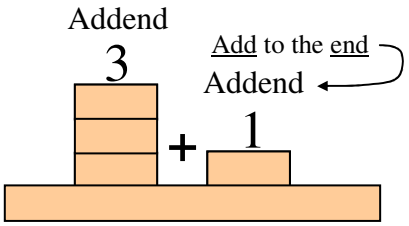
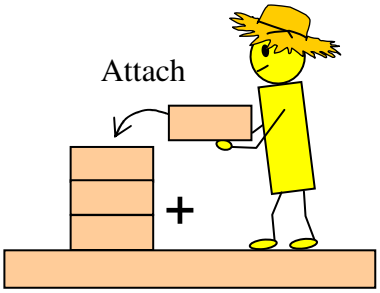
Mental Math

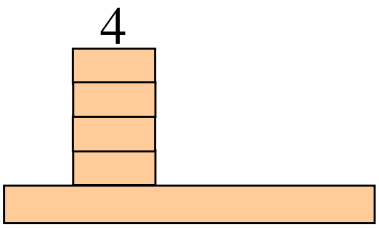
Addition Attaches

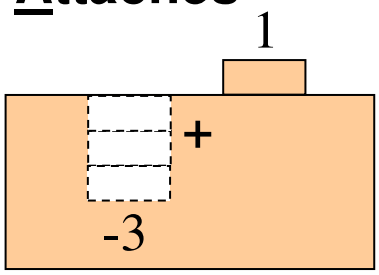


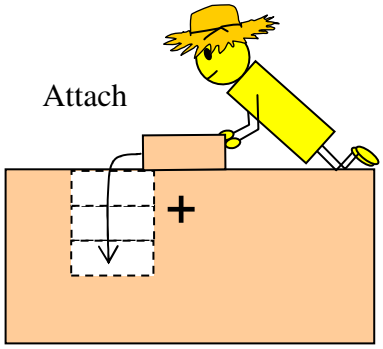


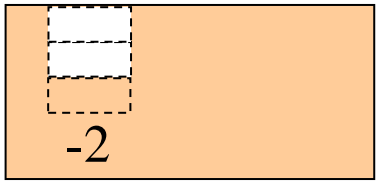
Summary

Sum









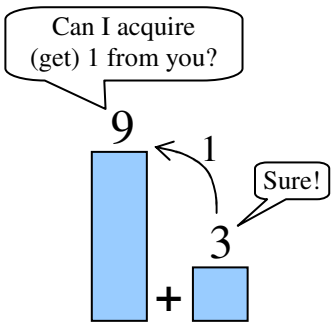
Your turn!

Draw a 3-deep hole, then attach a 1-deep hole to the bottom. How deep is the combined hole?

$-3 + -1$

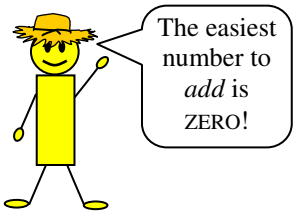
Add-quire

Acquire to make an addend end in ZERO.



10 + 2

12



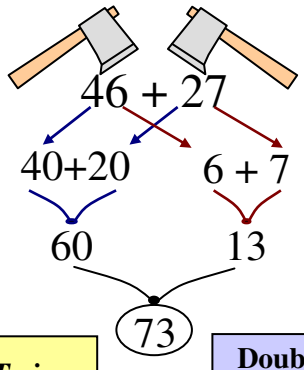
Your turn!

99 + 36

Split & Attach

Split by place values. Attach in the order you'd *say* it.

Like splitting wood



Twice done is well done!

46
+27

Double CHECK with a second TECH-nique!

Your turn!

25 + 17

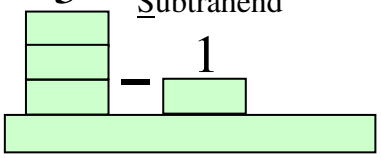
Subtraction Steals

Diminish this

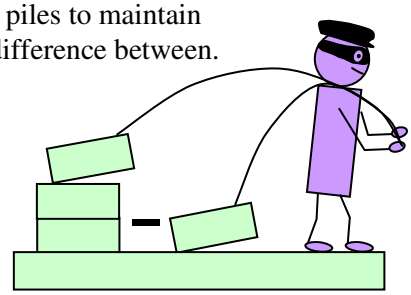
Minuend 3

Second number

Subtrahend 1

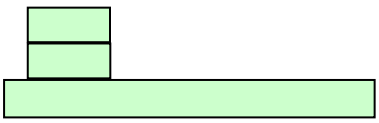


Steal from *both* piles to maintain difference between.



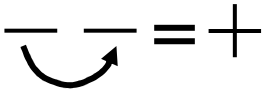
Difference

2



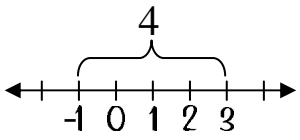
Paradox!
To *subtract* a hole, you must *add* a pile!

Subtract Negative = Positive



3 – – 1 = 3 + 1 = 4

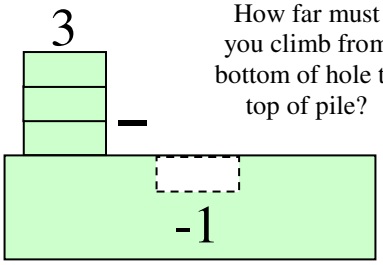
4



Difference between 3 and -1 is 4

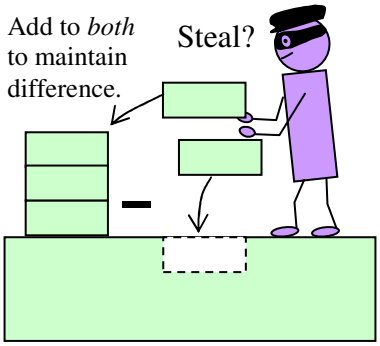
3

How far must you climb from bottom of hole to top of pile?



