Decomposing Numbers

What is it?

Decomposing and composing quantities or numbers are related concepts. Decomposing is essentially "breaking" a quantity into parts, such as ten can be decomposed into five and four and one. Alternately, a quantity of ten can be composed of parts put together to make ten, such as four and four and two.
It is important to think about decomposing numbers into more than two parts so that students have a broader understanding of quantities and fluency with decomposing numbers into multiple parts.

Unlike partitioning, which is usually considered a fractional concept used when "cutting" shapes into parts, and involves equi-partitioning or equal parts (Danielson, 2015), decomposing and composing quantities do not need to be of equal parts.


"Composing and decomposing small sets of objects can allow young students to see the whole groupas well as the subsets that created the whole." ~Sci et al, 2016

Why is it important?

Being fluent with decomposing and composing numbers develops a flexibility in understanding and calculating with numbers. In Kindergarten and Grade 1, it is essential that children develop a strong sense of both five and ten and the relationship between these quantities. The use of five and ten frames can support this understanding. Decomposing and composing numbers is a critical component of number sense.

"As children learn the combinations that make up numbers to 10, they will reach the point where they know the parts so well, they can identify the missing parts when they know the total and one part." ~Kathy Richardson

Students need a strong understanding of parts-whole relationships in order to use mental mathematics strategies to add, subtract, multiply and divide. This fluency is often seen during the routines of "Number Talks" when a question is presented to a class to solve and then the students share different approaches and strategies. Students who are able to fluently decompose quantities and then compose quantities are able to adapt their calculations to different sets of numbers. For example, when adding 8+7, a student might notice that 8 is just two away from 10 so she decomposes 7 into 2 and 5 and uses the 2 to add to 8 to make a 10. She then is able to efficiently add the 10 to the remaining part (5) to make 15. In another number talk, the same student may notice that to solve 47 + 26 that 47 is close to 50 so decomposes 26 into 23 and 3 and uses the 3 to add to 47 to make 50 and then adds on the remaining 23 to total 73. Decomposing larger numbers by place value is also an important concept and skill that students can use when adding, subtracting, multiplying and dividing.
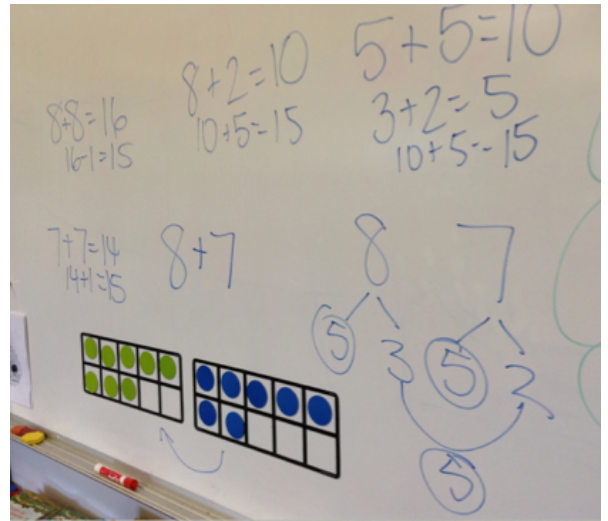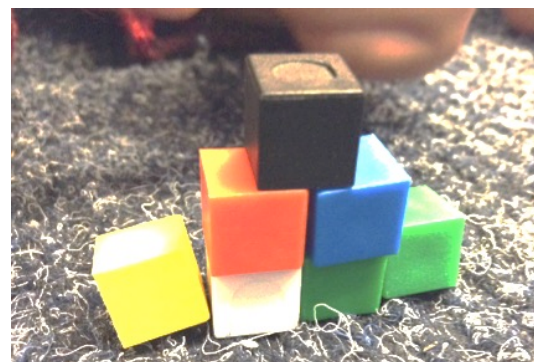
What to think about?
- Before students are able to decompose numbers they need to recognize that smaller numbers are contained in larger numbers (i.e. the quantity of 7 is not just a collection of seven 1s, but is composed of 3 and 3 and 1 more, for example).
- Students need lots of practice decomposing and composing quantities or numbers, working with various combinations for each number, before they will be able to decompose numbers to find the 'missing part.'
- Experience with composing and decomposing numbers will help to develop computational fluency.
- *Note that students can also make a math-to-math connection as they think about decomposing and composing shapes, for example, a rectangle can be decomposed into two triangles.*
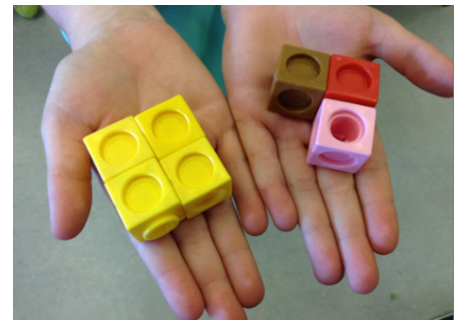
Materials to support decomposing understanding: loose parts, Unifix cubes, five and ten frames, blank hundred grids, rekenreks, abacuses, digit cards, wooden numbers, dominoes, dice, divided containers or parts-whole mats.

