Partitioning Numbers

An Essential Understanding and Skill

for

The Growth of Mathematical Thinking

Presented by

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Before we begin…

If you have any questions during the presentation, please post them in the chat at the left of your screen, and we will spend some time during the webinar as a Q/A time.

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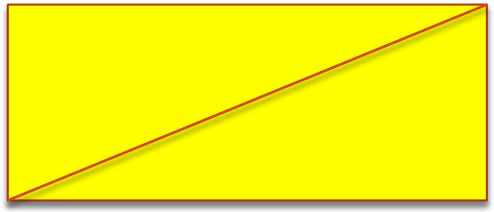
Part-Part-Whole Thinking

The ability to simultaneously think about a whole and its constituent parts. For example, in geometry, to see a rectangle and its partitioning into two congruent triangles by one of its diagonals, and the relationships among the shapes.



For example, in number, to see a an 8 and its various partitions, such as 1 and 7, 2 and 6, 3 and 5, and 4 and 4.

Goals

1. To examine what students who have robust knowledge of partitioning numbers can do
2. To illustrate various activities and focus questions that will help students develop robust knowledge of partitioning numbers
3. To discuss the connections between partitioning numbers and place value, addition, subtraction, multiplication, division, and fractions

Goal # 1

To examine what students who have robust knowledge of partitioning numbers can do

What is robust knowledge?

Knowledge that you "own" so that it changes how you think about, and do, things.

Goal # 1

To examine what students who have robust knowledge of partitioning numbers can do

Break 75 apart in five different ways.

Without reference to quantities, she spontaneously replies with examples such as:

- 70 and 5
- 50 and 25
- 74 and 1
- 65 and 10
- 60 and 15
- 25, 25, and 25
- 50, 20, and 5

Can you describe some relationships between 75 and other numbers?

He thinks for a little bit and replies with such things as:

- It's 1 more than 74.
- It's 1 less than 76.
- It's 5 more than 70.
- It's 5 less than 80.
- It's 25 less than 100.
- It's 25 more than 50.
- It's 10 more than 65.
- It's 10 less than 85.

Mentally calculate: 48 + 34

- The student thinks for a few seconds and replies 82.
- When asked to explain how she did it, she explains, “I took 2 from 34 and gave it to 48. Then I added 50 and 32, to get 82.”

If you know 345 + 215 = 560, then what is missing in each case?

- $346 + ____ = 560$
- $346 + 214 = 560$
- $350 + ____ = 560$
- $350 + 210 = 560$
- $____ + 212 = 560$
- $348 + 212 = 560$
- $345 + ____ = 550$
- $345 + 205 = 550$

QUESTIONS?

Goal # 2

To illustrate various activities and focus questions that will help students develop robust knowledge of partitioning numbers

In the beginning…

Initially, children learn to count sets of objects and view numbers as labels for these sets; they don't see relationships between/among numbers, nor do they see numbers in parts. For example, they would view 5 and 3 as two distinct numbers. They wouldn't think of 5 as 2 more than 3, nor would they think of 3 as part of 5.

Act Out Situations

- Have girls and boys sit at this table in different combinations.
- For each combination, ask: What part of the 4 children is girls? What part of the 4 children is boys?
- Record in a table, such as:

Part of 4 That is Girls	Part of 4 That is Boys
3	1
2	2
4	0

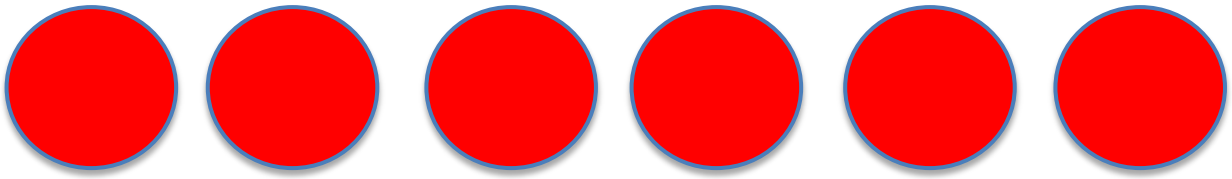
Act Out Situations

- There are apples and oranges on a table. You may select 3 fruit as a treat. How many different choices do you have?
- Have children select 3 fruit and record their selections in a table, not repeating one that is already recorded.

