

Activity D.1: Introduce Division

Special Note: This is an extremely successful way to introduce division, division with remainders, and remainders as fractions all at once because the patterns are so powerful. We recommend that you introduce division with remainders before you introduce division without remainders so students will understand that division is more than "multiplication backwards". In this activity think of each staircase as a vertical number line. Each staircase represents a different group size. Each step on the staircase represents a whole group. Students will find how many extra tokens are needed to reach 14. The extra tokens will be interpreted as remainders. You will begin on Zillio and then complete the exercise on the board or on a transparency.

Learning Objectives:

- 1) Understand meaning of division.
- 2) Learn how to calculate division with remainders.
- 3) Learn how to convert division with remainders to mixed numbers and improper fractions.

Examples of Skills Accomplished:

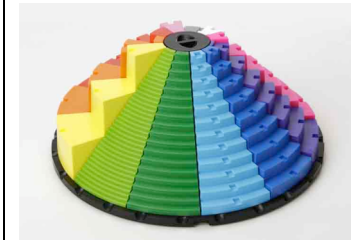
- 1) $14/12 = 1 \text{ r } 2$ or $1 \frac{2}{12}$
- 2) $14/3 = 4 \text{ r } 2$ or $4 \frac{2}{3}$

Setup:

- 1) Put staircases in counterclockwise sequence $1x \rightarrow 12x$.
- 2) Give each student a foam card.
- 3) Give students the handout (reproducible) below.
- 4) If desired, also make a transparency of the reproducible to begin filling out as a group activity. Otherwise plan to work on the board.

Maximum Number of Players for Small Group Activities: 4

Players Positions: Standing or seated



Activities:

- 1) Explain that with division you must be given two pieces of information to calculate the third. You must always be given the total quantity. You then will be given either of the following: group size or # of groups. In this exercise each staircase will represent the group size. We will find the # of groups that fit into 14.
- 2) Similar to Activity C.9, ask each student to find the elevation 14 on the staircases in front of them. They should do this by stacking the appropriate number of tokens on the step that represents the highest multiple less than the total quantity (in our case 14). We show numbered tokens to help explain this to you, but students should use any tokens blank side up to emphasize quantity.

Note: This wording doesn't fit for all division problems but it does for the major of them. It will be easier for children to understand word problems when we give them a frame of reference and language to describe the information they will likely see in word problems.

Elevations											
14	14	+2	+2	+4	+2	14	+6	+5	+4	+3	+2
13		+1	+1	+3	+1		+5	+4	+3	+2	+1
12	12	12	12	+2	12		+4	+3	+2	+1	12
11				+1			+3	+2	+1		11
10	10				10		+2	+1		10	
9		9					+1		9		
8	8		8					8			
7						7					
6	6	6			6						
5					5						
4	4		4								
3		3									
2	2										
1											

14	7r0	4r2	3r2	2r4	2r2	2r0	1r6	1r5	1r4	1r3	1r2
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3) Beginning with the largest group size (i.e. = 12) and working towards the smallest group size (i.e.= 1), ask students to take turns telling you how many whole groups (shown visually as steps) and how many tokens are left over (representing the remainder) for each group size when the total quantity = 14. Remind them to look at the Mountain if they need help. At this time just fill out the first 3 columns.

For Total Quantity = 14				
Group Size	# of Whole groups	Remainder (# of extra tokens)	Expressed as a mixed number	Expressed as a improper fraction
12	1	2	1 2/12	14/12
11	1	3	1 3/11	14/11
10	1	4	1 4/10	14/10
9	1	5	1 5/9	14/9
8	1	6	1 6/8	14/8
7	2	0	2 0/7	14/7
6	2	2	2 2/6	14/6
5	2	4	2 4/5	14/5
4	3	2	3 1/2	14/4
3	4	2	4 2/3	14/3
2	7	0	7 0/2	14/2
1	14	0	14 0/1	14/1

4) Discuss the patterns:

- a. As the group size gets smaller (reading down the chart), what happens to the number of whole groups?
- b. Did they notice that group size 10 and group size 5 both have remainders of 4? Why? What other group sizes have the same remainders?
- c. Point out that $2 \frac{0}{7}$ and $14 \frac{0}{1}$ would normally be written as 2 and 14 respectively, but that they were shown in this format to reinforce the patterns.

