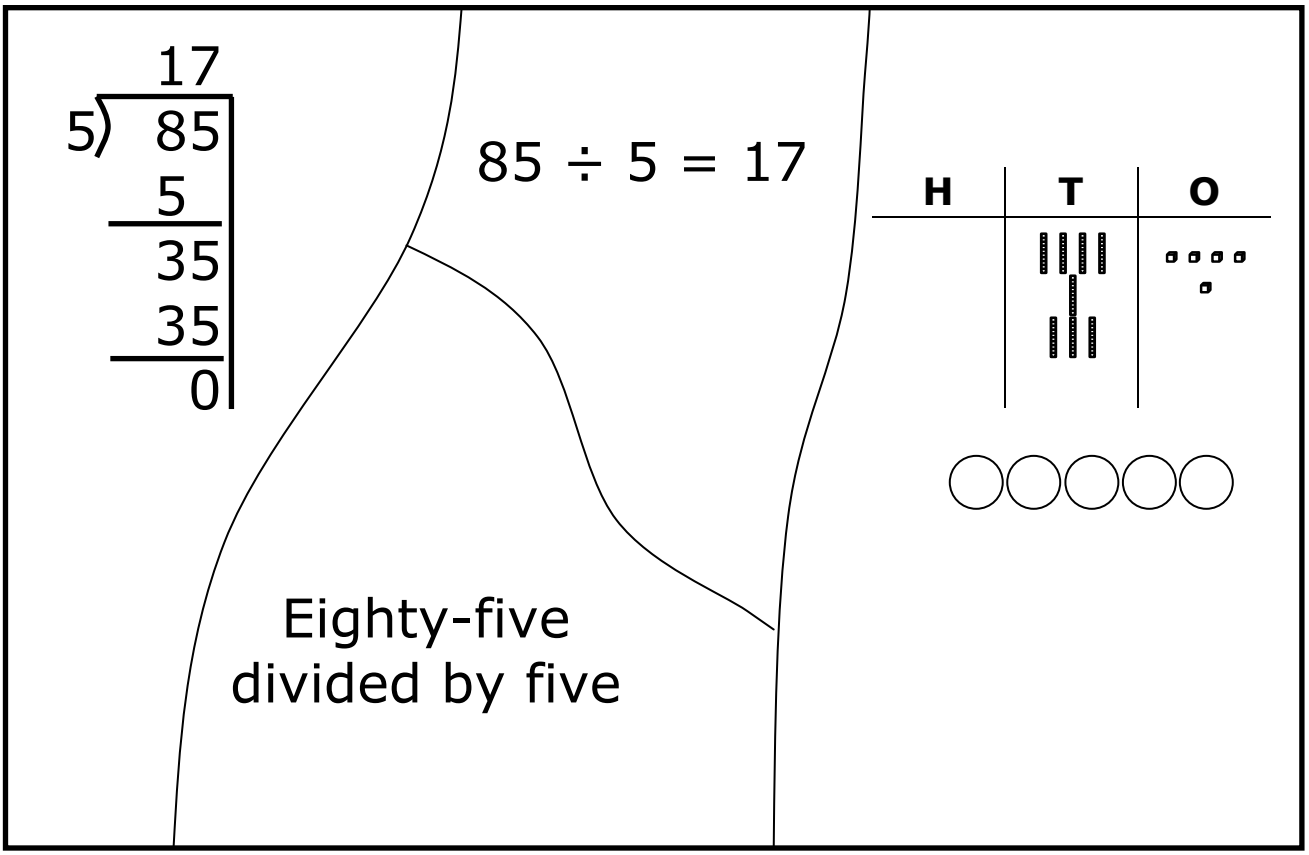
DS2 – Separation Division Mix-and-Match Cards Continued





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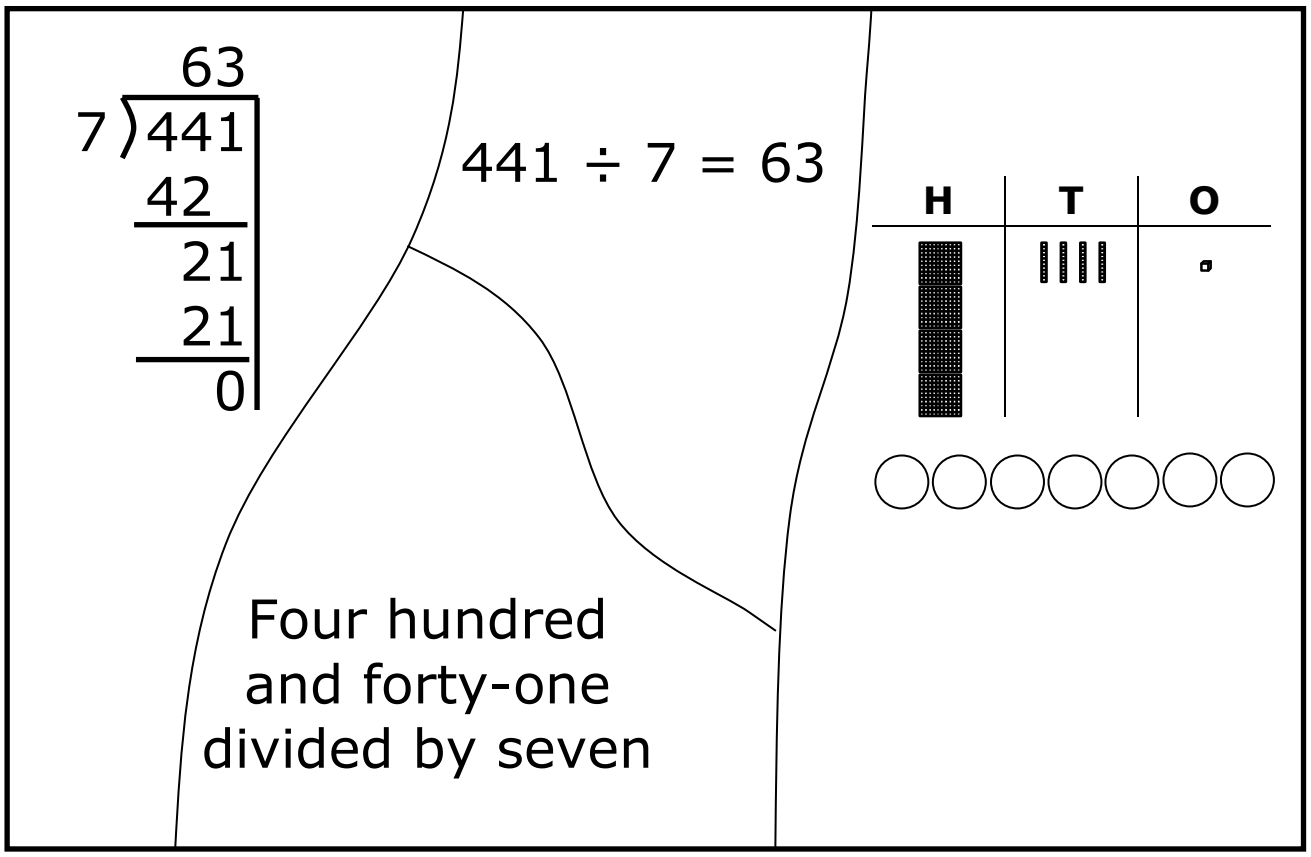
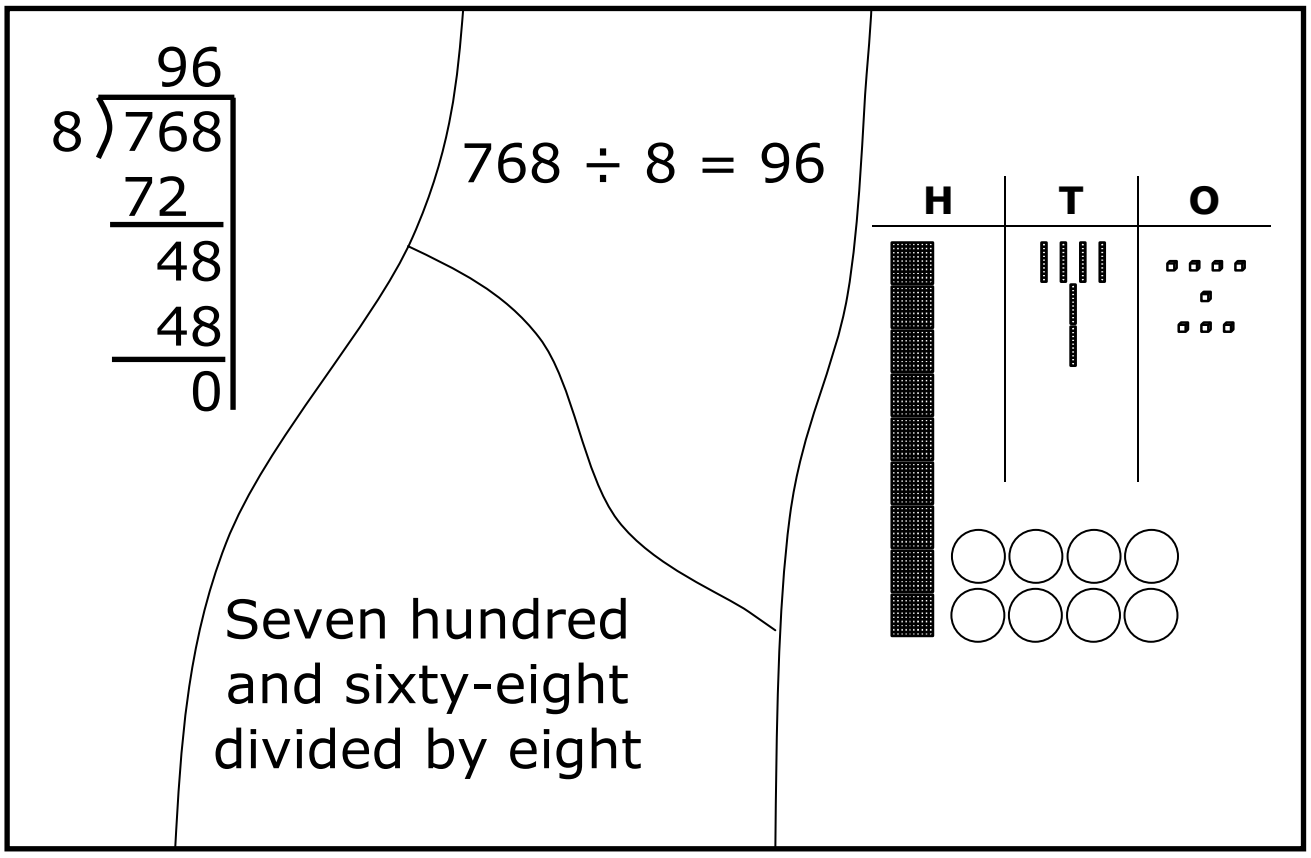
DS2 – Separation Division Mix-and-Match Cards Continued