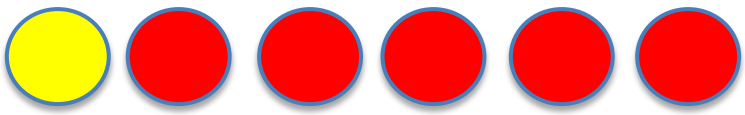
Number of Oranges	Number of Apples
3	0
2	1
1	2
0	3

Model Situations

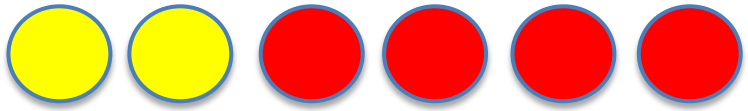
- You need to get $6 for a new binder. You will get part of the $6 from your parents and part from your piggy bank. Let's look at the different ways this can happen.
- Count out 6 two-colour counters to represent the $6.



- Turn over 1 counter to represent the part you get from your parents; then, the 5 other counters represent the part from your bank.



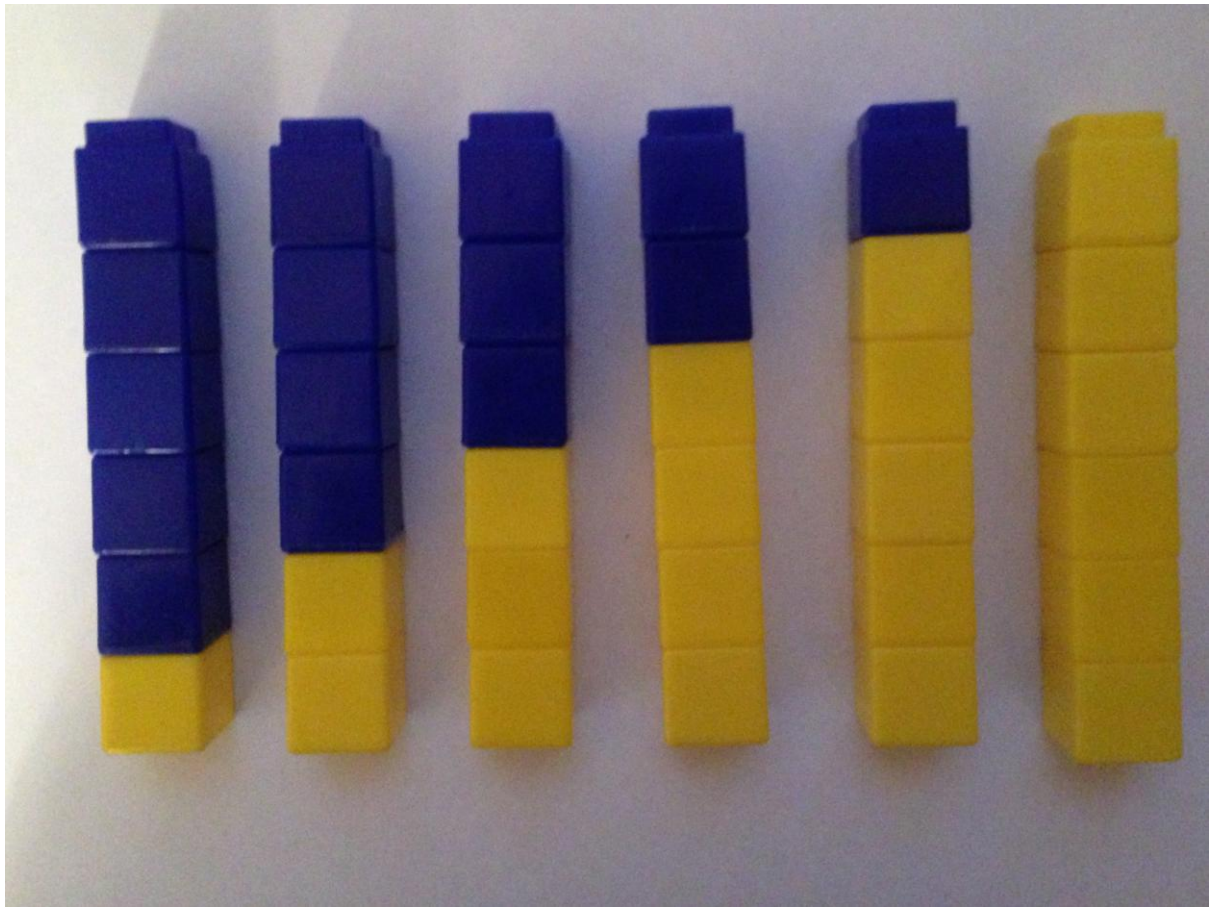
•Turn over 2 counters to represent the part from your parents; then, the 4 other counters represent the part from your bank.



