ROUTINE 7

HOW CAN YOU MAKE IT? (DECOMPOSITION)

About the Routine

Decomposition of number is essential for mathematics success. Skilled decomposers are better positioned to be efficient and flexible computers. These students are able to quickly recognize that 64 + 48 is the same as 100 + 12. They are also able to see that 47 + 29 is the same as 50 + 26. They apply understanding to other operations. They are able to think about 181 – 153 as 181 – 150 – 3 or even as 179 – 151. In time, they apply their understanding to partial product and partial quotient strategies. Unfortunately, some students only work with or become proficient with decomposing numbers by their place values. These students only see 83 as 80 and 3. This is a great start, but 83 is much more. 83 might be thought of as 75 and 8, which is helpful for adding 83 + 125. It might be thought of as 79 and 4, 50 and 33, and so on. We develop decomposition and flexible thinking about numbers through instruction, diverse experiences, and opportunities to practice and discuss. In this routine, *How Can You Make It?,* students consider the many ways to express a number. Students are prompted with a number to decompose. They think about one way to break it apart and share their ideas with a partner. The class shares with the teacher who records the different ideas. After ideas have been shared, you can prompt them to think of a new way to decompose the number that hasn't been shared and recorded already.

How can you make

15?

Why It Matters

This routine helps students:

- consider how to decompose a number (MP2);
- look for patterns and structure within decompositions (MP7);
- manipulate patterns, relationships, and operations (MP8);
- reinforce ideas about friendly numbers or benchmarks (MP2);
- practice computation to improve precision (MP6);
- reflect on diverse approaches to represent a number to determine which are most useful;
- develop confidence with quantity and computation; and
- communicate their reasoning with others (MP3).

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What They Should Understand First

How Do You Make It? works with any number or type of number, including fractions and decimals. You should use it after students show conceptual understanding of number and decomposition. They might show understanding through a collection of representations, but they must also be able to communicate how those representations connect to symbolic representations (numbers). Students should also show some ability to decompose a number. In kindergarten, decomposition might be limited to *one-more than* or *two-more than* a number. For example, they might only be able to think of 11 as 1 and 10 or 2 and 9. In later grades, decomposition might be limited to place value. Either is fine. The routine itself is intended to expose, develop, and reinforce new ideas about decomposing numbers. You might provide students with tools, such as 10 frames or base 10 blocks, during initial exposures to the routine. In these early experiences, you should also record and connect symbolic decompositions to representations if students do not do so themselves.

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What to Do

1. Select a number for students to decompose. (Note: Consider giving some examples of how it might be decomposed the first few times the routine is introduced.)
2. Direct students to decompose the number. (Optional: Have students decompose the number in two ways or more than three ways.)
3. Have students share their decomposition(s) with a partner.
4. Have students share their examples with the group.
5. Record student examples. Note that there is no better number of examples to record. In some instances, five will be plenty. In others, nine or 10 examples might be collected and recorded.
6. Discuss with the group the decomposition examples that were recorded. Questions to ask might include:
   - What do you notice about how we decomposed the number?
   - What two decompositions are most alike?
   - How did the numbers in those examples change?
   - Do you notice any patterns in how we broke apart the numbers?
   - Do you think this pattern will work with other numbers?
   - Which of the examples are easiest for you to think about?
   - Which of the examples are hardest for you to think about?
7. After discussion, ask students to decompose the number in a new way that wasn't recorded.
8. Have students share their new decompositions with partners and then the whole class.

Anticipated Strategies for This Example

How can you make
15?

For this example, students are asked to decompose 15. It is a good choice for later in the kindergarten year or early in first grade. Many students are likely to first decompose 15 into 10 and 5. Some students may be able to only decompose it into 10 and 5. Students who extend beyond place value decomposition are likely to use breaking a number into 1 and something and 2 and something. In this example, that would be 14 and 1 and 13 and 2. You should listen for students who consistently share something and 1 or something and 2 for different reasons. Some who rely on a number and 1 (14 and 1) might think of it in ways of counting and may not recognize that it is a decomposition. Those that understand might

