

# **Math — Does It Matter How You Teach?**

[info@RightStartMath.com](mailto:info@RightStartMath.com)

based on work of Joan A. Cotter, Ph.D.

## Teaching Math

- Do you struggle with math?  
What curriculum do you choose to avoid the same fate for your child?
- Maybe you are good in math?  
Yet you're unsure how to teach it?
- Should you include manipulatives? Or not?  
Which manipulatives do you choose?  
What in the world do you do with them?

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## Teaching Math

- What DOES it take to be the best teacher for your child?
- 40% of what a child learns depends on you.
  - Acquire language
  - Feed and dress themselves
  - Learn colors, shapes, and sounds
  - Providing the opportunity to learn

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## Teaching Math

- Science of teaching math –  
newer research on how children learn
- Art of teaching math –  
each child is different  
requires tweaking lessons to help each individual child

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## Teaching Math

- Mental development depends on an opportunity to learn.
- Complex activities create significant brain development.
- Research finds the same development does not happen with rote learning.
- Intelligence is not fixed.
- Intelligence is increased by learning!

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## Teaching Math

“What you have been obliged to discover by yourself leaves a path in your mind which you can use again when the need arises.”

– G.C.Lichtenberg,  
professor of physics,  
1742–1799

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## Great Math Teachers

- Watch their attitude about math.
- Nurture a strong number sense.
- Allow time for thinking.
- Foster self-confidence and independent thinking.
- Provide games and puzzles.
- Choose a good math curriculum.

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## Attitude about Math

- Never tell your children that you are “bad” at math.
- Or that you dislike math.
- Especially mothers to daughters.
- Research shows that as soon as a mother shares her negative ideas with her daughter, the daughter’s achievements go down.
- The same does not hold true with sons.

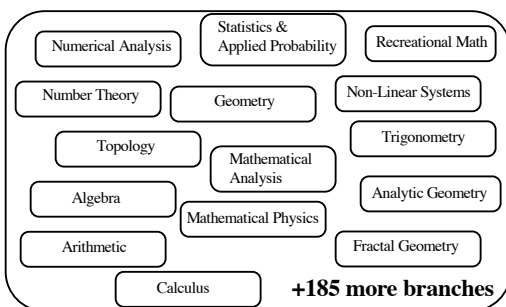
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## Attitude about Math

- Math education will depend on what the teacher believes, knows, and does.
- Believe in the importance of math for daily, living, future careers, and understanding of our world.
- Know that the “math brain” is a myth.
- Radiate joy for math and help your child develop a love of math.

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## Attitude about Math



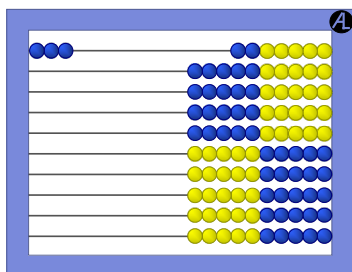
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## Number Sense

- If you don’t have an image in your mind, the word has no meaning.
- Think of foreign languages.
- Therefore, you have to “see” a quantity in your mind in order to attach the word.

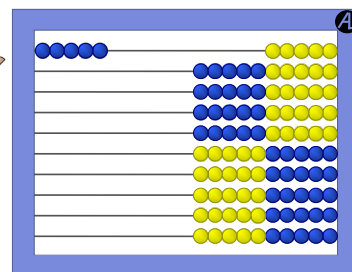
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## Quantities



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### Adding Quantities

$4 + 3 =$

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### Adding Quantities

$4 + 3 = 7$

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### Adding by Counting From a Child's Perspective

Because we're so familiar with 1, 2, 3,  
we'll use letters.

