Grade 3 — Critical concept: Addition and Subtraction to 1000

Curricular content

Number concepts to 1000: understanding place value and the relationship between the digit places and their values

Addition and Subtraction to 1000

Language

Decomposition: breaking a number into its parts. This doesn't always mean by place value.

Compensation:
In addition questions: taking some from one number and giving it to the other in order to make one number easier to work with (usually to the closest multiple of ten)

Compensation in subtraction: MUST keep the magnitude of the difference the same. Therefore, if you add to one number in order to bring it to the closest multiple of 10 then you must add the same amount to the other number. Likewise, if you subtract from one number to bring it to the closest multiple of 10 then you would subtract the same amount from the other number.

Partial sums: when you decompose a number and add parts, then add

Examples and Strategies

Place value: Key understandings

- ✓ Understanding the value of the digit. For example: 415 The value of the "1" means 1 ten, or 10.
- ✓ 804 The zero doesn't necessarily mean 0 tens. There are 80 tens in this number, or if you decompose it has 8 hundreds and 4 ones. Or, 80 tens and 4 ones. Students need to be sure to be able to flexibly think about the number and how it is composed.

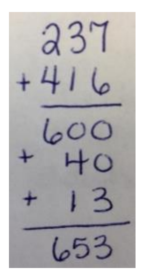
<u>Addition to 1000</u>

Teaching tip: make sure you expose your students to the various ways of writing addition and subtraction questions. They should be able to work horizontally and vertically and switch between the two with ease.

Before moving on to adding and subtracting to 1000, make sure students are efficient and flexible with adding and subtracting to 100. The same strategies can be applied to larger numbers, but once a solid understanding is in place you can introduce the algorithm for efficiency. Keep in mind that the algorithm is not always the most efficient strategy to use, but is one more strategy in the toolbox.

Examples of **<u>addition by decomposition</u>**

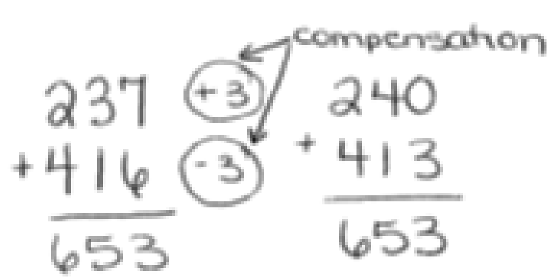
a)
$237 + 416 =$

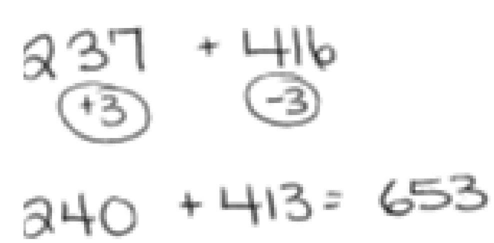


b) $237 + 416$
$237 + 400 = 637$
$637 + 10 = 647$
$647 + 6 = 653$

<u>Addition by compensation</u>: <u>**Caution- compensation is different with addition and subtraction.</u> When using compensation with addition, you are 'joining' two quantities. Think of it this way- if you have two jars of jelly beans that you will dump into a larger bucket, it doesn't matter how you distribute the jelly beans between the two jars, the total will still be the same once you've dumped them into the bucket. You can teach this by giving students towers of unifix cubes. Have them split the tower into two in various ways. The total will still be the same.