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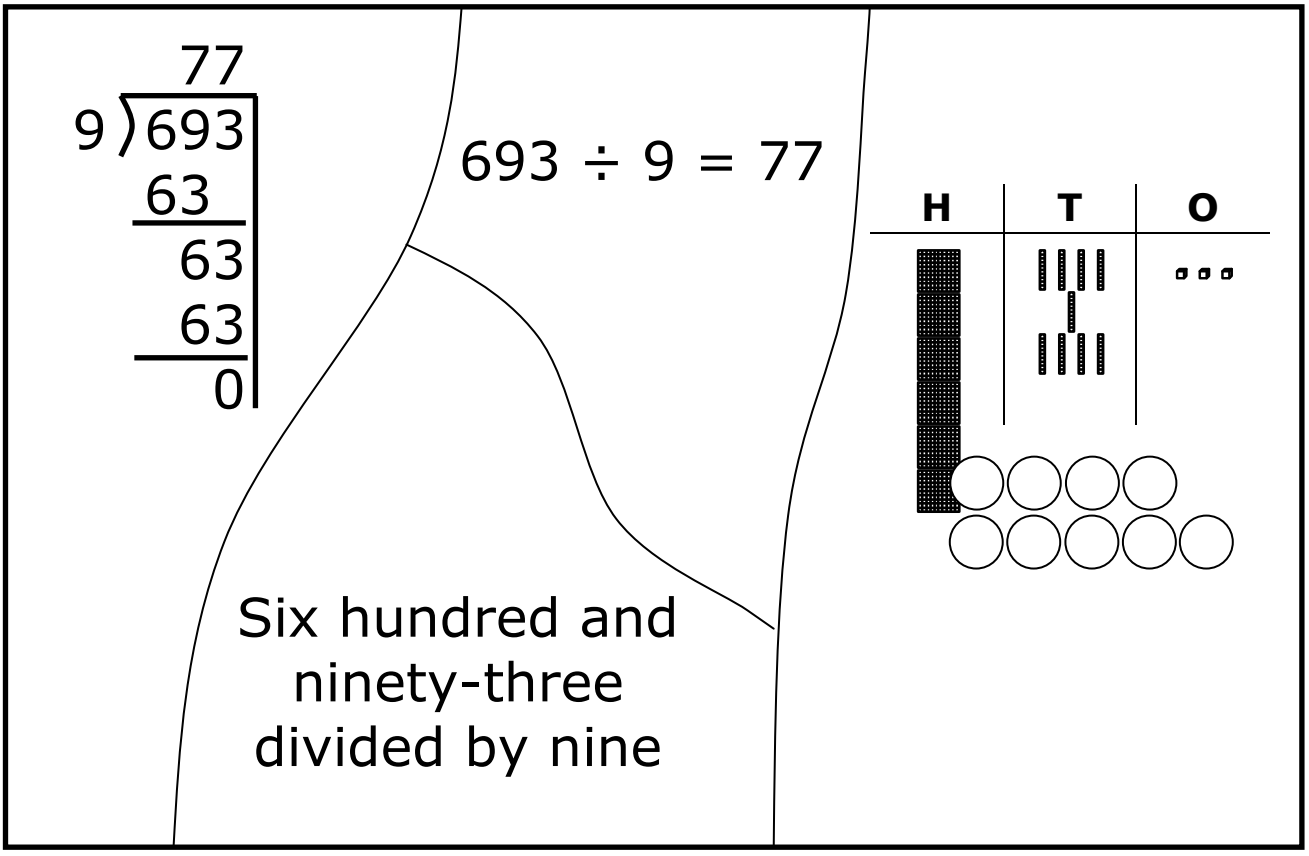
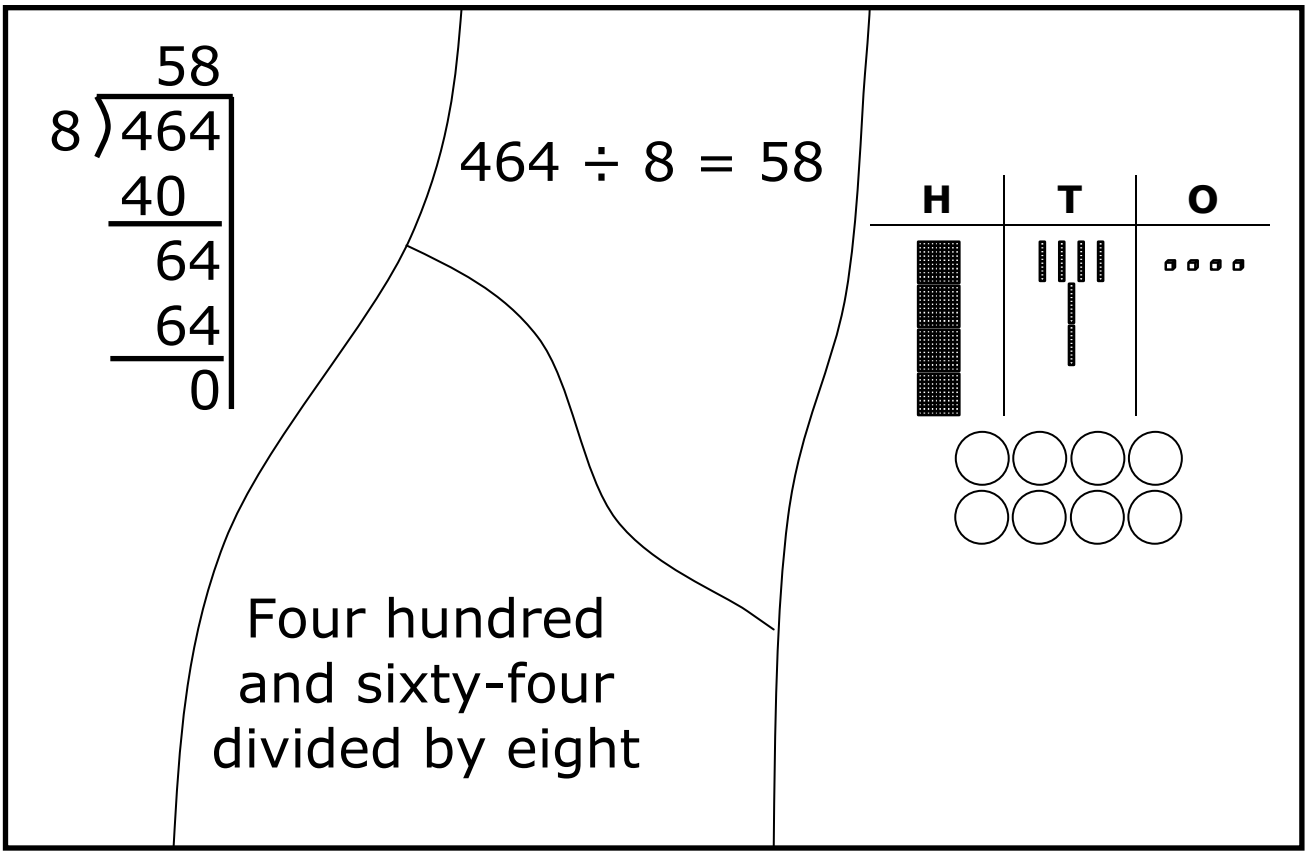
DS2 – Separation Division Mix-and-Match Cards Continued





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DS2 – Separation Division Bingo Flashcards

196 ÷ 7 = 28	128 ÷ 2 = 64	693 ÷ 9 = 77
432 ÷ 6 = 72	85 ÷ 5 = 17	464 ÷ 8 = 58
124 ÷ 4 = 31	752 ÷ 8 = 94	441 ÷ 7 = 63
215 ÷ 5 = 43	201 ÷ 3 = 67	768 ÷ 8 = 96

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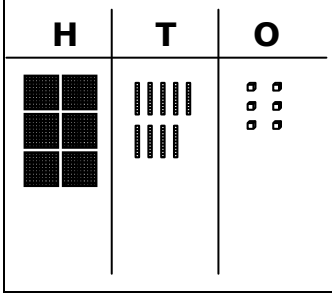
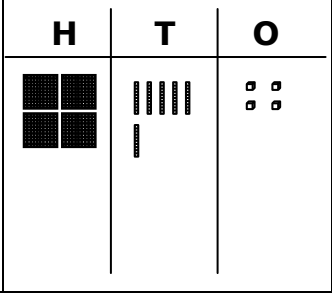
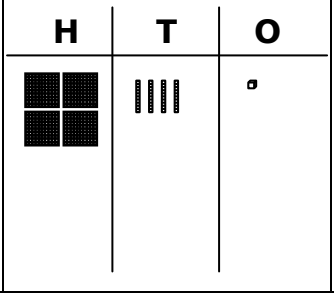
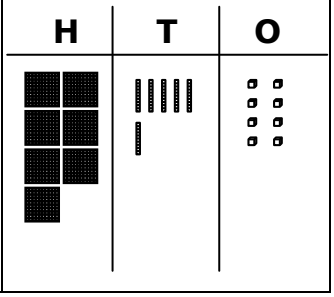
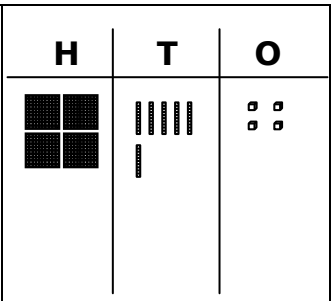
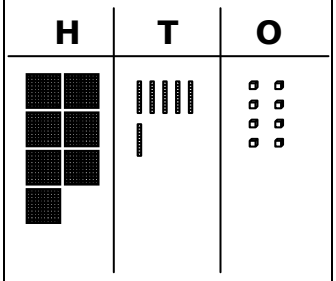
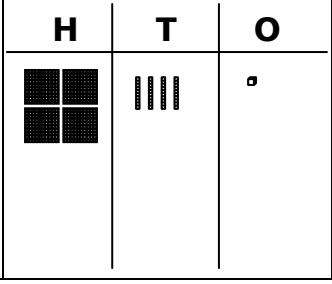
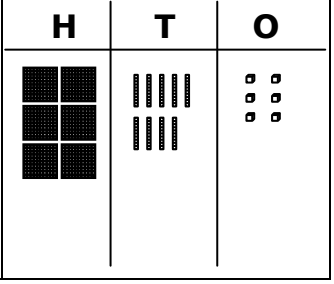
DS2 – Separation Division Bingo Boards

One hundred and ninety-six divided by seven	Four hundred and thirty-two divided by six	One hundred and twenty-four divided by four	Two hundred and fifteen divided by five
64 2⟌128 12 08 8 0	17 5⟌85 5 35 35 0	94 8⟌752 72 32 32 0	67 3⟌201 18 21 21 0
			

One hundred and ninety-six divided by seven	One hundred and twenty-four divided by four	67 3⟌201 180 21 21 0	
Four hundred and thirty-two divided by six	17 5⟌85 5 35 35 0		64 2⟌128 12 08 8 0
94 8⟌752 72 32 32 0		Two hundred and fifteen divided by five	

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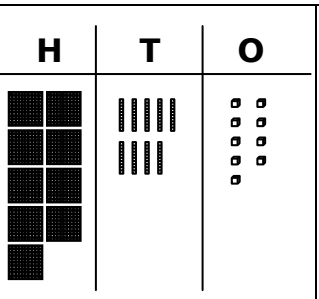
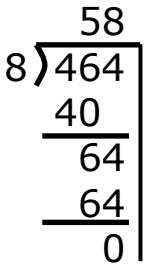
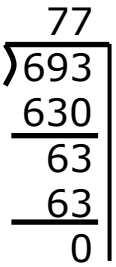
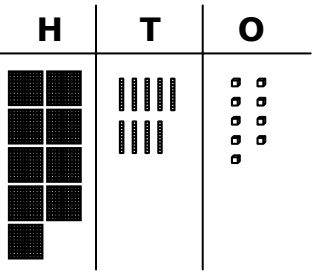
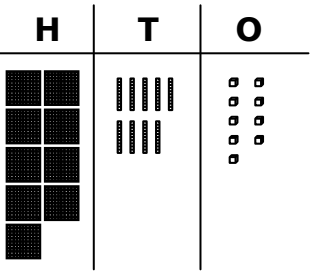
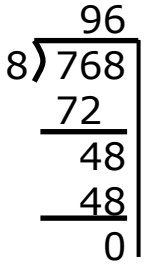
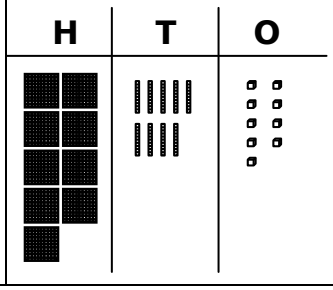
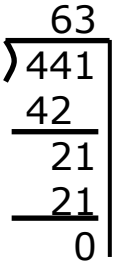
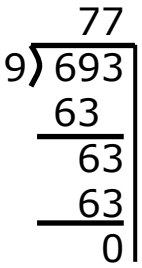
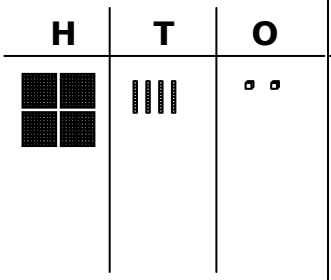
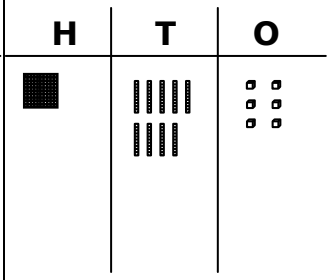
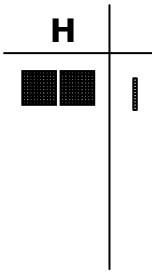
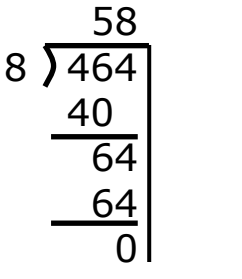
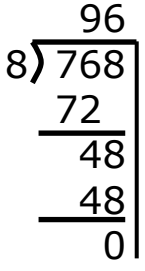
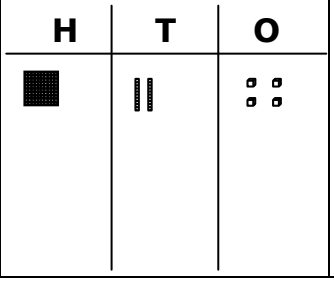
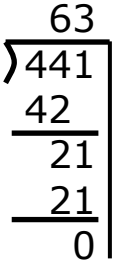
DS2 – Separation Division Bingo Boards Continued

