You CAN Be a Great Math Teacher

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?

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

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

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!

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

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.
- Encourage hard work and growth mindset.
- Choose a good math curriculum.

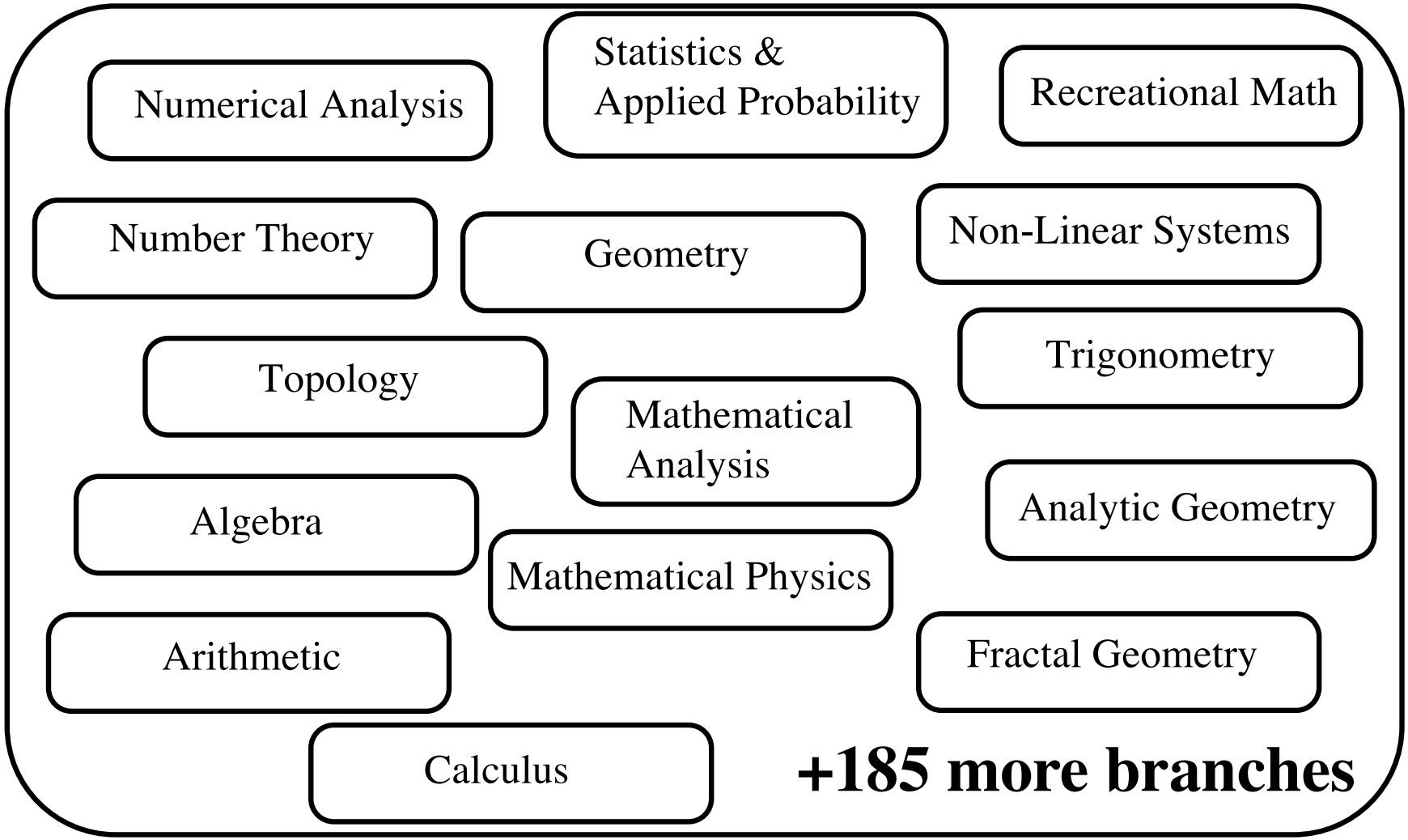
Attitude about Math

- 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.

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.

Attitude about Math



Great Math Teachers

- Watch their attitude about math.
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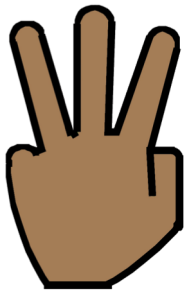
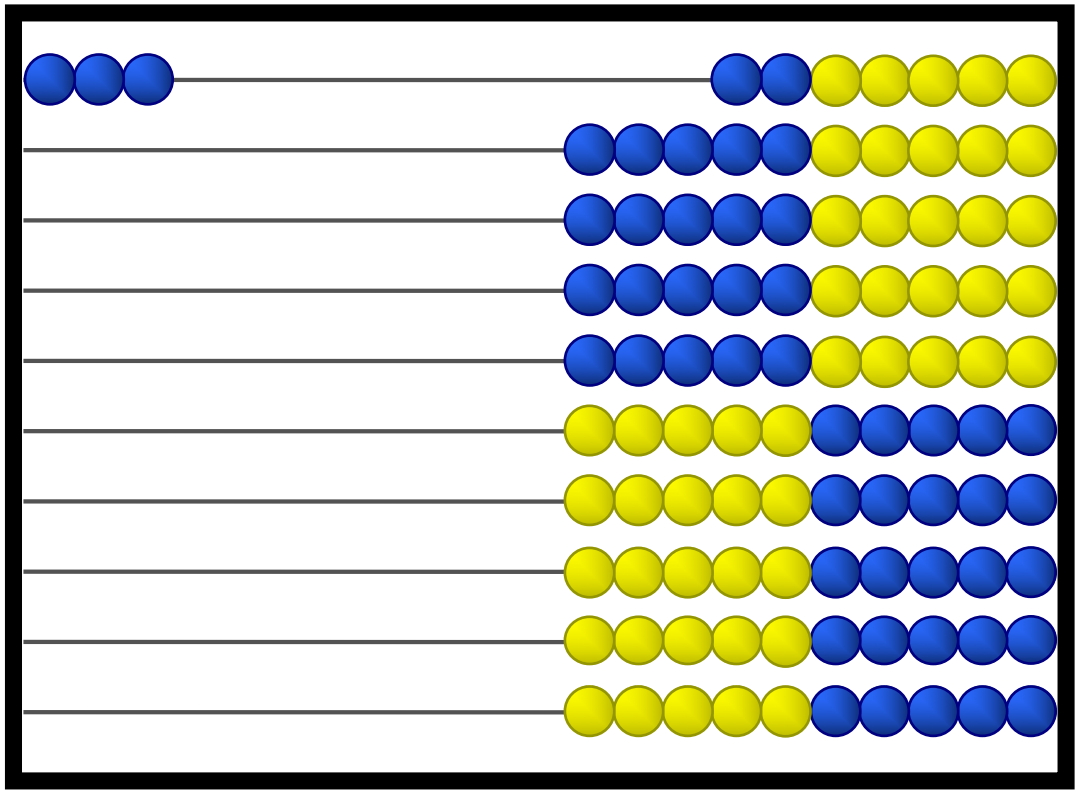
- Foster self-confidence and independent thinking.
- Provide games and puzzles.
- Encourage hard work and growth mindset.
- Choose a good math curriculum.

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.

Quantities





Quantities

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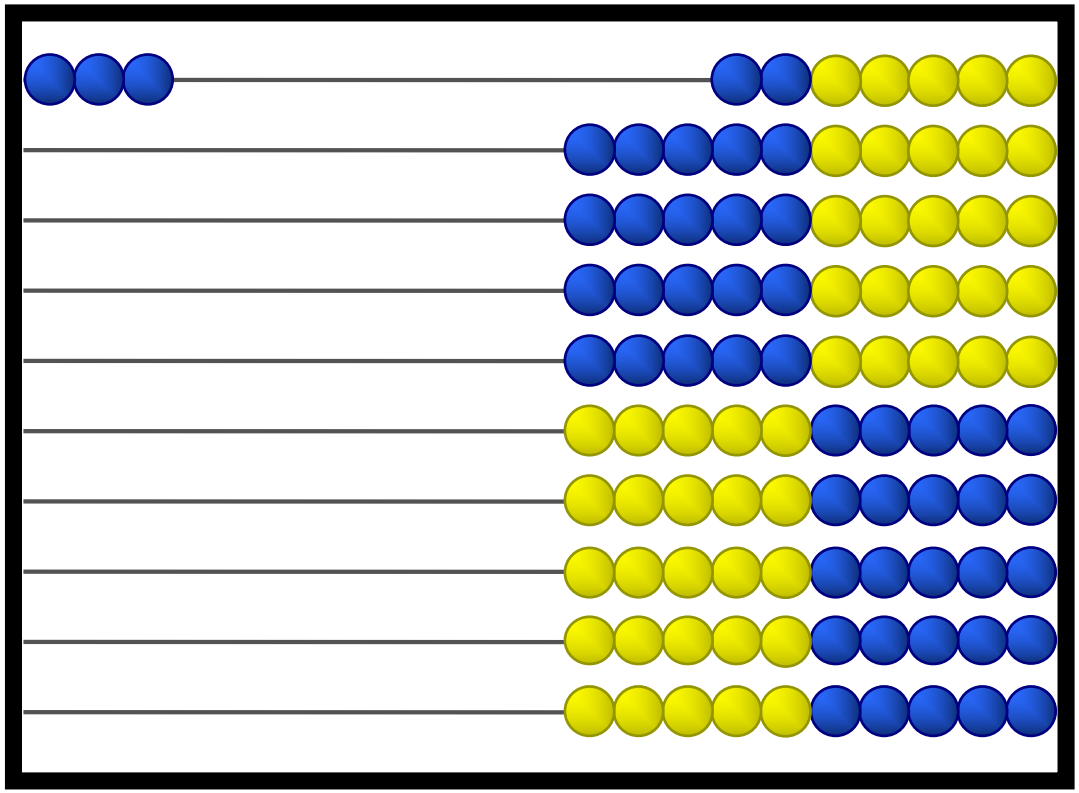

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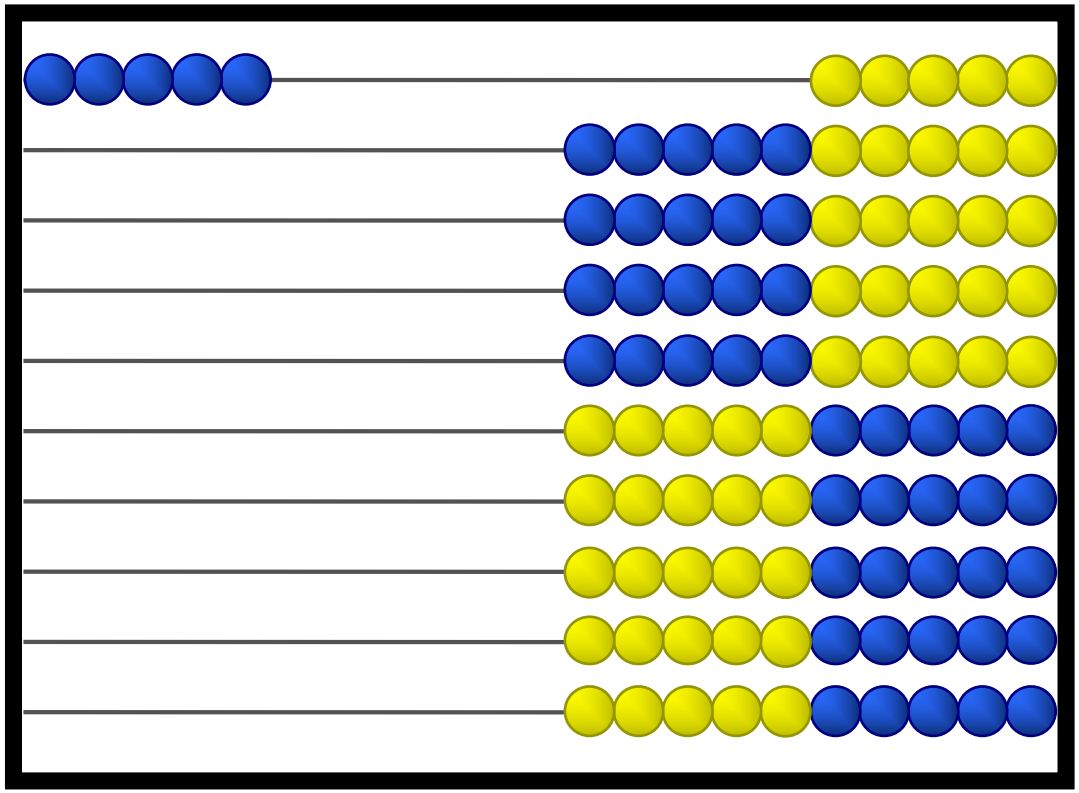

Quantities

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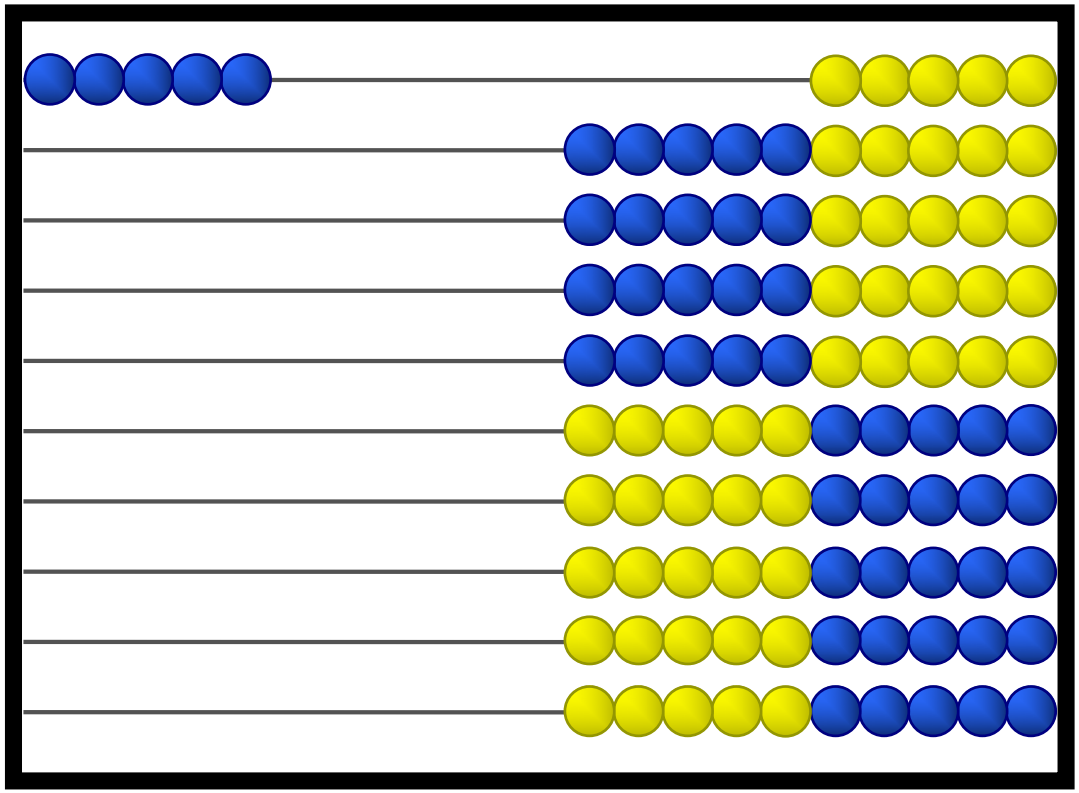