•Continue with other combinations, recording results in a table.

Parents' Part of $6	Bank's Part of $6
1	5
2	4
3	3
4	2
5	1

Make Towers Using Cubes of Two Colours



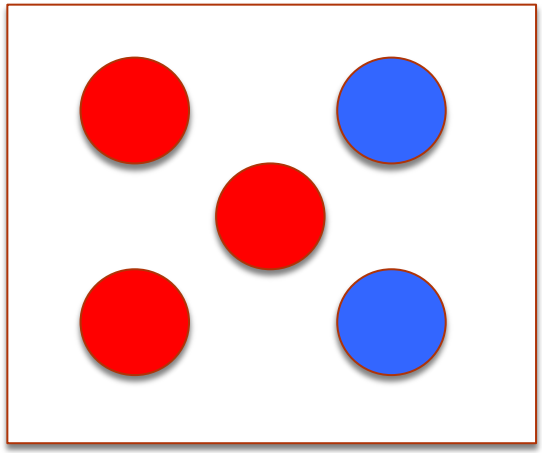
For each type of activity…

Model concretely

Draw pictures

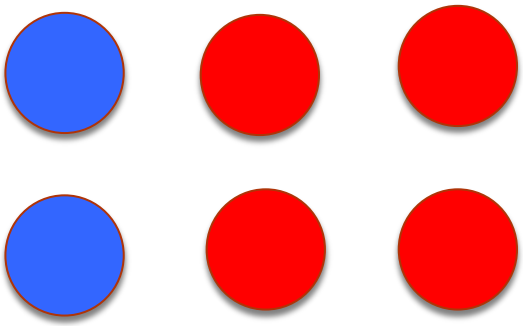
Visualize

Subitizing Special Arrangements in Two Colours



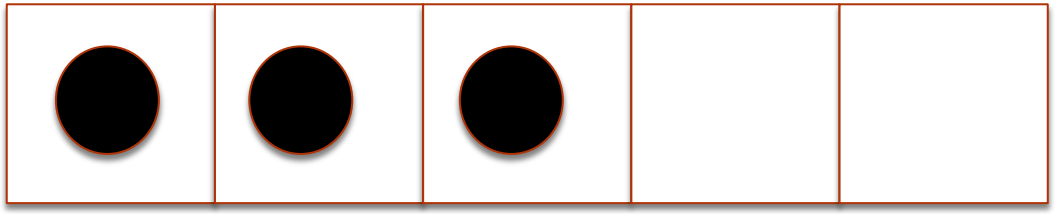
- How many dots do you see?
- How many are red? How many are blue?
- So, 5 has two parts: 3 (the red part) and 2 (the blue part)

