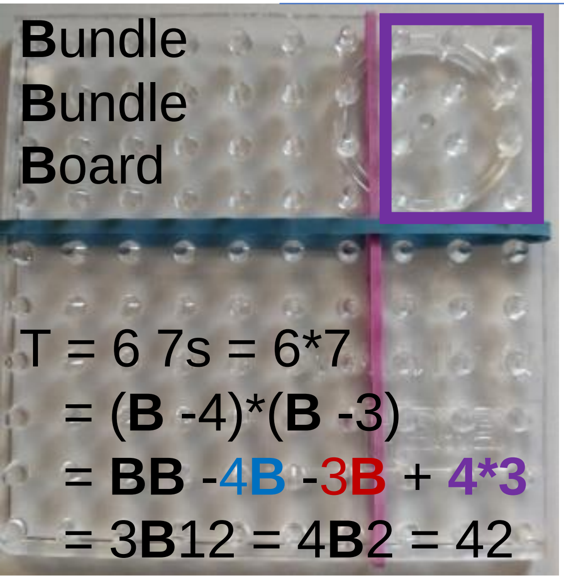
Decolonizing Math by Demodeling Essence as Existence

1+1 = 1 since 1 1s + 1 1s = 1 2s



DeColonized **Robin Hood Math** brings back **Children's BundleNumbers**: When **Existence** precedes **Essence**

Counting precedes **Adding**

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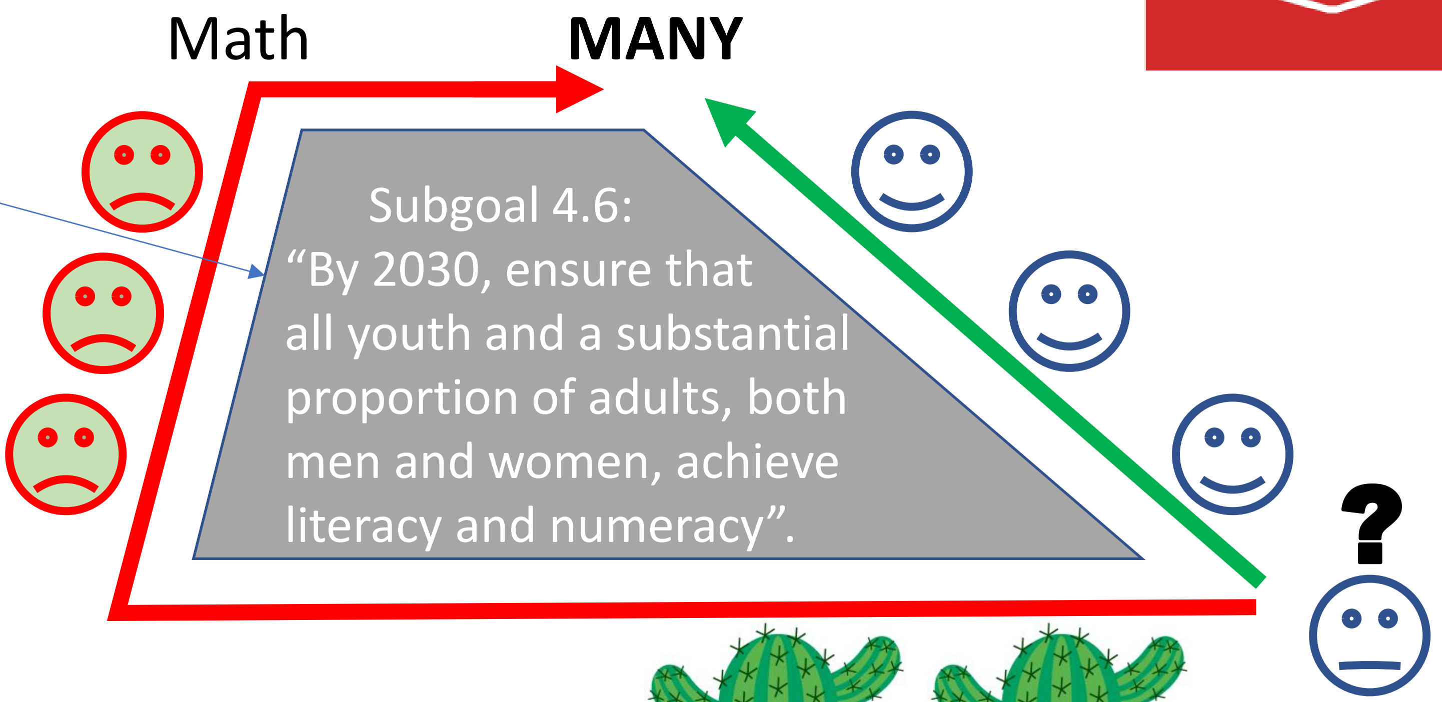
In Math Education, what comes first: to master Math - or to master Many?