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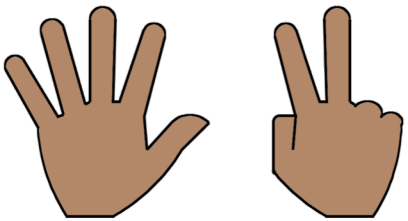
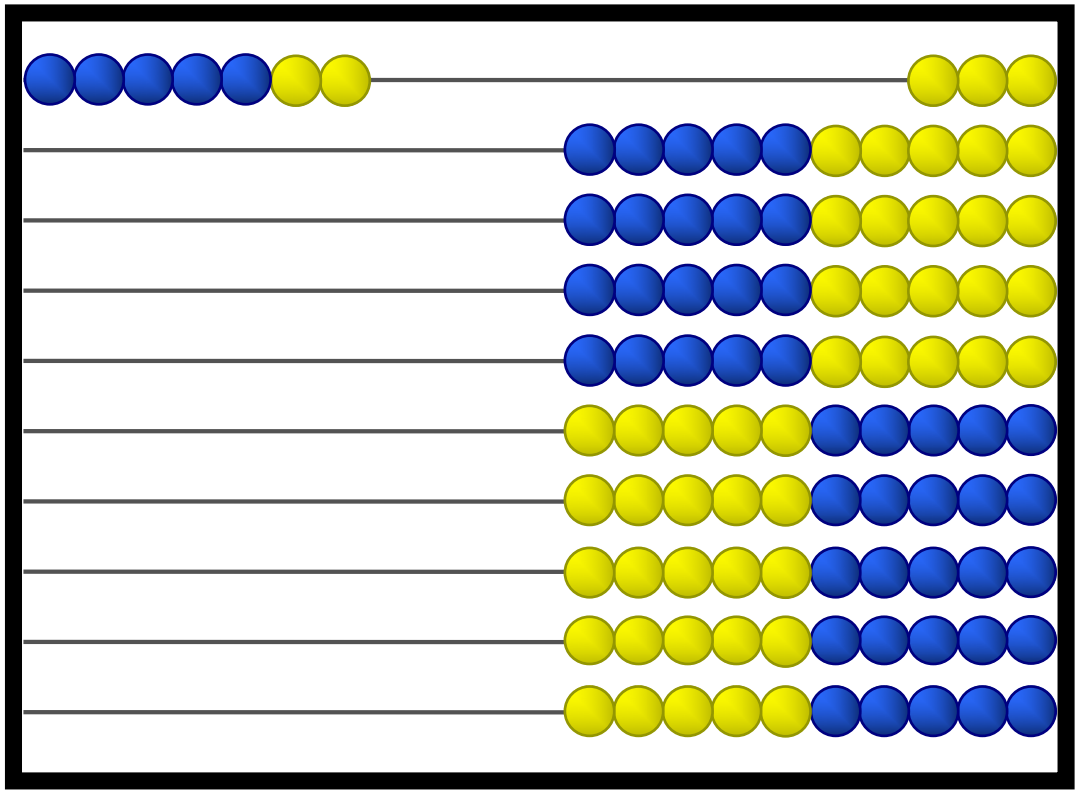
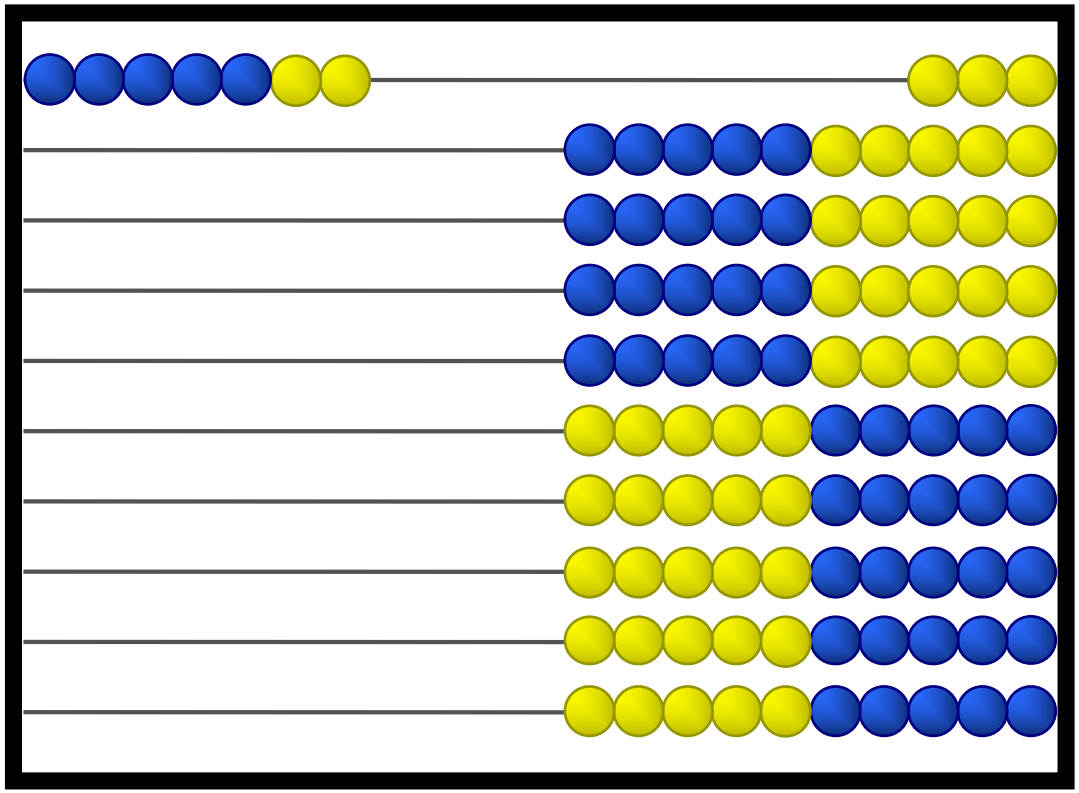




Quantities

7



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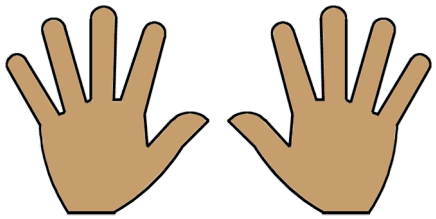
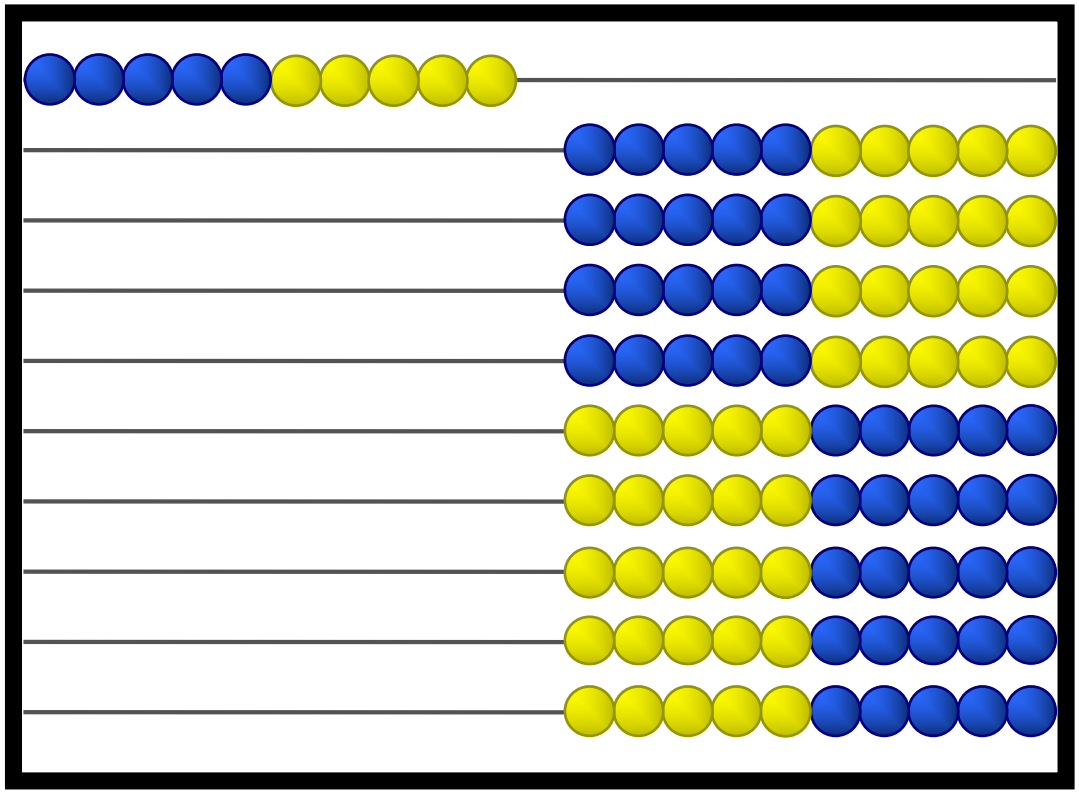
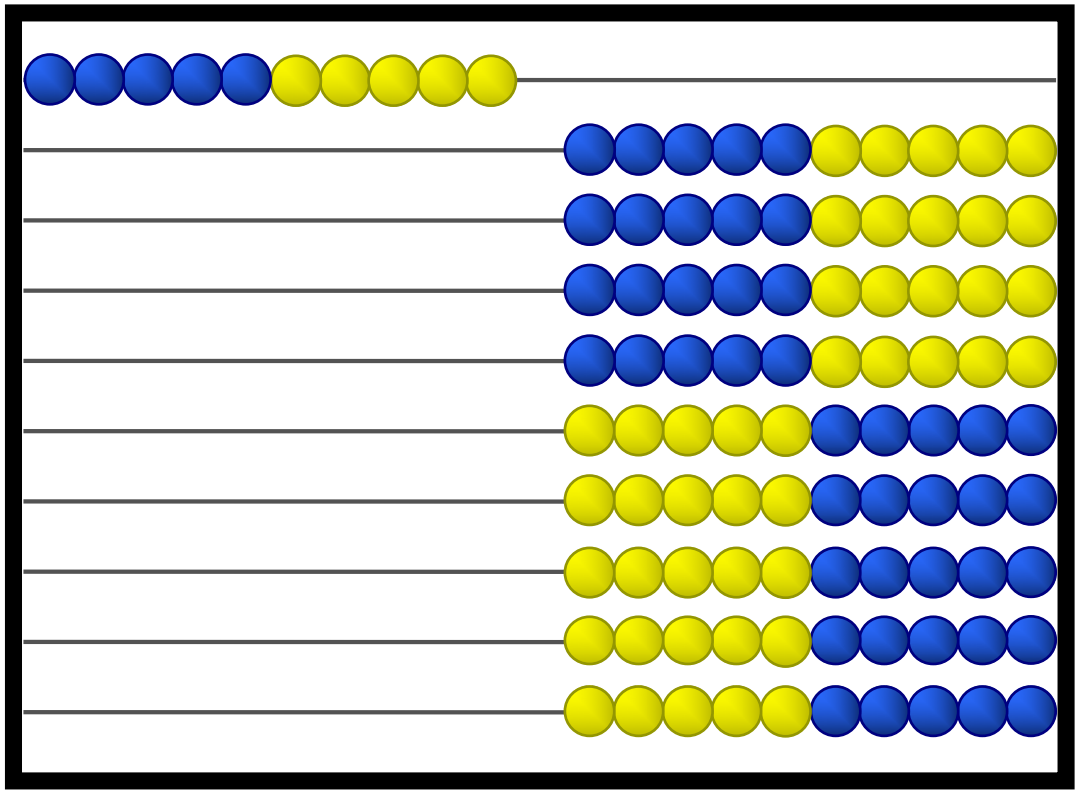




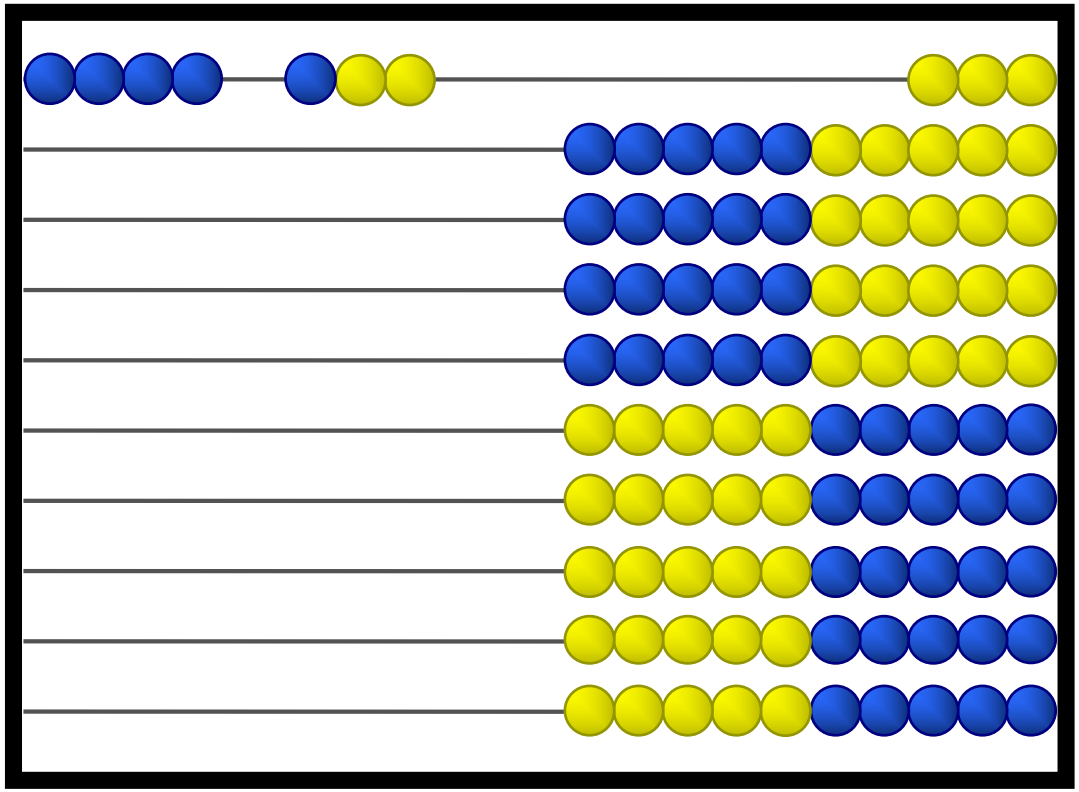
Quantities

10



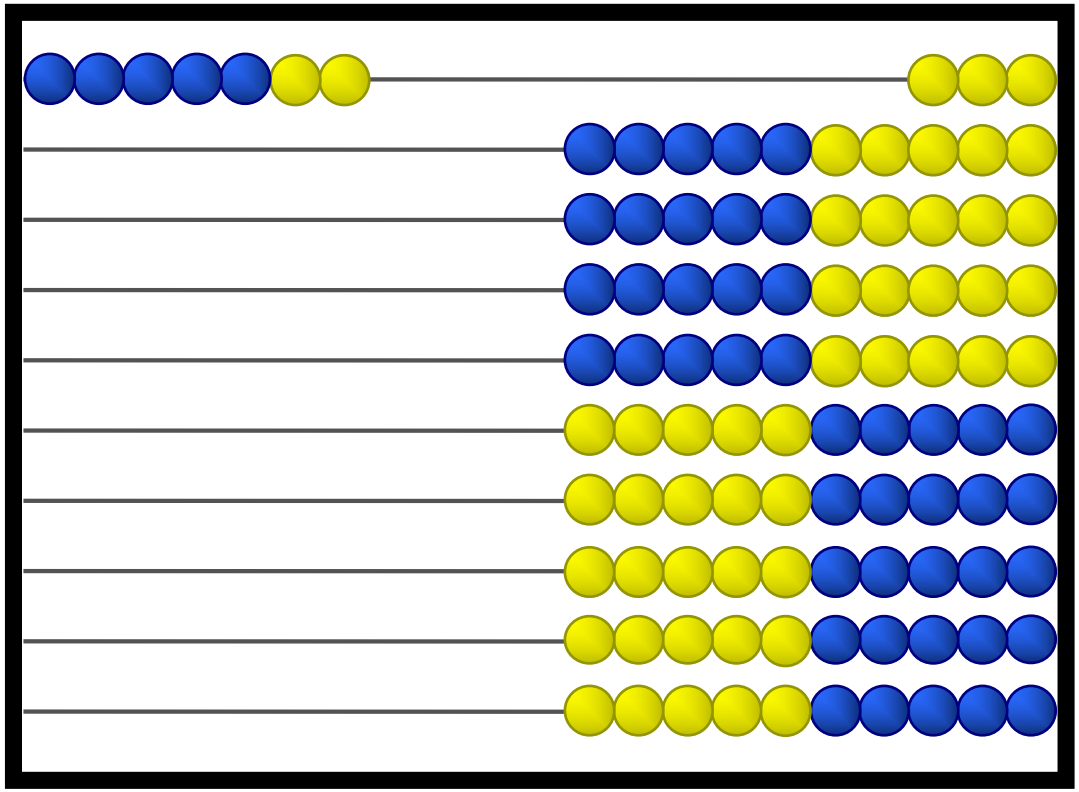
Adding Quantities

$4 + 3 =$



Adding Quantities

$4 + 3 = 7$



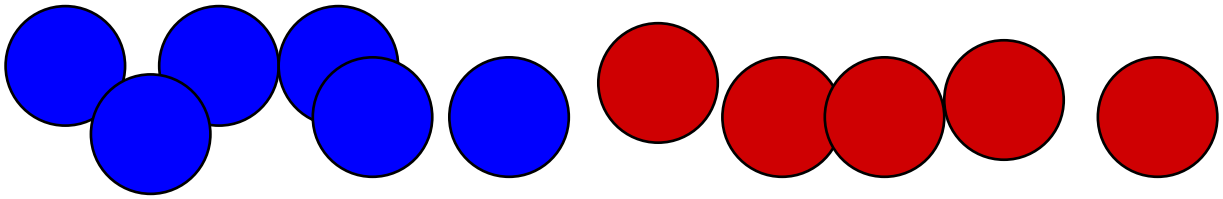
Adding by Counting From a Child's Perspective