**A = 1**  
**B = 2**  
**C = 3**  
**D = 4**  
**E = 5, and so forth**

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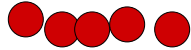
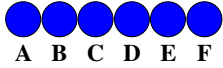
### Adding by Counting From a Child's Perspective

**F**  
**+ E**

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## Adding by Counting From a Child's Perspective

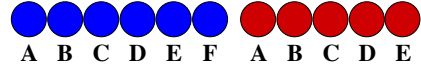
$$\begin{array}{r} F \\ +E \\ \hline \end{array}$$



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## Adding by Counting From a Child's Perspective

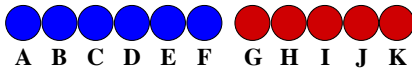
$$\begin{array}{r} F \\ +E \\ \hline \end{array}$$



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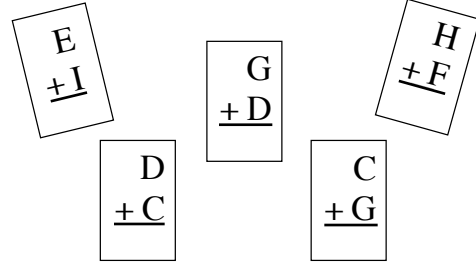
## Adding by Counting From a Child's Perspective

$$\begin{array}{r} F \\ +E \\ \hline K \end{array}$$



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## Adding by Counting From a Child's Perspective Now Memorize the Facts!!



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## Place Value From a Child's Perspective

**L**  
is written **AB**  
because it is **A J**  
and **B A**'s

*huh?*

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## Place Value From a Child's Perspective

**L** (twelve)  
is written **AB** (12)  
because it is **A J** (one 10)  
and **B A**'s (two 1s)

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### Transparent Place Value

2-ten

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### Transparent Place Value

2-ten 4

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### Transparent Place Value

3-ten 6

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### Transparent Number Naming

10 = ten	20 = 2-ten
11 = ten 1	21 = 2-ten 1
12 = ten 2	22 = 2-ten 2
13 = ten 3	23 = 2-ten 3
14 = ten 4	....
....	....
19 = ten 9	99 = 9-ten 9

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### Transparent Number Naming

- Use this for two reasons:
  1. Patterning
  2. Place value

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### Transparent Place Value

3-ten 7

3 0 7

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### Transparent Place Value

3-ten 7      37

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### Transparent Place Value

6-ten 2      602

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### Transparent Place Value

6-ten 2      62

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### Transparent Place Value

10-ten      100

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### Transparent Place Value

1 hundred      100

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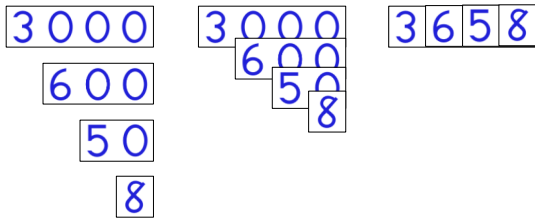
### Transparent Number Naming

30  
↑ ↑  
3 - ten

300  
↑ ↑ ↑  
3 hun-dred

3000  
↑ ↑ ↑ ↑  
3 th-ou-sand

## Transparent Number Naming



## Transparent Number Naming

- Just as reciting the alphabet doesn't teach reading, counting doesn't teach arithmetic.
- Just as we first teach the *sound* of the letters, we first teach the *name* of the quantity with transparent number naming.

## Transparent Number Naming

- Asian children learn mathematics using the math way of number naming.
- They understand place value in first grade; only half of U.S. children understand place value at the end of fourth grade.
- Mathematics is the science of patterns. The patterned math way of number naming greatly helps children learn number sense.

## Transparent Number Naming

- Use this for two reasons:
  1. Patterning
  2. Place value
- Then teach traditional names

## Transparent Number Naming

- Use this for two reasons:
  1. Patterning
  2. Place value
- Then teach traditional names
- No "random" recital of the numbers 10 to 100.
- Gives order and clarity to numbers.
- Makes place value a natural part of numbers.

## Time for Thinking

"I have never committed math facts to memory, although I can quickly produce any math fact, as I have number sense and I have learned good ways to think about number combinations.

My lack of memorization has never held me back at any time or place in my life, even though I am a mathematics professor."

– Jo Boaler,  
author and professor at  
Stanford University



## Time for Thinking

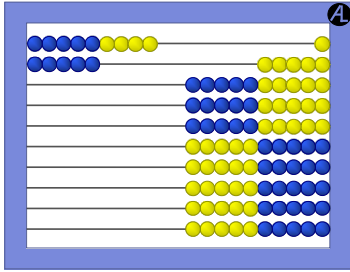
- A fact is considered to be known if it can be recalled in two or three seconds.
- Gives time to visualize, then produce the fact.
- Visual strategies help learn the facts.