Examples of addition by compensation

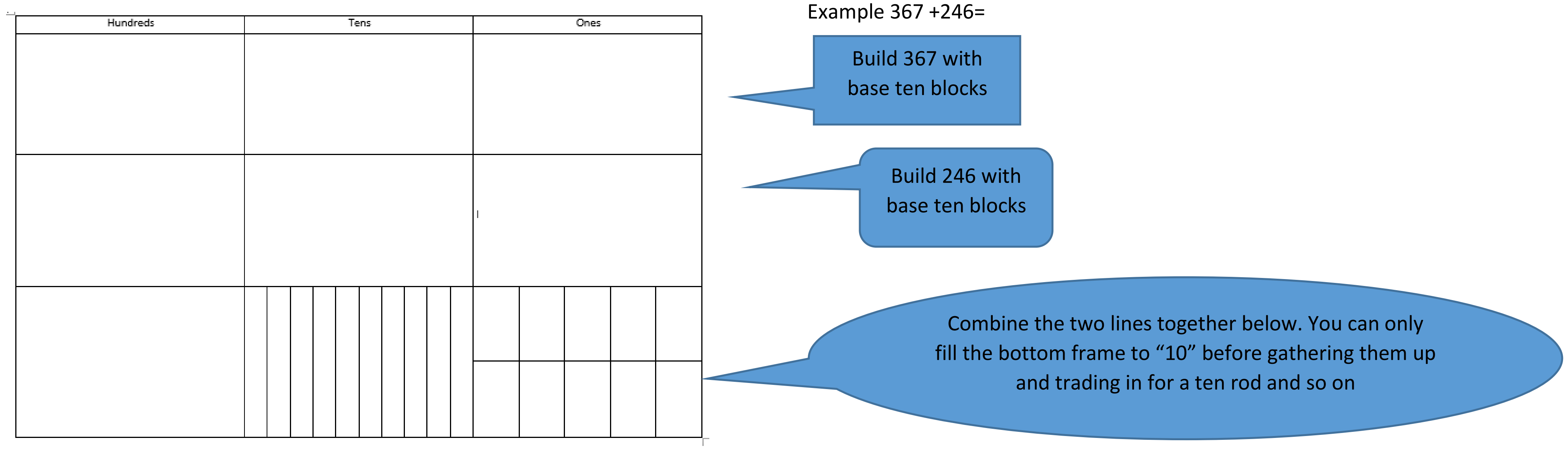




all the partial sums together to find the total

Difference: finding the magnitude of the difference- or how far apart the numbers are. Very important concept that starts developing early from the sequencing activities where you put numbers in a number line without having to look for each number in order.

Transition to the algorithm: only once students have a solid understanding of the other strategies. Some have found it helpful to use the base 10 blocks and a mat to build the equations with manipulatives. It is very helpful to use manipulatives and not go straight to pencil and paper. *Teaching tip* write the question on the board, have students build it, then write it with paper showing what they did. Move into partner work- one partner builds it and the other does it on paper. Compare final answer. Is it the same? If not- work together to find the error and fix it.

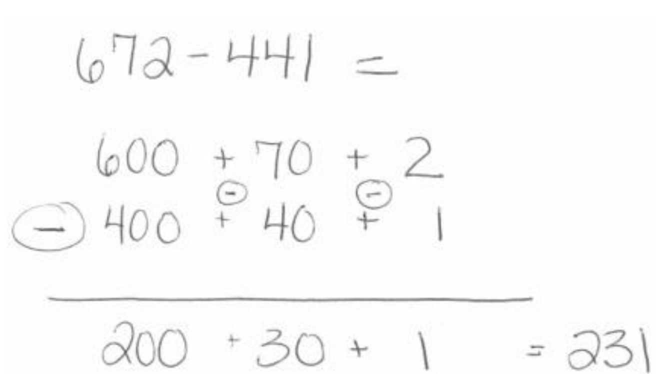


SUBTRACTION

Subtraction is not only taking away (There were 8 birds and 3 flew away how many do we have now?), it is also finding the difference (We have 8 eggs and need 12 for the omlet- how many more eggs are needed), and also "missing addend" (there are 18 students in the class. 10 are boys. How many are girls?) Students should be exposed to all types of thinking around subtraction.

Just like in addition- it is important that students are very fluent and flexible with subtracting up to 100, including the "not so pretty" questions that involve regrouping.

Subtraction by decomposition: Involves decomposing both the minuend (starting quantity) and the subtrahend, then subtracting each part, and adding up the partial differences. This works particularly well if there is no need to regroup.



Compensation

**Be aware that compensation in addition is different than compensation in subtraction. Since you are looking for difference in subtraction, you must keep the magnitude of the difference the same when you use compensation. If you add 3 to the subtrahend, you must also add 3 to the minuend.
In **addition**, you are keeping the total the same. Think of it as holding two quantities of marbles in your hands, one group in each hand. If you are dumping all the marbles into a jar and finding the total, it doesn't matter how many were in the right or left hand. You can shuffle between the two hands without changing the total.
In **subtraction**, you are keeping the magnitude of the difference the same between the two quantities. Therefore, if you add 4 to the subtrahend, you must add 4 to the minuend as well. A visual example of this is have two very different height students stand next to each other. What is the "difference" in height? Then have one stand on a chair. Is the difference still the same? No- so if one stands on a chair, the other would need to stand on a chair as well to keep the difference the same.