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

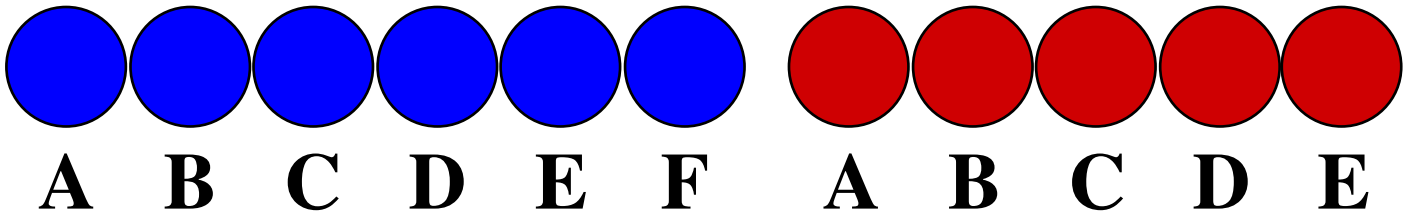
Adding by Counting From a Child's Perspective

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



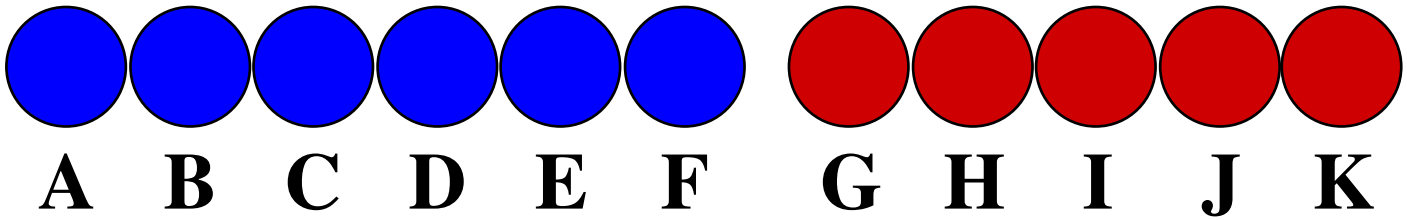
Adding by Counting From a Child's Perspective

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



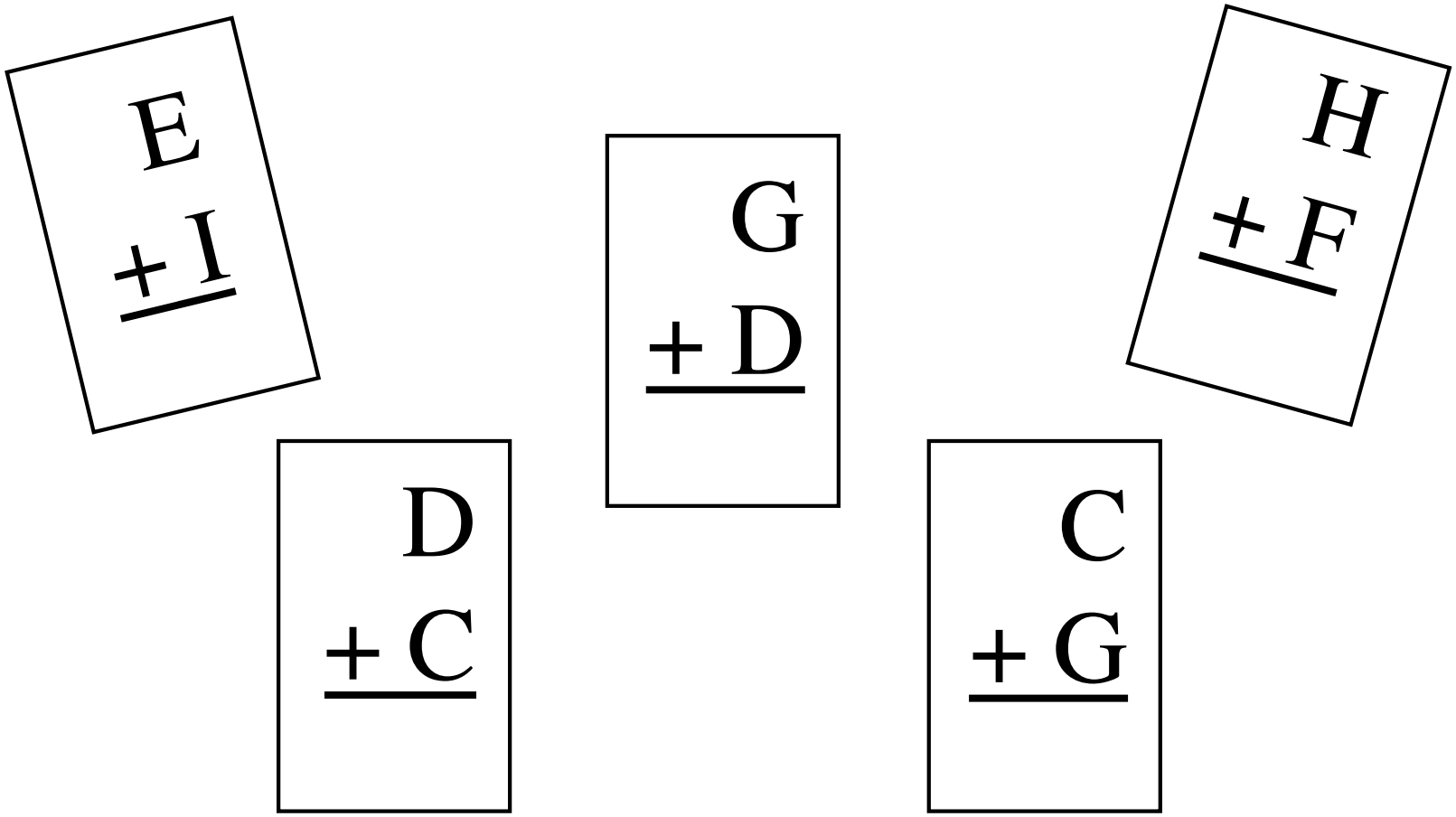
Adding by Counting From a Child's Perspective

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



Adding by Counting From a Child's Perspective

Now Memorize the Facts!!



Place Value
From a Child's Perspective

L

is written **AB**

because it is **A J**

and **B A**'s

huh?

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)

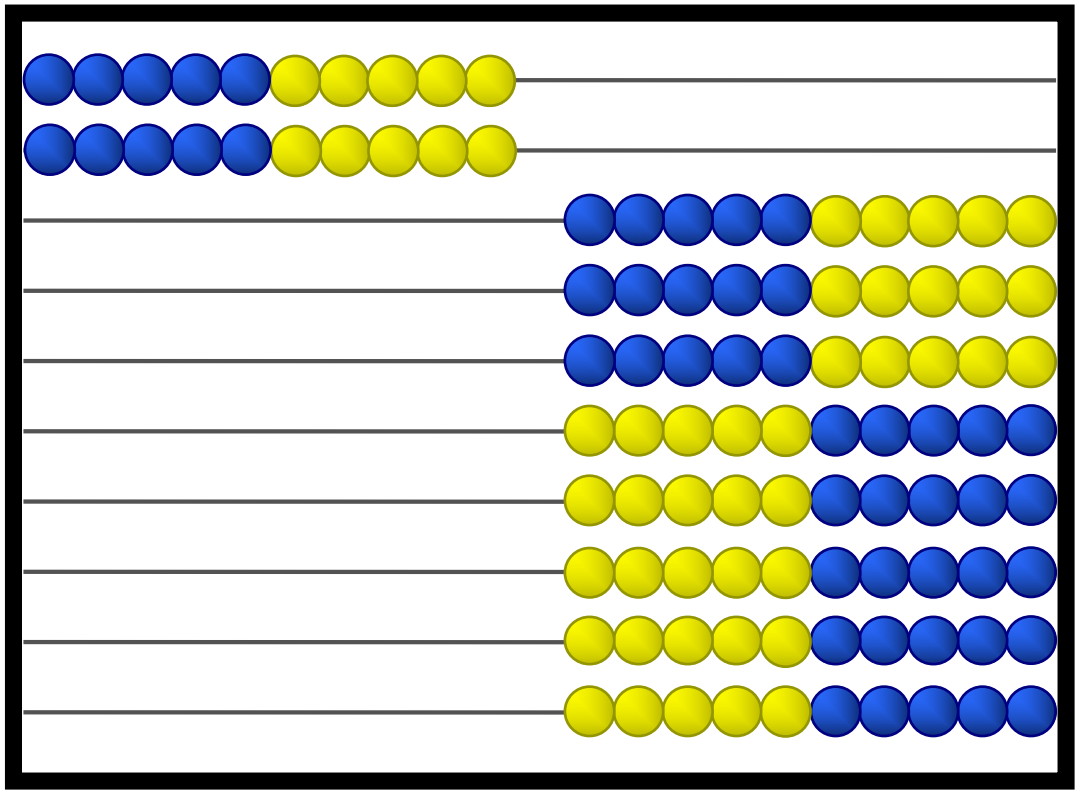
Place Value
From a Child's Perspective

Children often think of 14
as 14 ones,
not ten and 4 ones.

The pattern that is needed to make sense of tens and ones is hidden in the English language!

