TEACHING NOTES AND LESSON PLAN FOR "ORDER OF OPERATIONS".

I like to arrive at BIDMAS after an investigation of **"whether we get the same answer or not when we do operations in different orders".**
It would be a great shame to just "give the rule"!
You could use the following as a lesson plan if you wish:

Consider these pairs of questions and see if we get the same answers by changing the order.

1. $3 + 4 + 5$ or $3 + 4 + 5$

$= 7 + 5$ | $= 3 + 9$

$= 12$ | $= 12$

Clearly, the order did not matter in this case.

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2 $8 – 5 – 1$ or $8 – 5 – 1$

$= 3 – 1$ | $= 8 – 4$

$= 2$ | $= 4$

We get different answers so the order does matter!

We need to make a rule (or convention) so that we all do the same thing in cases like these above.

IF A PROBLEM HAS JUST + OR – OR BOTH, WE MUST START FROM THE LEFT.

eg 3. $12 – 5 + 2 – 1$
$= 7 + 2 – 1$
$= 9 – 1$
$= 8$

We obviously do not have to write out all these steps every time because we can do most things mentally.

eg 4. $14 – 6 – 3 – 1$
$= 8 – 3 – 1$
$= 5 – 1$
$= 4$

If we try ANY other order, we will get the wrong answer !

Now consider these pairs of questions:

5. $3 \times 4 \times 2$ or $3 \times 4 \times 2$

$= 12 \times 2$ $= 3 \times 8$

$= 24$ $= 24$

Clearly, the order did not matter in this case.

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6. Now consider:

$24 \div 4 \div 2$ or $24 \div 4 \div 2$

$= 6 \div 2$ $= 24 \div 2$

$= 3$ $= 12$

We get **different answers** so the order does matter !

We need to make a rule (or convention) so that we all do the same thing in cases like these above.

IF A PROBLEM HAS JUST × OR ÷ OR BOTH, WE MUST START FROM THE LEFT.

eg 7 $6 \times 8 \div 4$

$= 48 \div 4$

$= 12$

eg 8. $12 \div 2 \times 3$

$= 6 \times 3$

$= 18$

NOW SUPPOSE WE HAVE A MIXTURE OF +, –, ×, ÷ IN THE SAME PROBLEM!

eg If you buy a packet of cornflakes for \$5 and 3 cans of beans each costing \$2 then the cost could be written as $5 + 3 \times 2$

Clearly we do NOT start from the left here. The correct cost is $5 + \mathbf{6} = \$11$
If we were to start from the left we would get $8 \times 2 = \$16$

A RULE FOR THIS IS: **× COMES BEFORE +**

Basically, **+** and **–** are equal importance and if a problem only has **+** and **–** then we just start from the left.
Similarly, **×** and ÷ are also of equal importance and if a problem only has **×** and ÷ then we also just start from the left.
BUT if a problem has a combination of **+, –, ×** or ÷ we must do the **×** and ÷ before we do the **+** and **–**.

eg 10. $2 \times 4 + 3$
$= 8 + 3$
$= 11$

11. $5 + 6 \times 2$
$= 5 + 12$
$= 17$

12. $7 \times 2 - 9$
$= 14 - 9$
$= 5$

13. $9 - 3 \times 2$
$= 9 - 6$
$= 3$

14. $8 \div 4 + 2$
$= 2 + 2$
$= 4$

15. $8 - 20 \div 4$
$= 8 - 5$
$= 3$

16. $9 + \mathbf{2 \times 3} - 4$
$= 9 + 6 - 4$
$= 15 - 4$
$= 11$

17. $2 \times 3 + 4 \times 5$
$= 6 + 20$
$= 26$

18. $8 \div 2 + 5 \times 2$
$= 4 + 10$
$= 14$

19. $7 + 8 \div 2 - 5$
$= 7 + 4 - 5$
$= 11 - 5$
$= 6$

BREAKING THE RULES !

We can do this by using **BRACKETS.**

The order now is BRACKETS FIRST, then × and ÷, then lastly + and –

1(a) $3 + 2 \times 4$
$= 3 + 8$
$= 11$

(b) $(3 + 2) \times 4$
$= 5 \times 4$
$= 20$

2(a) $18 - 6 \div 3$
$= 18 - 2$
$= 16$

(b) $(18 - 6) \div 3$
$= 12 \div 3$
$= 4$

3(a) $8 - 3 \times 2$
$= 8 - 6$
$= 2$

(b) $(8 - 3) \times 2$
$= 5 \times 2$
$= 10$

4(a) $40 \div (4 \div 2)$
$= 40 \div 2$
$= 20$

(b) $(40 \div 4) \div 2$
$= 10 \div 2$
$= 5$

5(a) $(40 \div 4) \times 2$
$= 10 \times 2$
$= 20$

(b) $40 \div (4 \times 2)$
$= 40 \div 8$
$= 5$

THE FINAL STEP IS : INDICES

Instead of writing **2 × 2 × 2 × 2 × 2** we can just write $\mathbf{2^5}$

So $\mathbf{3^4}$ does not equal **3×4** but **3×3×3×3 = 81**

Things get a little bit confusing here but just do the following:

$$2 + 10 \times 3^2$$ first we do indices

$$= 2 + 10 \times 9$$ now we do ×

$$= 2 + 90$$ and finally do +

$$= 92$$

However in this problem:

$$(2 + 4) \times 3^2 - 5$$ first we do brackets

$$= 6 \times 3^2 - 5$$ now we do indices

$$= 6 \times 9 - 5$$ then ×

$$= 54 - 5$$ and finally subtract

$$= 49.$$

Also note that: $\dfrac{7+5}{9-6}$ is the same as though there were brackets $\dfrac{(7+5)}{(9-6)}$

And this means: $(7 + 5) \div (9 - 6) = \dfrac{12}{3} = 4$

Putting ALL these ideas together we can make a **"word"** to help remember them:

B I D M A S

Where B stands for BRACKETS

I stands for INDICES

D stands for DIVISION
M stands for MULTIPLICATION

note: Division is not really BEFORE Multiplication. They have equal priority.

A stands for ADDITION
S stands for SUBTRACTION

note: Addition is not really BEFORE Subtraction. They also have equal priority.

Sometimes the BIDMAS order does not seem to hold rigidly:
eg

$(2^3 - 5)^2$ because we can't do the Brackets before we do the Index 2^3

$= (8 - 5)^2$

$= (\ 3\ )^2$

$= 9$