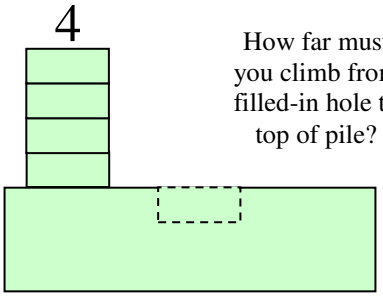
Add to *both* to maintain difference.

Steal?



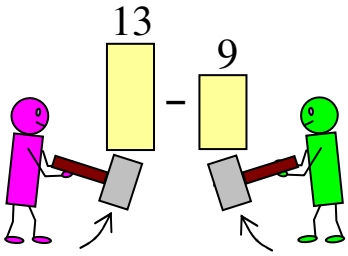
4

How far must you climb from filled-in hole to top of pile?



Sub Bump

Bump to make *subtrahend* end in ZERO.



Bump *both* numbers to maintain difference.

14 – 10

4

Bumping *down!*

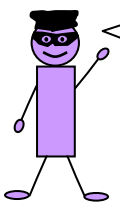
50 – 21

49 – 20

29

Your turn!

25 – 19



The easiest number to *subtract* is ZERO!

Fill Up

Add to fill up to zeros in minuend.

100

– 64

Fill to 9

100

3

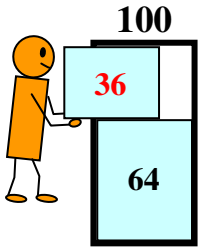
– 64

Fill to 10

100

36

– 64



Imagine filling up a container.

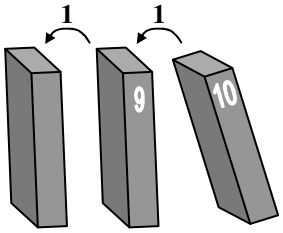
100

11 36

– 64

100 √

Add to verify the difference.



Filling the ones place to 10 starts dominos falling as 1s are carried and added.

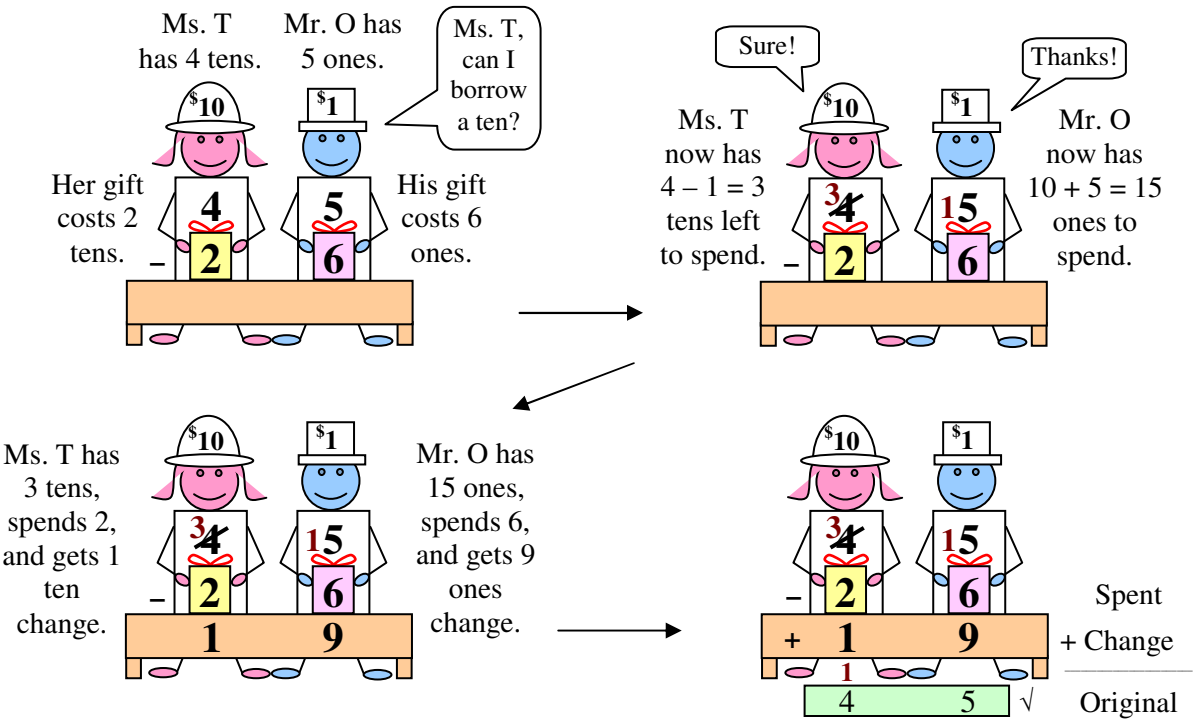
Your turn!

