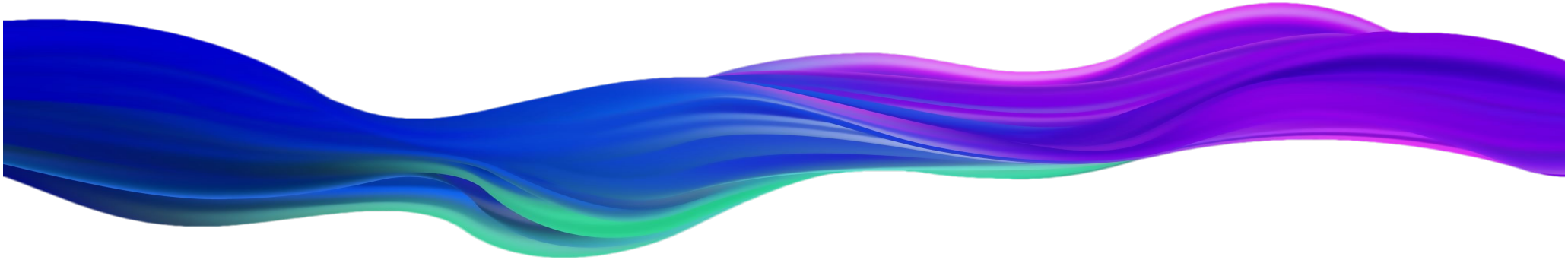
MATH SUPERPOWERS:

Building for Success



Based on the work of Joan A. Cotter, Ph.D.

Number Sense

- Confusion often due to vague understanding of what numbers mean and how they relate to each other.
- Attempt to solve with rote memorization.

$$7 + 6 = 13$$
$$7 - 6 = 1$$
$$7 \times 6 = 42$$

2

Rote Memorization

- There are 390 math facts to memorize.
- Rote memorization is based on behaviorism.
- It needs frequent review and is high maintenance.
- Nearly impossible for those with special needs or learning challenges.
- Rote memorization decreases the joy of math.
- Makes **applying** learning more difficult.

3

Experience Counting Process

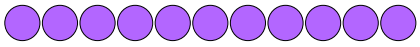
Because we're so familiar with numbers, 1, 2, 3, 4, and so forth,

A = 1
B = 2
C = 3
D = 4
E = 5

4

Experience Counting Process

K
– E
F



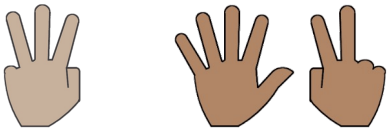
Does this overwhelm you? Create anxiety?

This is what our children experience….

5

Math Superpowers

- **Subitizing** is the rapid and confident recognition of quantity without counting.
- Need grouping in 5s and 10s.



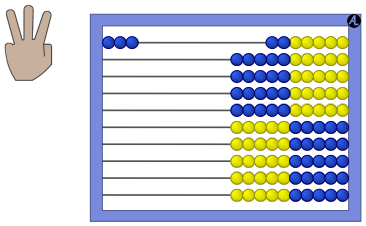
6

Math Superpowers

- **Subitizing** is the rapid and confident recognition of quantity without counting.
- Need grouping in 5s and 10s.
- **Visualizing** is the ability to form a mental image; to imagine; to see it in your mind.
- **Strategies** are a way to learn a new fact or to recall a forgotten fact; creates organization.
- **Visual representations = powerful strategies.**

7

Subitizing



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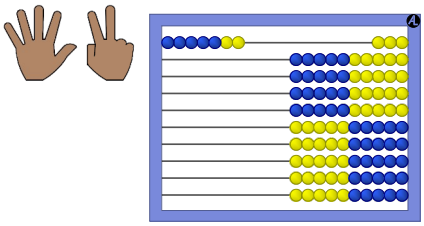
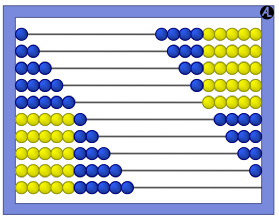
Subitizing



9

Counting with Meaning



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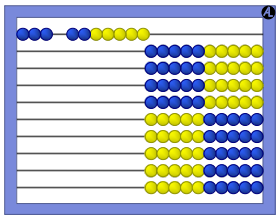
Subitizing and Visualizing



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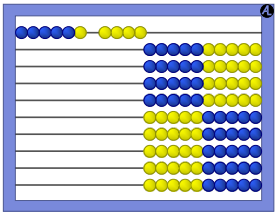
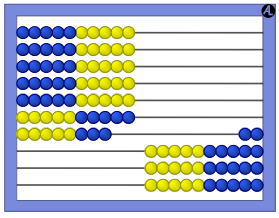
Subitizing and Visualizing