	Seven hundred and fifty-two divided by eight		Two hundred and one divided by 3
One hundred and twenty-eight divided by two			
		Eighty-five divided by five	

One hundred and twenty-eight divided by two			
		Two hundred and one divided by 3	Eighty-five divided by five
		Seven hundred and fifty-two divided by eight	

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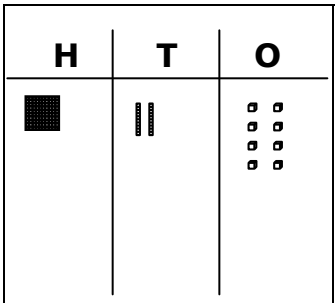
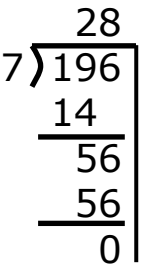
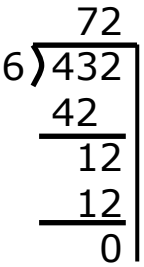
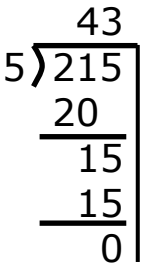
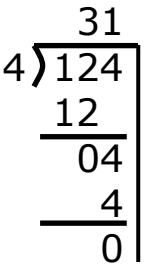
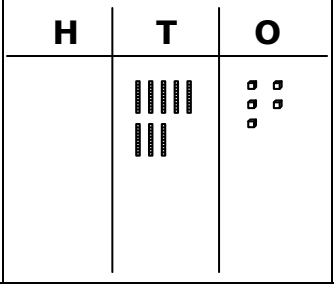
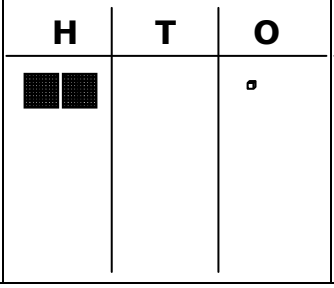
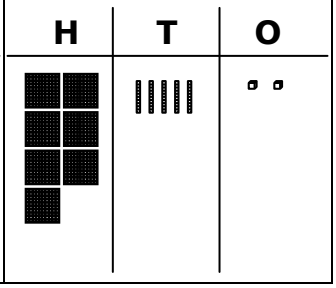
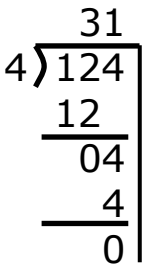
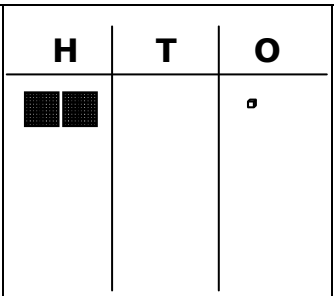
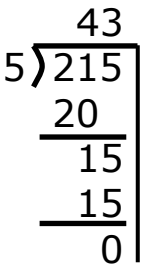
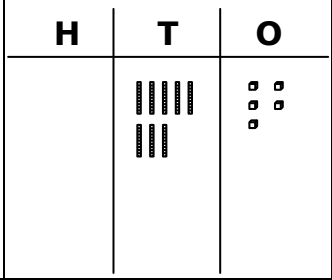
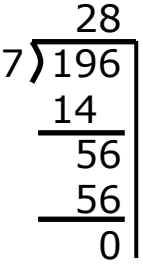
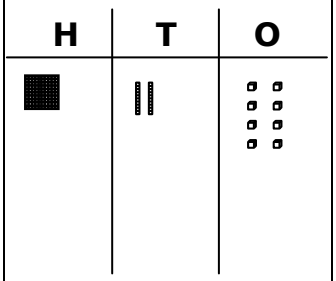
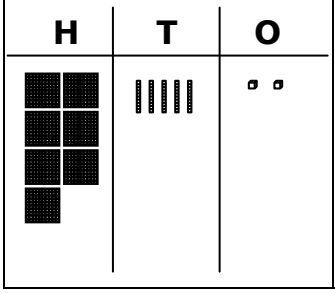
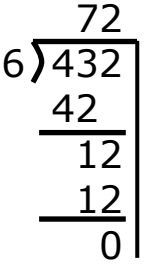
DS2 – Separation Division Bingo Boards Continued

	Four hundred and forty-one divided by seven	Four hundred and sixty-four divided by eight	
Six hundred and ninety-three divided by nine			
Seven hundred and sixty-eight divided by eight			

			
Four hundred and sixty-four divided by eight			Four hundred and forty-one divided by seven
	Seven hundred and sixty-eight divided by eight	Six hundred and ninety-three divided by nine	

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DS2 Activity Feedback Sheet

1. How the student found the activity (put a cross on lines)

NAME	STUDENTS' REACTIONS
	Boring ——— Interesting Difficult ——— Easy Not learning ——— Learning
	Boring ——— Interesting Difficult ——— Easy Not learning ——— Learning

2. How did you feel about trialling the activity?

   Mark the line with an X: Unconfident ——— Very confident

3. Do you think the student was engaged in the activity? Explain.

   _____

4. What do you think the student learnt from the activity?

   _____

5. Do you think the student has gained an understanding of the concept being taught? Explain.

   _____

6. What do you think of the activity?

   _____

7. What are your suggestions for improving the activity?

   _____

   _____

8. What else do you suggest could be done to help students who have trouble with this activity?

   _____

   _____

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ACTIVITY DS3

[Sequencing strategy for division computation]

Materials: Unifix, dot paper, calculator, pen, paper, attachments

Directions:

1. Use unifix and dot paper to make arrays. Ask: *How many rows for the following?*

   (a) 18 cubes, 3 per row (b) 32 cubes, 4 per row (c) 54 cubes, 9 per row

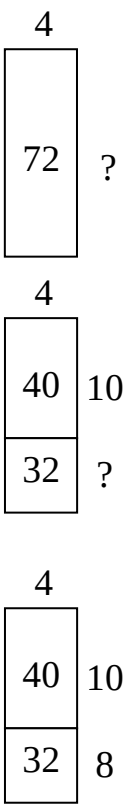
   Ask: *What do you notice?* Elicit that, for example (a), 6 rows, 6x3 = 8 and 18÷3 = 6. State: *By finding how many in each row, we are really finding division.*

2. State: *We are going to learn a new method for division based on sequencing. It uses rows and columns. It thinks about division like 18÷3 = 6 as "how many threes in 18?"* Ask: *Look at 72÷4.* State: *We think 72 cubes, 4 per row, how many rows?* Ask: *Look at drawing of this* [on right]. *Think! How many 4s in 72? Is there 10? 20?* For each answer, work out how many would be used.

   10x4 = 40; OK 20x4 = 80; too many

   State: *Need to be less than 72.* State: *Redraw the diagram to remove the 10 rows of 4.* Ask: *How many used?* [40] *How many left?* [72-40 = 32]

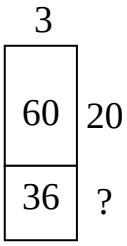
   Look at 32. Ask: *How many 4s in 32?* [8] State: *Recheck the diagram again. Redraw to include 8x4 = 32.* Ask: *What is the answer?* [18]



3. State: *This new method has a special algorithm which makes it really easy. Let's look at it for 96÷3 and 972÷4.* Check answers with calculators.

Problem	Drawing	Algorithm	Questioning / Directions
Step 1 Set up.			
96÷3	3 / 96 ?	$3\overline{)96}$	*How many 3s in 96? Is there 10, 20?*

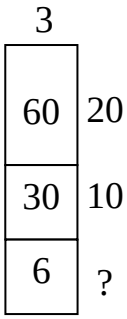
Step 2 Try tens that are less than needed.



$$\begin{array}{r|l} 3\overline{)\,96} & \\ -\,60 & 20 \\ \hline 36 & \end{array}$$

Try 20. 3x20 = 60. Redraw. How many used? [60] *How many left?* [96-60=36]

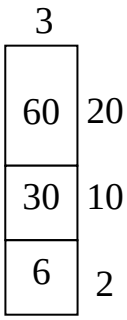
Step 3 Keep going.



$$\begin{array}{r|l} 3\overline{)\,96} & \\ -\,60 & 20 \\ \hline 36 & \\ -\,30 & 10 \\ \hline 6 & \end{array}$$

How many 3s for 6? [2] *How many all together?* [20+10+2 = 32]

Step 4 Finish off the ones and work out answer.



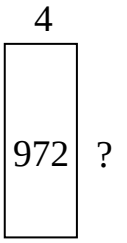
$$\begin{array}{r|l} 3\overline{)\,96} & \\ -\,60 & 20 \\ \hline 36 & \\ -\,30 & 10 \\ \hline 6 & \\ -\,6 & 2 \\ \hline & 32 \end{array}$$

Is there another 10? [Yes] *Remove it. How much removed?* [30] *How much left?* [6]

Problem	Drawing	Algorithm	Questioning / Directions

Step 1 Setting up.

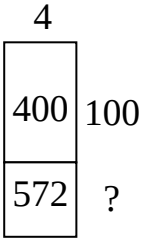
972÷4



$$4\overline{)\,972}$$

Start thinking! How many 4s in 972? Is there 10? Is there 100? Many 10s? Many 100s?

Step 2 Start removing and keep going.



$$\begin{array}{r|l} 4\overline{)\,972} & \\ -\,400 & 100 \\ \hline 572 & \end{array}$$

Remove the 100! How much is this? [4x100 = 400] *How much left?* [972-400 = 572] *Is there another 100? Many 10s?*

4	
400	100
400	100
172	?

4⟩ 972	
- 400	100
572	
- 400	100
172	

Remove another 100! How many used / how many left? [400/172]

Step 3 Keep going through tens and ones.

4	
400	100
400	100
120	30
52	?

4⟩ 972	
- 400	100
572	
- 400	100
172	
- 120	30
52	

Remove 30: How many – what's left? Any more? Ok remove 10? What is 30x4? [120] *What about the 12. How many 4s? Yes 3!*

4	
400	100
400	100
120	30
40	10
12	? = 3

4⟩ 972	
- 400	100
572	
- 400	100
172	
- 120	30
52	
- 40	10
12	
- 12	3
0	243

Answer? [100+100+30+10+3 = 243]

Note: State: The example could be completed by working out the 100s, 10s and 1s more accurately. e.g.

4
972 ?

4	
800	200
172	?

4	
800	200
160	40
12	?

4	
800	200
160	40
12	3

4⟌ 972	4⟌ 972	4⟌ 972	4⟌ 972
	- 800 | 200	- 800 | 200	- 800 | 200
	172	172	172
		- 160 | 40	- 160 | 40
		12	12
			- 12 | 3
			0 | 243

4. Complete Worksheet 3.1.

5. State: *Now we are going to do this method without a drawing (though we can think of a drawing)*. (Check answers with a calculator.)

   Look at examples 657÷9, 715÷5 and 836÷4 on the next page.