4 QUALITY EDUCATION

The UN goal is clear: **Many**
Still, all say:
The goal is to master Math,
to later master Many.
But Math is hard!
Why not first master Many,
to later master Math?
So, we may ask:



What Mathematics may grow from children's innate mastery of Many, where counting precedes adding?

SUSTAINABLE DEVELOPMENT GOALS

Many before or after Math?
The 3 Grand Theories give no Clue

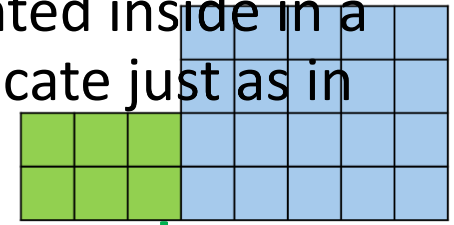
In **PHILOSOPHY**, **Existentialism** says: The outside existence must precede any inside socially constructed institutionalized essence, to prevent an essence from colonizing the existence. **Essentialism** says no: physical existences are only shadows of the metaphysical essence (Plato's Cave).

SOCIOLOGY warns against a **goal displacement** in **institutions**, socially constructed as a **means** to reach a common **goal**, but using '*not reaching the **goal***' as a **means** to become the **goal** itself.

In **PSYCHOLOGY**, **Piaget** says learn by meeting the outside **existence**. **Vygotsky** says no, learn by listening to inside institutionalized **essence**.

Listening to 3year-old children

- Asking a 3year-old "How many years next?", the answer typically is 4, with 4 fingers shown. But held together 2 and 2, the child says “No, that is not 4, that is 2 2s."
- Where the educated sees the **essence**, four, the uneducated sees the **existence**, two 1s **bundled** as one 2s in space, and 2 of them when counted in time.
- The child thus sees two-dimensional **bundle-numbers** with a horizontal **unit-number**, and a vertical **counting-number**. So, what exists outside are totals counted inside in a number-language sentence with an outside subject and an inside predicate just as in word-language sentences, e.g., T = **2 3s** or T = **4 5s**.



- **Many-math** respects that **MANY** is described by the child's own **bundle-numbers with units**. Instead of being colonized by line-numbers without units that becomes ‘**Mathema-tism**’ claiming that 2 + 1 = 3 always, even though 2days + 1week = 9days.

Kids use units (2 **3s**), Schools don't. So Math Differs OUTSIDE & INSIDE the 'NoUnitMath' GreenHouse

OUTSIDE

ManyMath

2+1 = ??

depends on the units

2weeks + 1day = 15days

2m + 1m = 3m

2km + 1mm = 2km

20$ + 10% = 22$

INSIDE

NoUnitMath

GreenHouse

2+1 = 3 always

MatheMatism

True inside,

but seldom outside

2+3 is 5 sometimes. But 2*3 is 6 always. Why? Because here 3 is the unit!

Bundle-numbers with units exist on a ten-by-ten BundleBundle Board, a BBBoard

The BBBoard shows a total of 6 7s. To be precise we should say

T = 6 Bundles with 7 per Bundle

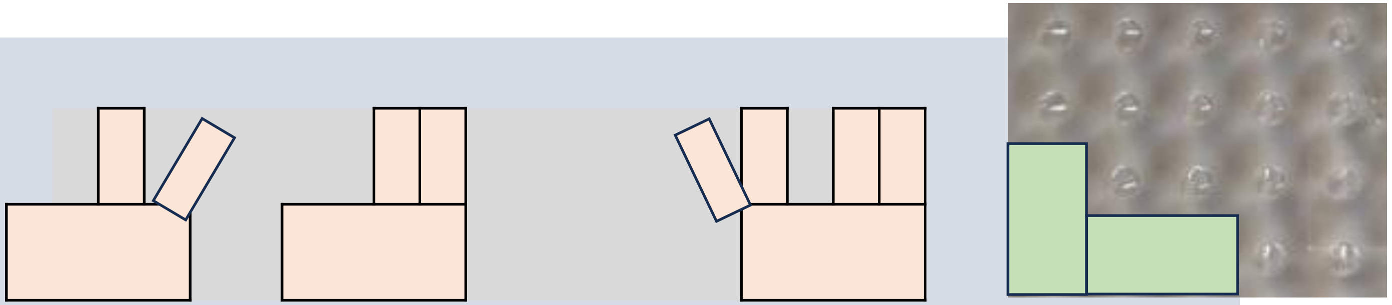
Likewise, 58 should be phrased, not 5-ten-8, but

T = 5 Bundles with ten per bundle and 8 unbundled

Calling 6 and 7 for a **unit-number** and a **per-number** our goal is to fill in this **Algebra Square**, where algebra in Arabic means to reunite numbers.