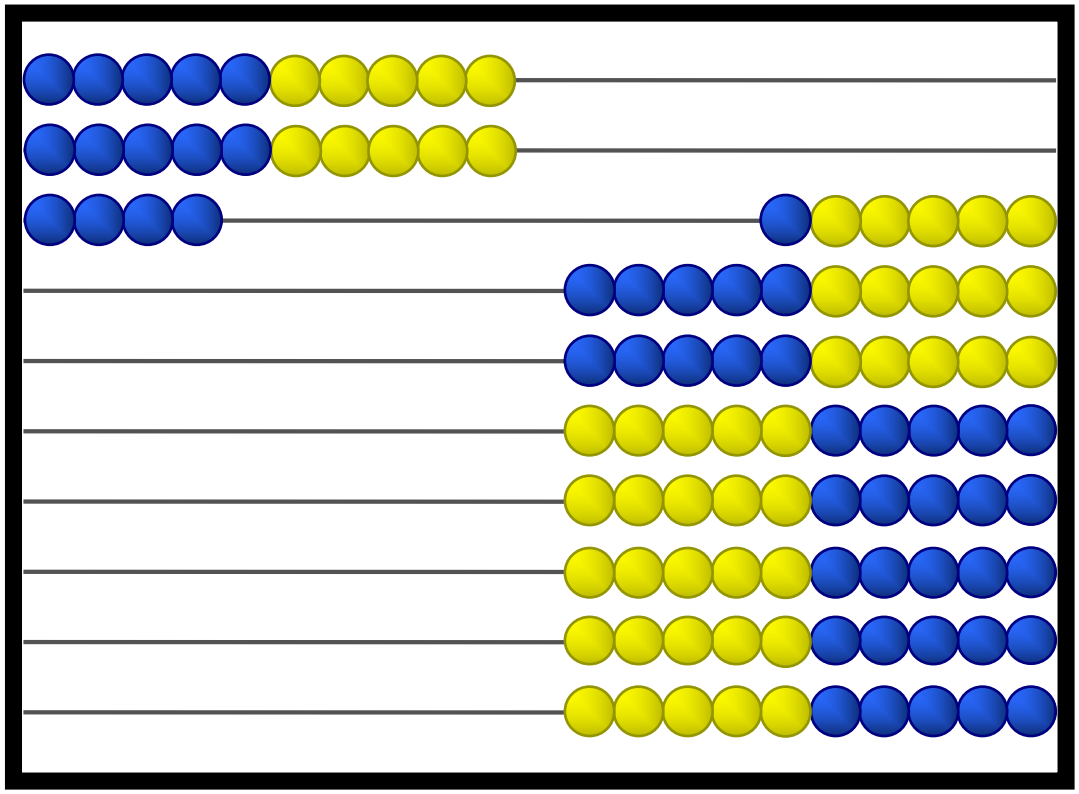
Transparent Place Value

2-ten



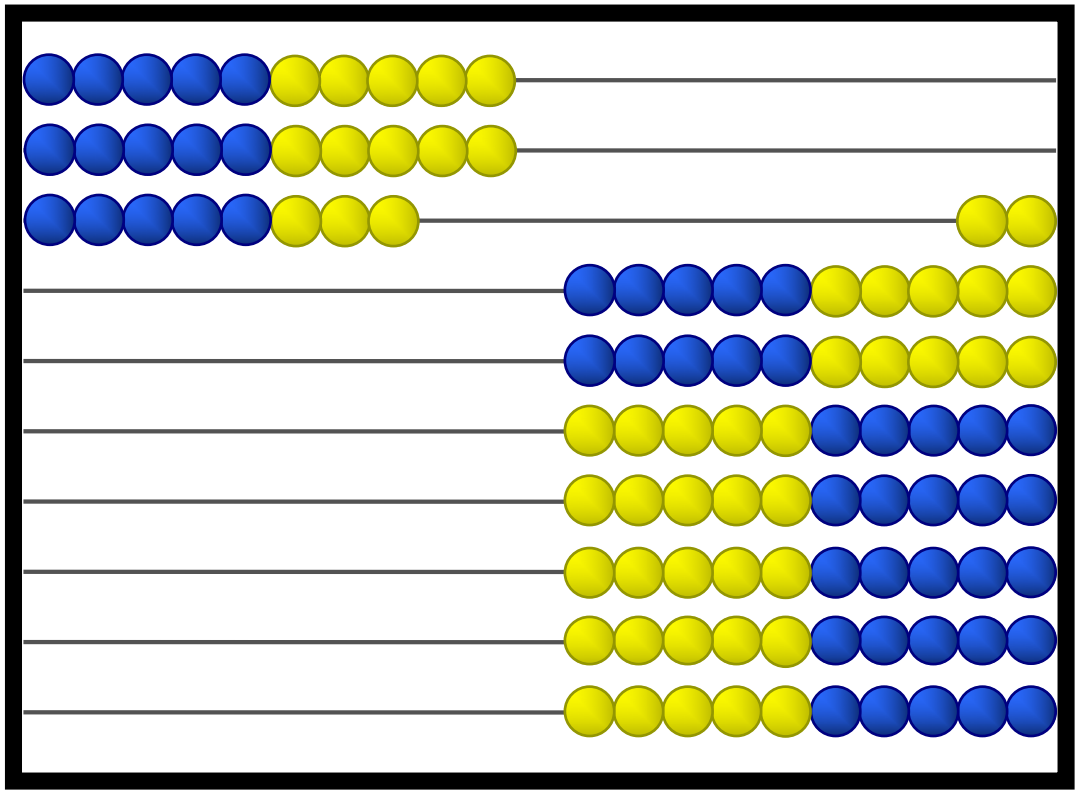
Transparent Place Value

2-ten 4



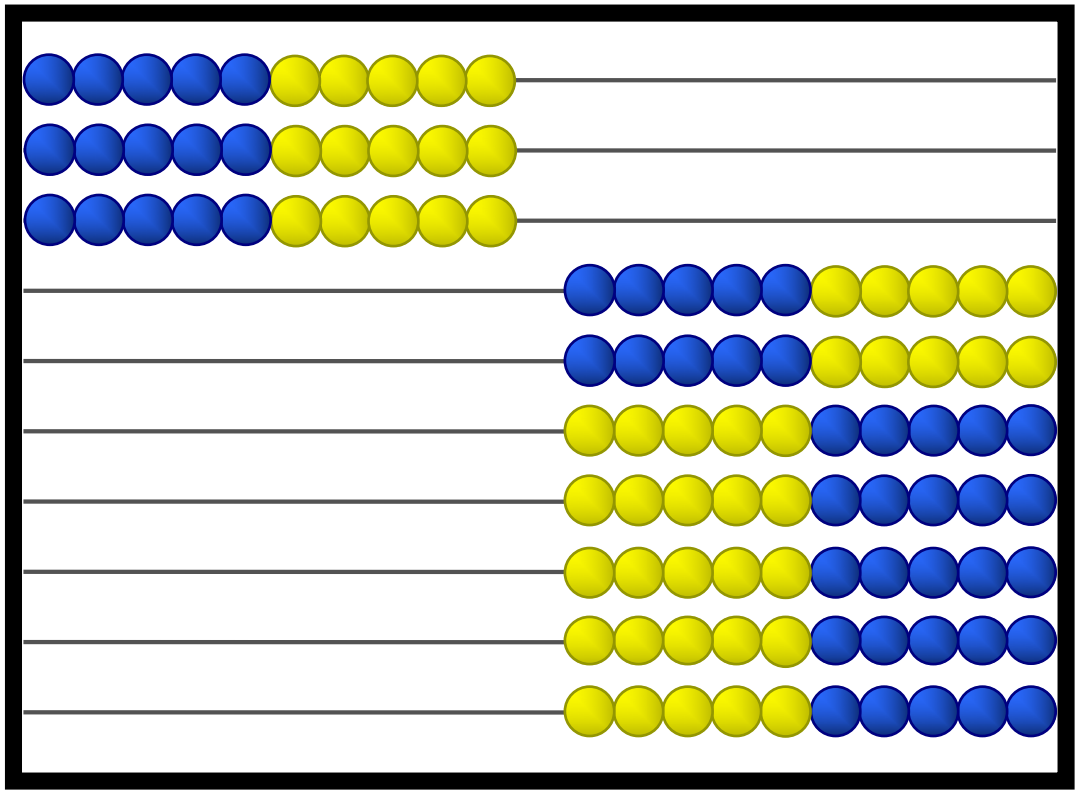
Transparent Place Value

2-ten 8



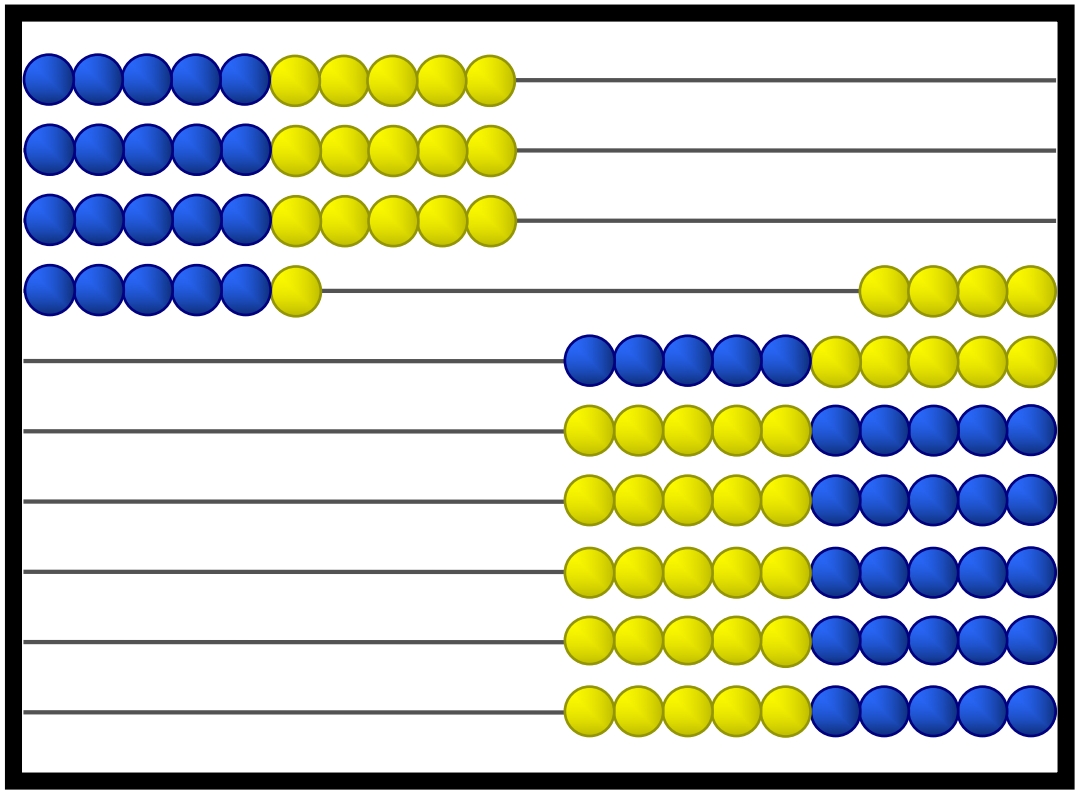
Transparent Place Value

3-ten



Transparent Place Value

3-ten 6



Transparent Number Naming

10 = ten
11 = ten 1
12 = ten 2
13 = ten 3
14 = ten 4
. . . .
19 = ten 9

20 = 2-ten
21 = 2-ten 1
22 = 2-ten 2
23 = 2-ten 3
. . . .
. . . .
99 = 9-ten 9

Transparent Number Naming

- Use this for two reasons:
  1. Patterning

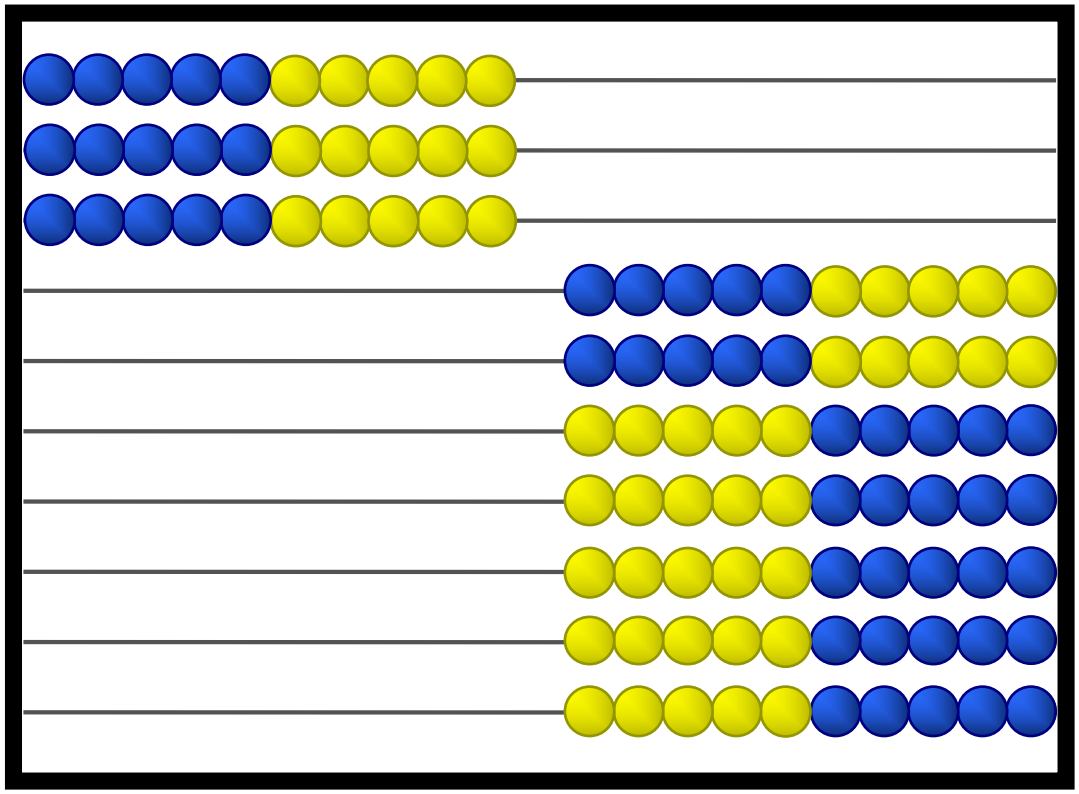
Transparent Number Naming

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

Transparent Place Value

3-ten

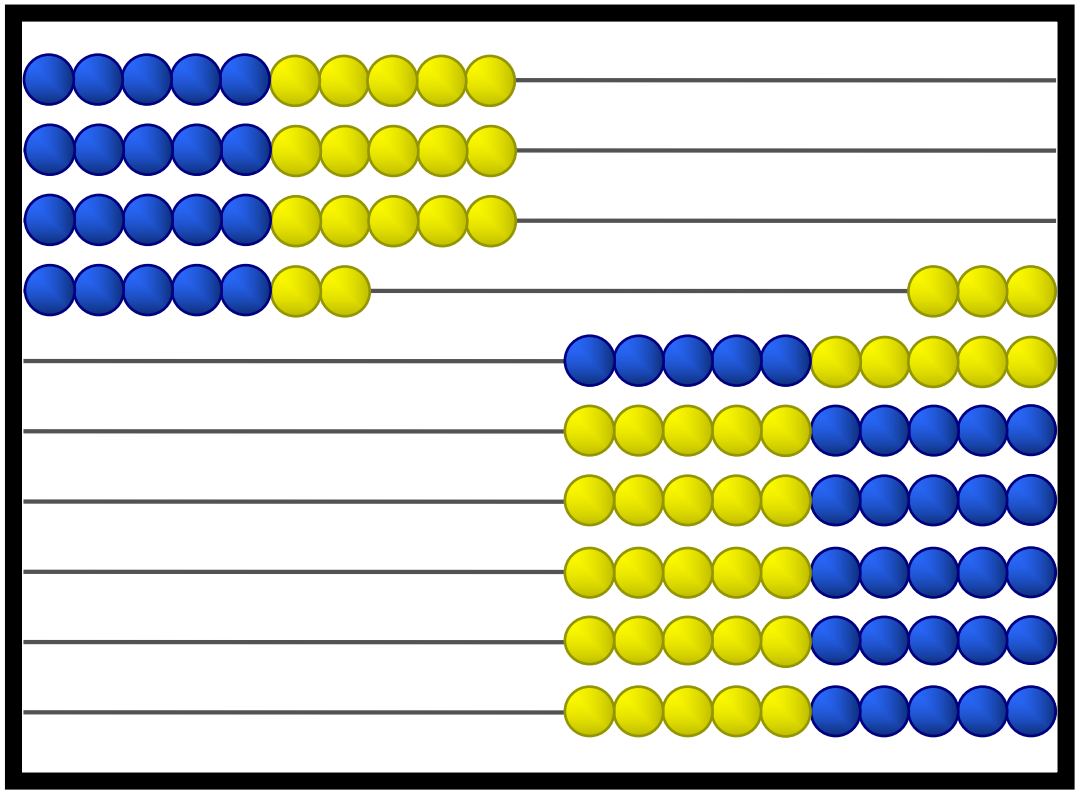
30



Transparent Place Value

3-ten 7

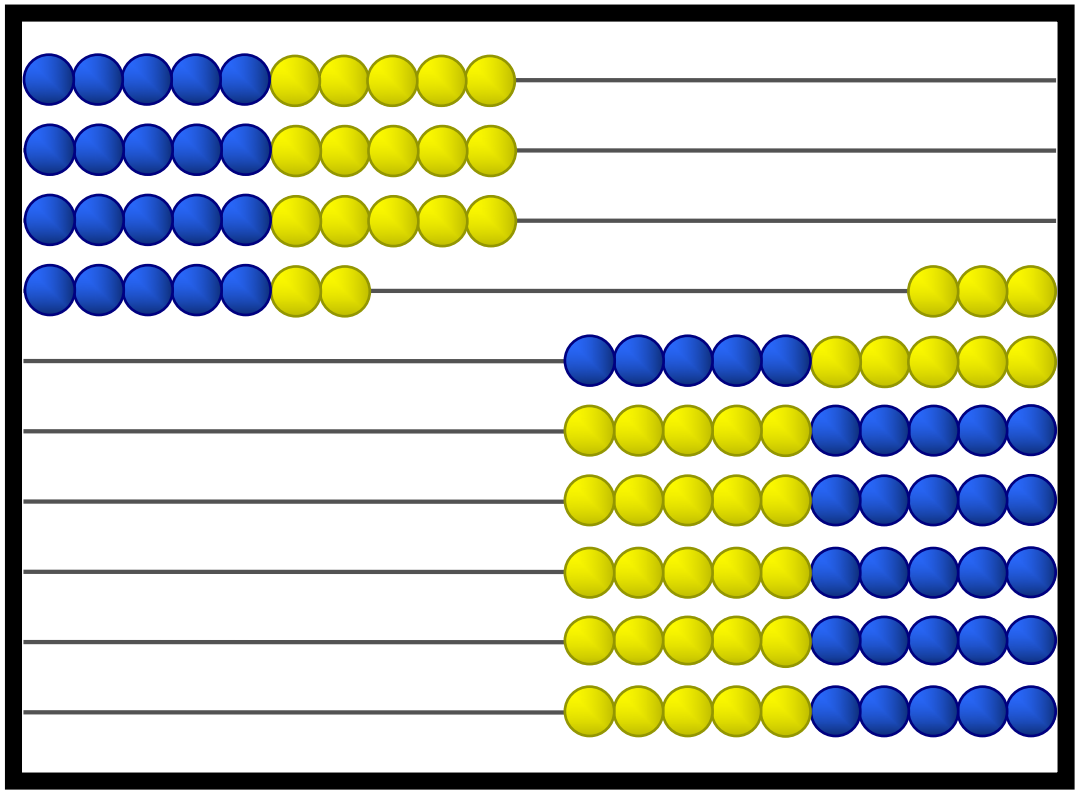
3	0	7



Transparent Place Value

3-ten 7

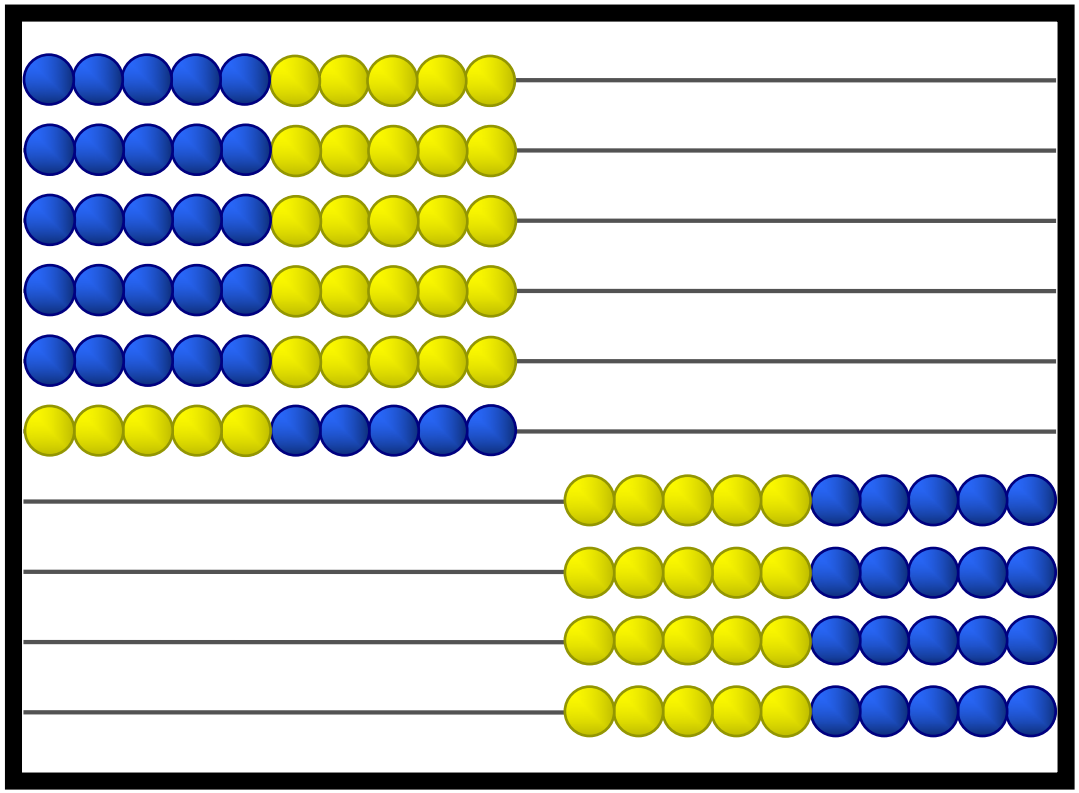
3	7



Transparent Place Value

6-ten

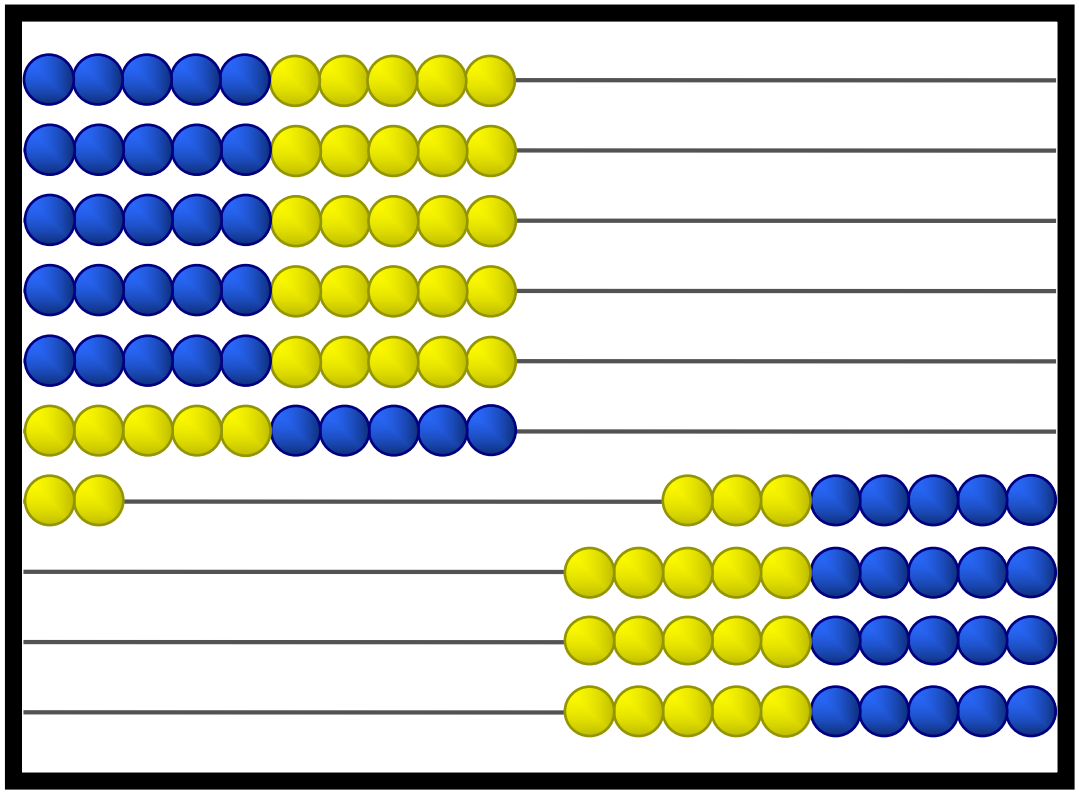