12

Subitizing and Visualizing



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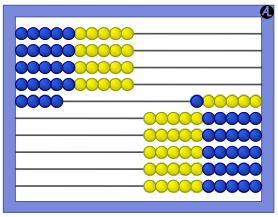
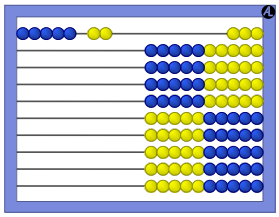
Subitizing and Visualizing



14

Addition

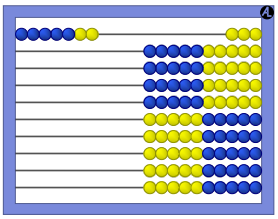
5 + 2 =



15

Addition

5 + 2 = 7



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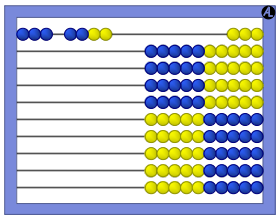
Addition

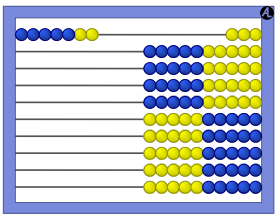
3 + 4 =



17

Addition

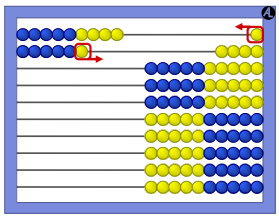
3 + 4 = 7



18

Addition Strategies

9 + 6 =

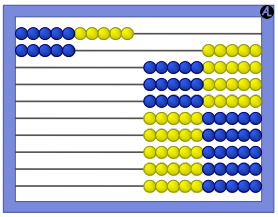


Complete the Ten Strategy

19

Addition Strategies

$9 + 6 = 15$

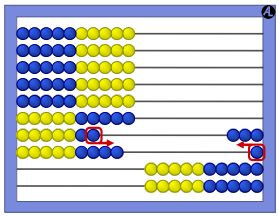


Complete the Ten Strategy

20

Addition Strategies

$67 + 9 =$

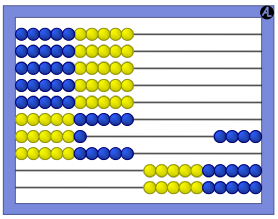


Complete the Ten Strategy

21

Addition Strategies

$67 + 9 = 76$

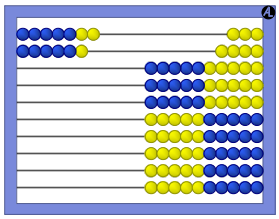


Complete the Ten Strategy

22

Addition Strategies

$7 + 6 =$

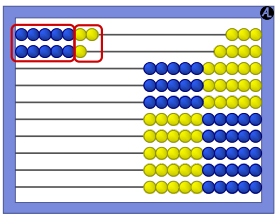


Two Fives Strategy

23

Addition Strategies

$7 + 6 = 13$

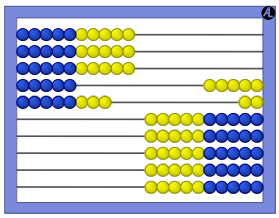


Two Fives Strategy

24

Addition Strategies

$35 + 8 =$

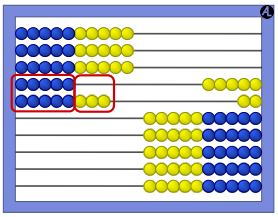


Two Fives Strategy

25

Addition Strategies

$35 + 8 = 43$

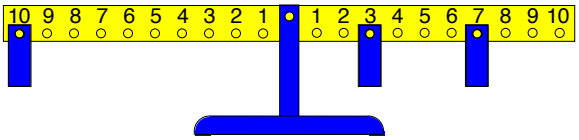


Two Fives Strategy

26

Math Balance

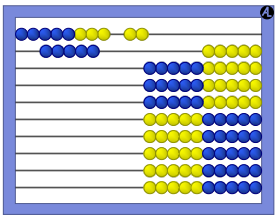
$10 = 3 + 7$



27

Subtraction Strategies

$15 - 8 = 7$

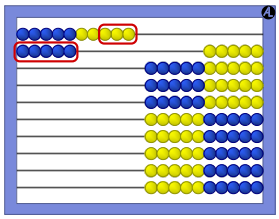


Going Up Strategy

28

Subtraction Strategies

$15 - 8 =$

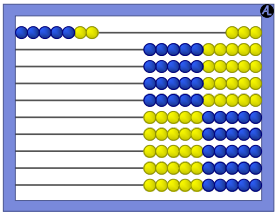


Taking Part from Ten Strategy

29

Subtraction Strategies

$15 - 8 = 7$

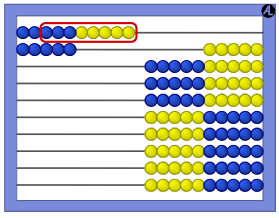


Taking Part from Ten Strategy

30

Subtraction Strategies

$15 - 8 =$

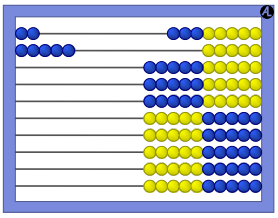


Taking All from Ten Strategy

31

Subtraction Strategies

$15 - 8 = 7$

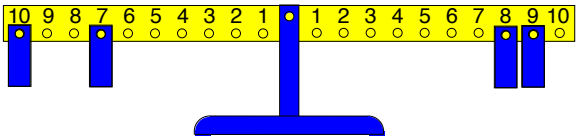