5) Now ask them to express each of the remainders as a fraction. Fill in column A again beginning with the group size of 12 (12x staircase), teach them to look at the remainders as a portion of the next whole group. Refer them to the staircases to see that the tokens on top of step represent a portion of the next whole group. What is the fraction for a remainder of 2 when the group size is 12? Help them think of the remainder as the numerator of the fraction and the group size as the denominator. Then ask how many whole groups (and write 1) and what is the fraction of the next whole group (write $\frac{2}{12}$) to express the problem $14 \div 12$ as the mixed fraction, $1 \frac{2}{12}$. Fill in the rest of the column, guiding students to look at the staircases, as needed.

Note: Students often make the mistake of saying the mixed fraction for a group size of 11 as $1 \frac{3}{12}$ instead of $1 \frac{3}{11}$ (because the group size was 12 for the previous problem). Ask them how many equal parts make up this group? Guide them to the conclusion that the correct fraction is $1 \frac{3}{11}$.

6) Next fill in the last column for improper fractions for each group size.

7) When finished the chart should look like the one below.

Observe and Assess:

- 1) How well students understand division with remainders, mixed numbers, and improper fractions.

Group Discussion & Review of Findings:

- 1) Make sure all students understand that the numerator of the fraction changes in the mixed fraction format because each problem is for a different group size. They can count the lines on the face of the step behind the stack of tokens and see that the tokens represent a portion of the next full step.

Transition to Paper:

- 1) Present a few of the same problems you just solved on Zillio in the traditional format (for long division).
- 2) Assign the reproducible as either class work or homework.

Name: _____ Date: _____

With division you must be given two pieces of information to calculate the third. You must always be given the total quantity. Then you will be given either of the following: group size or # of groups. If you are given group size you will be calculating # of groups. If you are given # of groups you will be calculating group size.

A.
$$\frac{\text{Total quantity}}{\text{Group size}} = \# \text{ of groups}$$
 B.
$$\frac{\text{Total quantity}}{\# \text{ of groups}} = \text{Group size}$$

In this problem your total quantity = 14. Group size is represented by the size of the steps on each staircase. We will be doing 12 division problems for groups sizes that vary from 12 to 1. We will be calculating # of groups for each group size.

1. Find the elevation 14 on each staircase.
2. Now report how many whole groups (represented by the number of steps) fit into 14 for each group size and the remainder (represented by how many extra tokens are needed).
3. Express the number of groups as a mixed numbers for each group size.
4. Express the number of groups as an improper fraction for each group size.

For Total Quantity = 14				
Group Size	# of Whole groups	Remainder (# of extra tokens)	Expressed as a mixed number	Expressed as a improper fraction
12				
11				
10				
9				
8				
7				
6				
5				
4				
3				
2				
1				

Name: _____ Date: _____

a) $55 \div 5 = 11$	b) $56 \div 5 = 11 \text{ r } 1$	c) $57 \div 5 = 11 \text{ r } 2$
d) $28 \div 7 = 4$	e) $29 \div 7 = 4 \text{ r } 1$	f) $30 \div 7 = 4 \text{ r } 2$
g) $54 \div 9 = 6$	h) $55 \div 9 = 6 \text{ r } 1$	i) $56 \div 9 = 6 \text{ r } 2$
j) $12 \div 2 = 6$	k) $13 \div 2 = 6 \text{ r } 1$	l) $14 \div 2 = 7$

Can you express the remainders as a fraction?