60



Transparent Place Value

6-ten 2

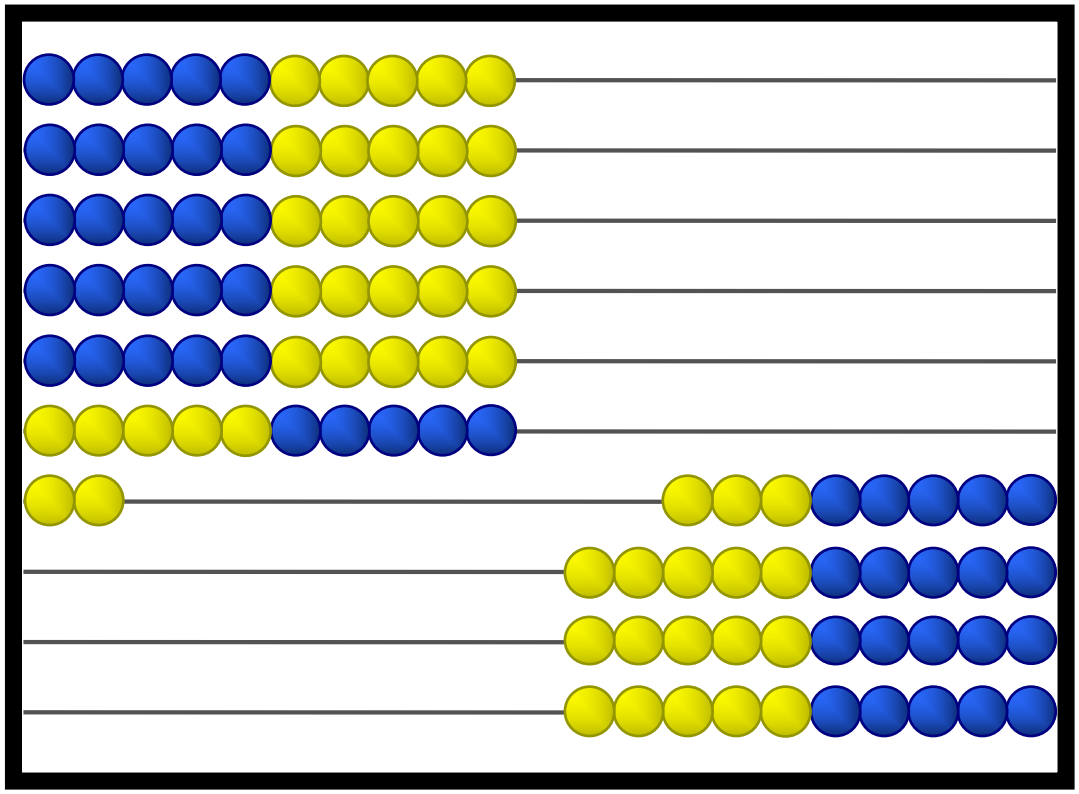
6	0	2



Transparent Place Value

6-ten 2

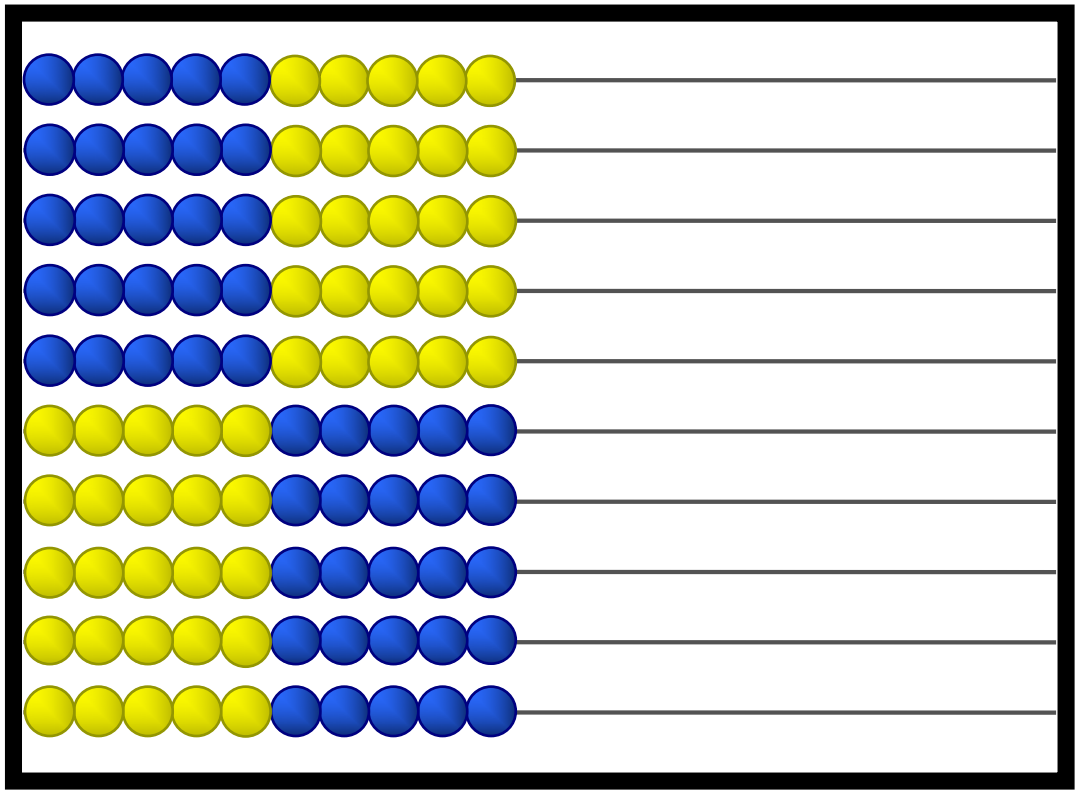
6	2



Transparent Place Value

10-ten

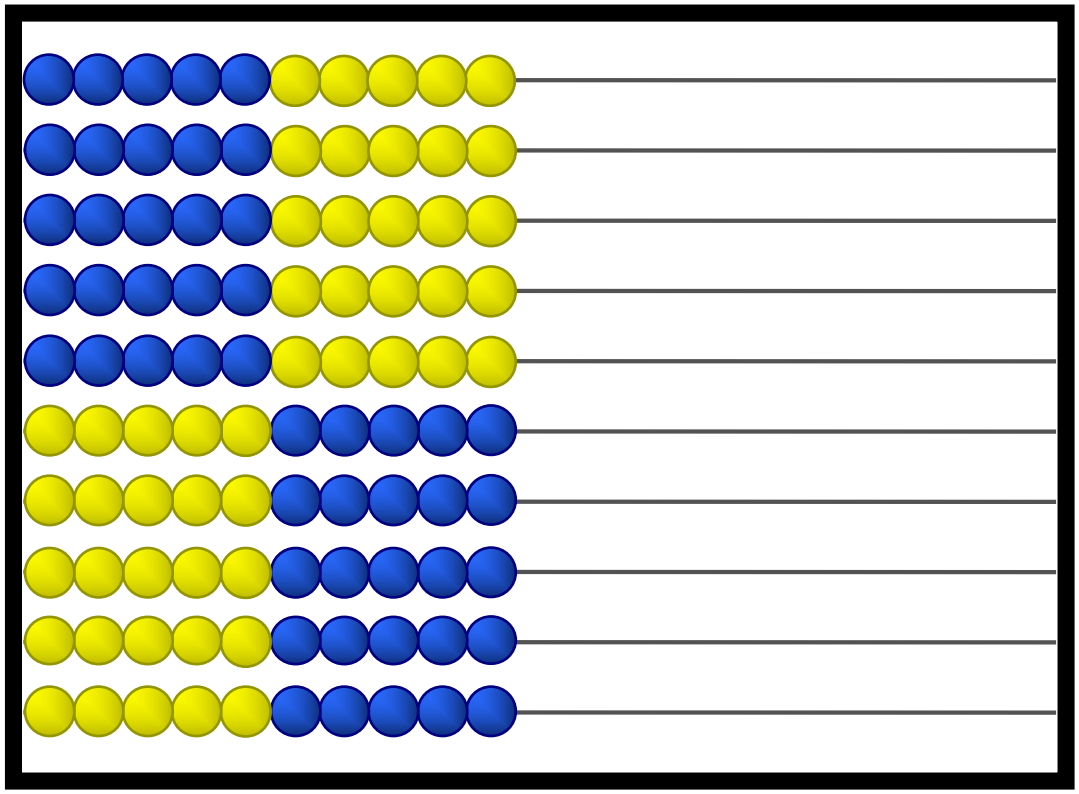
100



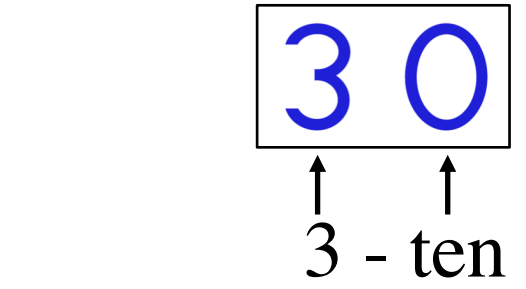
Transparent Place Value

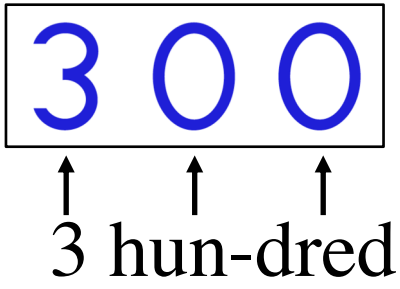
1 hundred

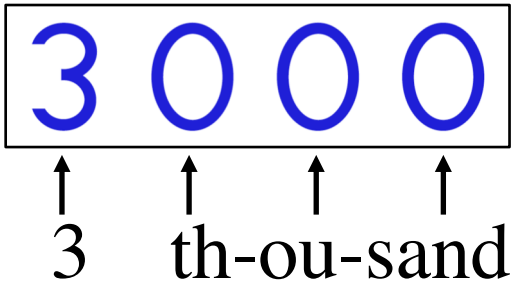
100



Transparent Number Naming







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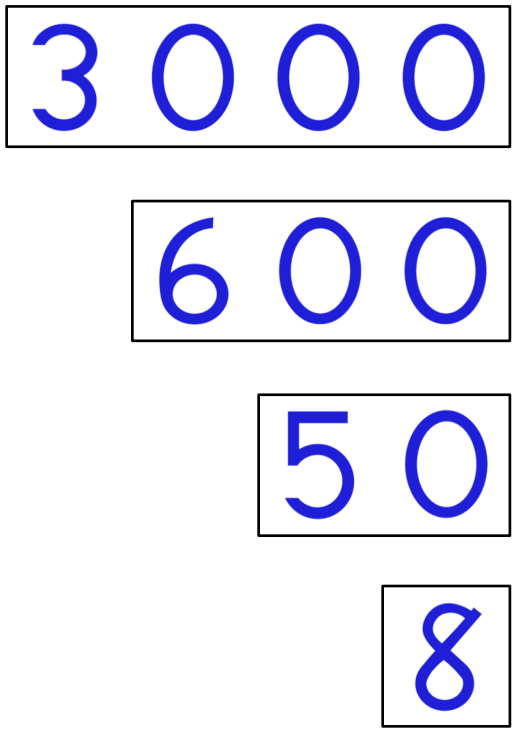
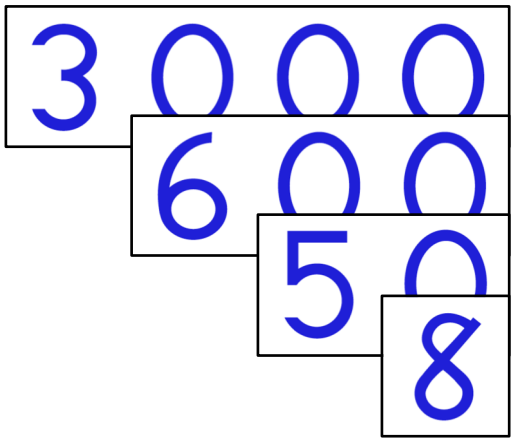
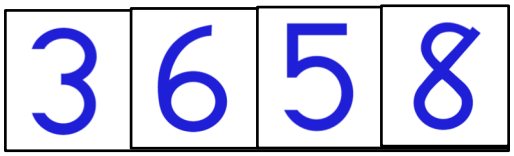






Transparent Number Naming

- 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.

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

- No “random” recital of the numbers 10 to 100.
- Gives order and clarity to numbers.
- Makes place value a natural part of numbers.

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.
- Encourage hard work and growth mindset.
- Choose a good math curriculum.