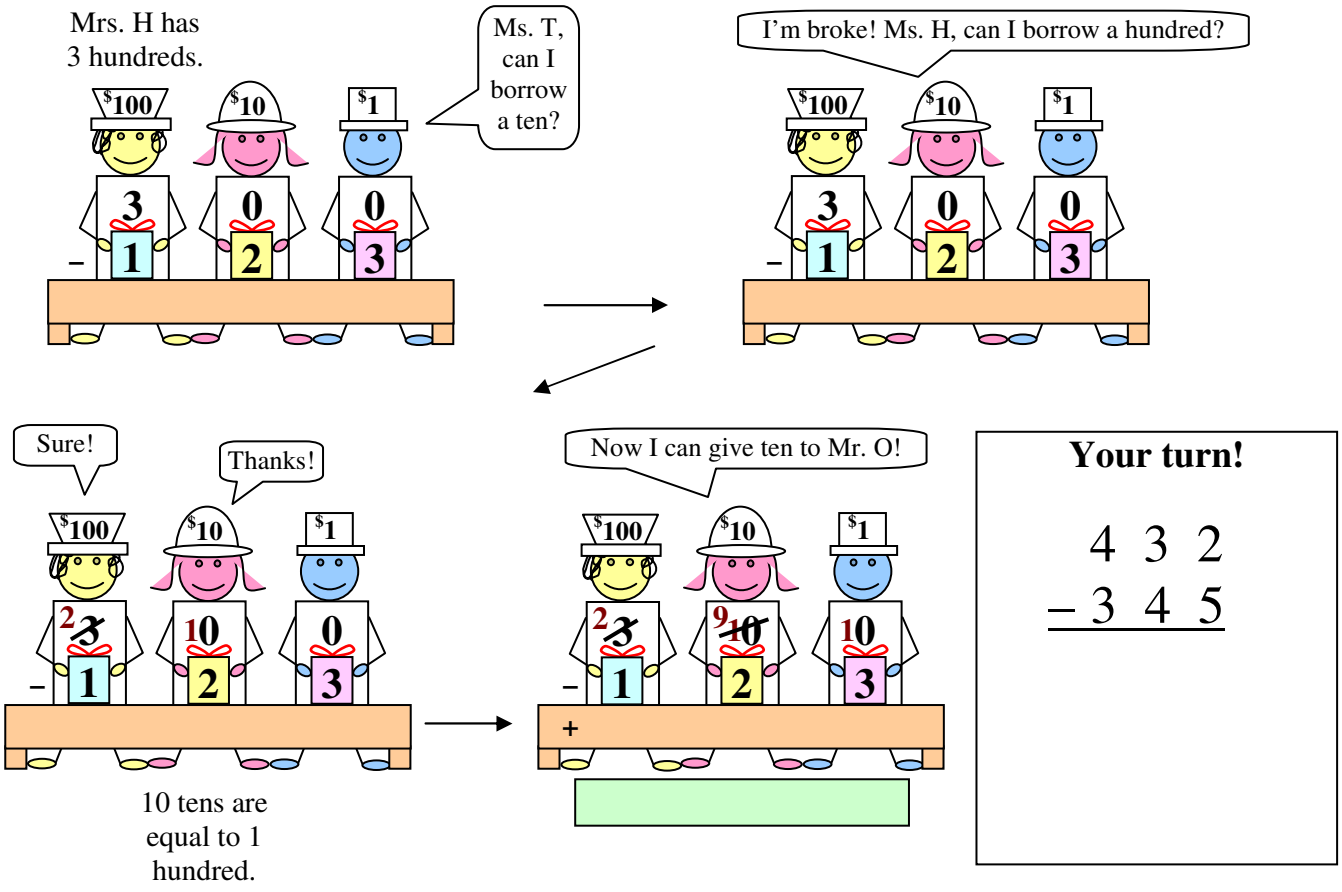
100

– 28

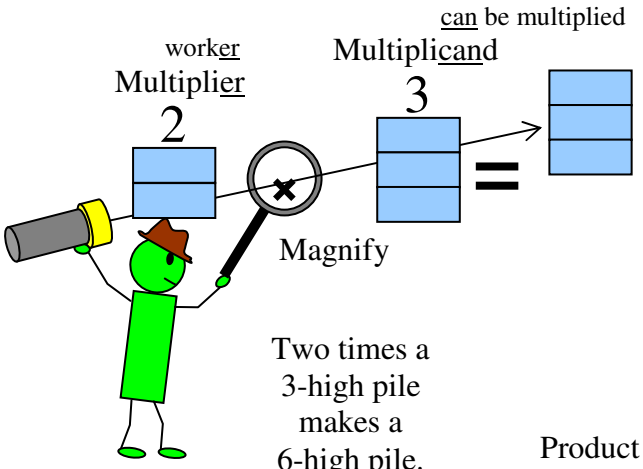
Borrow & Spend Subtraction

Shop till you drop!

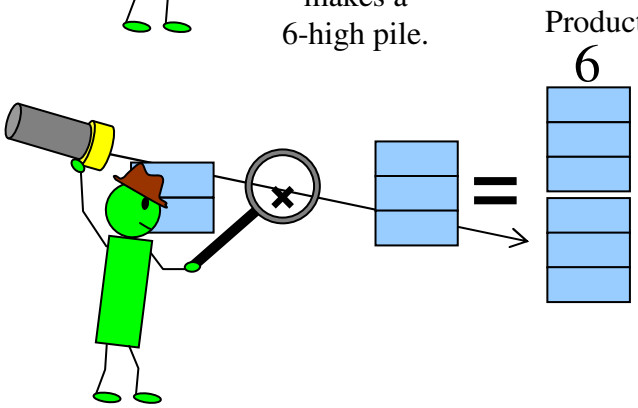


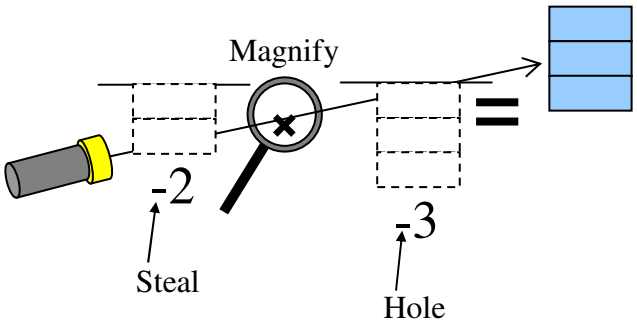


Multiplication Magnifies

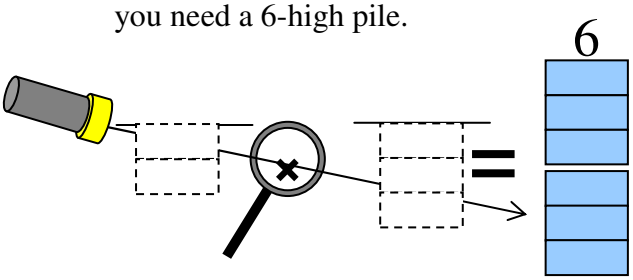


Two times a 3-high pile makes a 6-high pile.