Subitizing Special Arrangements in Two Colours



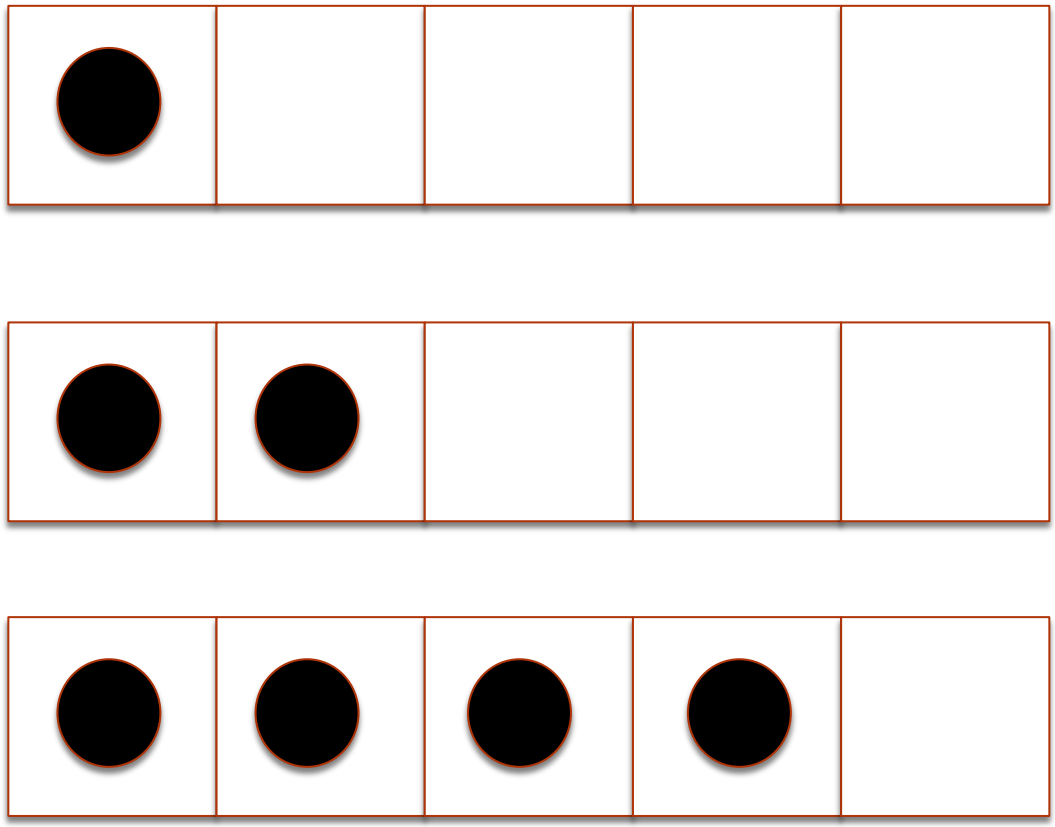
- How many dots do you see?
- Focus Question: What part of 6 is red? What part of 6 is blue?

5-Frame Activities

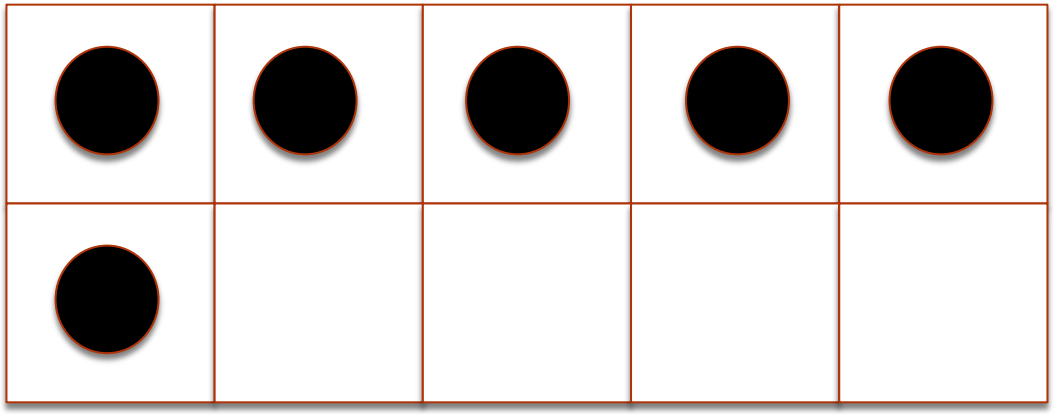


- Focus Question: What part of the 5 frame has counters? What part of the 5 frame is empty?
- So, two parts of 5 are 3 and 2.

How can we see 5 as two parts in other ways?

