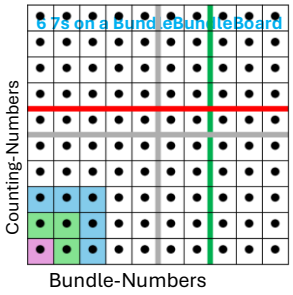
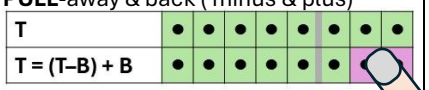
STeN solves Problems on a BundleBundleBoard to make all Youth Numerate by 2030

NUMERACY

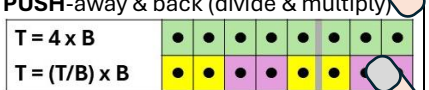
BBM • BundleBundleMath with units *(Kids: II II "Not 4, but 2 2s")*



PULL-away & back (minus & plus)



PUSH-away & back (divide & multiply)



0B 5 1B 3 2B 1 1BB 0B 1 2s

Ten = 2BB 0B 2 = 1BBB 0BB 1B 0 2s

- **ReUnite formula:** **T = (T–B) + B**

***u* + 3 = 5**. But, 5 = (5-3) + 3, so *u* = 5-3 = 2

***u* - 3 = 5**. But, *u* = (*u*-3) + 3 = 5 + 3 = 8

5 - *u* = 3. But, 5 = (5-*u*) + *u* = 3 + *u*, so, *u* + 3 = 5

- **ReCount formula:** (changes units in STEM) **T = (T/B) x B**

***u* * 3 = 12**. But 12 = (12/3) * 3, so *u* = 12/3 = 4

***u*/3 = 5**. But *u* = (*u*/3) * 3 = 5 * 3 = 15

12/*u* = 3. But 12 = (12/*u*) * *u* = 3 * *u*, so *u**3 = 12

Next **BundleBundle**: 1**BB** 2**B** 1

Before **BB-square**: 1**BB** -2**B** 1

7 = 0**B** 7 = 1**B** -3 = ½**B** 2 **tens**

Squares: 01 04 09 16 25 81 64 49 36

Δ**B**^2 = 2**B**+1 Later, (*x*^2)' = 2**x*

Add & Subtract etc.

8 + 6 = (½**B** 3) + (½**B** 1) = 1**B** 4 = 14

28+36 = 2**B** 8+3**B** 6 = 5**B** 14 = 6**B** 4 = 7**B** -6

8 x 46 = 8 x 4**B** 6 = 32**B** 48 = 36**B** 8 = 368

368 / 8 = 36**B** 8 / 8 = 32**B** 48 / 8 = 4**B** 6 = 46

T = 8 – 6 = (½**B** 3) – (½**B** 1) = 0**B** (3 – 1) = 0**B** 2 = 2

T = (1**B** -2) – (1**B** -4) = 0**B** (-2 + 4) = 0**B** 2 = 2

(notice - - is +)

Place value & carry & borrow unneeded

Video: Many before Math

T = 6*7 = 6*(½**B** 2) = 3**B** 12 = 42 (Overload)

T = 6 * 7 = (**B** - 4) *(**B** - 3)

BBM FOIL Down & Cross

= **BB** - 3**B** - 4**B** - - 12 (notice - - is +)

= (10 - 3 - 4)**B** + 12 = 3**B** 12 = 4**B** 2 = 42

6 * 7 = (**B**-4) * (**B**-3) = (½**B** 1) * (½**B** 2)

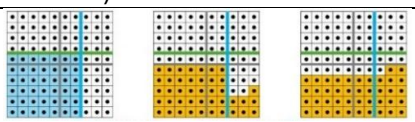
With fingers :

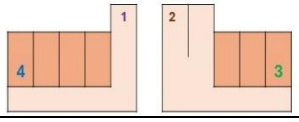
T = (1+2+5) * ½**B** + (1*2) = 8 * ½**B** 2 = 4**B** 2

T = (1+2)**B** (4*3) = 3**B** 12 = 4**B** 2 = 42

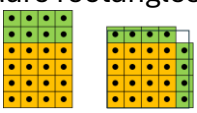
T = 6 * 7 = 6 * (6+1) = 6^2+ 6 = 36+6 = 42

ReCount 6 **7s** into 5**B** -8 **tens** and 4**B** 2 **tens**





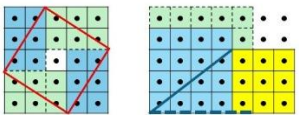
Square rectangles



To square the total T = 6 **4s**, half of the (6-4) **4s** move from the top to the side to get a 5 x 5 square, and an unfilled square in the upper corner.