Taking All from Ten Strategy

32

Math Balance

$17 - 9 = 8$



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Multiplication

- Multiplication has been the mathematical downfall of many students (and adults).
- It's the problem of memorizing the 100 facts.
- Multiplication is often taught as repeated addition.
- This gives a limited view of multiplication.
- An array in rows and columns, like this abacus, makes a better model.

34

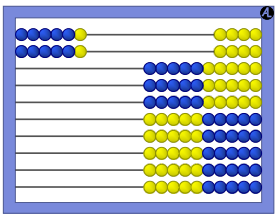
Multiplication

- There are different interpretations about the meaning of 6×2.
  - $6 + 2$: start with 6 and transform by adding 2
  - $6 - 2$: start with 6 and transform by decreasing 2
  - $6 \div 2$: start with 6 and transform it by dividing it into either 2 groups or groups of 2
- Therefore, to be consistent, 6×2 starts with 6 and transforms it by duplicating it.

35

Multiplication

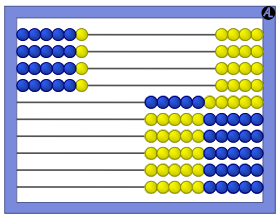
$6 \times 2 = 12$



36

Multiplication

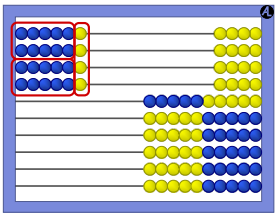
$6 \times 4 =$



37

Multiplication

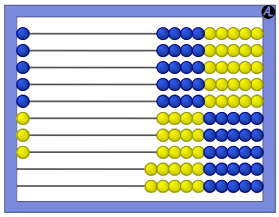
$6 \times 4 = 24$



38

Multiplication

$1 \times 8 = 8$



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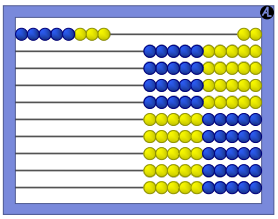
Multiplication

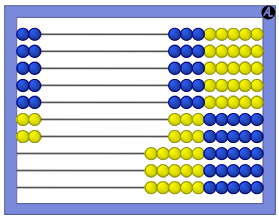
$8 \times 1 = 8$



40

Multiplication

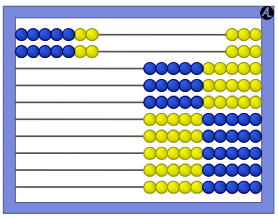
$2 \times 7 = 14$



41

Multiplication

$7 \times 2 = 14$



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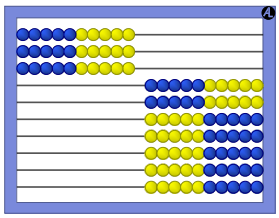
Multiplication

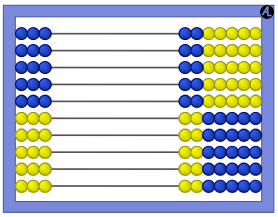
$10 \times 3 = 30$



43

Multiplication

$3 \times 10 = 30$



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Multiplication

- In a 10 by 10 multiplication table, the commutative property reduces the number of facts from 100 to 55 facts.

1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

- Facts of 1s, 2s, and 10s are generally easy.
- Now there are only 28 facts left to learn!

