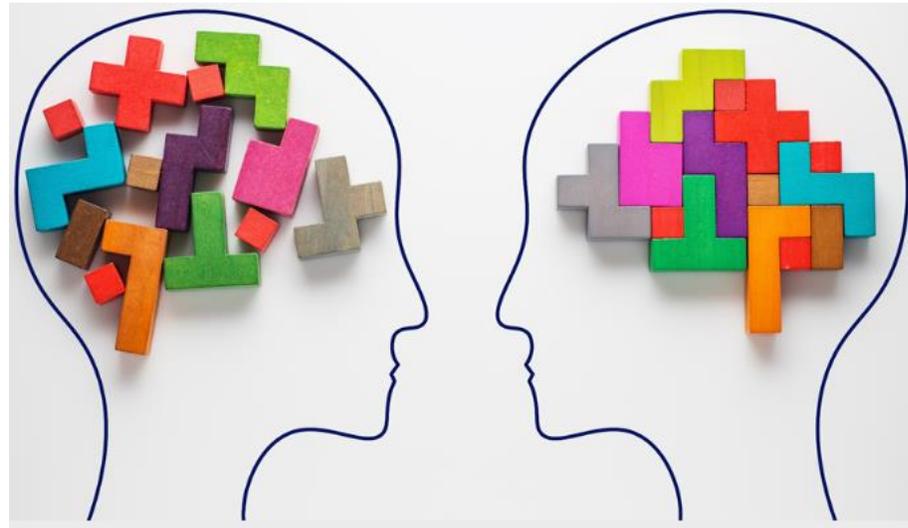# Mathematical Fluency

The national curriculum for mathematics aims to ensure that all pupils:
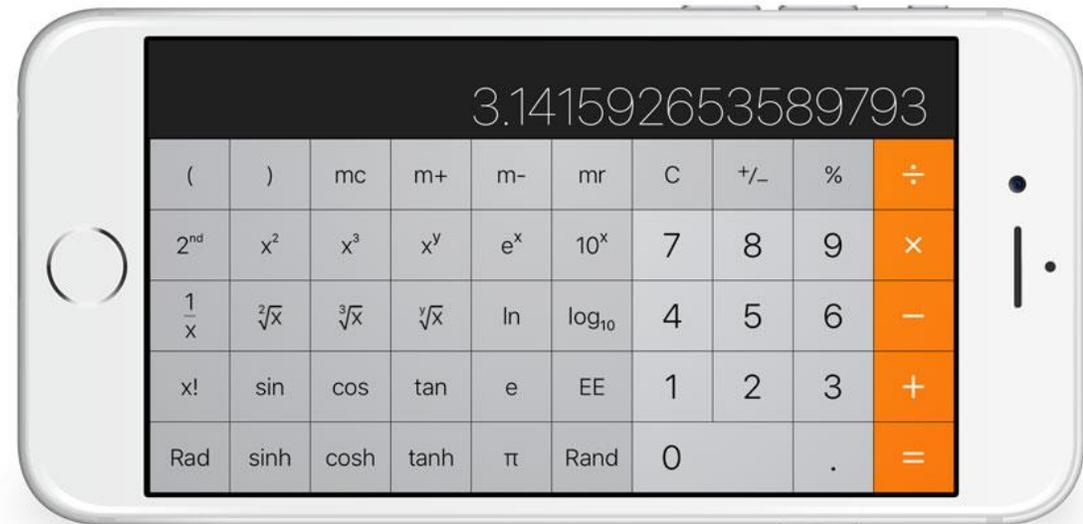
1. become **fluent in the fundamentals of mathematics**, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately

2. **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language

3. can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

Fluency

Students exhibit computational fluency when they demonstrate flexibility in the computational methods they choose, understand and can explain these methods, and produce accurate answers efficiently. There are 3 key elements:

1. **Efficiency** - this implies that children do not get bogged down in too many steps or lose track of the logic of the strategy. An efficient strategy is one that the student can carry out easily.

2. **Accuracy** depends on several aspects of the problem-solving process, among them careful recording, knowledge of number facts and other important number relationships, and double-checking results.

3. **Flexibility** requires the knowledge of more than one approach to solving a particular kind of problem, such as two-digit multiplication. Students need to be flexible in order to choose an appropriate strategy for the numbers involved, and also be able to use one method to solve a problem and another method to check the results.

So fluency demands more of students than memorising a single procedure – they need to understand *why* they are doing what they are doing and *know when it is appropriate* to use different methods.

- **Procedural fluency**

- **Conceptual fluency**

$$112$$
$$+40$$
$$\overline{512}$$

Example 1: Compute 3.14×4.5

Conceptual Understanding: *comprehension of mathematical concepts, operations, and relations*	Procedural Fluency: *the ability to apply procedures accurately, efficiently, and flexibly*
Students have an understanding that the product 3.14×4.5 must be between 12 and 20 and might more accurately estimate the product to be close to 14	Students use a procedure or algorithm to compute the product $3.14 \times 4.5 = 14.13$, and they use their *conceptual understanding*, to assess the reasonableness of the result

Conceptual fluency without procedural fluency can make the problem-solving process tortuous – children lose track of their thinking because they have to divert their energies into calculations which should be quick but aren't.