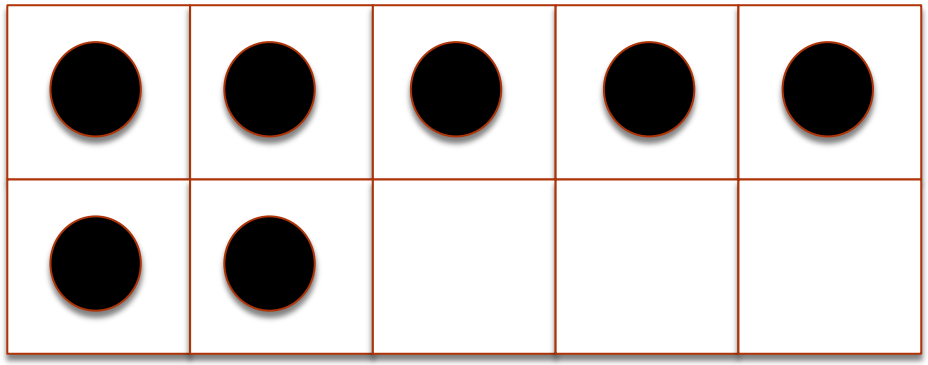


10-Frame Activities

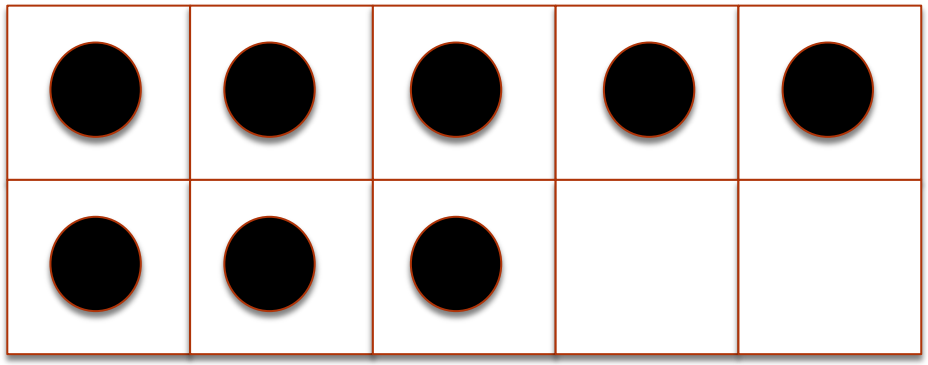


- Focus Question: What are two parts of 6?
- Focus Question: What part of the 10 frame is filled? What part is empty?
- So, two parts of 10 are 6 and 4.

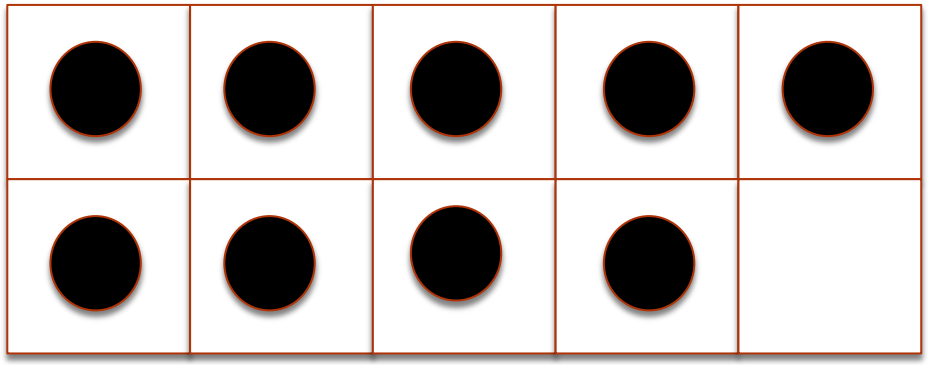
How may we see 10 in two parts in other ways?