To steal two 3-deep holes, you need a 6-high pile.



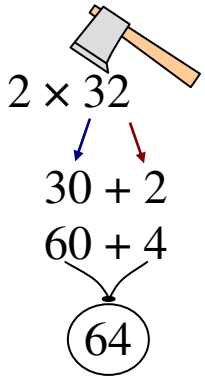
Multiply Negatives = Positive

$-\times-=+$

Multiplication = Fast Addition (if memorized!) 5 + 5 + 5 + 5 = 20 or 4 × 5 = 20

2 × nn: Split & Double

Split by place values, double each, reattach.

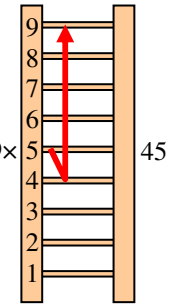


Your turn!

2 × 46

The 9 × Ladder

Jump down one, climb to 9!



Sum of digits is *always* 9!

5 = ½ × 10

5×64

½×64 → 32×10 = 320

8 in a Row!

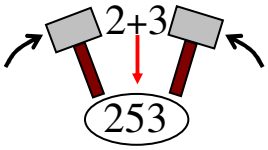
1 2 3 4 5 6 7 8

12=3×4 56=7×8

11 × nn: Smash & Add

Smash digits so they add in the middle.

11 × 2 3

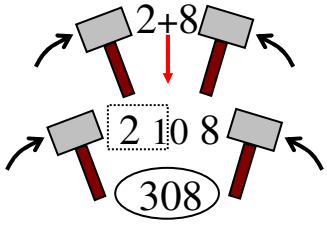


Your turn!

11 × 4 3

If the middle is 10 or more, smash again to fuse the 1 to the hundreds digit.

11 × 2 8

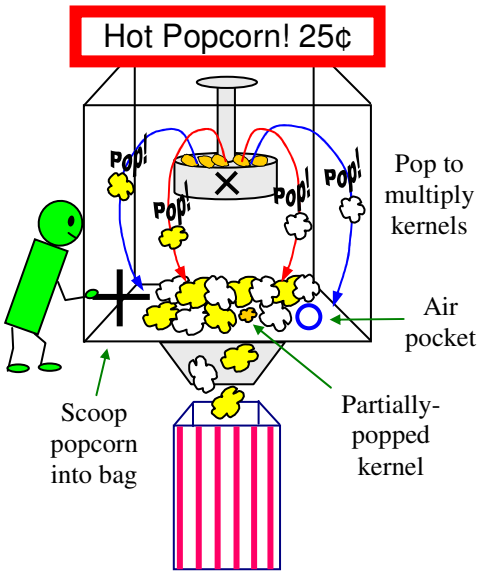


Your turn!

11 × 9 9

Popcorn Multiplication!

Multi-digit multiplication can be as much fun as the popcorn machine at the movies!



Imagine the digits to be multiplied are unpopped kernels.

$$\begin{array}{r} 89 \\ \times 76 \\ \hline \end{array}$$

Pop! 54

Use a magnifying glass to heat 6 times 9 kernels until they pop to 54.

$$\begin{array}{r} 89 \\ \times 76 \\ \hline {}^{5}4 \end{array}$$

5 kernels partially pop

4 kernels fully pop

Pop! 48

$$\begin{array}{r} 89 \\ \times 76 \\ \hline {}^{5}4 \end{array}$$

Magnify 6 times 8 kernels to pop 48.

48 hot kernels heat & pop 5 partial kernels to make 53.

$$\begin{array}{r} 89 \\ \times 76 \\ \hline {}^{5}{}^{5}34 \end{array}$$

3 covers 5 so the 5 is not added again later.

Magnify 7 (really 70) times 9 kernels.

Pop! 63

$$\begin{array}{r} 89 \\ \times 76 \\ \hline {}^{5}{}^{5}34 \\ {}^{6}30 \end{array}$$

Air pocket (0) forms

6 kernels partially pop

3 kernels fully pop

Pop! 56

$$\begin{array}{r} 89 \\ \times 76 \\ \hline {}^{5}{}^{5}34 \\ {}^{6}{}^{6}230 \end{array}$$

Magnify 7 times 8 kernels to pop 56, which heat & pop 6 partials to make 62.

2 covers 6 so the 6 is not added again later.

$$\begin{array}{r} 89 \\ \times 76 \\ \hline {}^{5}{}^{5}34 \\ +\ {}^{6}{}^{6}230 \\ \hline 6764 \end{array}$$

Add up and scoop 6,764 kernels into the bag. Eat & enjoy!