What to do?

Gather the students together and provide them with a variety of materials such as glass gems, cubes or rocks. Begin with an opening conversation about decomposing by asking, "How many ways can you make 5?" Have the students use materials to show various ways to decompose the quantity of 5 and share their thinking. Record the various combinations with drawings and/or by saying '3 and 1 and 1 is 5' or '5=2+2+1' depending on the understanding of the students. Writing the equation as 5=2+3 reflects decomposing while 2+3=5 reflects composing. It is important for students to see equations written in both forms to contribute to their understanding of the = sign as a symbol of equality. After a mini lesson, invite the students to investigate materials with a focus of representing quantities by decomposing in different ways. By providing a basket of objects, numerals, wooden ten frames, and black felt mats, you are encouraging student to explore ways to decompose and compose quantities. Provide provocations such as; *"How many ways can you make…? What parts and whole relationships are represented on dominoes? What do you notice when you decompose numbers?"*

What to look for?

As a student works with a quantity to decompose:

- Is the student able to keep track of the quantity when counting?
- Is the student able to accurately count the quantity/set?
- Can the student reasonably estimate the quantity?
- Is the student able to subitize the quantity? Explain how she can "see" it?
- Does the student move the materials to create different parts?
- Does the student consider a pattern in how they decompose – two parts, three parts, four parts, etc?
- How does the student keep track of the different ways they have decomposed the quantity?

- Does the student demonstrate that there many, yet a finite, number of ways to decompose a quantity?
- Is the student able to work abstractly with a number to decompose versus a quantity of materials?

What next?
1) If a student is having difficulty decomposing, reduce the quantity of objects the student is using. Students may also benefit from having representations of their decomposing to refer to. So, for example if the student is working with 4 and they make 3 and 1, then have the student leave that representation with blocks and then take another 4 blocks and decompose 4 in a different way. This encourages the student to check and see if they have or have not already decomposed the number in that way. Prompt the student with questions like, can you decompose that into three parts? four parts? etc to help her with different ways of decomposing.

2) If a student is fluent and confident with decomposing, move towards using number symbols and larger numbers. A challenging question, involving mathematical competencies of justification and proof, is "*How do you know you have found all the ways to decompose this number?*"

References
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Common Core Math for Parents *by Christopher Danielson*
How Children Learn Number Concepts *by Kathy Richardson*
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Complex Counting in Kindergarten *by Eve Sci, Kirten Sendrowski Kircher and Heather Shook, Teaching Children Mathematics*, March 2016

Children's Literature
12 Ways to Make 11 by *Eve Merriam*
Ten Black Dots *by Donald Crews*
1 Cookie, 2 Chairs, 3 Pears *by Jane Brocket*
One is a Snail, Ten is a Crab *by A. Pulley Sayre*

TouchCounts app

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