7 and 3 are two parts of 10

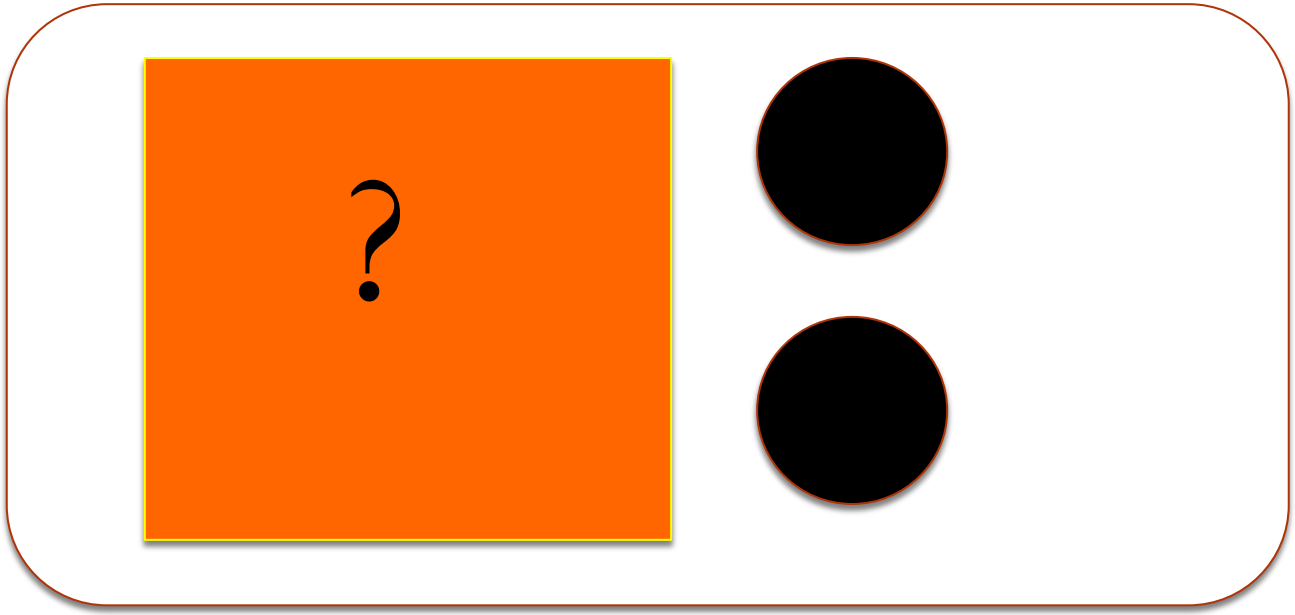


8 and 2 are two parts of 10



9 and 1 are two parts of 10

Missing Part Activity



- If the total is 4, what part do you see? What part is hidden?
- If the total is 7, what part do you see? What part is hidden?

Extending Partitioning of Numbers

Once children are comfortable seeing that a number can be partitioned into two parts in more than one way, they need to see that a number can be partitioned into more than two parts.

For example, parts of 10 could be 2, 5, and 3; or 5, 2, 2, and 1; or 3, 3, 3, and 1.

QUESTIONS?

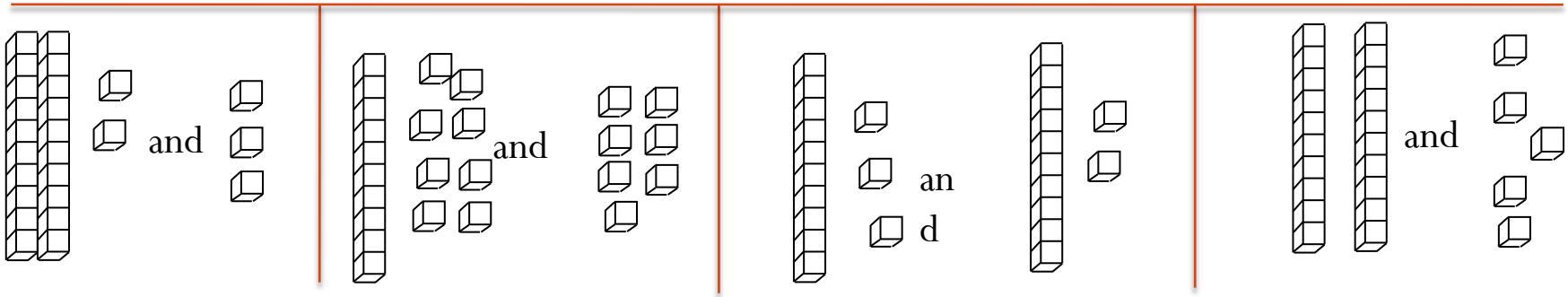
Goal # 3

To discuss the connections between partitioning numbers and place value, addition, subtraction, multiplication, division, and fractions

Partitioning of Numbers Related to Place Value

Children should be introduced to place value as a special partitioning of larger numbers.

For example, 25 can be partitioned in a variety of ways, such as 24 and 1, 22 and 3, 20 and 5, 18 and 7, 13 and 12, etc. If all these partitions are modelled with base-ten blocks, there can be a discussion of the special nature of the 20 and 5 display.