Your turn!

$$\begin{array}{r} 98 \\ \times 59 \\ \hline \end{array}$$

Division Dissolves

Divide number divided

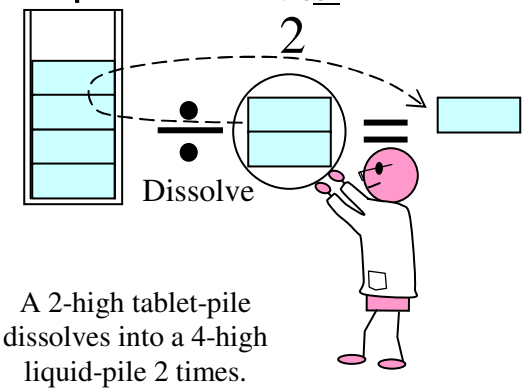
Dividend

4

laborer

Divisor

2

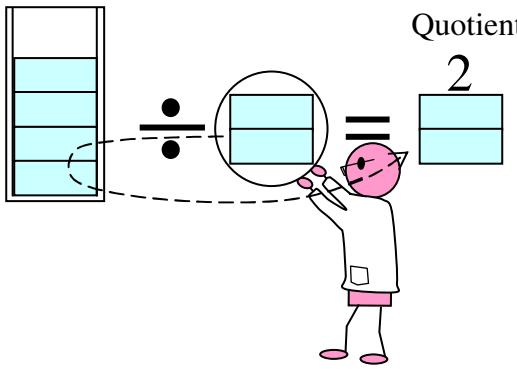


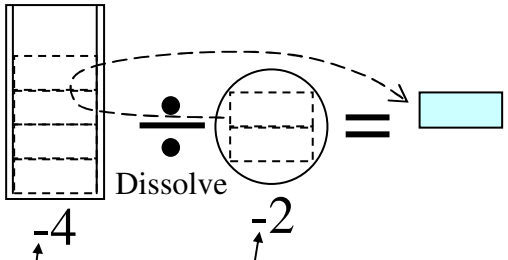
A 2-high tablet-pile dissolves into a 4-high liquid-pile 2 times.

Quo=how many tient=times

Quotient

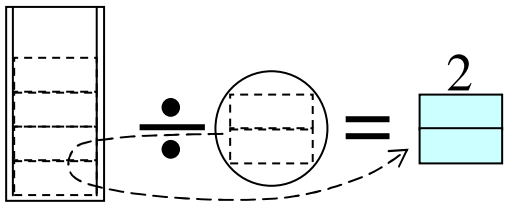
2



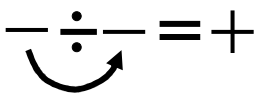


Negative impurities neutralize each other, producing a clean, positive tablet-pile.

A 2-deep tablet-hole dissolves into a 4-deep liquid-hole 2 times.

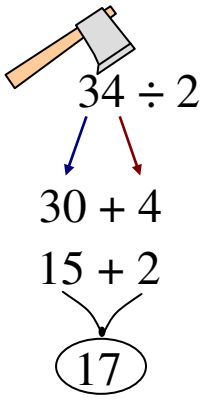


Divide Negatives = Positive



even ÷ 2: Split & Halve

Split by place values, halve each, reattach.



Your turn!

58 ÷ 2

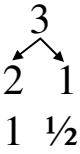
It doesn't matter how ***fast*** **you are if you get it wrong!**

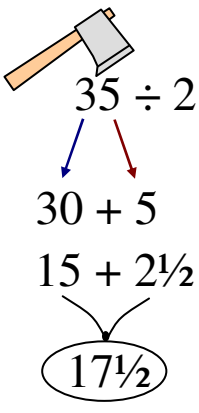
odd ÷ 2: Split & Halve

Split by place values, halve each, reattach.

Memorize the Odd Halves!	
1	½
3	1½
5	2½
7	3½
9	4½

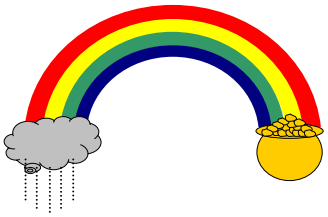
If you forget, any odd number can be split into an even number + 1.





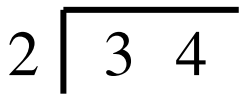
Your turn!

67 ÷ 2

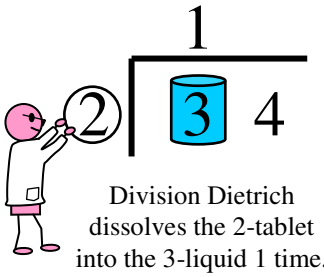


RAINBOW Division

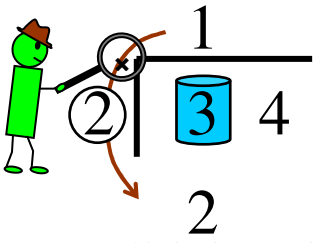
Legend has it there's a pot of gold at the end of every rainbow.
Here's a fun way to perform the long division algorithm!



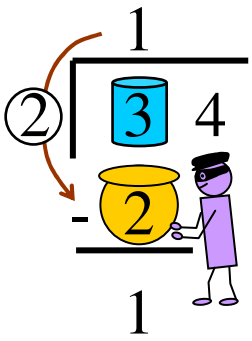
Starting with a traditional long division problem...



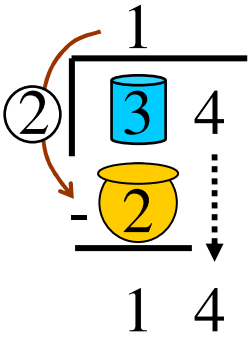
Division Dietrich dissolves the 2-tablet into the 3-liquid 1 time.



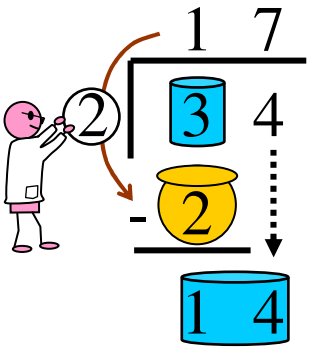
Multiplication Morris magnifies 1 times the 2-tablet creating the first arc of the rainbow.