Unite ***Split into***	**Unlike**	**Like**
Unit-numbers (meter, second)	**T = a + b** *T – b = a*	**T = a*b** *T/b = a*
Per-numbers (m/sec, m/100m = %)	**T = ∫ f dx** *dT/dx = f*	**T = a^b** *b√T = a* *loga(T) = b*

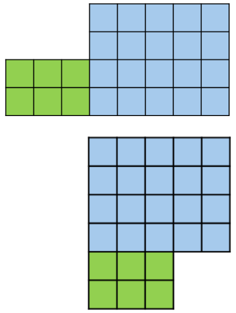
Their and my first lesson



In my first lesson I said that math, is about a number line, where one plus one is two always.

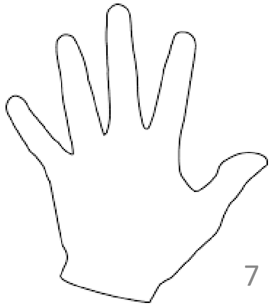
Then a child stopped me, showing a V-sign: “Mister teacher, here is one 1s, and here is one 1s. Now I add them and get one 2s. So, 1 plus 1 is 1 , and not 2 as you say”. The child then added an extra V-sign and said: “And, here I have two 1s and one 2s. If I add them with your numbers, I should get 3 3s, but I only get 1 4s. Why? Because we must multiply before we add, 2*1 + 1*2 = 4, which my uncle calls calculus, an which we can see on this 2D ten-by-ten peg board, a **Bundle-Bundle** board, or a **BBB**oard.

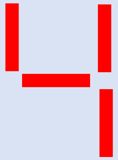
Instead of colonizing our number-language, become a Robin Hood and help us with the numbers we bring to school, **bundle-numbers with units** as **2 3s** and **4 5s**, that we would like to add next-to as 8s, or on-top as 3s or 5s using calculus or linearity taught the first year at college, but we need it here.



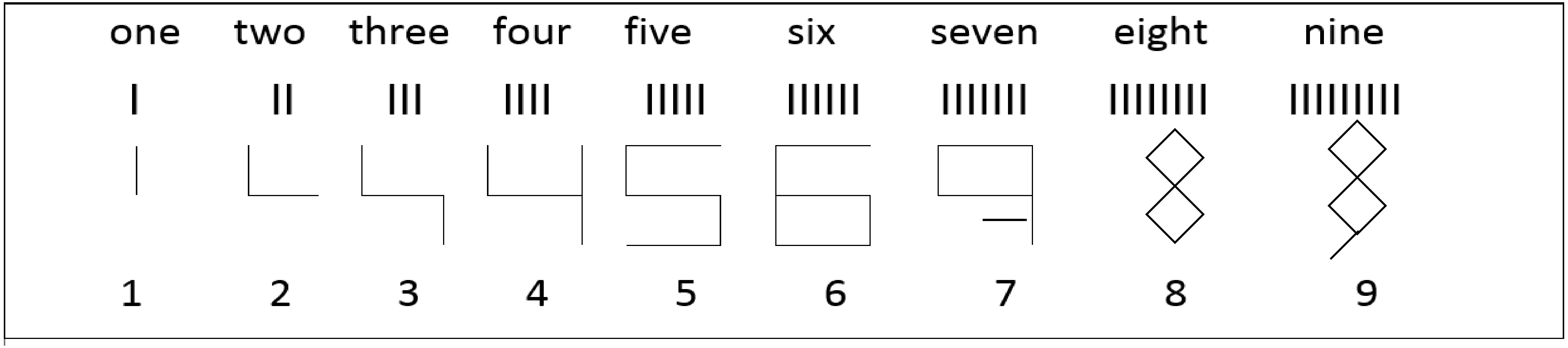
Don’t worry, we will teach you. let us begin with the fingers on a hand. You only see the essence, five, but we see all the ways the fingers may exist as **Bundles** to be counted.

5 *1s*, ● **1B** 0 *5s* ● **1B** 1 *4s* ● 1**B** 2 *3s* ● **2B** less 1 *3s* ● **1B** 3 *2s* ● **2B** 1 *2s* ● **3B** less 1 *2s*, ● 1**BB** 0**B** 1 *2s*.