Partitioning of Numbers Related to Addition and Subtraction

Children initially view the number they get when they add or subtract two numbers as the answer to the question. They also should understand that:

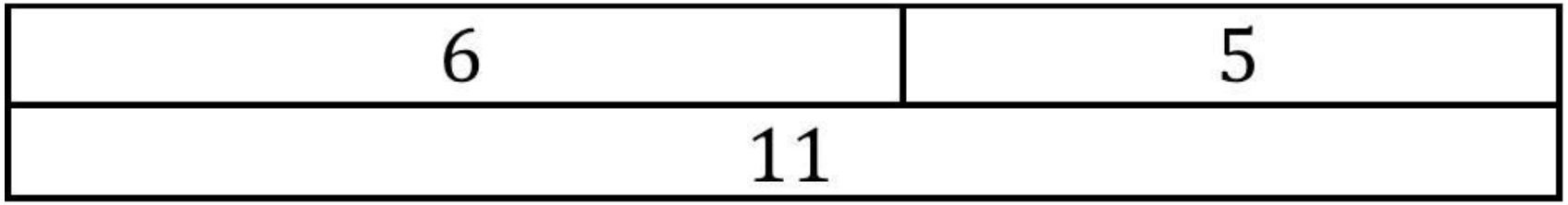
a) *In addition, the answer is the whole and the two addends are two parts of that whole*

b) *In subtraction, the minuend is the whole and one part is the amount subtracted (subtrahend) and the other part is the difference*

Partitioning of Numbers Related to Addition and Subtraction

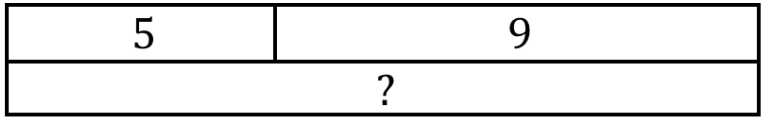
This part-part-whole view of addition and subtraction can be illustrated by a Singapore Diagram; for example:

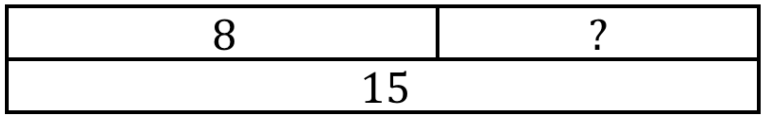
$6 + 5 = 11$, $5 + 6 = 11$, $11 - 5 = 6$, *and* $11 - 6 = 5$ *all are illustrated by this one diagram:*



Partitioning of Numbers Related to Addition and Subtraction

Over time (from grades 1 to 3), children should internalize that both addition and subtraction involve a whole and two parts. If the parts are known, then addition can be used to find the missing whole; if the whole and one part is known, then subtraction can be used to find the missing part.





Partitioning of Numbers Related to Multiplication

When students are introduced to multiplication in grade 3, this introduction should include a discussion of partitioning. For example, for $4 \times 3 = 12$*, not only should students understand that this is "four groups of 3", but also they should understand that 12 is partitioned into 4 equal parts and each of those parts is 3. A diagram for this could be:*

3	3	3	3
12			

Partitioning of Numbers Related to Division

When students are introduced to division, this introduction should include a discussion of partitioning. For example, for $15 \div 3 = 5$, not only should students understand that this is "15 divided into 3 groups or groups of 3", but also they should understand that 15 is partitioned into 3 equal parts and each of those parts is 5, or 15 is partitioned into 3's and there are 5 of these parts. A diagram for this could be:

5	5	5
15		

3	3	3	3	3
15				

Partitioning of Numbers Related to Fractions

Children's initial experiences with fractions involve one-half, where a whole is divided into two equal parts. This most likely begins with area models to represent one-half of objects (such as cookies or pizzas). That is an example of geometric partitioning. However, the development of one-half will move on to include set models (such as groups of objects) that will involve a special partitioning of a number – partitioning it into two equal parts.

For example, one-half of a group of 12 children will involve the 6 and 6 partitioning of 12.

Partitioning of Numbers Related to Fractions

Children's understanding of other unit fractions should include connections to division and special partitions of numbers.

For example, one-fourth of 20 should be connected to 20 ÷ 4 and to partitioning the number 20 into 4 equal parts.

5	5	5	5
20			

QUESTIONS?

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