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

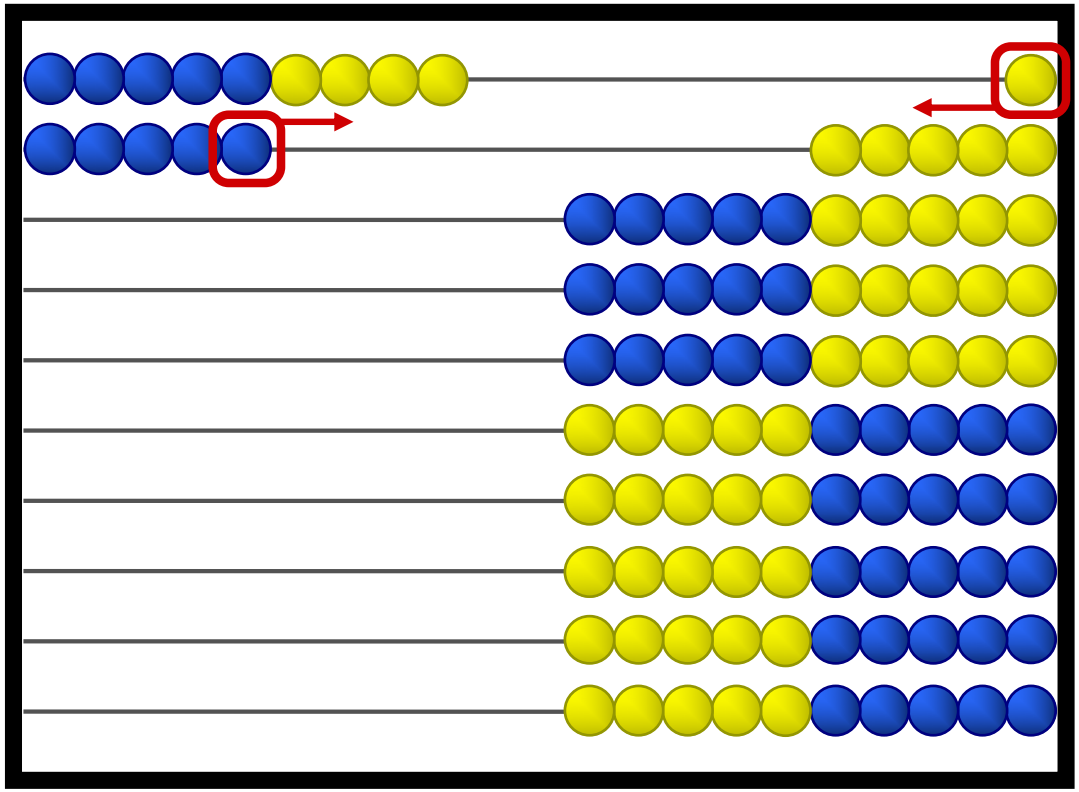
- A fact is considered to be known if it can be recalled in two or three seconds.
- Gives time to visualize, then produce the fact.
- Visual strategies help learn the facts.