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There are actually an infinite amount of number facts in the world. 963 multiplied by 748 equals 720,324 is a fact, but isn't worth remembering. There are only a few number facts we expect children to learn - our 'Learn Its'.

Knowledge of number facts enhances understanding and fluency. When a child doesn't know their times tables it can obstruct progress as they can't draw on this knowledge to solve other maths problems – try multiplying 70 X 80 without knowing 7 X 8!

Practice Learn Its twice a day for 10 mins!

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Year & Term	Step	Addition	Multiplication	Doubles	Halves
Y4:T3	15		X12 Table		
Y4:T2	14		X11 Table		3, 5, 7, 9
Y4:T1	13		The Six Fact Challenge!		
Y3:T3	12		X8 Table		
Y3:T2	11		X4 Table		
Y3:T1	10		X3 Table		
Y2:T1	9	5+9, 6+9, 7+9, 5+7, 5+8, 6+8	X2 Table		300,500700,900
Y2:T2	8	5+4, 5+6, 6+7, 8+7, 8+9	X5 Table		
Y2:T1	7	3+8, 3+9, 4+7, 4+8, 4+9	X10 Table	50, 60, 70, 80, 90	30, 50, 70, 90
Y1:T1	6	6+6, 7+7, 8+8, 9+9	Multiples of 2 – In counting		3,5,7,9
Y1:T2	5	4+2, 5+2, 6+2, 7+2, 9+2, 4+3, 5+3, 6+3		5, 6, 7, 8, 9	
Y1:T1	4	1+9, 2+8, 3+7, 4+6, 5+5	Multiples of 5 – In counting	10, 20, 30, 40	
RT1	3	2+1, 2+3	Multiples of 10 – In counting	1, 2, 3, 4	
R:T2	2	3+3, 4+4, 5+5			
R: T1	1	1+1, 2+2			

1. Skip count

e.g. 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33

2. Practise facts in order

1x3 = 3

2 x 3 = 6

3 x 3 = 9

3. Test children out of order

What is 7 x 3?   5 x 3?

4. Test the inverse calculation

How many 3s are there in 21? What is 30 divided by 3?

For fun ways to skip count, search for 'Rolling Numbers' on YouTube.

Fizz-Buzz

Take it in turns to count up from 1.

When you reach a multiple of the times table you are practicing, instead of the number, say 'Fizz'.

If the number is a multiple of both, then say 'Fizz Buzz'

This can be extended to practice two times tables at once, e.g. for the 3 times table and the 5 times table: 1, 2, Fizz, 4, Buzz, Fizz, 7, 8, Fizz, Buzz, 11, Fizz, 13, 14, Fizz Buzz

- <u>Playing Cards</u>

Deal your child 2 cards and ask them to multiply them.
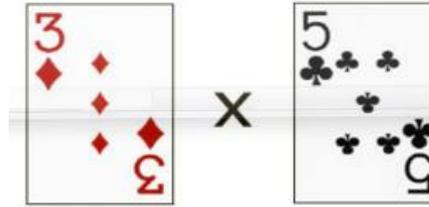
- <u>Speed Challenge</u>

How many questions can you answer orally in a minute? Alternatively there is an online version:

- <u>Create 'tricks' and funny rhymes</u>

e.g. I ate and I ate until I was sick on the floor. Eight times eight is sixty four.

7 X 8 = 56 is easy to remember because 5 and 6 come before 7 and 8.

- <u>Password</u>

Would you like me to pass the salt? Enter a room? Get on the bus? First you must give the password by answering a multiplication question.

- <u>Answer First</u>

Can the child work out what the question should be? E.g. Parent: 15   Child: 3 X 5!

Fun Songs

- Friends of Ten: https://www.youtube.com/watch?v=o0bKIeYdvCc

- That Makes Ten: https://www.youtube.com/watch?v=cdlxSwokZRw

- Mr. DeMaio on YouTube does covers of pop songs for each times table, e.g. the 6 times table to 'Cheerleader'. https://www.youtube.com/watch?v=9os1VUUp5io

Laughalongandlearn on YouTube have some very fun and memorable songs:

- 2 Times Table Song: https://www.youtube.com/watch?v=lUIB-dZRCiA

- 3 Times Table Song: https://www.youtube.com/watch?v=dzVyBQ5uTbo

- 4 Times Table Song: https://www.youtube.com/watch?v=lBmSshEDVnQ

- 5 Times Table Song: https://www.youtube.com/watch?v=vCjt1dbhvWU

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Mathletics