Example	Algorithm	Thinking
657÷9	9⟌ 657	*How many 9s in 657? 10, 100? Not 100, so try a fair number of 10s! What about 5 10s or 50?* [50x9 = 450]
	9⟌ 657 - 450 | 50 207 - 180 | 20 27	*Not there yet? Try another 2 10s or 20!* [20x9 = 180]
	9⟌ 657 - 450 | 50 207 - 180 | 20 27 - 27 | 3 0 | 73	*Finish the 1s! How many 9s in 27?* [3] *How much left?* [0] *So answer is?* [50+20+3 = 73]
715÷5	5⟌ 715 - 500 | 100 215 - 200 | 40 15 - 15 | 3 0 | 143	*How many 5s in 715? Is there 1, 10, 100? How many of these?* [one 100] *Try a 100 – how much left?* [215] *How many 10 lots of 5?* [4 10s or 40]. *How much do we remove?* [40x5 = 200] *Finish off the 1s.*

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836÷4

4 ⟩	836	
	- 400	100
	436	
	- 400	100
	36	
	- 36	9
	0	209

Is there 10 or 100 4s in 836? Try 100 – how much left? [436] *Ok there's another 400 so remove another 100 – how much left?* [36] *Finish off the 1s – how many 4s in 36?* [9]

6. Complete Worksheet 3.2.

7. Play games: "Sequencing Division Snap, Rummy or Concentration", "Sequencing Division Cover-the-Board", "Sequencing Division Mix-and-Match", and "Sequencing Division Bingo". The rules for these games are in DS2.

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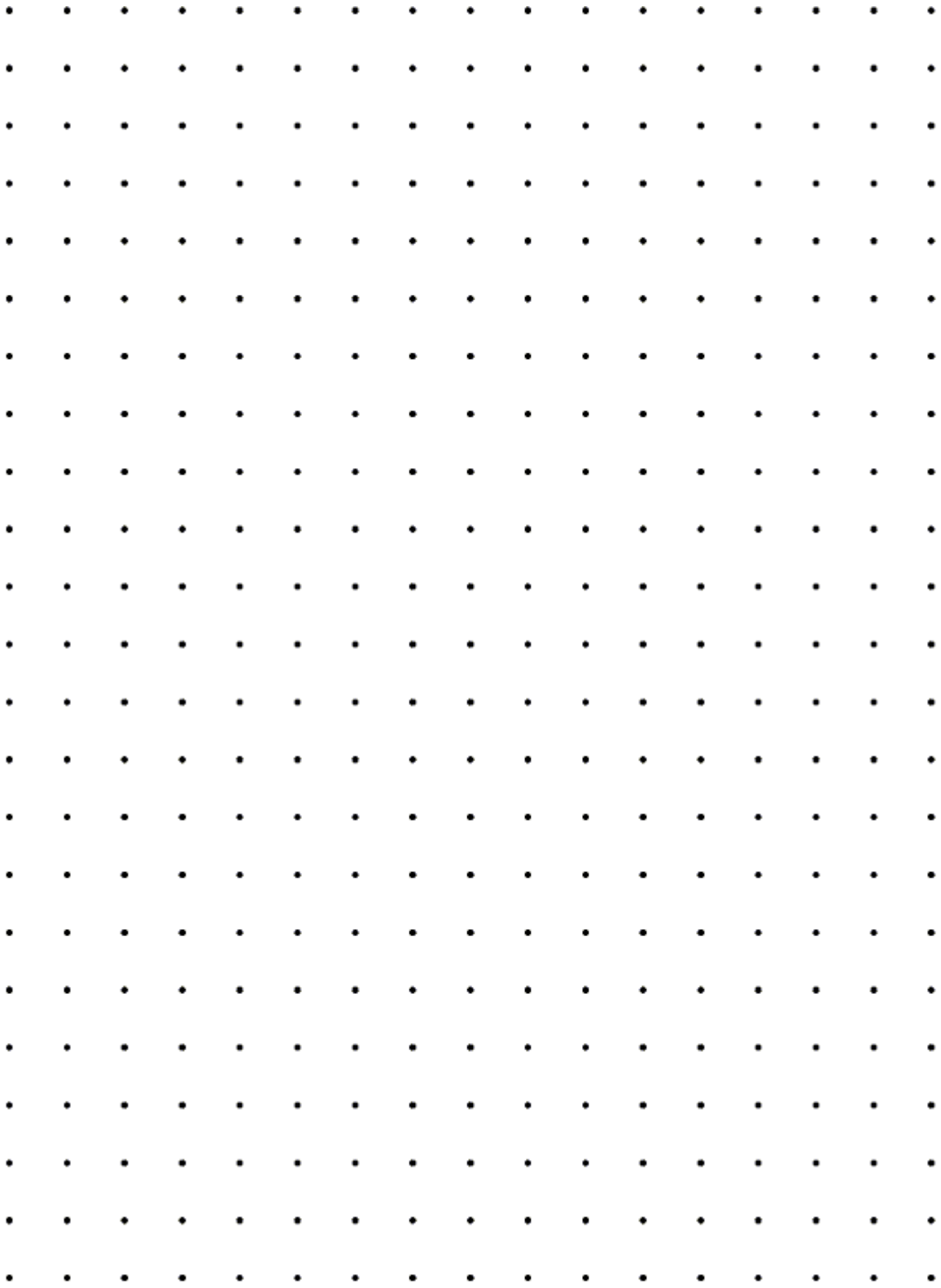
DS3 – Dot Paper



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DS3 – Worksheet 3.1

Do the following using the diagram! (Check with calculators)

(1) $8\overline{)976}$ S

(2) $6\overline{)870}$ C

(3) $4\overline{)904}$ P

(4) $3\overline{)921}$ T

(5) $2\overline{)984}$

(6) $7\overline{)868}$ E

We want what the song says!

492	124	122	126	124	145	307

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DS3 – Worksheet 3.2

Do the following thinking of the diagram! (Check with calculators)

(1) $6\overline{)882}$

(2) $5\overline{)995}$

(3) $2\overline{)786}$

(4) $3\overline{)711}$ G

(5) $4\overline{)964}$ L

(6) $2\overline{)602}$ D

(7) $3\overline{)918}$ T

(8) $4\overline{)828}$ N

(9) $8\overline{)816}$ R

(10) $7\overline{)756}$ H

We want on which we walk!

241	199	207	301		202	147	237	108	306	393

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DS3 – Sequencing Division Snap, Rummy, Concentration and Cover-the-Board Cards/Board

215 ÷ 5 = 43	124 ÷ 4 = 31	432 ÷ 6 = 72	196 ÷ 7 = 28
201 ÷ 3 = 67	752 ÷ 8 = 94	85 ÷ 5 = 17	128 ÷ 2 = 64
768 ÷ 8 = 96	441 ÷ 7 = 63	464 ÷ 8 = 58	693 ÷ 9 = 77

5) 215 200 40 15 15 3 0 43	4) 124 120 30 4 4 1 0 31	6) 432 420 70 12 12 2 0 72	7) 196 140 20 56 56 8 0 28
3) 201 180 60 21 21 7 0 67	8) 752 720 90 32 32 4 0 94	5) 85 50 10 35 35 7 0 17	2) 128 120 60 8 8 4 0 64
8) 768 720 90 48 48 6 0 96	7) 441 420 60 21 21 3 0 63	8) 464 400 50 64 64 8 0 58	9) 693 630 70 63 63 7 0 77

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DS3 – Sequencing Division Snap, Rummy, Concentration and Cover-the-Board Cards/Board Continued

? 5 | 215	? 4 | 124	? 6 | 432	? 7 | 196
? 3 | 201	? 8 | 752	? 5 | 85	? 2 | 128
? 8 | 768	? 7 | 441	? 8 | 464	? 9 | 693

40 ? 5 | 200 | 15	30 ? 4 | 120 | 4	70 ? 6 | 420 | 12	20 ? 7 | 140 | 56
60 ? 3 | 180 | 21	90 ? 8 | 720 | 32	10 ? 5 | 50 | 35	60 ? 2 | 120 | 8
90 ? 8 | 720 | 48	60 ? 7 | 420 | 21	50 ? 8 | 400 | 64	70 ? 9 | 630 | 63

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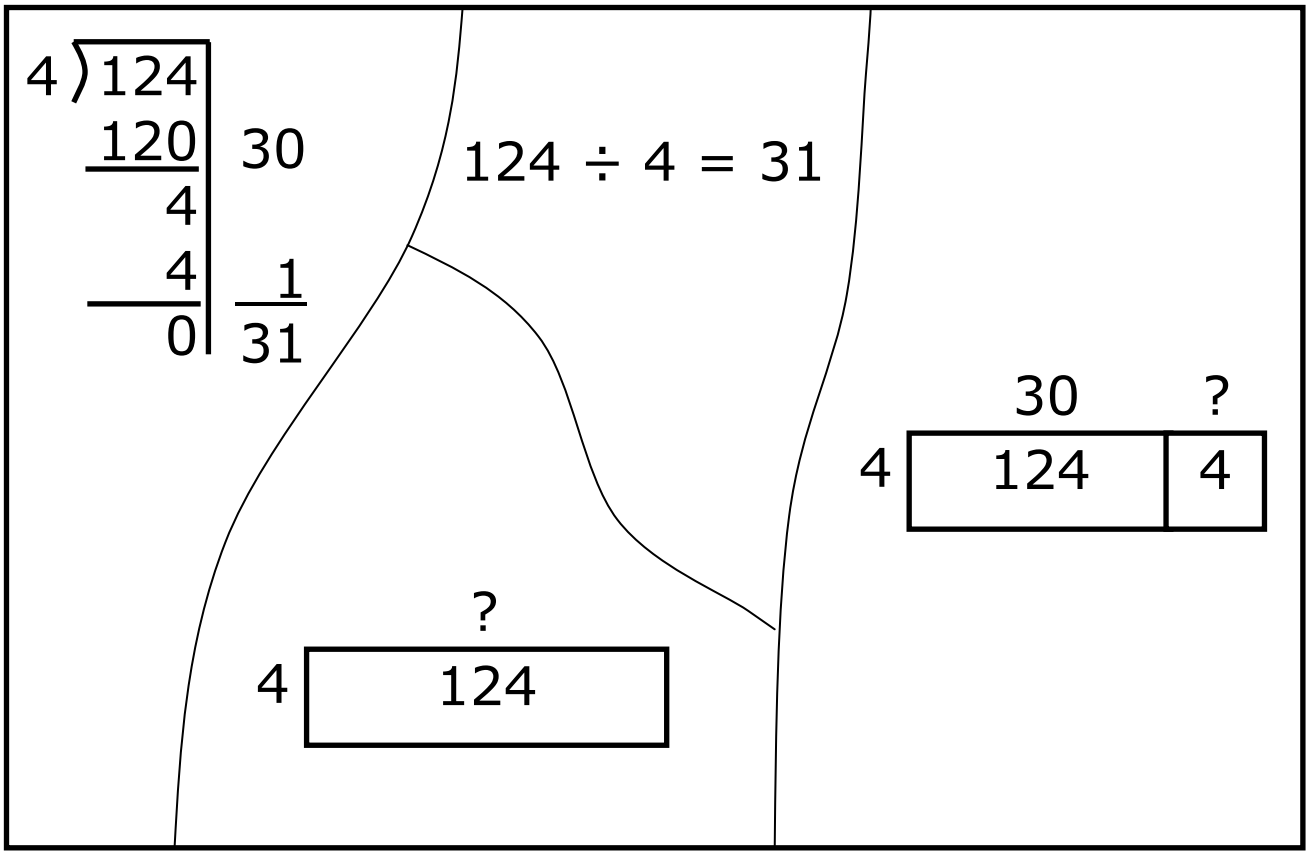
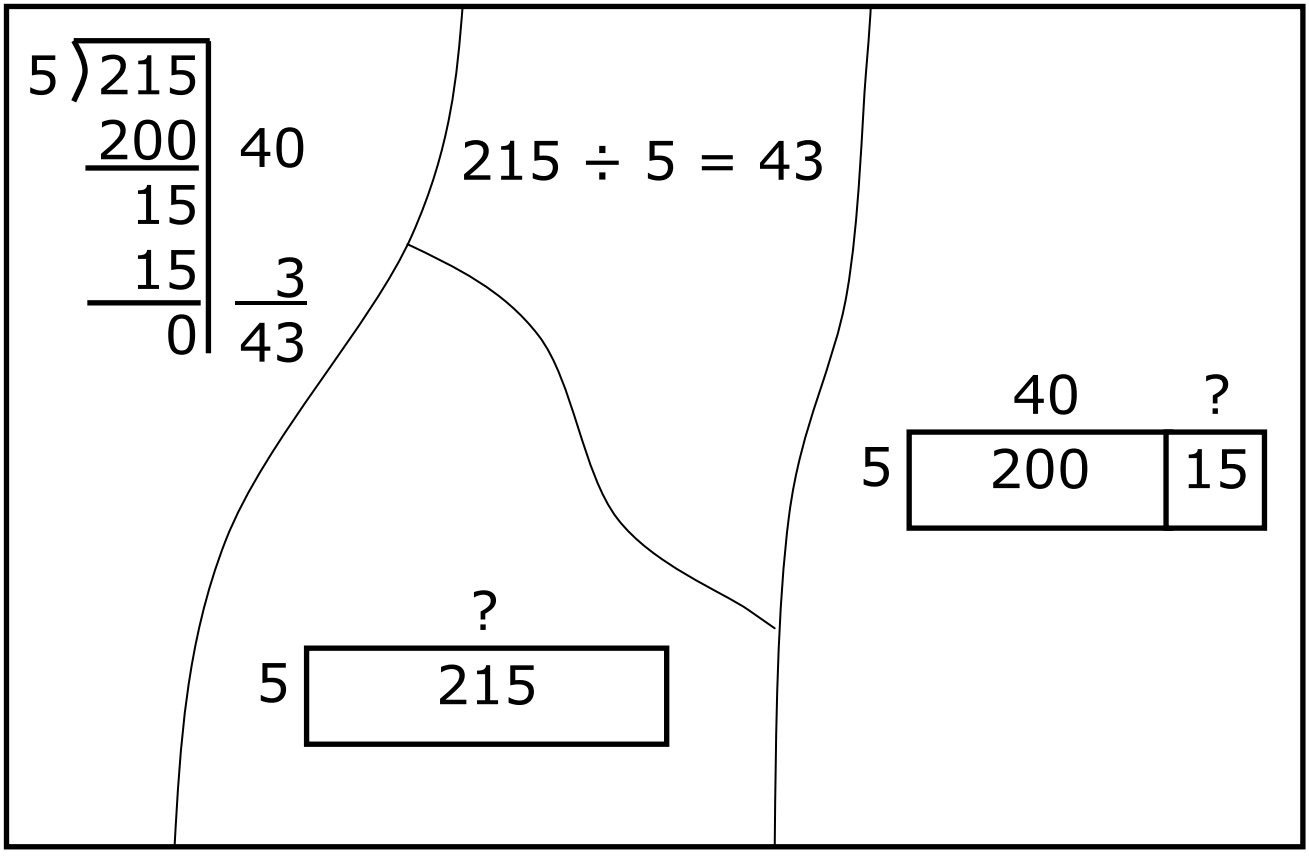
DS3 – Sequencing Division Mix-and-Match Cards