Digits are Icons: IIII → IIII →  →

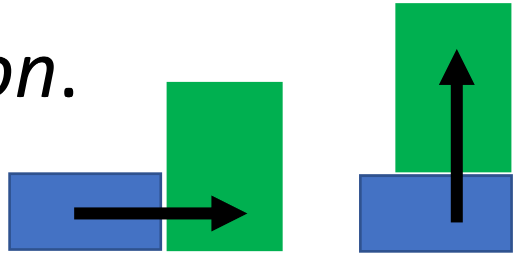
Children love making number-icons of cars, dolls, spoons, sticks.
Changing four ones to one fours creates a 4-icon with four sticks.
An icon contains as many sticks as it represents, if written less sloppy.
Once created, icons become **UNITS** when counting in bundles, as kids do.

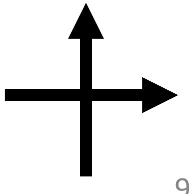


Divide & Multiply & Subtract & Add may be 'de-modeled' as Icons also

- From 9 **PUSH** away **4s** we write 9/4 iconizing a broom, called *division*.
- 2 times **LIFT** the **4s** to a stack we write 2x4 iconizing a lift called *multiplication*.

- "From 9 **PULL** away 2 **4s** to find un-bundled" we write 9 – 2x4 iconizing a rope, called *subtraction*.
- **UNITING** next-to or on-top we write **B**+**C** iconizing the two directions, called *addition*.





BundleCounting creates a units-shifting Recount-Formula

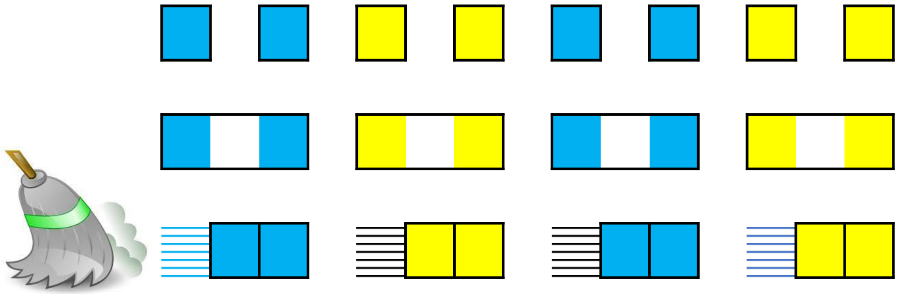
$8 = (8/2)x2$

$T = (T/B)xB$

Shift unit from **tens** to **2s**: 8 = ? **2s**

Bundle-counting: 8 = 4 **2s** = 4x2

Predict by a calculation: 8/2 = 4



Recount result: 8 = (8/2)x2

Recount-Formula: $\boxed{T = (T/B)xB}$ *" **T** contains **T/B Bs**"*

*u*x2 = 8

u = 8/2

= (8/2)x2

Equations

Proportionality

Shifting units	y = k * x
Linearity	Δy = (**Δy/Δx**) * Δx = **m** * Δx
Local linearity	dy = (**dy/dx**) * dx = **y'** * dx
Trigonometry	a = (**a/b**) * b = **tanA** * b
Trade	$ = (**$/kg**) * kg = **price** * kg
STEM	meter = (**meter/sec**) * sec = **speed** * sec

Move: OPPOSITE Side & Sign

Recounting gives **per-numbers** and fractions

Goods can be counted in kg and dollar connected by a **per-number** as 4kg per 5$, or 4kg/5$. We then change the unit by recounting in the per-number. This is also known as proportionality.

- Question: 20kg = ? $.
- Answer: 20kg = (20/4) * 4kg = (20/4) * 5$ = 25$.

Nature and STEM are filled with per-numbers.

- Motion can be counted in meters and seconds, where the per-number meter/second is called the speed.

With like units, per-numbers become fractions, 4$/5$ = 4/5, and 40$/100$ = 40%

Recounting sides in a stack halved by its diagonal gives trigonometry before geometry, and Pi