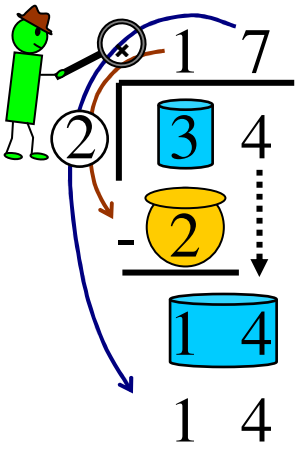
Subtraction Sam steals the 2-pot of gold from the 3-liquid, leaving 1.



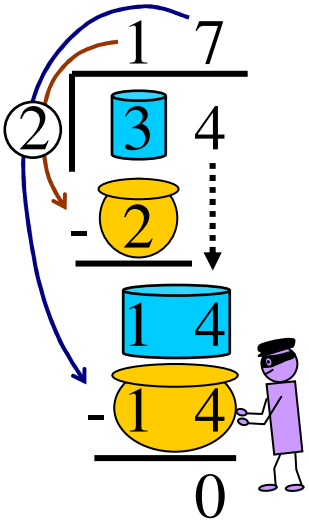
Rainbows need rain, so 4 rains down to join the 1.



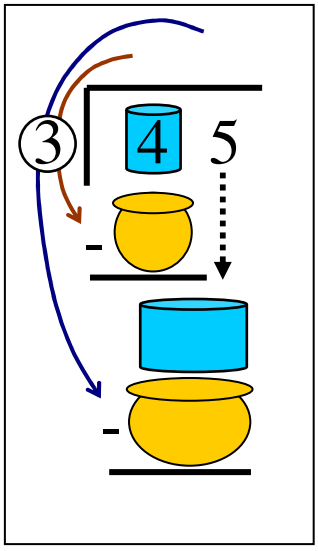
Dietrich dissolves the 2-tablet into the 14-liquid 7 times.



Morris magnifies 7 times the 2-tablet creating the second arc of the rainbow.



Sam steals the 14-pot of gold from the 14-liquid, leaving 0.

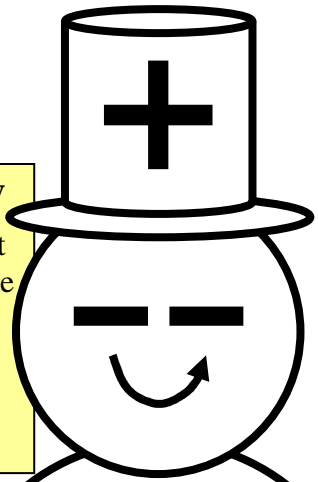


Your turn!
Fill in the missing items.

BrainAid A cloud DMS the light then it rains!
Do Division, Multiplication, Subtraction, then rain. Repeat as needed.

Long division does *not* use Addition!

A Tale of Two Snowmen

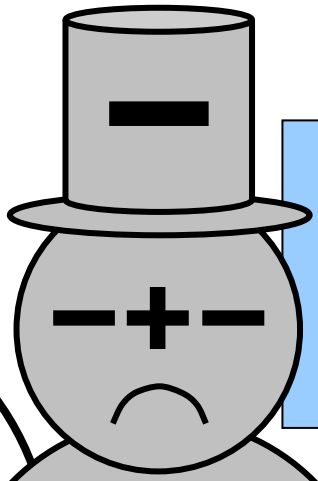


When do two negatives make a positive?

When don't they?

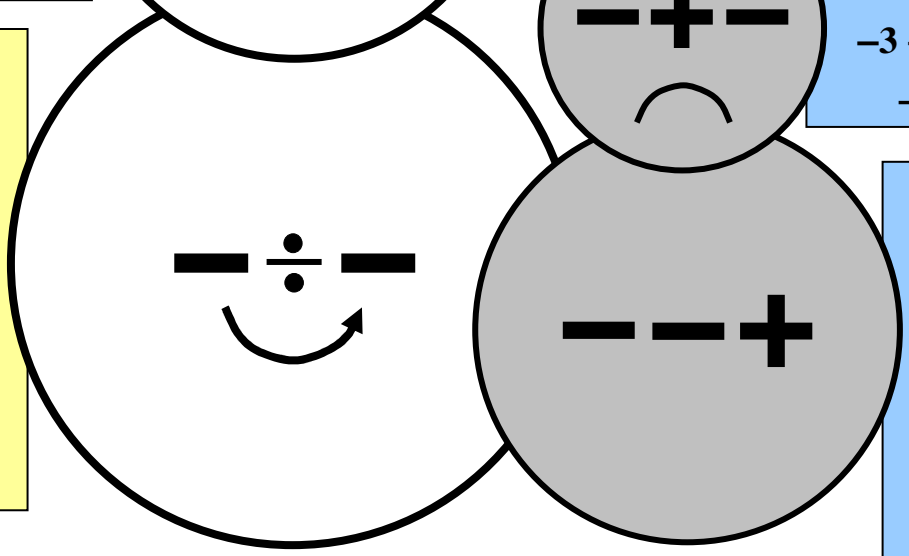
SNow
Subtract Negative
3 – – 1
3 + 1
4

MaN
Multiply Negatives
–3 × –1
3 × (+1)
3



Always Negative
Add Negatives
–3 + –1
–4

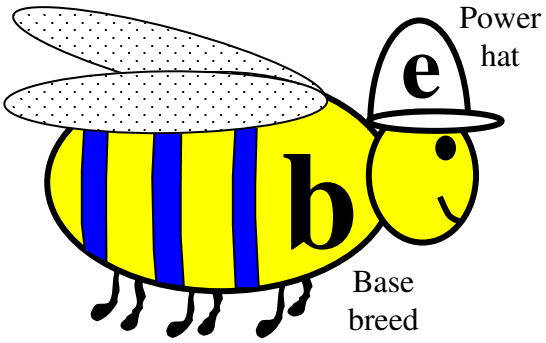
DowN
(at first)
Divide Negatives
–3 ÷ –1
3 ÷ (+1)
3
Delighted Now