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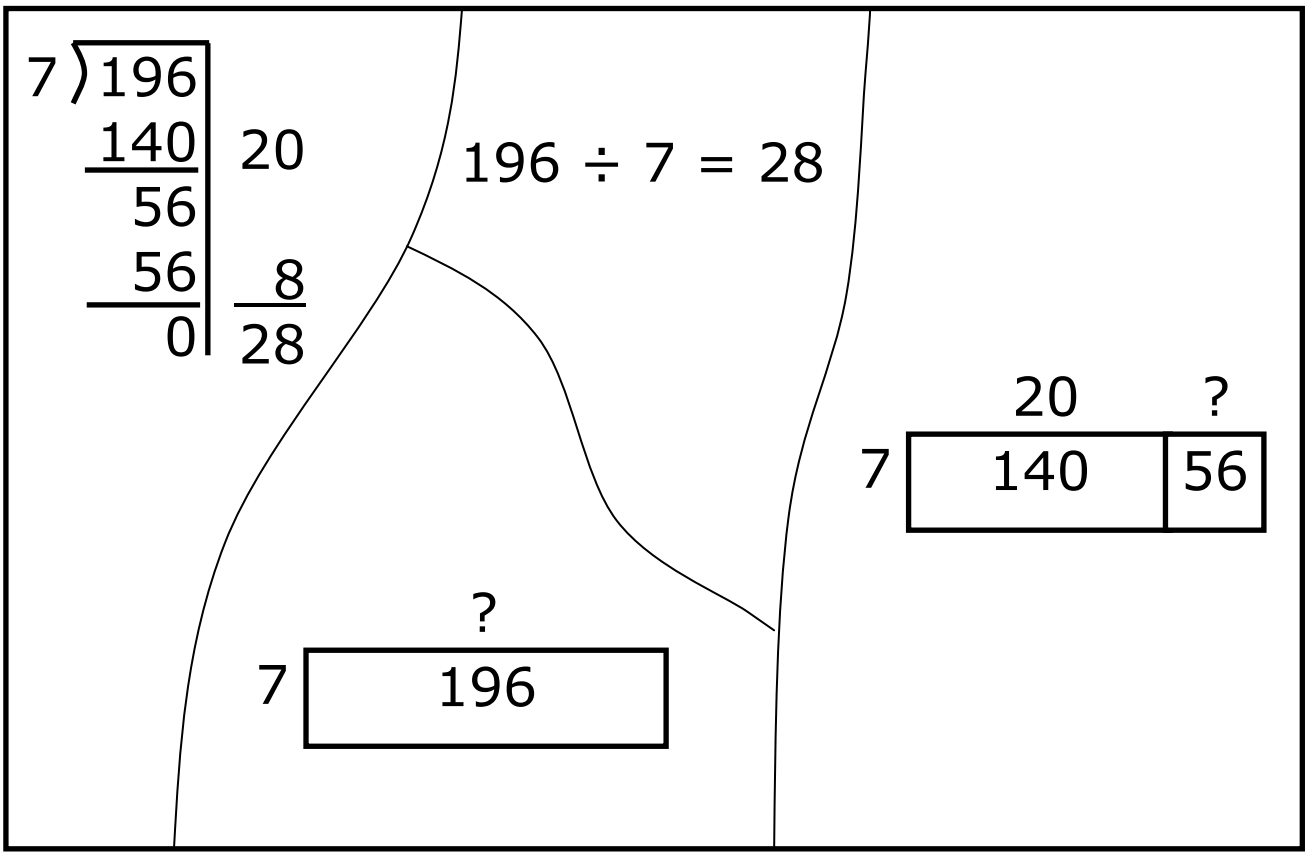
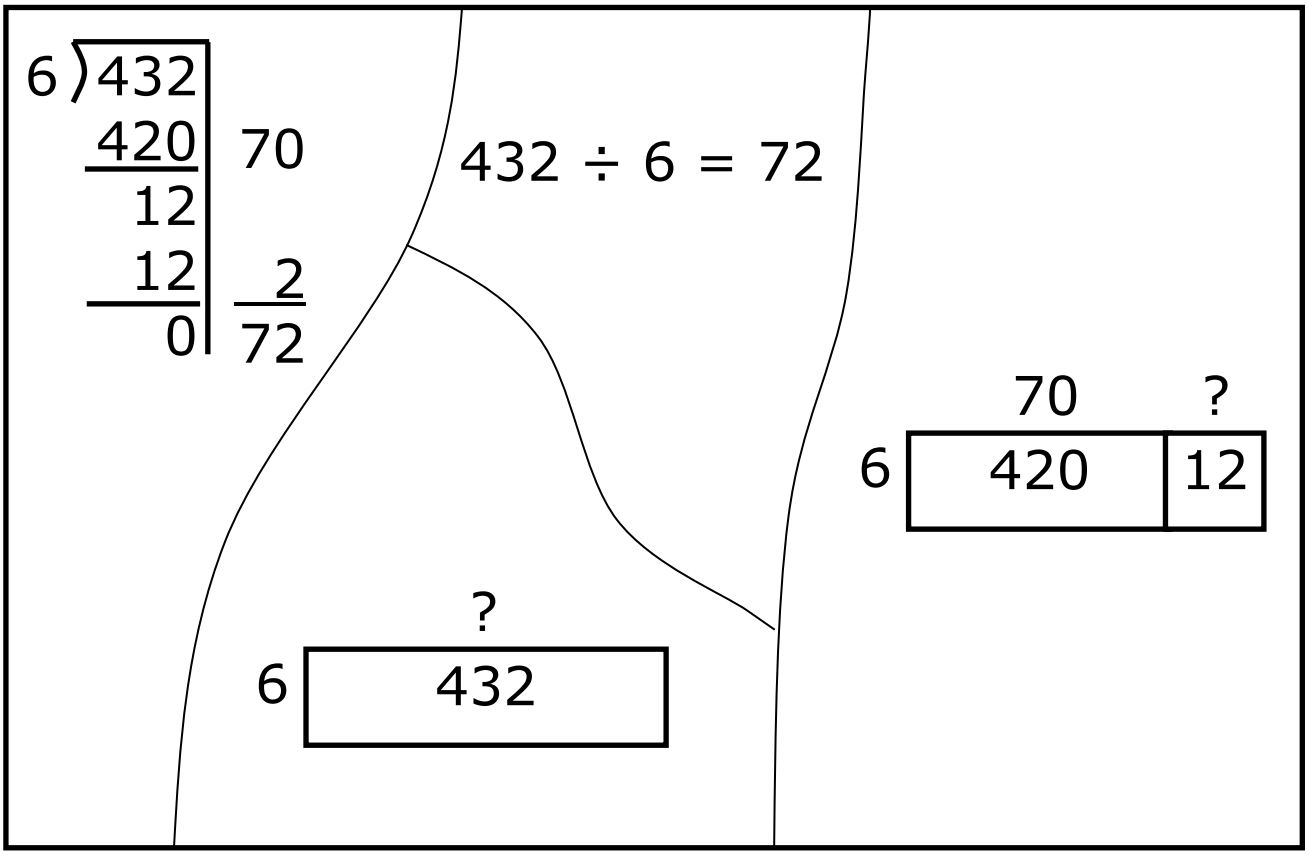
DS3 – Sequencing Division Mix-and-Match Cards Continued