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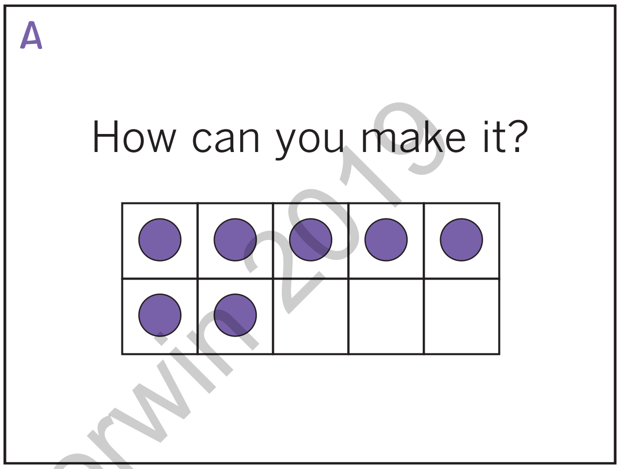
rely on 1 more and 2 more as their *only* strategies for decomposing. For these and other students it is necessary that you connect those *comfortable decompositions* to different ideas. In this example, 15 decomposed as 14 and 1 or 13 and 2 should be connected 12 and 3, 11 and 4, or anything else. In time, you might pose new challenges to advance student thinking. An example of this might be to decompose 15 with two single-digit numbers to advance student thinking.

HOW CAN YOU MAKE IT? —ADDITIONAL EXAMPLES

A. Ideally, *How Can You Make It?* is a mental mathematics routine. That is, students should not use tools, paper, or lapboards to support their thinking. However, that's not the best place to begin with young students—especially kindergarteners—who are first learning to break apart numbers. Example A shows how you might use this routine with them. Here, 7 is shown on a 10 frame. Students might have personal mini-10 frames with them on the floor to help them manipulate the number. It may be better for students to have a double-10 frame to help them show the number. 7 can be shown as 6 and 1, 5 and 2, or even 3 and 4. You can model the representation (6 + 1, 5 + 2, etc.), record the expression, and connect these as students share their ideas. Young students should not be expected to generate expressions. You can adjust this example of the routine to use groups of counters, counting bears, dot cards, dominos, or blocks.



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NOTES

B. Elementary students clearly need to decompose numbers greater than 20. Example B asks students to decompose 84. They might do so by breaking it into 80 and 4, 79 and 5, or something more *exotic* like 60 and 24, 44 and 40, or even 49 and 35. Over time, this should become almost effortless for students. However, some numbers might be problematic at first. It is likely best for them to first work with friendly numbers and benchmarks. So, students might first work to decompose tens such as 30, 40, or 80. Then, students might work with benchmark numbers of 25, 50, or 75 before working with numbers like 84, 71, or 43. As your students' confidence and proficiency grows, you can shift the routine to explore decomposition of these *different* numbers. Using this progression enables students to leverage ideas about friendlies and benchmarks in order to decompose other numbers like 84, 71, and 43.

B

How can you make

84?

C. It makes sense to expose students to decomposing three-digit numbers. It is helpful for them to find partial sums and differences on a number line or even mentally. Like other numbers, there is no limit to how three-digit numbers can be decomposed. Again, like other numbers, students are most likely to initially rely on decomposition through place value. If and when this happens, you may need to offer a new example for students to make use of. For 350, you might share 250 and 100 as a possible decomposition as well as other examples. You might decide to place *limitations* or restrictions on how your students can decompose numbers. For this example, you might ask students to decompose 350 into two numbers with one of those numbers being greater than 300. Or, you might ask them to decompose 350 into two numbers that both have more than four ones. Making this adjustment helps students break out of safe decompositions so that you can advance their understanding. It could be used with smaller numbers in earlier grades as well.

C

How can you make

350?

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D. Sometimes, we make inadvertent missteps when we accept the same types or strategies for decomposition. Continuously breaking apart numbers in the same ways become habitual decompositions. Thoughts about 350, shared above, are good examples of this. Students who consistently decompose numbers into place value or one part that has no ones (e.g., 84 as 70 and 14, 60 and 24, or 350 as 340 and 10, 330 and 20) seem to be *fluent* but their understanding may not be very deep. Example D shows how you can adjust this routine to tackle that challenge. It asks students to decompose numbers into more than two parts. Here, students are asked to decompose 15 (the original example) into three numbers. Students might first think about 10, 2, and 3, which is completely fine. From there, students might think about 7, 7, and 1 or something similar. Students in any grade can decompose a number into three parts. You might provide a triple ten frame for young students to organize their thinking when breaking a number into three parts.

