

Mental arithmetic for addition and subtraction to 100

John Munro

Addition facts for numbers less than twenty : recommended sequence:

Prerequisite counting strategies. Students need to automatize counting up strategies to 20:

1. Counting up to 10.
2. Counting up to 10 from any number less than 10 and then to 20.
3. Counting up 1, 2, 3 or 4 steps from any number less than 10.

Adding by counting on 1, 2, 3 or 4. Students count mentally up to four steps.

The addition facts that sum to ten; the following sequence is recommended: Pupils

1. use a 'stairs' or other model to describe sums that produce 10.
2. say each item and write it in numbers when part of the model is obscured.
3. start to break up the set of items; say every second item and write it in numbers, visualize each item in the model.
4. work on items out of order.
5. work on complementary pairs, for example, $8 + 0 = 10$ and $2 + 0 = 10$, using the grid.
6. respond rapidly to individual facts, decide whether facts add to ten.

Addition facts for a sum of 11, 12 and 9 are derived from the addition facts to ten:

1. Using an extended stairs model for sums of 11 or 12 orally
2. Given a number fact, e.g. " $9 + 3 =$ ", use corresponding sum to ten and increment.
3. Apply the going down procedure for sums to 9.
4. Mixed addition facts, deciding which strategy they will use

The addition ties (or "sames", or "doubles") for example " $8 + 8 =$ " can be developed initially from the number path, or from the extended model. Useful activities include the following:

1. Pupils generate the ties, say each tie and write it
 2. Pupils complete sets of mixed addition facts, deciding first which strategy they will use
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|--------|---------|---------|
| $2+2=$ | $8+8 =$ | $3+9 =$ |
| $6+6=$ | $5+2 =$ | $4+3 =$ |

The addition ties add one or two for example " $6+8 =$ ", " $8+9 =$ " from the addition ties:

1. Pupils begin with the tie and increment by one or two
2. Given a number fact derived from a tie, pupils say or write the tie and then increment.
3. Pupils use a similar decrementing procedure for addition ties take away one or two.
4. Pupils complete sets of mixed addition facts

Adding on 10 ; develop either using a number path to 20 and a ten-strip or a bundle of ten. Pupils

1. derive the pattern as an action, make and check predictions on the number path.
2. imagine or picture in their minds how a number will change when ten is added.
3. generate complementary pairs, for example, " $2 + 10 = 12$ " and " $10 + 2 = 12$ ".

Adding on 9 or 8 derived by adding on ten and then going down one or two ..

Adding on 11, 12 and 13 Pupils add on 11, 12 and 13, by adding on 10 and then 1, 2 or 3.

Subtraction from twenty

Prerequisite strategies. Students automatize counting down strategies for numbers less than 20:

1. Counting backwards from 10.
2. Counting backwards from any number less than 10 and later, from any number less than 20.
3. Counting backwards 1, 2, ... 5 steps from any number less than 10.

The subtraction strategies. Develop using the approach for adding to 20. Link with the corresponding addition fact.

1. Subtracting from any number less than 20 by counting down 1, 2 .. 5 steps.
2. Subtraction from 10, for example $10 - 1 = 9$, $10 - 2 = 8$ developed from complementary addition to 10. Begin by using the 'stairs' model or other concrete models.
3. Subtraction from 8, 9, 11 or 12, for example $9 - 2 = .$ Develop fro "ten minus" facts.
4. The subtraction ties, for example $18 - 9 = 9$, $16 - 8 = 8$. Develop from matching addition ties.
5. The subtraction ties +1, +2, for example, $14 - 8 = , 14 - 6 = .$
6. Subtracting 10 from a teens number, for example, $17 - 10 = .$
7. Subtracting 9, 8 or 7 from a teens number.

Addition and subtraction for numbers to 100

Prerequisite counting strategies. Students automatize counting up and down strategies for numbers up to 100: counting

1. up to 100 and down from 100 in steps of one.
2. from any number less than 100, either up to 100 or down to 0.
3. up or down 1, 2, 3 or 4 steps from any number less than 100.
4. up or down in steps of 10 from any number less than 100.
5. up and down between decades, for example, counting down from 71.

The addition and subtraction strategies to 100. Use the approach for adding to and subtracting from 20. S

1. Add 1, 2, 3 or 4 to any 2-digit number without crossing a decade
2. Decide whether adding to any 2-digit number will take them to another decade, for example
3. Add a number less than 10 to any 2-digit number by using the matching sum to 20.
4. Subtract 1, 2, 3 or 4 from any 2-digit number without crossing a decade.
5. Decide whether subtracting from any 2-digit number will take them to another decade
6. Subtract a number less than 10 to any 2-digit number by using the matching subtraction for numbers to 20.
7. Add 10 to any 2-digit number.
8. Add 9, 8, 7 to any 2-digit number.
9. Subtract 10 from any 2-digit number.
10. Subtract 9, 8, 7 from any 2-digit number.
11. Add 20, 30, 40 to any 2-digit number.
12. Subtract 20, 30, 40 from any 2-digit number.
13. Subtract 1, 2, .. 9 from multiples of 10, for example, $80 - 3 = , 70 - 8 = .$

Learning the multiplication tables.

Recalling and applying multiplication tables facts causes difficulty for many students; for example

- they can't recall particular table facts out of order
- they consistently mix up and jumble the multiplication patterns.

Maths performance in many areas is enhanced if students can recall multiplication facts automatically.

The recommended order for learning the tables

- two, ten, three, and five times tables are learnt first.
- four, six times tables.
- tables based on incrementing by ten; nine, eight and seven, eleven and twelve times tables.

The recommended sequence for learning each table involves the following components:

1. "groups of" pattern : pupils manipulate grouped quantities and produce a "groups of" table.
2. counting on : pupils count in steps on which the table is based.
3. "groups of" table : pupils write and recite the "groups of" table.
4. the "times" notion : pupils translate the "groups of" table into the "times" notation.
5. the symbolic notation : pupils translate the "times"(x) notation into symbols.

6. the table in symbolic notation: pupils produce the table by counting on, etc.
7. breaking up the table : pupils begin to break up the table into particular items.
8. individual table facts : pupils manipulate individual table facts.
9. table facts mixed up : table facts are mixed up with other tables.

Useful models and materials

Bead chain :displays the "groups of" notion. Each number is represented by a bead in a linear order.

Table stamps : the table stamps save teachers the need to write out a table several times. The stamp can be used first when students are learning the facts in order and when they are learning to break up the order (the teacher crosses out particular items).

$$\begin{array}{r}
 1 \times 3 = \\
 2 \times 3 = \\
 3 \times 3 = \\
 4 \times 3 = \\
 5 \times 3 = \\
 6 \times 3 =
 \end{array}$$

Quantity cards :