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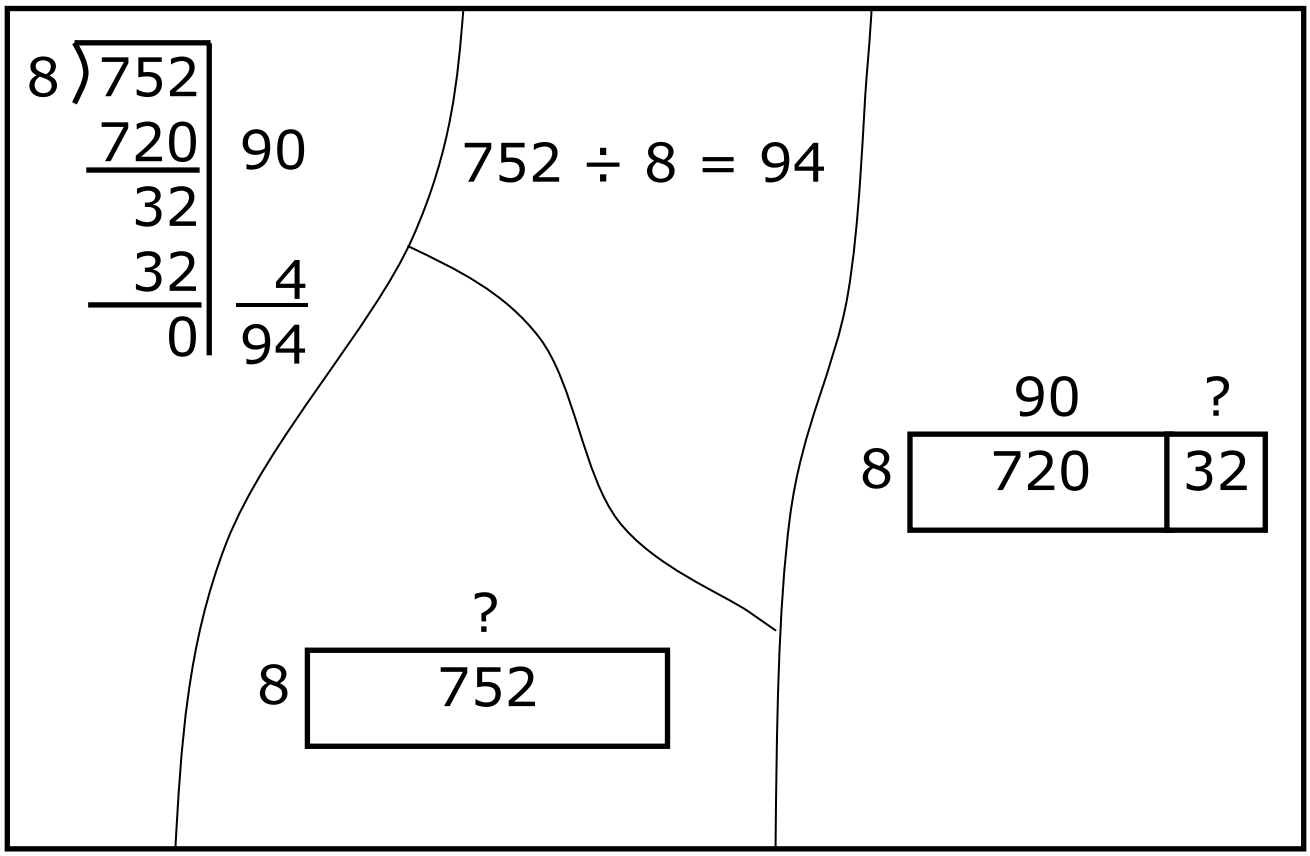
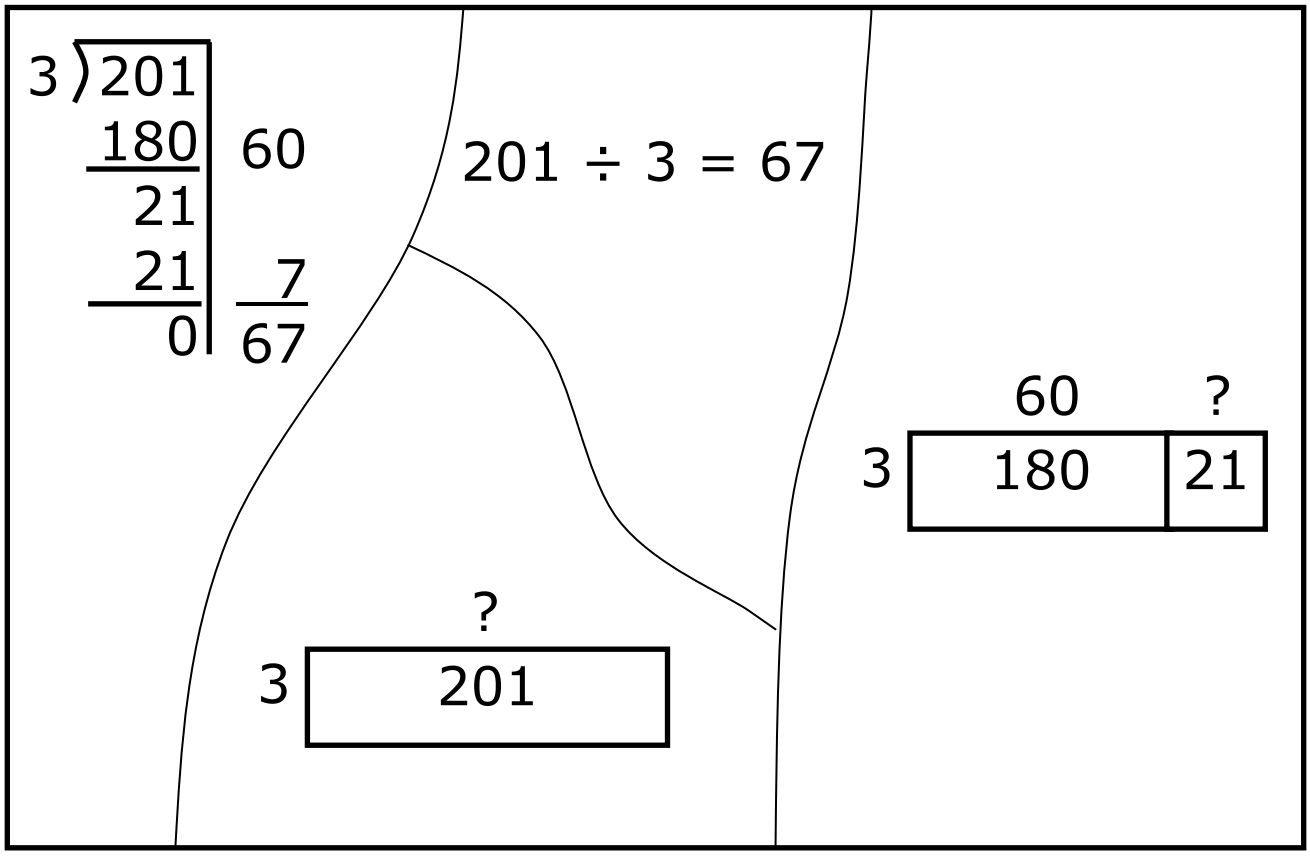
DS3 – Sequencing Division Mix-and-Match Cards Continued





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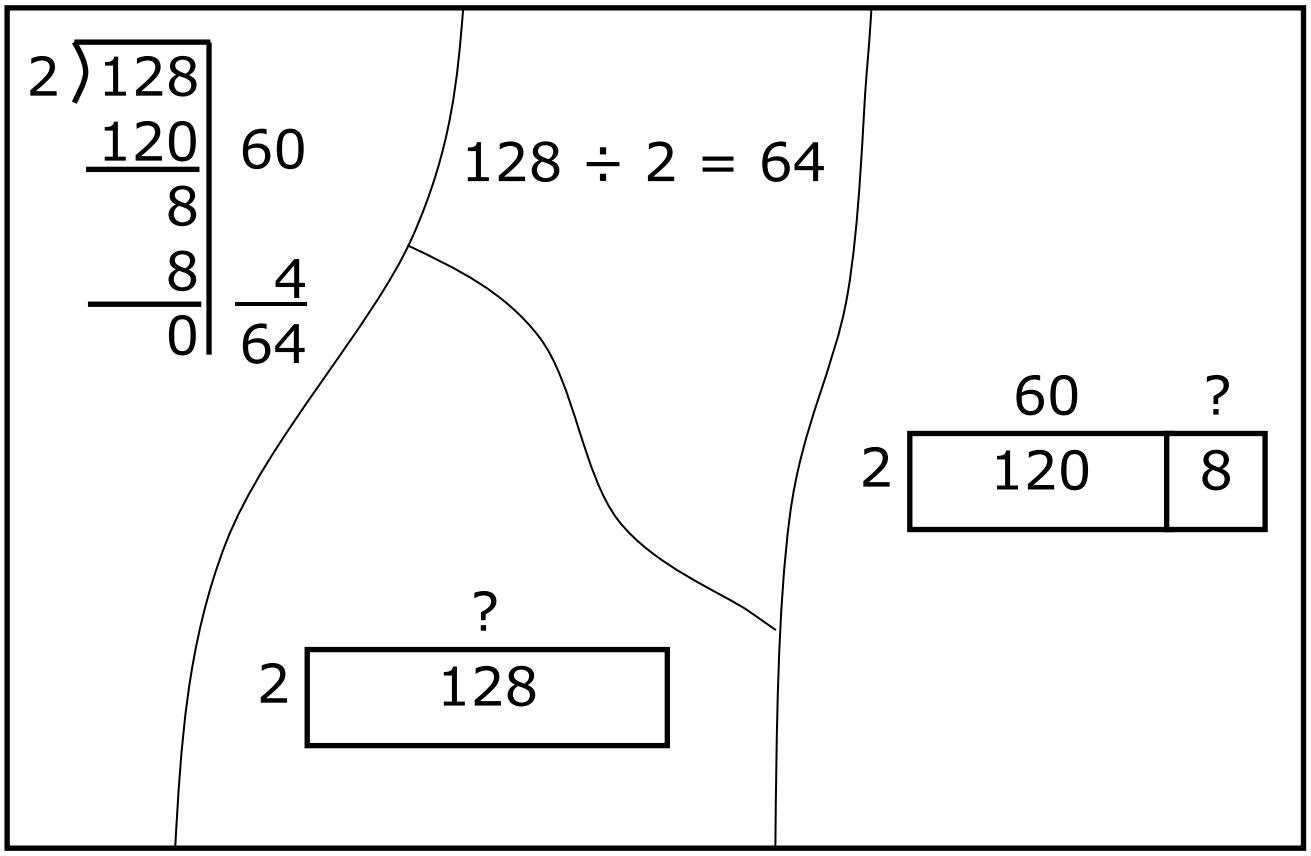
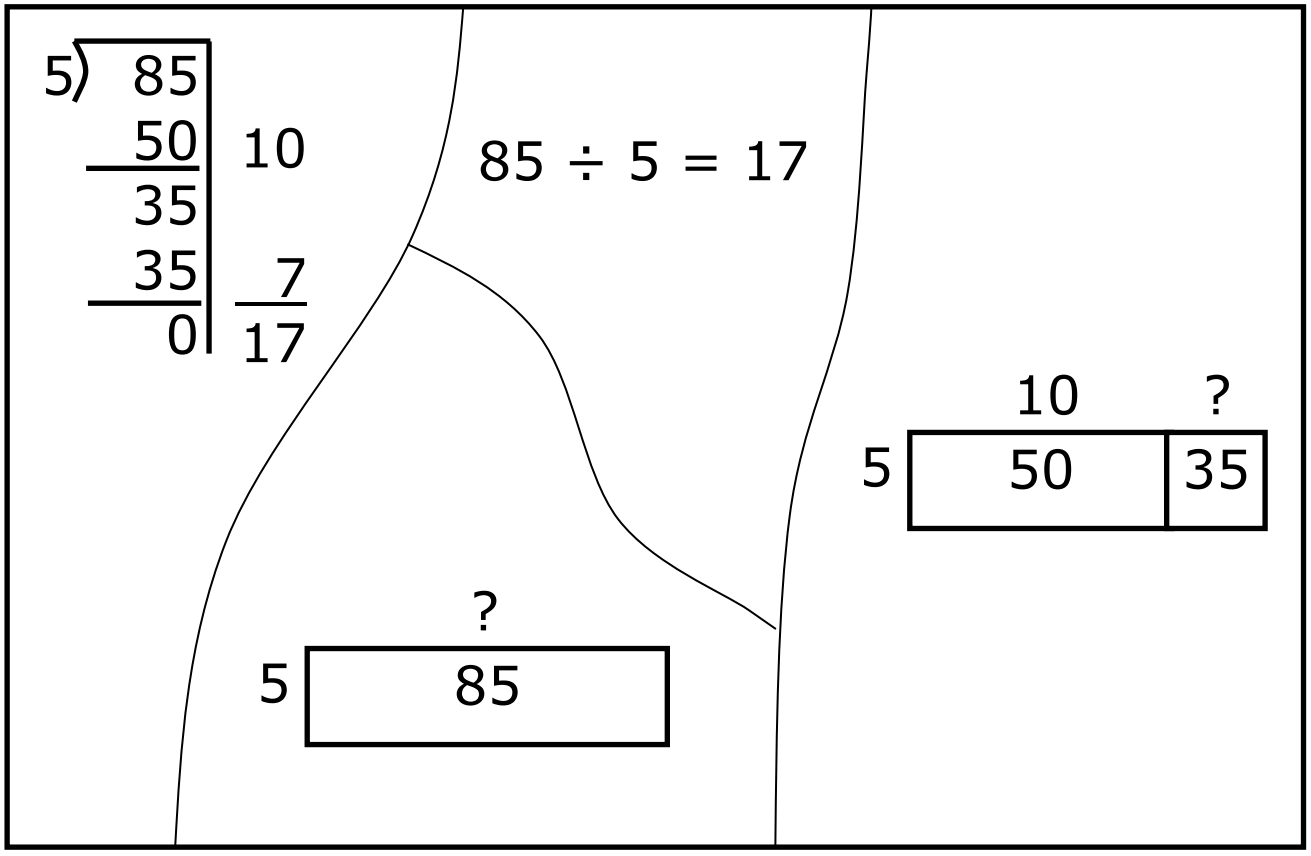
DS3 – Sequencing Division Mix-and-Match Cards Continued