## Strategies

- A strategy is a way to learn a new fact or recall a forgotten fact.
- A visual representation is a powerful strategy.

### Strategy: Complete the Ten

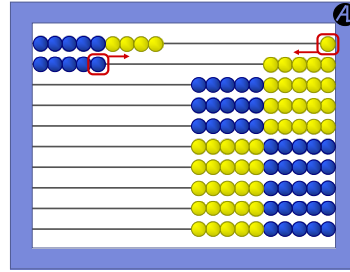
$$9 + 5 =$$



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### Strategy: Complete the Ten

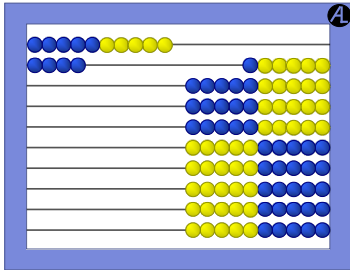
$$9 + 5 =$$



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### Strategy: Complete the Ten

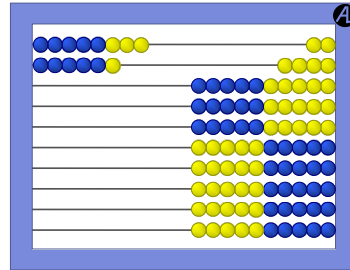
$$9 + 5 = 14$$



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### Strategy: Two Fives

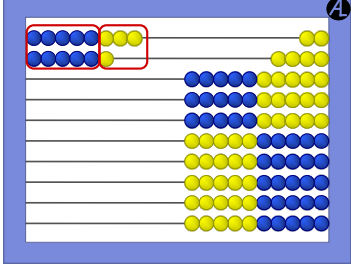
$$8 + 6 =$$



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Strategy: Two Fives

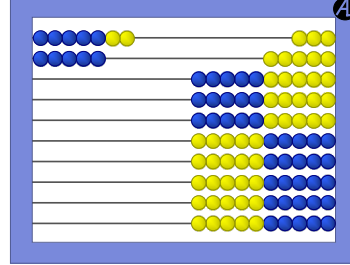
$$8 + 6 = 10 + 4 = 14$$



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Strategy: Two Fives

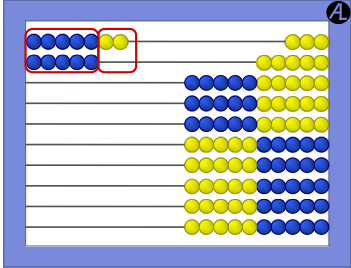
$$7 + 5 =$$



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Strategy: Two Fives

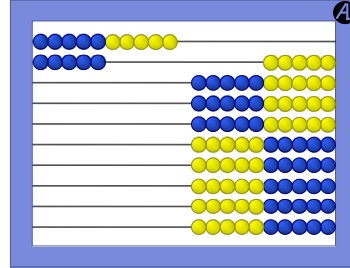
$$7 + 5 = 10 + 2 = 12$$



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Strategy: Part from Ten

$$15 - 9 =$$

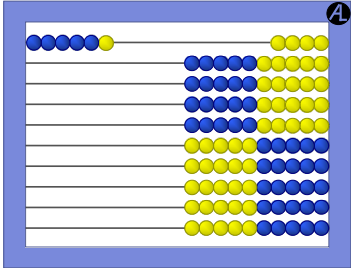


Subtract 5,  
then 4

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Strategy: Part from Ten

$$15 - 9 = 6$$

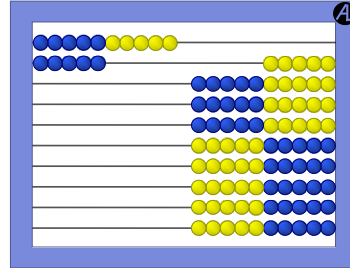


Subtract 5,  
then 4

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Strategy: All from Ten

$$15 - 9 =$$

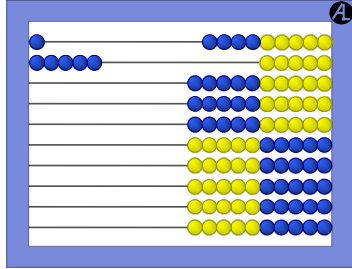


Subtract 9  
from the 10

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### Strategy: All from Ten

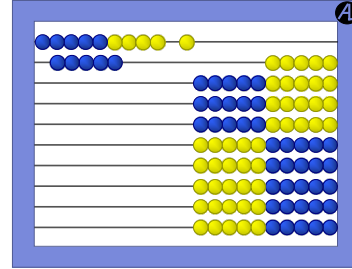
$$15 - 9 = 6$$



Subtract 9 from the 10

### Strategy: Going Up

$$15 - 9 = 6$$



Start at 9; go up to 15

### Time for Thinking

- A fact is considered to be known if it can be recalled in two or three seconds.
- Gives time to visualize, then produce the fact.
- Visual strategies help learn the facts.
- Rely on number sense.
- Avoid flashcards, speed drills, and timed tests as these create anxiety, especially with girls.

### Foster Confidence

- Be encouraging.
- Realize that there is more than one way to do calculations – some more efficient than others.
- Not everything needs to be written down.
- Ask the child to explain their logic.
- Help them identify where errors were made so that they can avoid them in the future.