Strategies

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

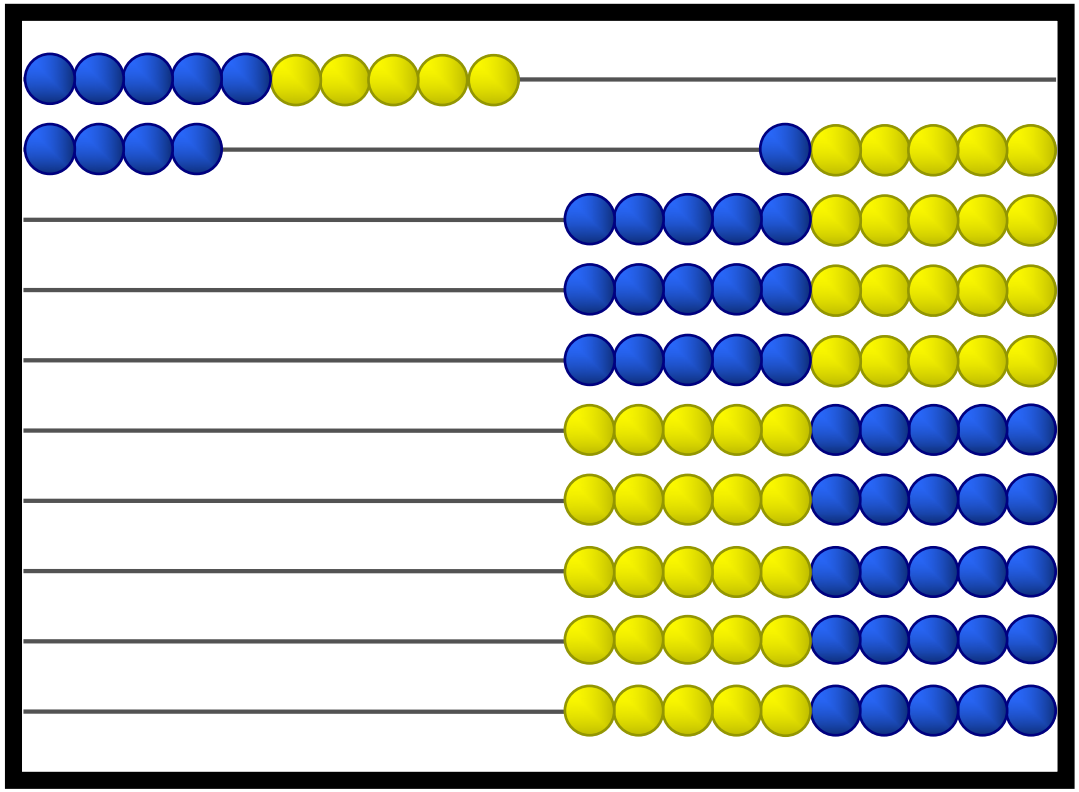
Strategy: Complete the Ten

$$9 + 5 =$$



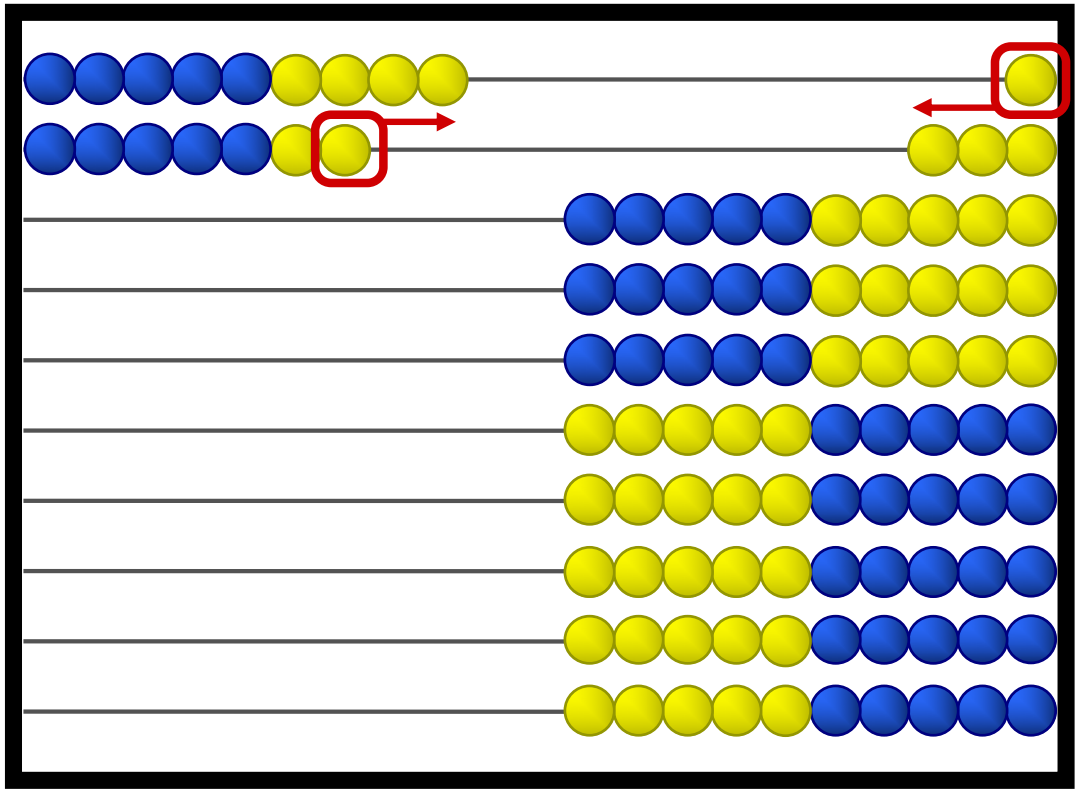
Strategy: Complete the Ten

$$9 + 5 = 14$$



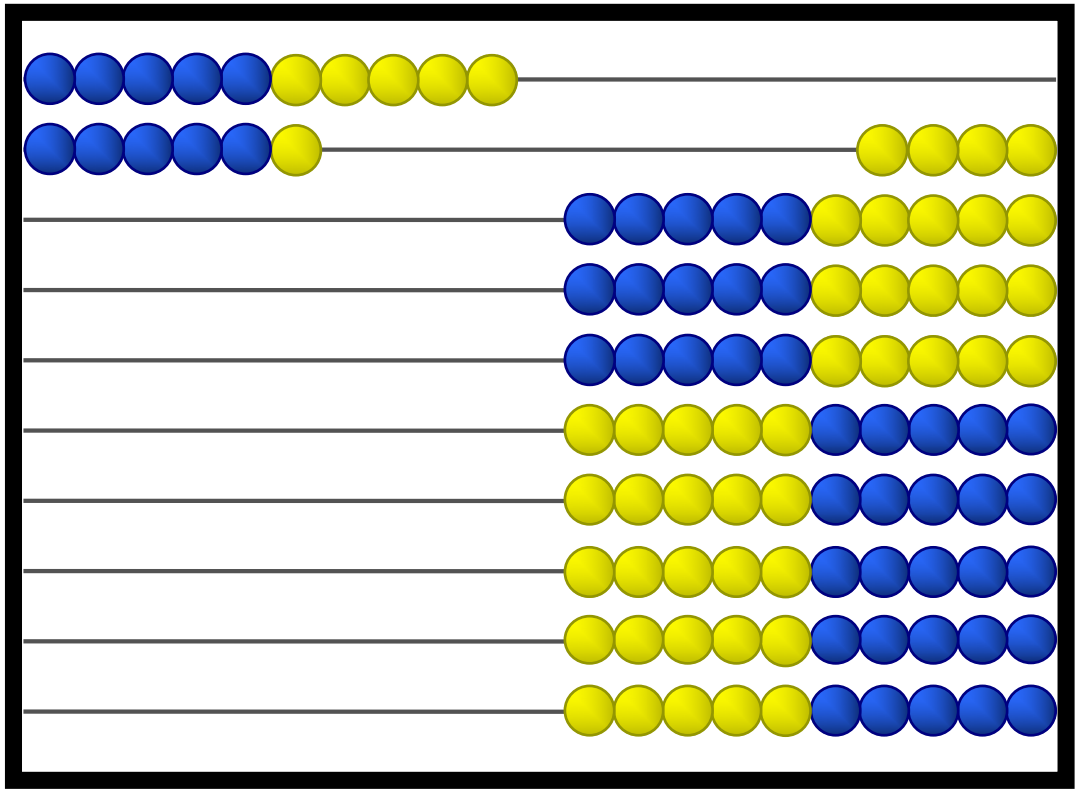
Strategy: Complete the Ten

$$9 + 7 =$$



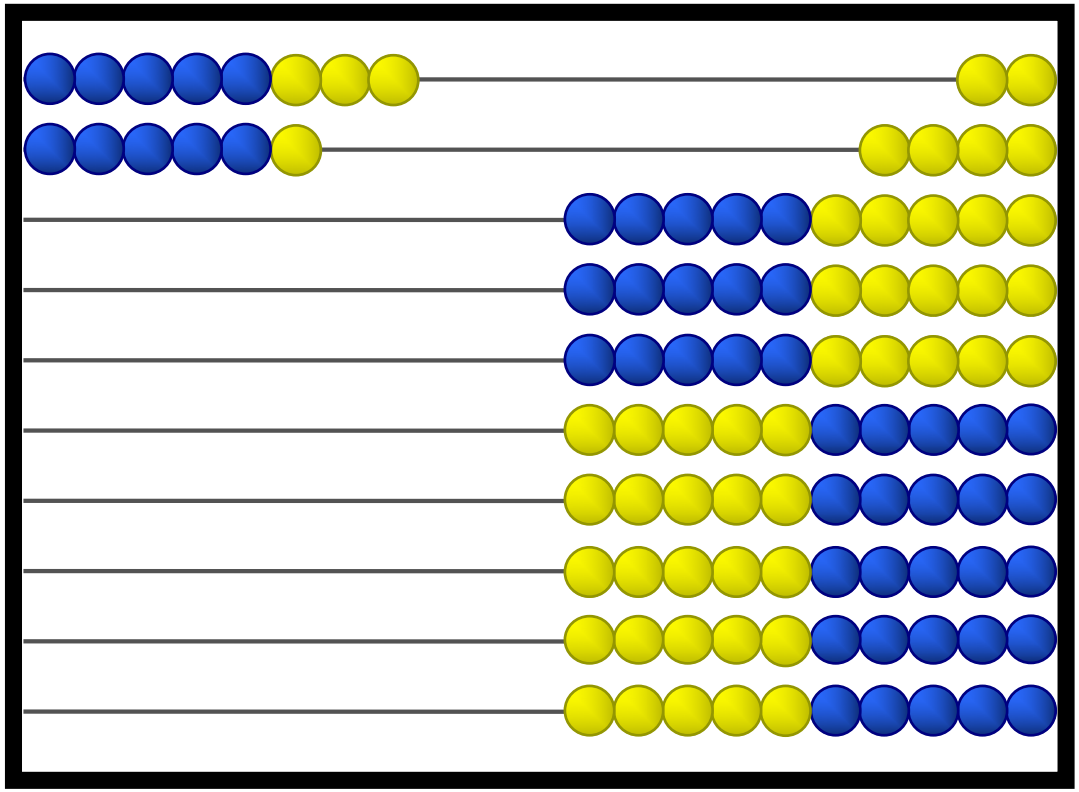
Strategy: Complete the Ten

$$9 + 7 = 16$$



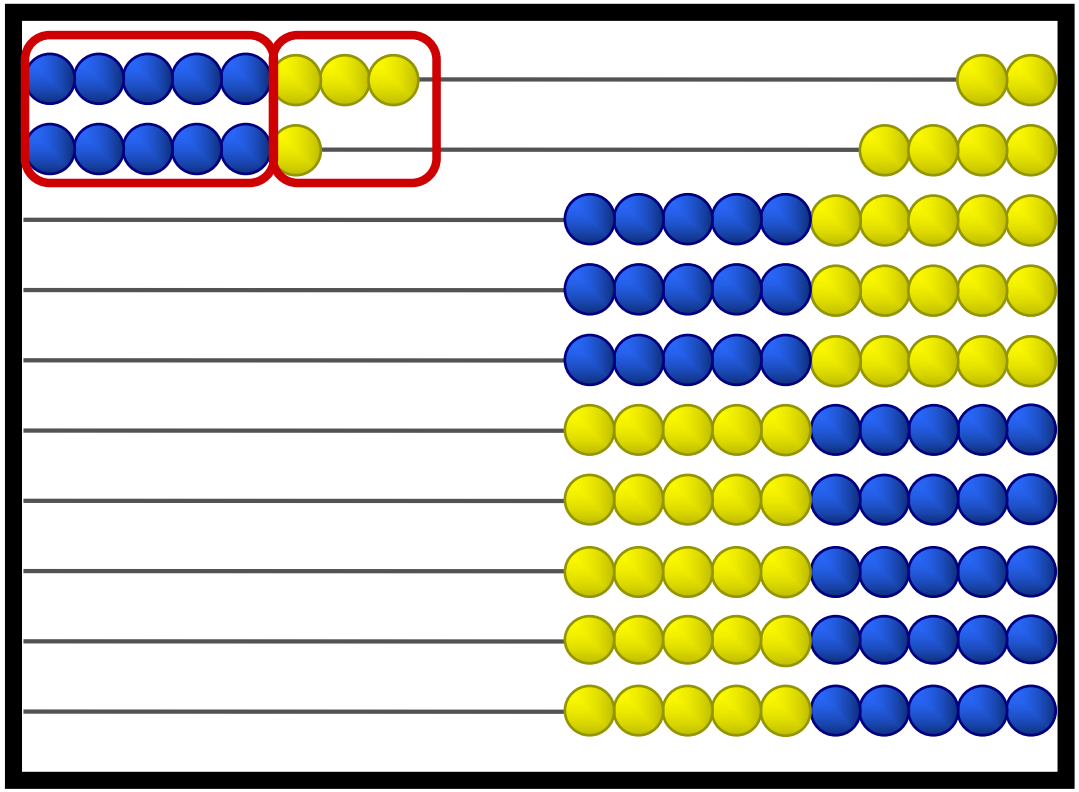
Strategy: Two Fives

$8 + 6 =$



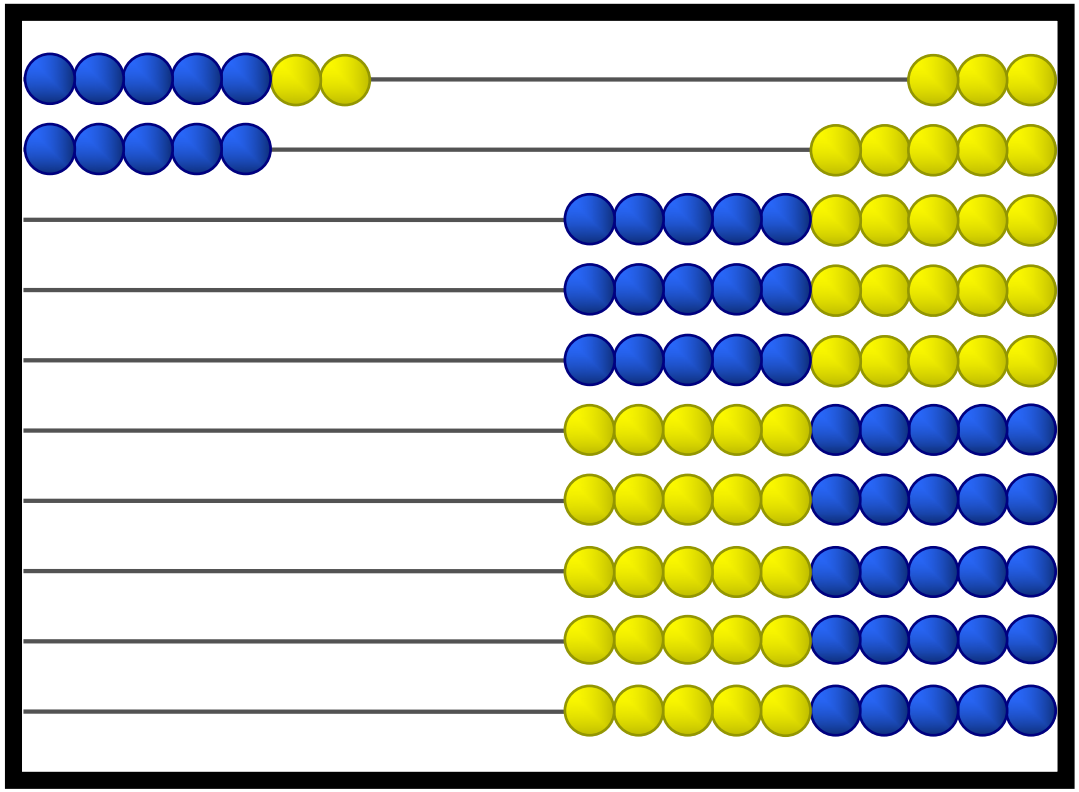
Strategy: Two Fives

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



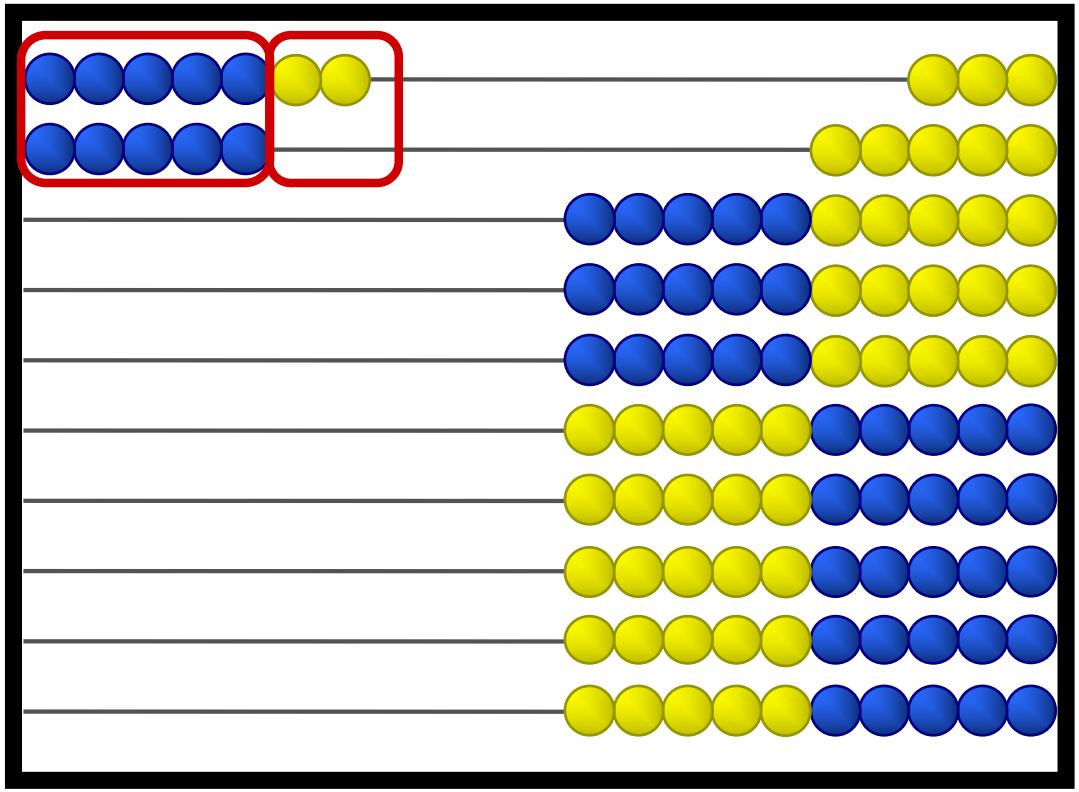
Strategy: Two Fives

$7 + 5 =$



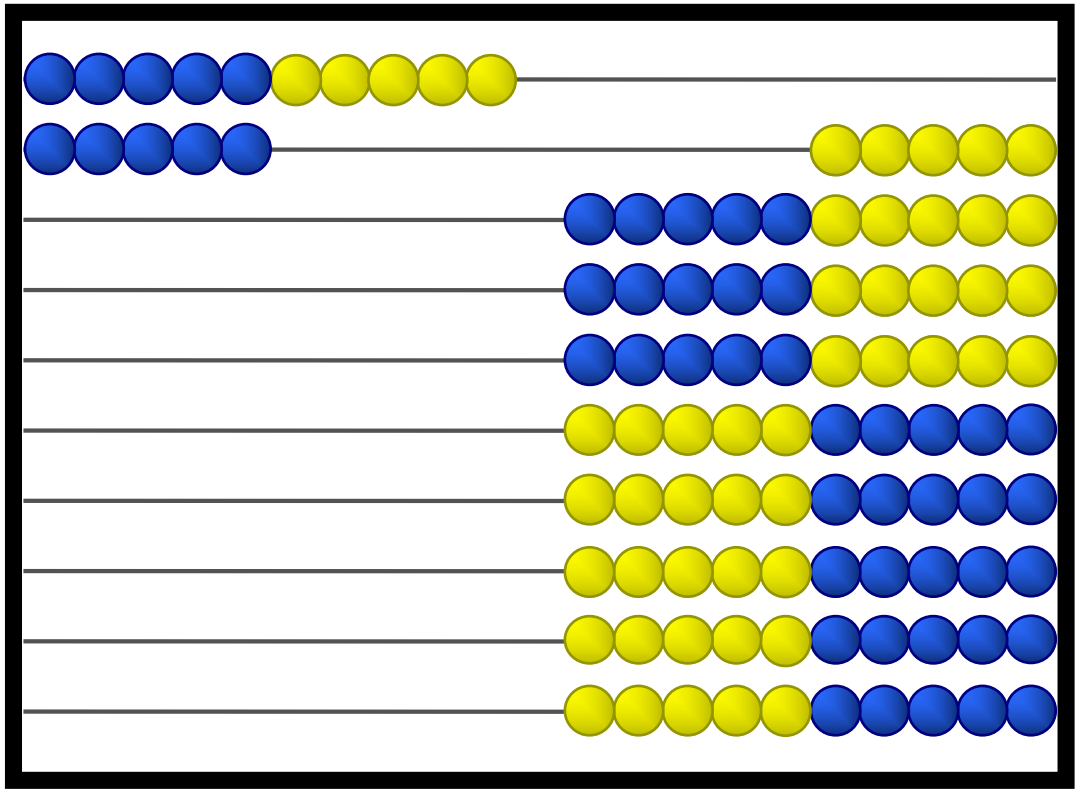
Strategy: Two Fives

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



Strategy: Part from Ten

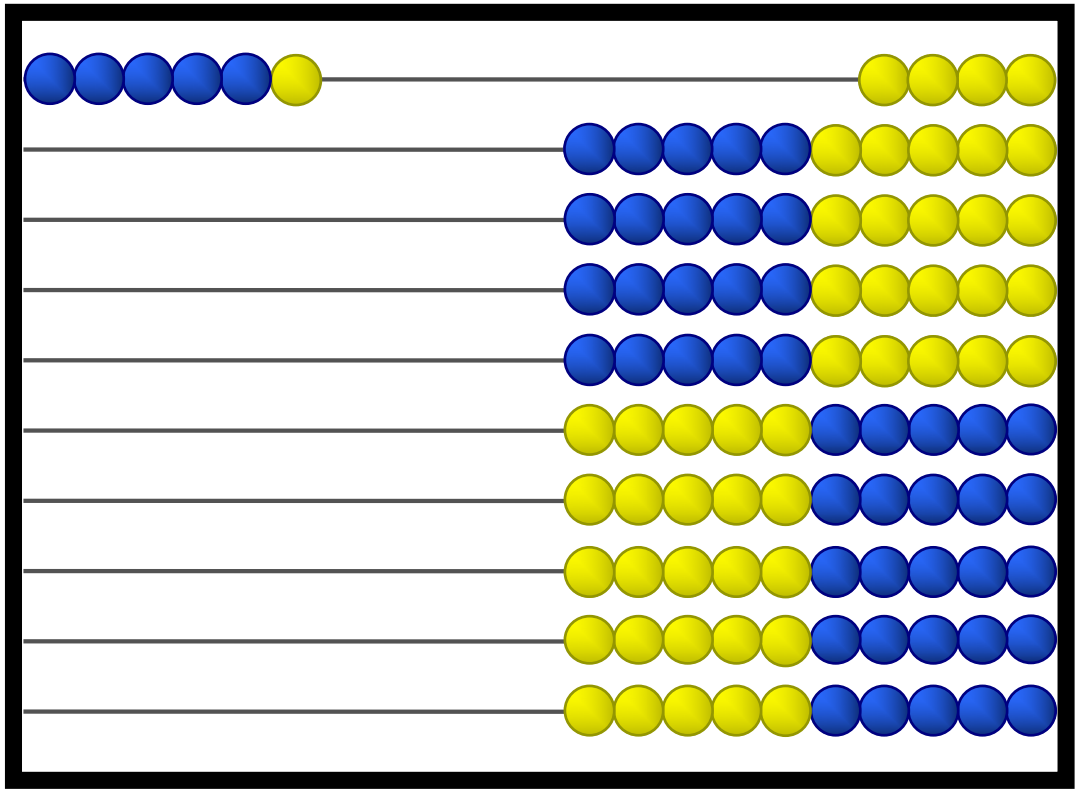
$$15 - 9 =$$



Subtract 5,
then 4

Strategy: Part from Ten

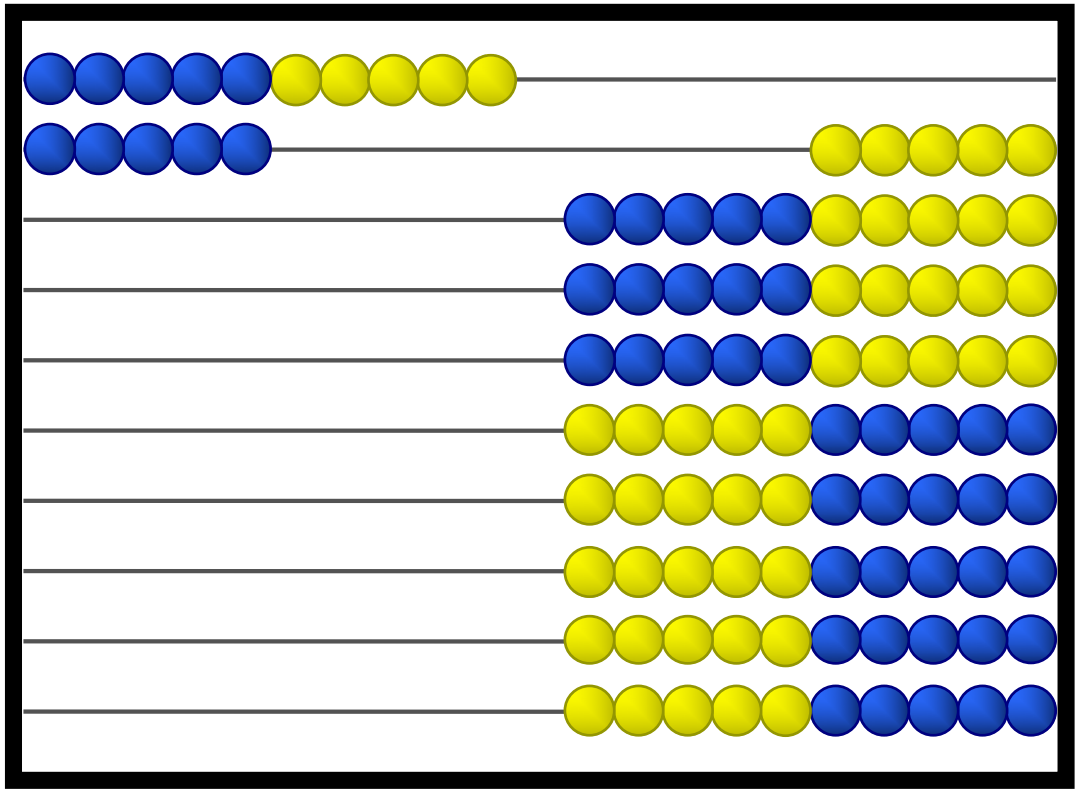
$$15 - 9 = 6$$



Subtract 5, then 4

Strategy: All from Ten

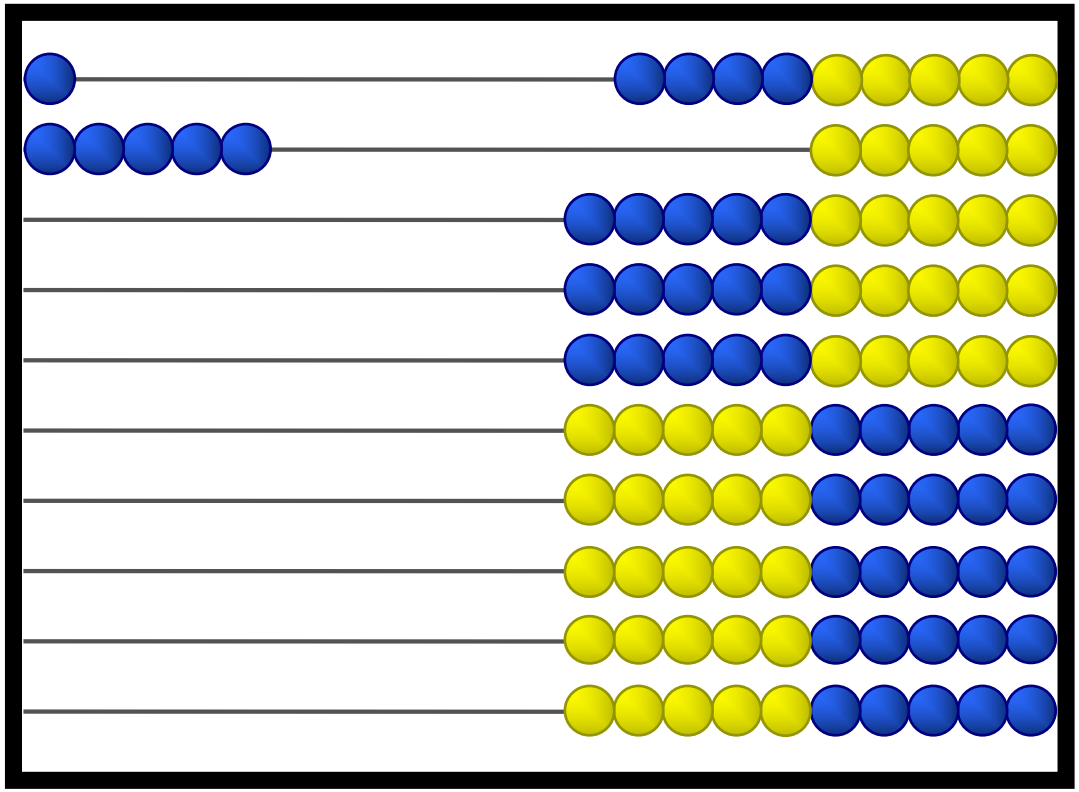
$$15 - 9 =$$



Subtract 9
from the 10

Strategy: All from Ten

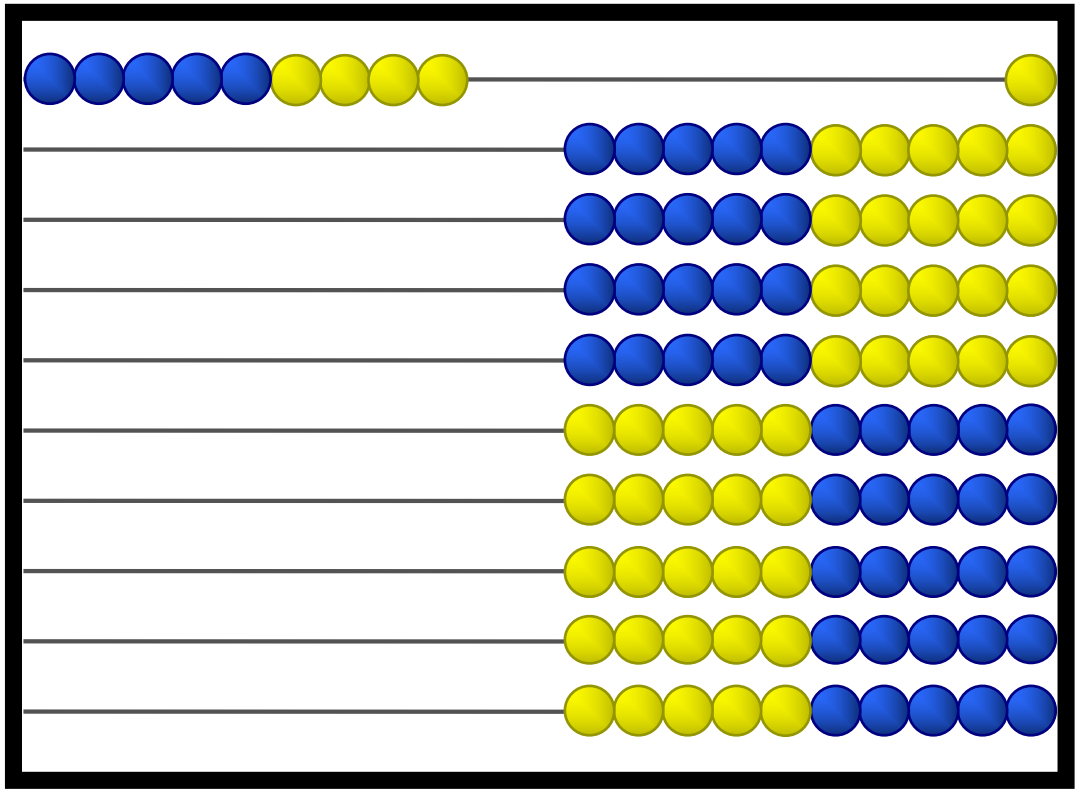
$$15 - 9 = 6$$



Subtract 9
from the 10

Strategy: Going Up

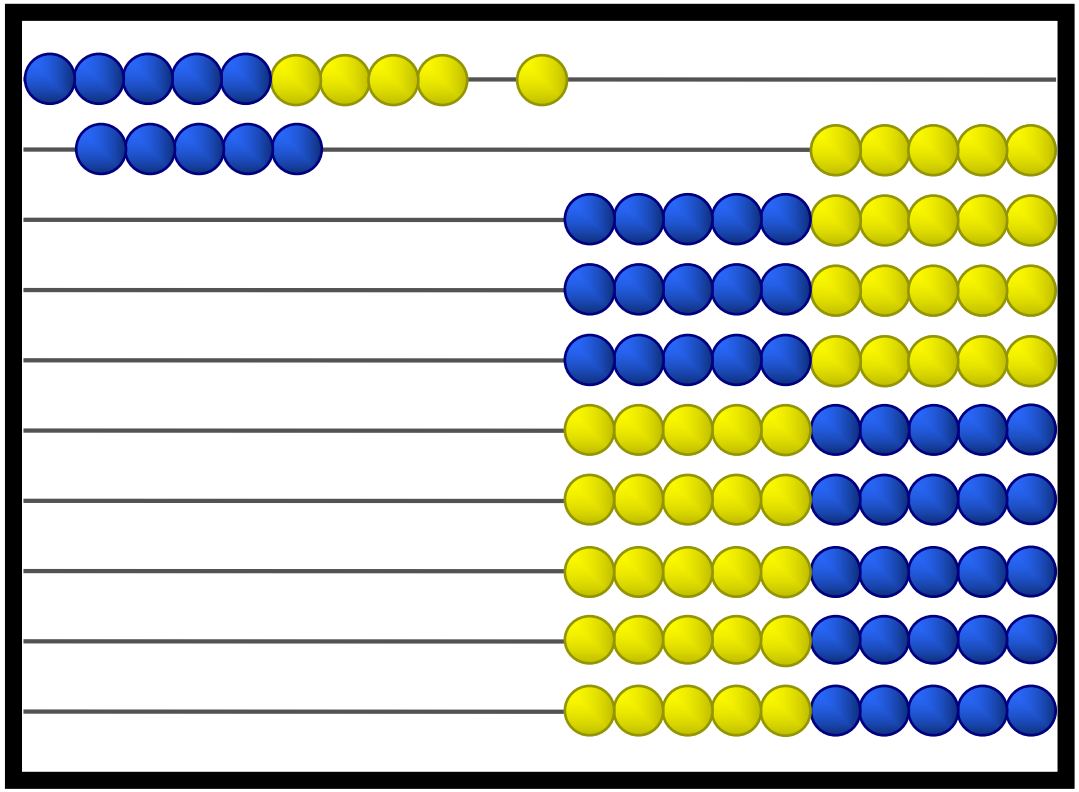
$$15 - 9 =$$



Start at 9;
go up to 15

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.

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.
- Encourage hard work and growth mindset.
- Choose a good math curriculum.

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.