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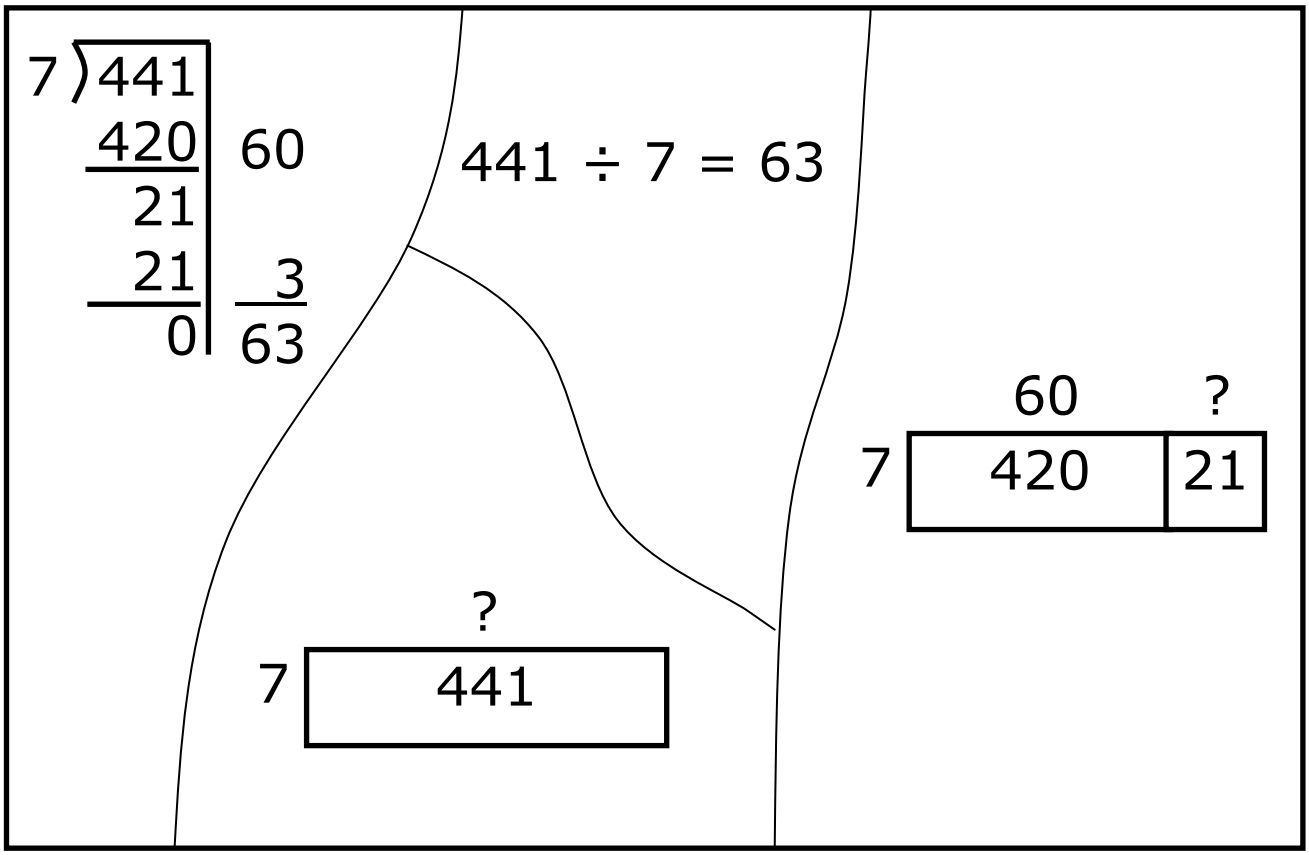
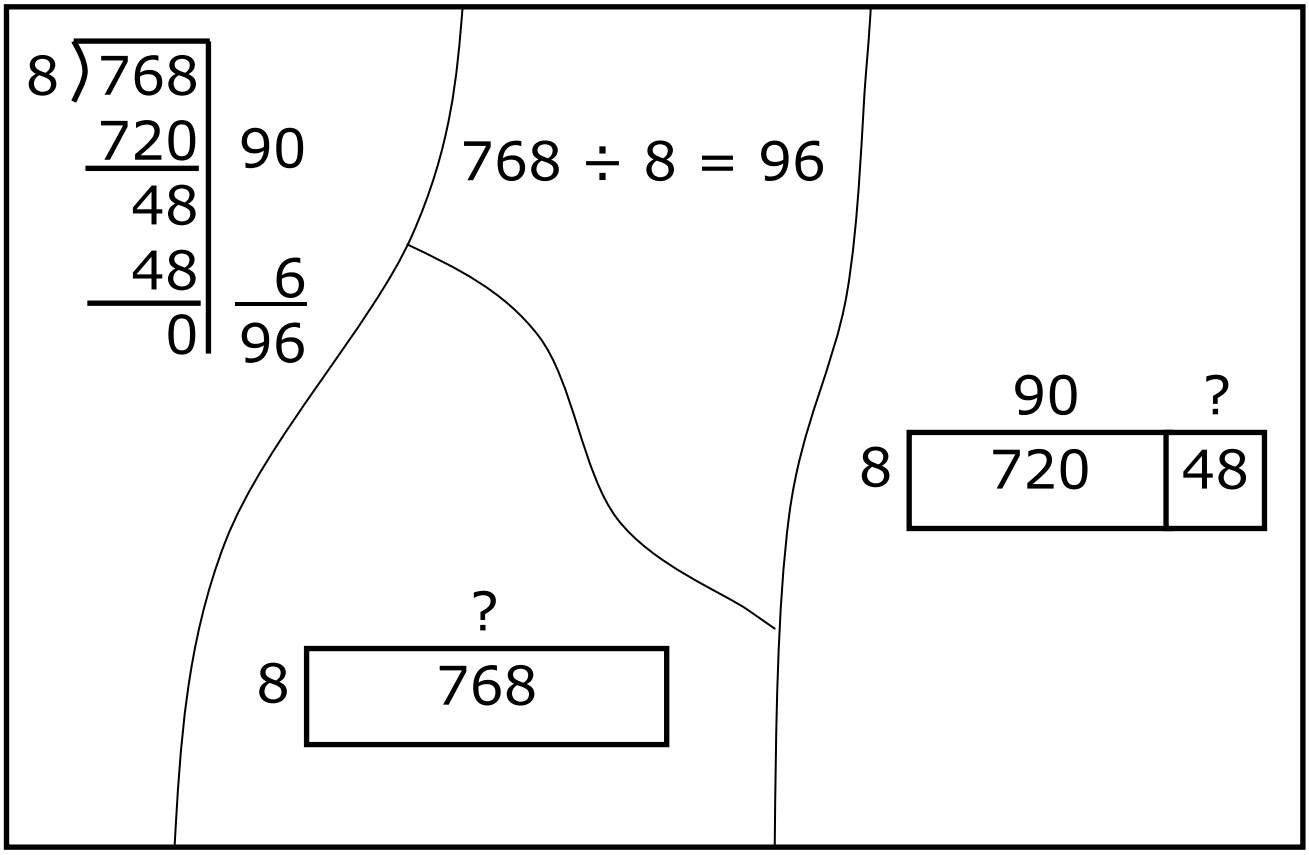
DS3 – Sequencing Division Mix-and-Match Cards Continued





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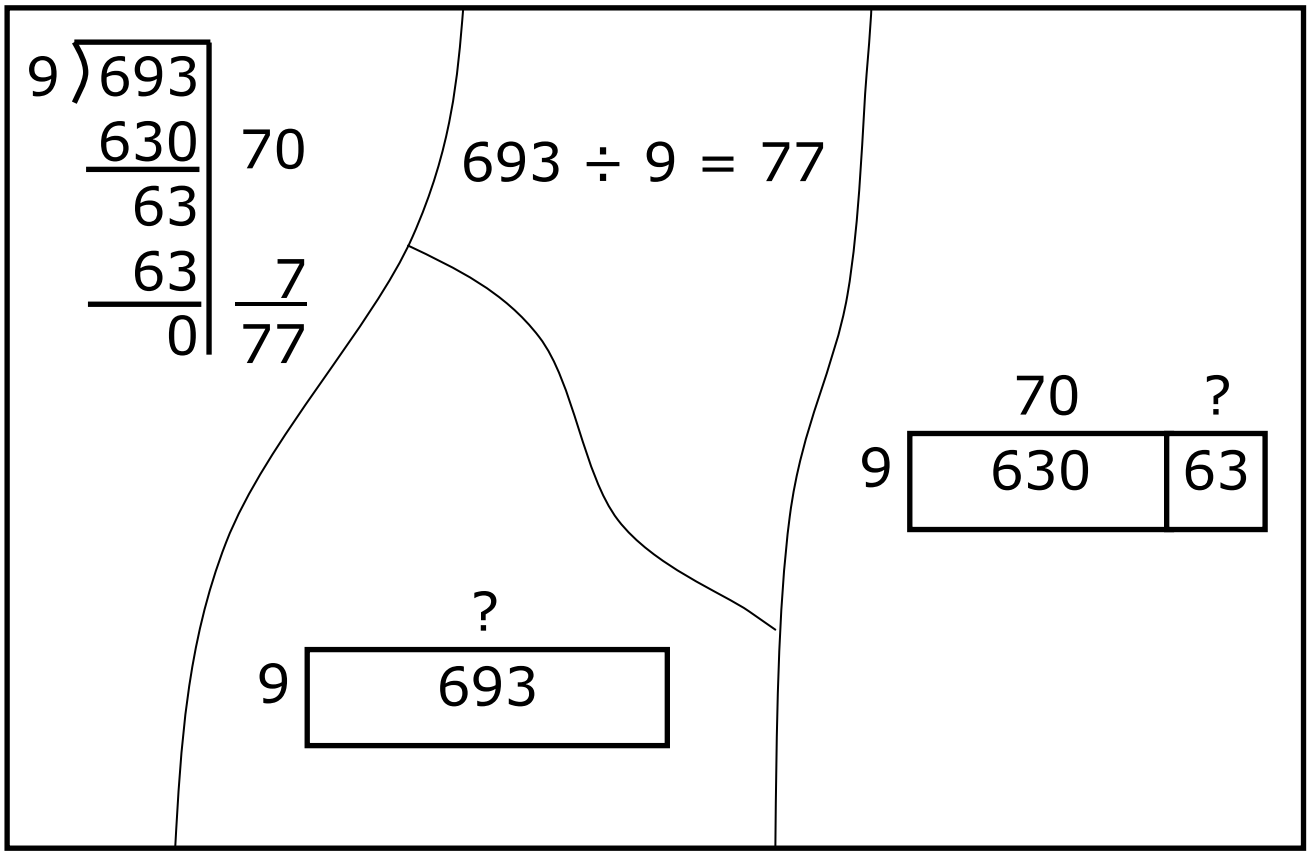
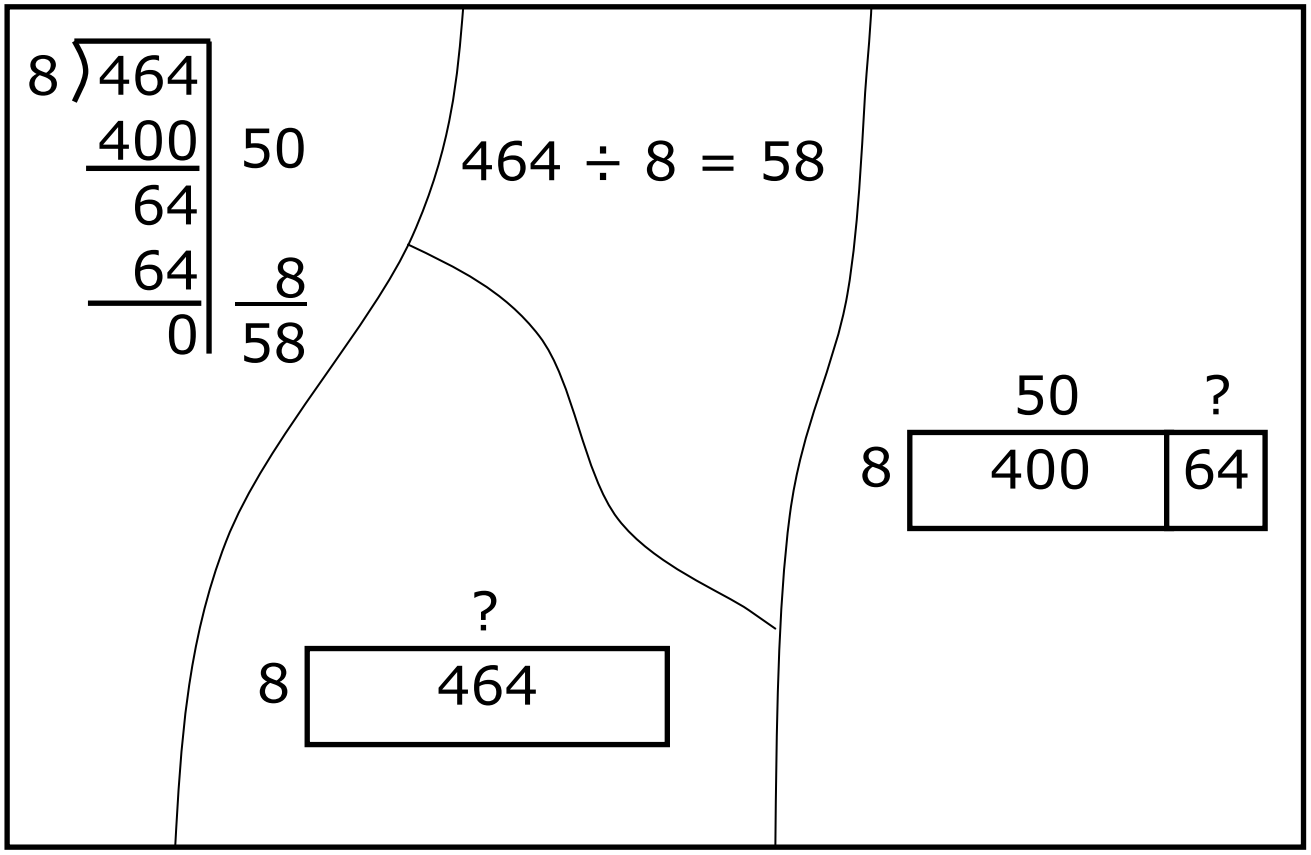
DS3 – Sequencing Division Mix-and-Match Cards Continued