Example of subtraction by compensation:

342 - 127 =

Rewrite as

```
  342   +3    345
- 127   +3  - 130
            -----
              215
```

342 - 127 = 215

Subtraction using compensation: easier to see if you rewrite the question vertically.

Take the subtrahend to the nearest multiple of 10. Treat the minued the same way (e.g add 3 to each).

The subtraction is much easier now!

Another place where compensation can save a lot of issues:

1000 - 682 =

compensation

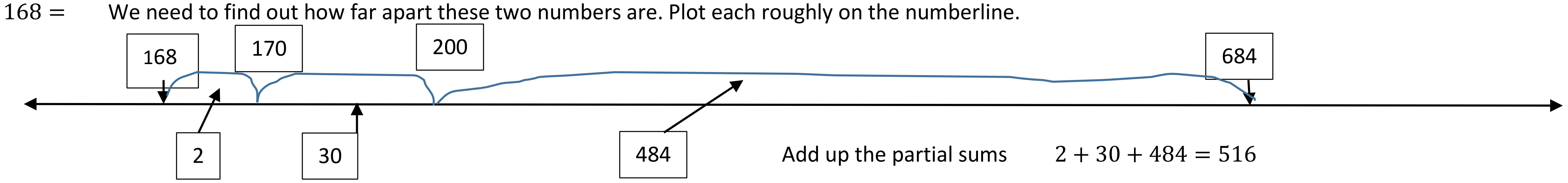
```
  1000   -1    999
-  682   -1  - 681
             -----
               318
```

1000 - 682 = 318

Subtraction via Adding up to find the difference

Adding up to find the difference

$684 - 168 =$ We need to find out how far apart these two numbers are. Plot each roughly on the numberline.



Add up the partial sums $2 + 30 + 484 = 516$

When you add up to find the difference, you can use as many or as few "jumps" as you need to. Some students may be able to see that 168 + 32 gets you to 200, whereas others may need to get to 170 first. ***The goal is to be able to do this in two jumps** as it is more efficient. For example, be able to find how many to 200 (which is 32) and how far from 200 to 684 (Which is 484) and then add 484 and 32 together to get 516.

***Once students have a very good understanding of adding and subtracting using strategies flexibly, they will need to know how to use the **standard algorithm.** This is because it is often the most efficient way to perform the required operation. This is particularly true when addition and subtraction become embedded in larger tasks. For example, in division students will need to be able to subtract efficiently in order to divide (whether you are using repeated subtraction for division or other methods). It would quickly become unwieldly to have to subtract by compensation or decompensation at the side of the page, then write in the answer in your division question. For this reason, we teach the algorithm but **only once students have a strong understanding of the concept of addition and subtraction.** It is well worth the time to spend all of grade 2 and a substantial part of grade 3 building that conceptual knowledge and understanding. Do not teach the algorithm in grade 2.

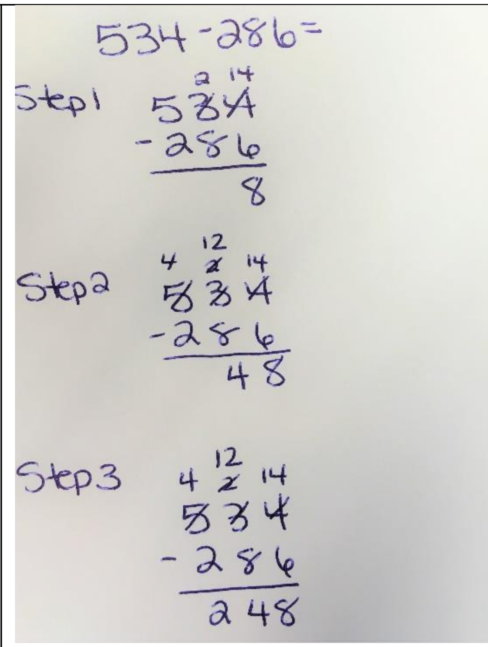
Transitioning to the standard algorithm: Subtraction

It is essential to use manipulatives to transition to the algorithm.

$432 - 267 =$

Step 1: Have three students build the number with base ten blocks and stand at the front of the room. One holds the 4 hundreds flats, one hold three ten rods and one holds 2 ones.
Step 2: Tell the students we are going to subtract 267 from the quantity held at the front of the room.
Step 3: instruct a student to go to the front and take 7 ones. Do not help them. Let them figure out they will need to trade in a ten rod for 10 ones over at the "bank" of base 10 blocks.
Step 4: continue in the same fashion until you have the final solution. Record the answer.