### Foster Confidence

- Remember mastery is achieved through thinking, not blindly following an example.
- Mastery is not practicing some rule over and over and over.
- Mastery is a continuing process.
- Some frustration is a normal part of learning.
- Develop concentration by being allowed to concentrate without interruptions.

### Play Games

$$\frac{\text{Games}}{\text{Math}} = \frac{\text{Books}}{\text{Reading}}$$

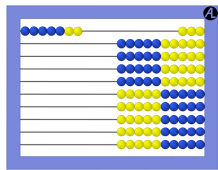
Games provide interesting repetition needed for automatic responses.

More importantly, games provide an application for the new information!

## Go to the Dump Game

A "Go Fish" type of game where the pairs are:

- 1 & 9
- 2 & 8
- 3 & 7
- 4 & 6
- 5 & 5



## Patterns in Multiples

Twos

2	4	6	8	10
12	14	16	18	20

## Patterns in Multiples

Fours

4	8	12	16	20
24	28	32	36	40

## Patterns in Multiples

Sixes and Eights

6	12	18	24	30
36	42	48	54	60

8	16	24	32	40
48	56	64	72	80

## Patterns in Multiples

Nines

9	18	27	36	45
90	81	72	63	54

## Patterns in Multiples

Threes

3	6	9
12	15	18
21	24	27
30		

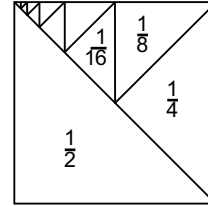
## Patterns in Multiples

Sevens

7	14	21
28	35	42
49	56	63
70		

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## Squares: Halves of Halves



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## Good Math Curriculum

- Look at the authors' credentials.
- Look at their philosophy of teaching math.
  - Based on understanding?
  - Incorporate manipulatives?
  - Include real-life application?
- Look at the objectives – what is being taught?
- Is it more than just arithmetic?
- Are you actively involved in the teaching?

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## Conclusion

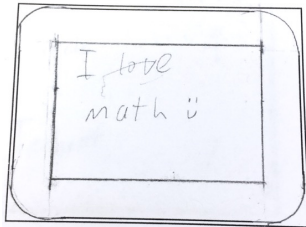
- Each time a child discovers the beauty of math, a region of the brain lights up.
- This is the same region of the brain that lights up when an artist finds beauty in art.
- Help your child find the beauty in math!
- Bonnie, age 13, learning about the Golden Ratio said: "It's just one of these things in life that make you feel satisfied to know."

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## Conclusion

"You cannot love what you do not know."

– David McCullough, author



– Ben, math student,  
learning to draw  
tangent arcs

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