This we fill with a 4****u*** slice of the top and the side. Here ***u*** is found by the equation 2****u****4 = 1, or 8****u*** = 1, or ***u*** = 1/8 = 0.125, So, 5-0.125 = 4.88. Calculator: √24=4.90

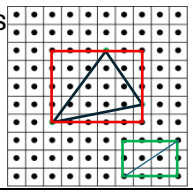
Add Squares



On a **BBB**oard four 2 **3s** arranged as a 5-by-5 square contains 2 squares (3 **3s** and 2 **2s)** as well as 2 stacks. But it also contains one square formed by the stacks' diagonals as well as four half stacks.

So, a 4- and a 3-square add as the square formed by the mutual **B**ottom-**T**op **BT** line thus having the length as the square-root of the sum, i.e., √(4^2 + 3^2) = 5. Pythagoras or Gougu rule.

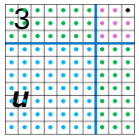
Triangles



A triangle has the points **A**(3,4) and **B**(6,8) and **C**(8,5) packed inside at 4 **5s** stack.
We find its angles and sides.
Ar is **A**'s right angle.
• π = *n**tan(180/*n*) for *n* large

In a stack with a diagonal, up = (up/out)*out = TanAngle*out.
In a 2 **3s** stack, Tan**A** = 2/3. A calculator shows **A** = 33.7
Tan**Ar** = 1/5 gives **Ar**= 11.3 and **AC** = √(1+25) = 5.1
Tan**Br** = 4/3 gives **Br**= 53.1 and **AB** = √(16+9) = 5.0
Tan**Cr** = 2/3 gives **Cr** = 33.7 and **BC** = √(4+9) = 3.6
A = 90 - 11.3 - (90 - 53.1) = 41.8 & **B** = 70.6 & **C** = 67.6

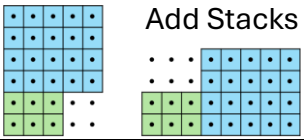
Solve quadratic equations



On a **BBB**oard, (***u***+3)*(***u***+3) is a square with four parts, two squares (***u***^2 and 3^2), and two stacks, 2*3****u***, so that T = ***u***^2 + 6****u*** + 9.

The quadratic equation ***u***^2 + 6****u*** + 8 = 0 then makes the whole square go away except for 9-8 = 1. So (***u***+3)^2 = 1. This gives two solutions, ***u*** = -2 and ***u*** = -4.

Add Stacks



OnTop: **Proportionality** makes units like

2 **3s** + 4 **5s** = 1**B** 1 **5s** + 4 **5s** = 5**B** 1 **5s**

2 **3s** + 4 **5s** = 2 **3s** + 6**B** 2 **3s** = 8**B** 2 **3s**

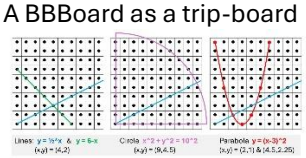
NexTo: **Calculus** adds or splits areas

2 **3s** + 4 **5s** = 4**B** -6 **8s** = 3**B** 2 **8s**

2 3**s** + ? **5s** = 4 **8s**

? = (4 **8s**–2 **3s**)/5 = 5**B** 1 **5s** = (T2-T1)/5 = ΔT/5

A BBBoard as a trip-board



On a 2/4 trip from the (0,0)-dot to the (*x*,*y*)-dot we have that *y*/*x* = 2/4, or *y* = 2/4**x* = ½**x*. Another line has *y* = 6-*x*. Where the two lines meet, we have *y* = 1/2**x* = 6-*x*. This gives *x* = 12-2**x*, or 3*x* = 12, or *x* = 4. Here, *y* = 6 – 4 = 2. So, they meet in point (4,2).

On a circle with radius 10 and center in the (0,0)-dot, *x*^2 + *y*^2 = 10^2. On its way the *y* = 1/2**x* line meets the circle. Here *y* = ½*x* makes *x*^2 + *y*^2 = *x*^2 + (½*x*)^2 = 100, or *x*^2 + 1/4*x*^2 = 100. This gives *x* = 2*4.5 = 9. Here *y* = 2/4*9 = 4.5. So, they meet in point (9,4.5).

A trip where *y* = (*x*-3)^2 is a bent line called a parabola. It meets the *y* = 1/2**x* line in point (*x*,*y*). Here *y* = ½*x* makes ½**x* = *x*^2 – 6**x* + 9, or *x*^2 – 6.5**x* + 9 = 0. There are two solutions, *x* = 2 and *x* = 4.5. This gives *y* = 1 and *y* = 5.25. So, they meet in points (2,1) and (4.5, 5.25).

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