It is often effective to do this many times using manipulatives without putting pencil to paper. Once they understand the process, the teacher may record their actions the 'way that mathematicians would record' on the whiteboard. As was the case in addition- have students build the equation with manipulatives, then do it with pencil. They may work in partners and have one build it, one solve with pencil and paper, and then compare solutions. If they aren't the same, find the error and solve it.



Step 1: When a ten rod is needed to be traded for 10 ones, record that by showing they now only have 2 ten rods, but now we have 14 ones. Don't have students just sneak a little 1 next to the existing 4. Cross it out and write 14 clearly above the ones column.

Step 2: When a hundreds flat is traded for 10 ten rods, do the same thing and record that you now only have 4 hundreds, but you have 12 ten rods. Again, write it clearly above the tens column.

Step 3: Finish subtracting. The answer is 248.

Step 4: Students should now be able to VERIFY their answer, by adding $248 + 286$ together and they should have 534 altogether. (248 was the difference, 286 was the subtrahend and 534 was the minuend)

Important vocabulary note: try to refrain from using the term "Borrow", and use regroup instead. Borrow implies that we are getting something extra, that we should give back. The reality is we are just reorganizing how we see the number and we aren't changing the quantity.

Where does this lead?

Grade 4 decomposition in multiplication: 26×8

$$(20+6) \times 8$$
$$(20 \times 8)+(6 \times 8)$$
$$160+48=208$$

Grade 9/10: $(2x^2+3x-5)+(7x^2-4x+3)=9x^2-x-2$ (adding polynomials)

Example 2 $2x^2+7x+5$ (Factoring trinomials)

$$2x^2+2x+5x+5$$

$$2x\,(x+1)+5(x+1)$$

$$(2x+5)(x+1)$$

Grade 3

Critical Concept: **Equations**

Curricular content

One step addition and subtraction equations with an unknown number

-unknown can be represented by a letter, shape.

Language

Equal: the same as, or balanced

Unequal: not the same as, imbalance

Start unknown: the variable is at the beginning of the statement or equation

Change unknown: a variable is in the middle of the equation.

Result unknown: the final result is the variable which is unknown

Variable: an unknown quantity that we are solving for. Symbols used to indicate the variable might be a box, a letter, a picture etc

Examples and Strategies

Equations are really important. In Kindergarten they learn balance and imbalance. In grade 1 students are introduced to = and ≠ and the connection to balance needs to be reinforced. In grade 3 it is important to reinforce that the = doesn't always mean "the answer is coming next". It is a sign meaning balance. You want both sides of the equation to have the same value. There can be multiple terms on each side of the equation, similar to d) in the list below.

Four types of equations:

a) Start unknown example $\blacksquare + 7 = 13 \quad or \quad x + 7 = 13$

b) Change unknown example $6 + \blacksquare = 13$ or $6 + x = 13$

c) Result unknown example $6 + 7 = x$ or $6 + 7 = \blacksquare$

d) Balance $3 + 5 = 2 + x$

It is important to not always have the = in the same place too. You can write it as $13 = 6 + x \quad OR\ 6 + x = 13$. Students sometimes assume that = means "the answer is coming" and we need to ensure they think of = as a balance or "same as". For example, saying 13 is the same as 6 and 7 rather than always saying 6 and 7 is 13. An example where "the answer is coming next" doesn't make sense would be $3 + 2 = 4 + 1$ and this is certainly how students will experience equations in more complex math.

Examples: $3 + 4 = 5 + \blacksquare$

$\blacksquare - 7 = 10 \quad OR\ x - 7 = 10$ (start unknown)

$17 - x = 10$ (Change unknown)

$17 - 7 = x$ (result unknown)

Story problem examples:
Start unknown. I had some apples. I ate 7 and now I have 10. How many did I have to start with?
Change unknown: I had $17. I bought some groceries and now I have $10 left. How much did the groceries cost?
Result unknown: I had 17 blocks and Jared took 7 of them. Now how many blocks do I have left?

Where does this lead?

Solve for x
$-3x + 3 = 12$ (grade 8 level) Answer $x = -3$

$5x^2 + 2x - 4 = 3x^2 + 5x - 2$ (grade 11 level)