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DS3 – Sequencing Division Bingo Flashcards

215 ÷ 5 = 43	124 ÷ 4 = 31	432 ÷ 6 = 72	196 ÷ 7 = 28
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DS3 – Sequencing Division Bingo Boards

? 5 | 215	? 4 | 124	? 6 | 432	? 7 | 196
3) 201 180 21 21 0 60 7 67	8) 752 720 32 32 0 90 4 94	5) 85 50 35 35 0 10 7 17	2) 128 120 8 8 0 60 4 64
90 ? 8 | 720 | 48	60 ? 7 | 420 | 21	50 ? 8 | 400 | 64	70 ? 9 | 630 | 63

? 7 | 196	? 4 | 124	3) 201 180 21 21 0 60 7 67	50 ? 8 | 400 | 64
? 6 | 432	5) 85 50 35 35 0 10 7 17	90 ? 8 | 720 | 48	2) 128 120 8 8 0 60 4 64
8) 752 720 32 32 0 90 4 94	60 ? 7 | 420 | 21	? 5 | 215	70 ? 9 | 630 | 63

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DS3 – Sequencing Division Bingo Boards Continued

5 [200 | 15] (40 ?)	8 [752] (?)	8) 464 / 400 / 64 / 64 / 0 — 50, 8, 58	3 [201] (?)
2 [128] (?)	9) 693 / 630 / 63 / 63 / 0 — 70, 7, 77	6 [420 | 12] (70 ?)	7 [140 | 56] (20 ?)
8) 768 / 720 / 48 / 48 / 0 — 90, 6, 96	4 [120 | 4] (30 ?)	5 [85] (?)	7) 441 / 420 / 21 / 21 / 0 — 60, 3, 63

2 [128] (?)	9) 693 / 630 / 63 / 63 / 0 — 70, 7, 77	6 [420 | 12] (70 ?)	7 [140 | 56] (20 ?)
5 [200 | 15] (40 ?)	8) 464 / 400 / 64 / 64 / 0 — 50, 8, 58	3 [201] (?)	5 [85] (?)
8) 768 / 720 / 48 / 48 / 0 — 90, 6, 96	4 [120 | 4] (30 ?)	8 [752] (?)	7) 441 / 420 / 21 / 21 / 0 — 60, 3, 63

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DS3 – Sequencing Division Bingo Boards Continued

60 ? 2 | 120 | 8	? 7 | 441	? 8 | 464	7) 196 140 56 56 0 20 8 28
? 9 | 693	6) 432 420 12 12 0 70 2 72	5) 215 200 15 15 0 40 3 43	4) 124 120 4 4 0 30 1 31
? 8 | 768	10 ? 5 | 50 | 35	60 ? 3 | 180 | 21	90 ? 8 | 720 | 32

4) 124 120 4 4 0 30 1 31	60 ? 3 | 180 | 21	5) 215 200 15 15 0 40 3 43	10 ? 5 | 50 | 35
? 8 | 464	7) 196 140 56 56 0 20 8 28	60 ? 2 | 120 | 8	? 7 | 441
90 ? 8 | 720 | 32	? 8 | 768	? 9 | 693	6) 432 420 12 12 0 70 2 72

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DS3 Activity Feedback Sheet

1. How the student found the activity (put a cross on lines)

NAME	STUDENTS' REACTIONS
	Boring ——— Interesting Difficult ——— Easy Not learning ——— Learning
	Boring ——— Interesting Difficult ——— Easy Not learning ——— Learning

2. How did you feel about trialling the activity?

   Mark the line with an X: Unconfident ——— Very confident

3. Do you think the student was engaged in the activity? Explain.

   _____

4. What do you think the student learnt from the activity?

   _____

5. Do you think the student has gained an understanding of the concept being taught? Explain.

   _____

6. What do you think of the activity?

   _____

7. What are your suggestions for improving the activity?

   _____

   _____

8. What else do you suggest could be done to help students who have trouble with this activity?

   _____

   _____

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ACTIVITY DS4

[Compensation strategy for division computation]

Materials: Pen, paper, attachments

Directions:

1. State: *We are going to look at very quick ways to do division if you can spot the shortcut. We have to start by reminding ourselves of easy multiplications*. Organise students to remember the following:

   (1) multiplying by 10 – $8\times10 = 80$

   (2) multiplying by 5 – $\frac{1}{2}\times10 : 8\times5 = \frac{1}{2}(8\times10) = \frac{1}{2}\ 80$

   (3) multiplying by 100 – $7 \times 100=700$

   (4) multiplying by 50 – $\frac{1}{2}\times100 : 7\times50 = \frac{1}{2}(7\times100) = 350$

   (5) multiplying by 25 – $\frac{1}{4}\times100 : 7\times25 = \frac{1}{4}(7\times100) = 175$

   (6) higher decade – $2\times4 = 8 : 20\times4 = 80 \quad 20\times40 = 800 \quad 200\times4 = 800$

   (7) multiplying by 2 – doubling : $2\times62 = 124$

   (8) multiplying by 4 – double double : $4\times62 = 2\times124 = 248$

   (9) multiplying by 8 – double double double : $8\times62 = 4\times124 = 2\times248 = 496$

   State: *We have to remember these as easy ones.*

2. State: *In this new way to divide, we change the example to an easy one and then compensate for this (that's why it's called compensation). Let's look at a few examples 72÷4, 438÷3, and 924÷6. Check with calculators!*

Thinking

Example	Easy Answer	Compensation	Answer
72÷4	4×20 = 80 so 80÷4 is easy and equals 20	72 is 8 less than 80 so 20 is 8÷4 = 2 too high	80÷4 = 20 − 8÷4 = 2 72÷4 = 18

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438÷3	3×100 = 300 3×50 = $\frac{1}{2}$300 = 150 3×150 = 450 so 450÷3 = 150	438 is 12 less than 450 so 150 has to be reduced by 12÷3	450÷3 = 150 − 12÷3 = 4 438÷3 = 146
924÷6	6×100 = 600 6×50 = 300 6×150 = 900 so 900÷6 = 150	924 is 24 more than 900 so 150 has to be increased by 24÷6	900÷6 = 150 + 24÷6 = 4 924÷6 = 154

3. State: *We can also manipulate the number we divide by. Consider 576÷4, 936÷8 and 786÷6. (Check with calculators!)*

Example	Thinking	Answer
576÷4	÷4 is halving and halving	half of 576 = 288 half of 288 = 144
936÷8	÷8 is halving, halving and halving	half of 936 = 468 half of 468 = 234 half of 234 = 117
786÷6	6 is 3×2 so ÷6 is ÷2 (halving) and then ÷3	half of 786 = 393 dividing by 3 = 131

4. Complete Worksheets 4.1 and 4.2.

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DS4 – Worksheet 4.1

Do the following by thinking of easy ways and compensating. Tell us what you did. Put letters where answers are at bottom of sheet.

(1)	815÷2 = _____	W	(2)	915÷3 = _____	R
(3)	985÷5 = _____	D	(4)	716÷2 = _____	E
(5)	968÷4 = _____	V	(6)	477÷3 = _____	S
(7)	864÷6 = _____	P	(8)	924÷7 = _____	N
(9)	840÷8 = _____	O	(10)	645÷5 = _____	I

What do we want?

___	___	___	___	___	___	___	___
193	129	242	129	159	129	105	132
___	___	___	___	___			
144	105		358	305			

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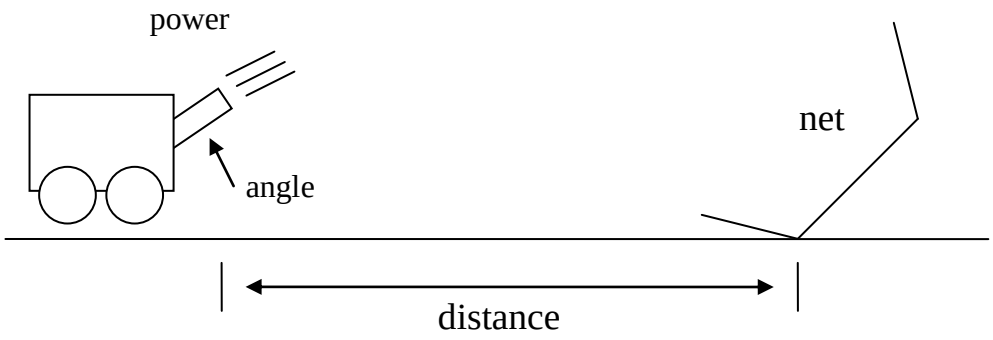
DS4 – Worksheet 4.2

The Human Cannonball!

(Power × Angle = Distance)



Complete the chart – check your answer with a calculator.

The first has been done with you.

Distance	Power	Angle	Power x Angle (use calculator)
456	4	456÷4 Think: 440÷4 = 110 456 is 16 more so 456÷4 = 114	114×4 = 456
(1) 875	5		
(2) 510	6		
(3) 742	7		
(4) 464	8		
(5) 531	9		
(6) 658	7		
(7) 736	8		
(8) 774	6		
(9) 996	4		
(10) 987	3		

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DS4 Activity Feedback Sheet

1. How the student found the activity (put a cross on lines)

NAME	STUDENTS' REACTIONS
	Boring ——— Interesting Difficult ——— Easy Not learning ——— Learning
	Boring ——— Interesting Difficult ——— Easy Not learning ——— Learning

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