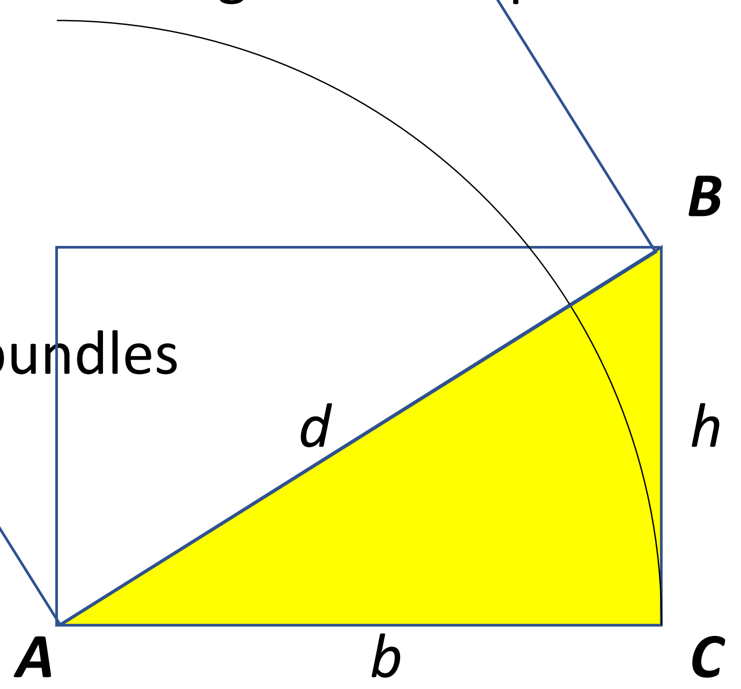
In Greek, geo-metry means to earth-measure. The earth may be divided in triangles; that may be divided in right triangles; that may be seen as a stack halved by its diagonal. This ‘half-stack’ has three sides: the <u>base *b*</u>, the <u>height *h*</u>, & the <u>diagonal *d*</u>, connected with the <u>angle *A*</u> by per-number formulas recounting the sides pairwise.

$h = (h/b) \times b = \tan\boldsymbol{A} \times b$
$h = (h/d) \times d = \sin\boldsymbol{A} \times d$
$b = (b/d) \times d = \cos\boldsymbol{A} \times d$

$\underline{h \times h + b \times b = d \times d}$, so the sides add as bundle-bundles

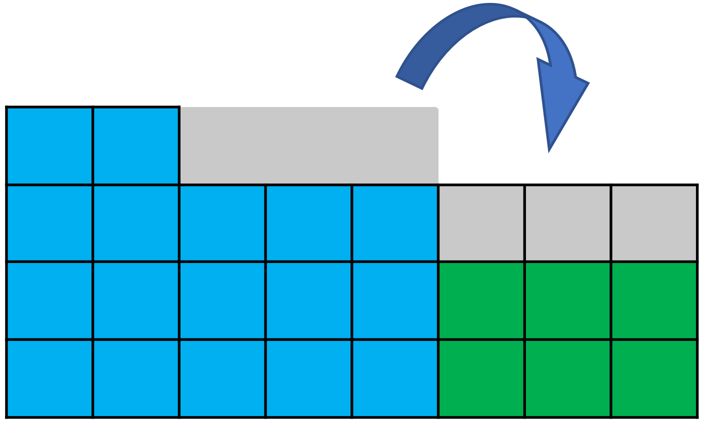
$\tan\boldsymbol{A} = h/b = \Delta y/\Delta x$ = rise/run = diagonal gradient

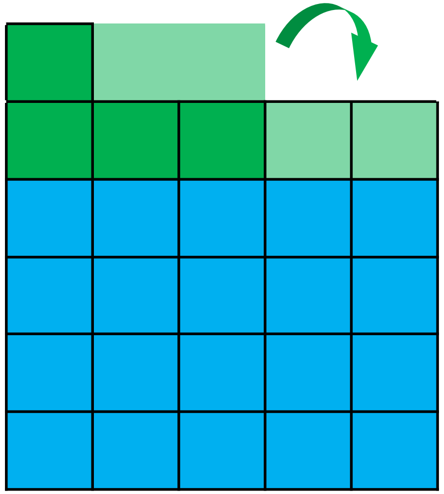
A circle contains very many small half-stacks, so half the circumference is: $\boldsymbol{\pi = n \times \tan(180/n)}$ for n large



Once Counted & Recounted, Totals may Add

BUT: NextTo	**or OnTop**
4 **5s** + 2 **3s** = 3**B**2 **8s**	4 **5s** + 2 **3s** = 5**B**1 **5s**
The areas are integrated *Adding areas = Integration*	The units are changed to be the same *Change unit = ReCounting = Proportionality*





A Final Question

SUSTAINABLE DEVELOPMENT GOALS

4 QUALITY EDUCATION

Should Ethical Quality Education force children inside a ‘no-unit-math’ greenhouse that slowly strangles their innate number-language by using line-numbers to learn no-unit addition that folds outside?

Where children’s innate mastery of Many just waits to be developed by flexible bundle-numbers available at their fingertips.