D

How can you make

15

with **three** numbers?

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NOTES

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HOW CAN YOU MAKE IT? VARIATION—BASIC FACTS AND COMPUTATION

Learning to decompose numbers may be most applicable to computation. But while some students are able to decompose numbers when they appear in isolation, they are sometimes unable to translate their understanding of computations. This occurs for a variety of reasons most particularly when they are rushed to learn procedures without having lots of opportunities to explore patterns and relationships that underpin computational strategies. In other cases, students are exposed to these strategies but don't have enough time to discuss and reinforce the connections.

E. You can modify *How Can You Make It?* to make connections between decomposition of number and basic facts. It can galvanize students' acquisition and usage of basic fact strategies. Example E shows what that might look like. Here, students are asked how they can make 6 + 9. Granted some students might be able to simply recall the sum. Even so, you should prod them to *rewrite* the expression. Their recall can be satisfying but it may undermine development of more advanced ideas that they can apply to computations that aren't easily recalled. An obvious way to make 6 + 9 is 5 + 10 or 10 + 5 in which one is given to 9 to make a 10. But, there are other ways. It might be thought of as 5 + 1 + 9, which is a similar idea. It might also be thought of as 6 + 6 + 3. In time, students might make it as 9 + 9 − 3. Though using subtraction hasn't been a highlighted strategy for decomposing numbers it can be useful. You should accept and lift it up when it happens.

E

How can you make

6 + 9?

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F. The true power of flexibility in thinking about numbers becomes evident as addends become more complex. The same holds true for the other operations. Example F shows how you can modify this routine to go beyond basic facts. Here, students consider other ways to make 36 + 19, which may include 35 + 20 or 36 + 4 + 15. Students themselves might come up with even more resourceful ways to think about the expression. You should note that 36 + 19 clearly relates to the basic fact in Example E. For classes ready to work with 36 + 19 and similar expressions, you might first open with the related fact (6 + 9) so that students are poised to make connections to 36 + 19 that they might not do so on their own.

F

How can you make

36 + 19?

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HOW CAN YOU MAKE IT? VARIATION—FRACTIONS AND DECIMALS

Proficiency with decomposing multi-digit numbers isn't necessarily the end goal. Students should have experiences decomposing and manipulating expressions as noted in the first variation (Examples E and F). Students can also learn to decompose other types of numbers including fractions and decimals.

G. Some students have experience decomposing fractions. They likely work to decompose fractions into a collection of unit fractions or other arrangements. They might decompose $\frac{5}{8}$ into $\frac{1}{8}+\frac{4}{8}$ or $\frac{3}{8}+\frac{2}{8}$. As with other fraction work, student experiences with fractions greater than one may be unbalanced or inadequate. Example G shows how you can modify the routine to have students decompose a mixed number. Here, they might break $1\frac{7}{8}$ into 1 and $\frac{7}{8}$, $\frac{6}{8}$ and $1\frac{1}{8}$, and so on. You might first have students work with fractions less than 1 before providing opportunities for them to decompose mixed numbers. Keep in mind that you should have them decompose mixed numbers beyond the whole and the fraction part.

G

How can you make

$1\frac{7}{8}$?

H. Decomposing decimals has the same advantages as decomposing whole numbers. Example H presents a decimal number to be decomposed. Students might revert to *simple* strategies when working with decimals. That is, they might decompose by place value (10 + 4 + 0.5) or they might make *clean breaks* (14 + 0.5 or 10 + 4.5). As they show these preferences, you can once again restrict how numbers can be decomposed as mentioned in Example C. You can also help your students connect whole number decompositions with decimal decompositions by sequencing the routine intentionally. For example, fifth graders might be asked to decompose 145 in a variety of ways before shifting to 14.5. You might leave the decomposition of 145 on the board or screen for students to reference as they decompose 14.5.

H

How can you make

14.5?

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