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Play Games

Play Games

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

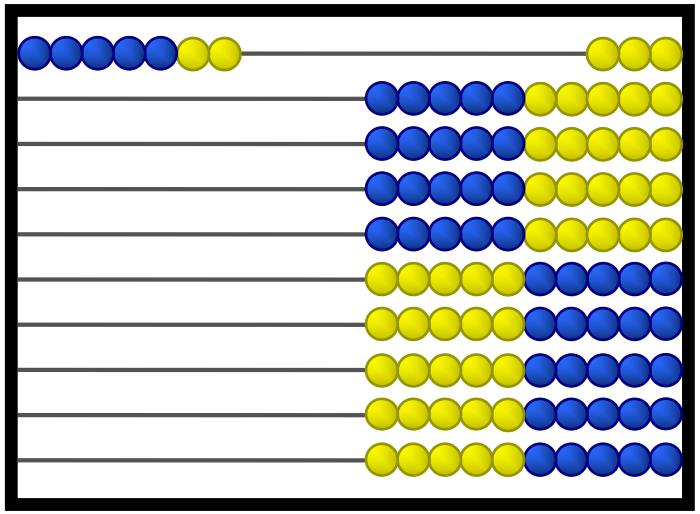
Games provide interesting repetition needed for automatic responses.

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:

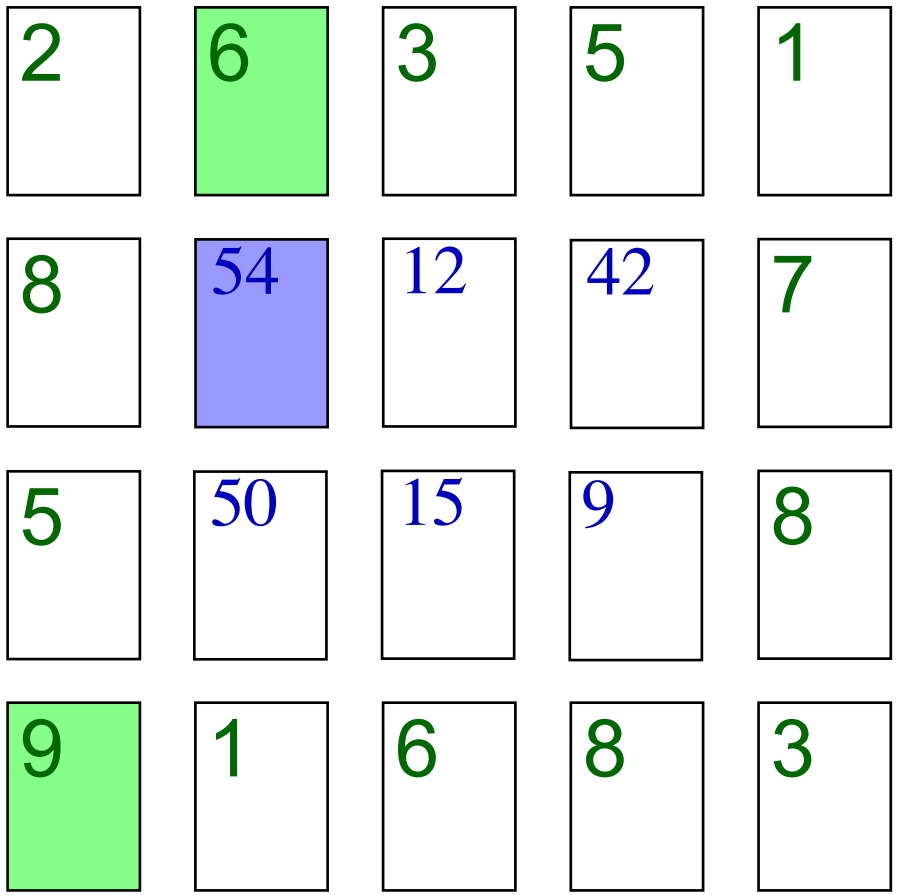
1 & 9
2 & 8
3 & 7
4 & 6
5 & 5



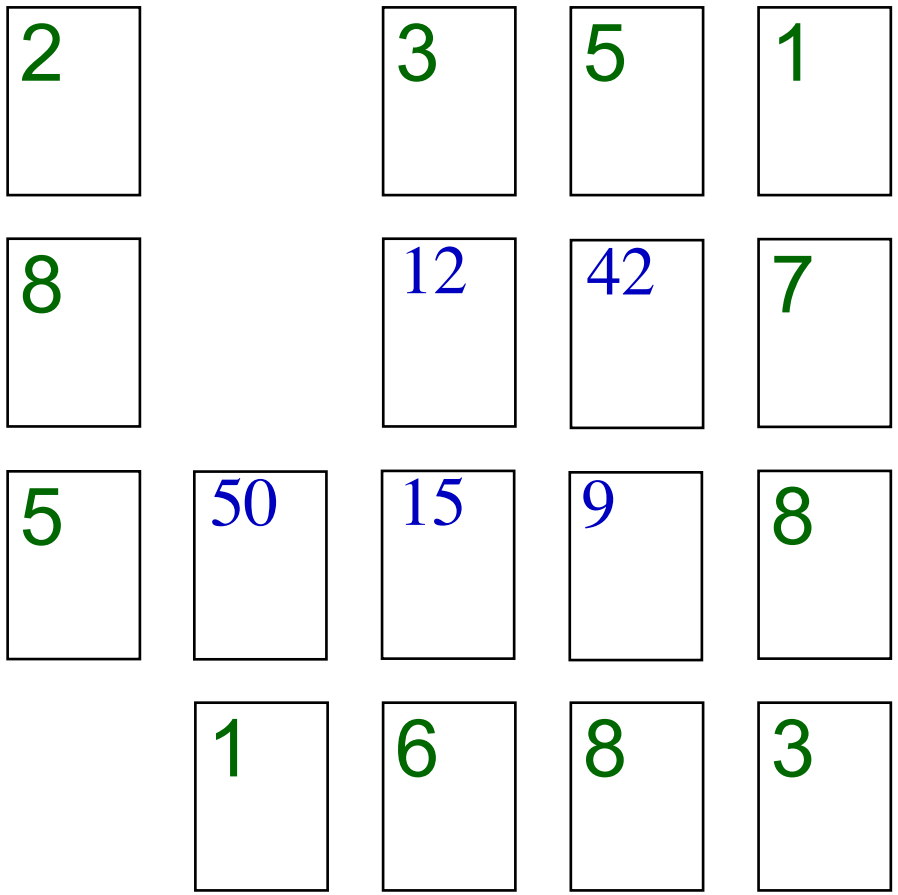
Ring Around the Products

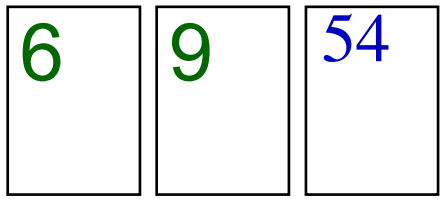
- Game to review the multiplication facts.
- Goal is to collect the most cards.

Ring Around the Products



Ring Around the Products





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- **Encourage hard work and growth mindset.**
- Choose a good math curriculum.

Hard Work and Growth

- Encourage the child to persist, learn, and grow.
- Do not constantly dispense rewards, verbal or otherwise.
    - This causes the child to rely on you for assurance.
    - Need to learn to rely on their own thinking each step of the way.

Hard Work and Growth

"All progress takes place

outside the comfort zone."

– Michael Bobak,

digital artist

Great Math Teachers

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- Encourage hard work and growth mindset.
- **Choose a good math curriculum.**

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?

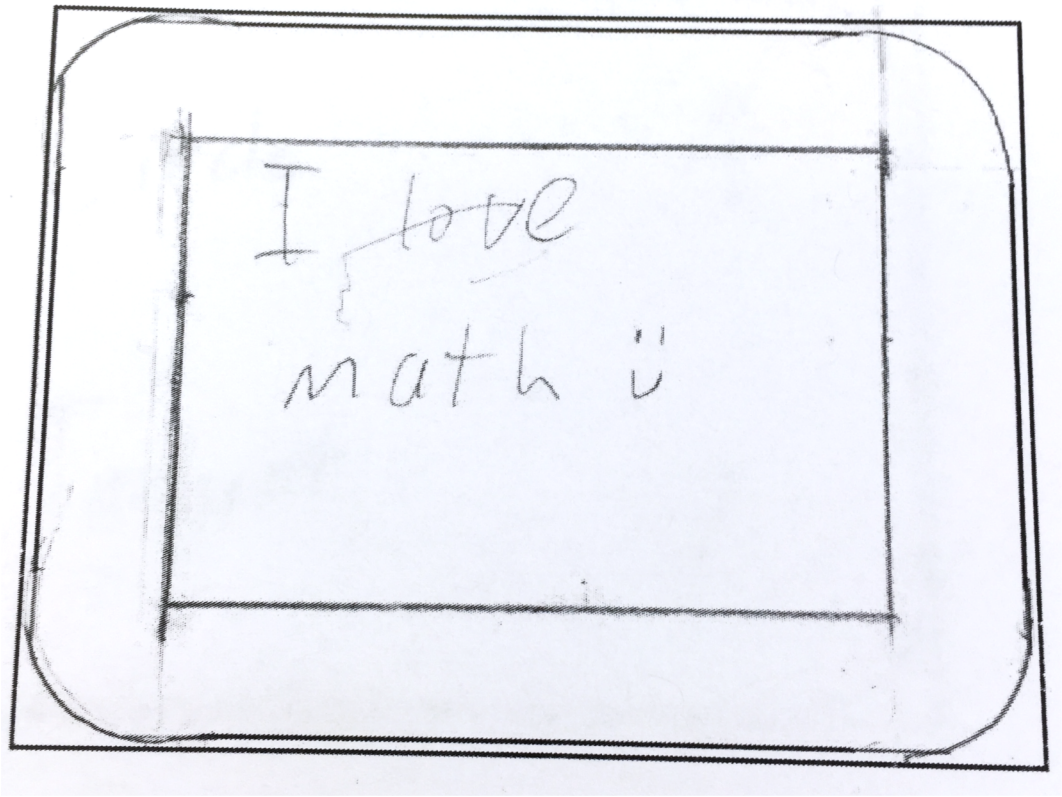
Conclusion

- 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.”

Conclusion

"You cannot love what you do not know."

– David McCullough, author



– Ben, math student, learning to draw tangent arcs