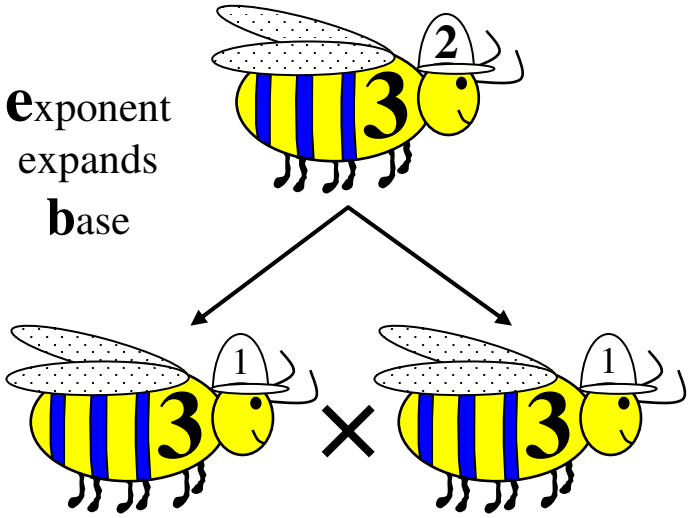


Never Seems Positive
Negative Subtract Positive
–3 – (+1)
–3 – 1
–4

Your turn!	Your turn!	Your turn!	Your turn!	Your turn!
5 – – 2	–3 × –2	–4 ÷ –2	–1 + –2	–1 – 2

Exponentiation Expands

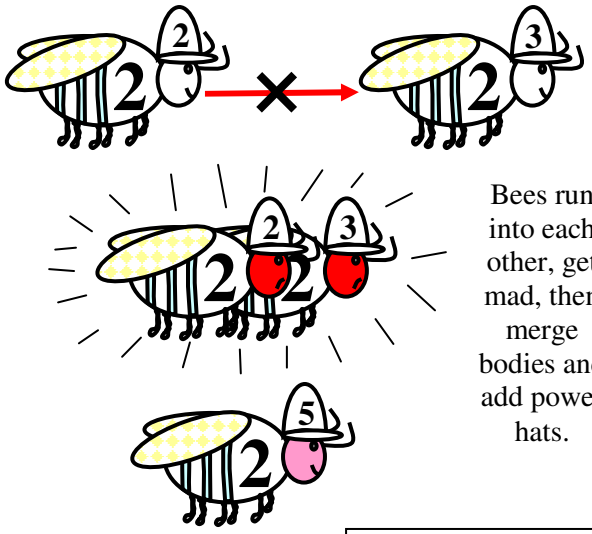




Exponentiation = Fast Multiplication $2 \times 2 \times 2 = 8$ or $2^3 = 8$

M-Ad Bees

To multiply bees of the *same* breed,
Merge bases and Add exponents.



Bees run into each other, get mad, then merge bodies and add power hats.

$2^2 \times 2^3$

2^{2+3}

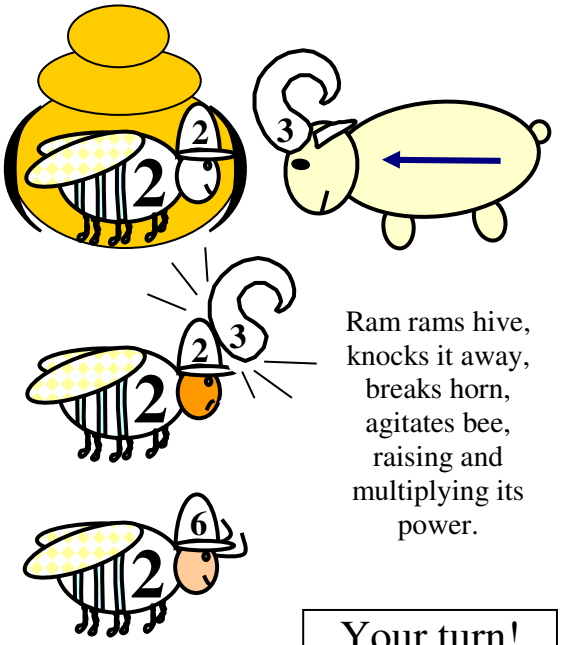
2^5

Your turn!

$2^3 \times 2^4$

Ra-M Bee

To Raise a bee to a power,
Multiply exponents.



Ram rams hive, knocks it away, breaks horn, agitates bee, raising and multiplying its power.

$(2^2)^3$

$2^{2\times3}$

2^6

Your turn!

$(2^3)^4$

PEMDAS Prioritizes

Priority of Operations

When a math problem has more than one operator, work in this order:

- Parentheses
  If nested, start with innermost set: (Do 2nd (do 1st)).
- Exponentiation
- Multiplication or Division
  If encounter both, perform in left-to-right order.
- Addition or Subtraction
  If encounter both, perform in left-to-right order.

Operators are symbols for procedures.