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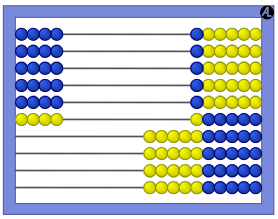
Multiplication Strategies

$4 \times 6 =$



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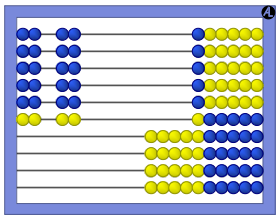
Multiplication Strategies

$4 \times 6 = 2 \times 6 \times 2$



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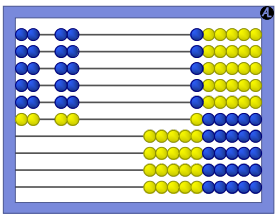
Multiplication Strategies

$4 \times 6 = 12 \times 2 = 24$



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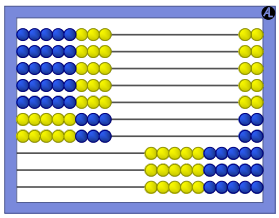
Multiplication Strategies

$8 \times 7 =$



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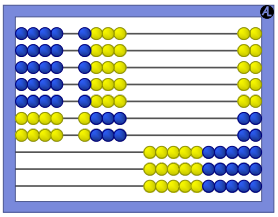
Multiplication Strategies

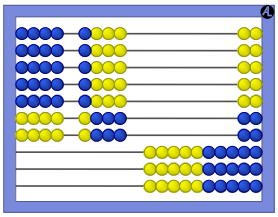
$8 \times 7 = 4 \times 7 \times 2$



50

Multiplication Strategies

$8 \times 7 = 28 \times 2 = 56$



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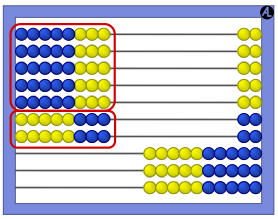
Multiplication Strategies

$8 \times 7 = 8 \times 5 + 8 \times 2$



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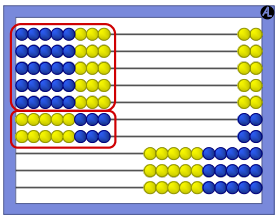
Multiplication Strategies

$8 \times 7 = 40 + 16 = 56$



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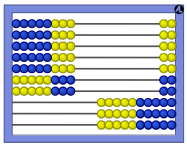
Multiplication Strategies

- Adults generally think in pictures.
- Children definitely think in pictures.
- This approach provides solid visualizable strategies.



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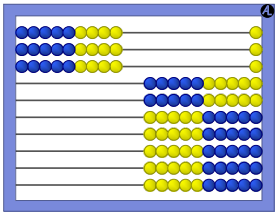
Multiplication Strategies

$9 \times 3 =$



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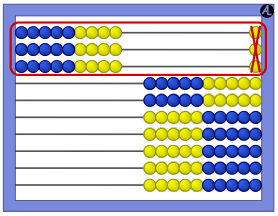
Multiplication Strategies

$9 \times 3 = 30 - 3 = 27$



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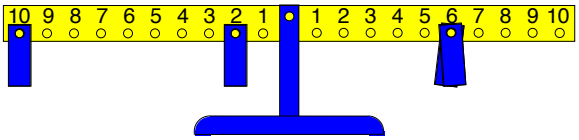
Math Balance

$6 \times 2 = 10 + 2$



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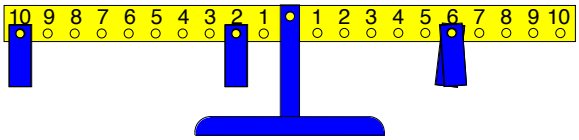
Math Balance

$6 \times 2 = 12$



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Problem Solving

- A problem is not a problem if the solution is obvious.
- Don't have the child look for "key" words.
  *There are 9 items in each box and we bought 8 boxes. How many items do we have **altogether**?*
- Using "key words" as a problem solving strategy turns an opportunity to THINK into just another procedure to follow, masking understanding.

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Problem Solving

- is NOT rote memorizing
- is NOT following rules blindly
- is NOT passive learning

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Problem Solving

- Problem solving is:

  thinking carefully about the situation
  - discovering what is given
  - figuring out what is needed
  - and deciding on methods to get there

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Problem Solving

- Japanese teachers discuss one problem in depth, rather than four problems superficially.
- They encourage multiple solutions.
- Wrong solutions are discussed.
- If an error isn't addressed, it will happen again. And again and again!

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Guided Discovery

- To encourage and guide the child to discovery. And to get them to think.
- Ask questions, encouraging the child to find the "trick" or "secret pattern".
- It is vitally important that children think about what they are doing and not be satisfied with memorizing a rule.
- This promotes critical thinkers!

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Summary

- 5s and 10s are the foundation for **subitizing**.
- Subitizing is the foundation for **visual representations**.
- Visual representations strengthen **strategies**.
- Visual representations and strategies gives answers in a format that can be easily recalled.

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Summary

- These three components will give your child a new way of learning.
- No rote memorization needed.
- Guide your child to discovery.
- **Develop your child's superpowers with subitizing, strategies, and visualization to build success!**

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