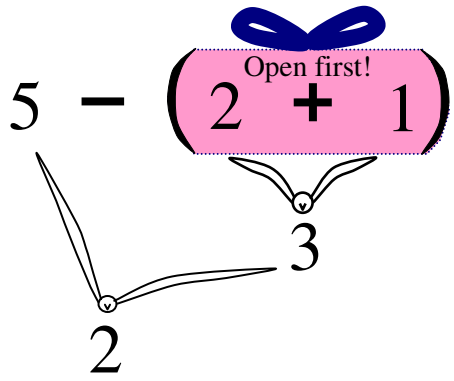
( )

b^e

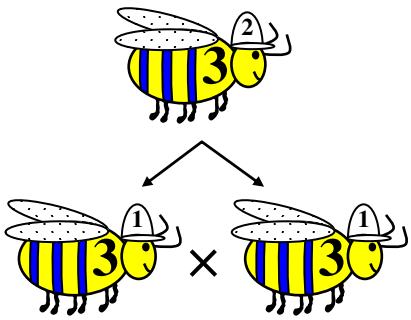
× ÷

\+ −

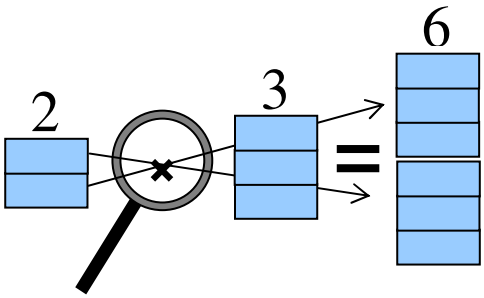
Parentheses Package



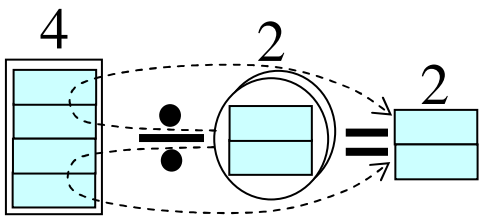
Exponentiation Expands



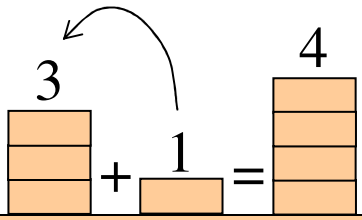
Multiplication Magnifies



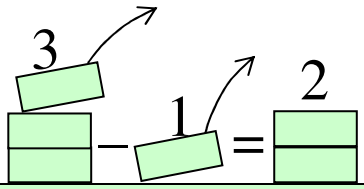
Division Dissolves



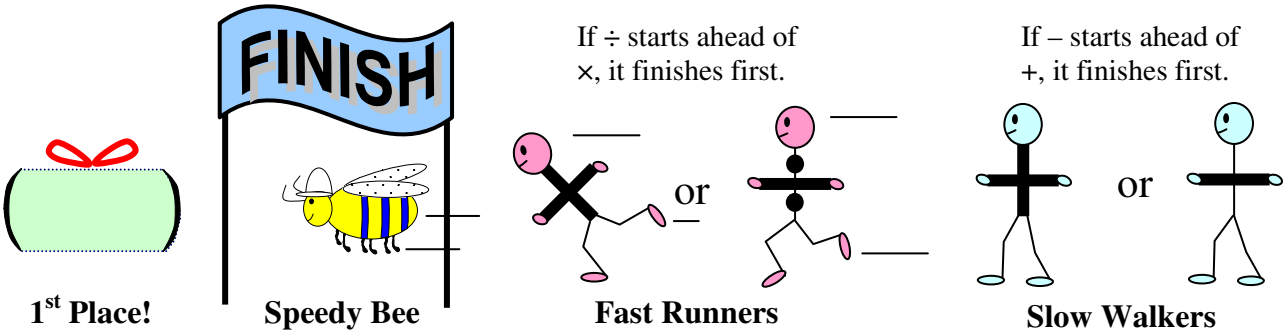
Addition Attaches



Subtraction Steals

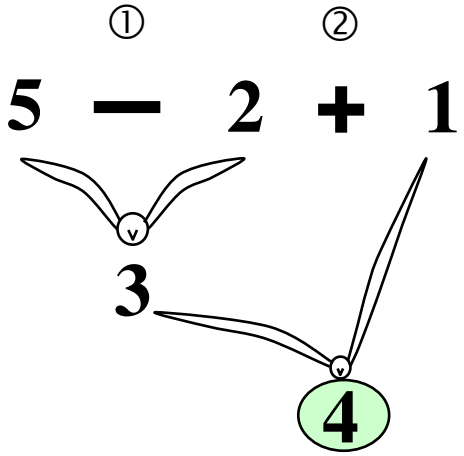


The PEMDAS Racers

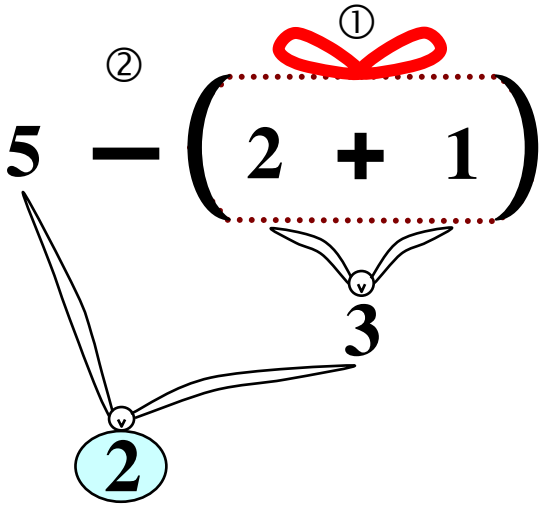


1st Place! Speedy Bee Fast Runners Slow Walkers

Place a number (make it small and circle it so you don't calculate with it) above each operator in priority order. Solve one operator at a time in order.



Parentheses Package
Open me first!



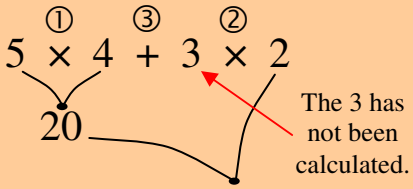
Your turn!

Draw a seagull's head as a dot below an operator. From the head, draw wings up to each number.

$$12 - 5 \times (2 + 4) \div 3$$

TRAP!

Do *not* fly past an uncalculated number.



Use the numbers *closest* to the operator.