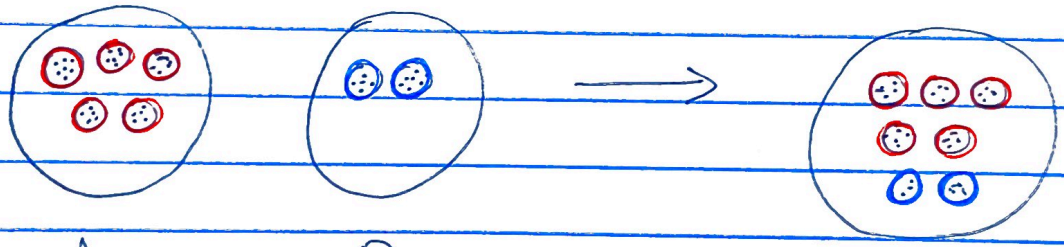
Section 3-2 Addition of Whole #s

Whole #s {0, 1, 2, 3, 4, 5, ...}
Natural #s {1, 2, 3, 4, ...}
(Counting Numbers)

Models for Whole # Addition

1. Set Model: If A and B are 2 disjoint, finite sets and $n(A) = a$ and $n(B) = b$ then $a + b = n(A \cup B)$.

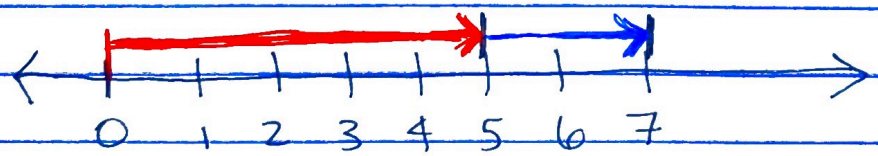


A B AUB

$n(A) = 5$ $n(B) = 2$ $n(A \cup B) = 5 + 2$

5 cookies + 2 cookies = 7 cookies

2. Number Line



$5 + 2 = 7$

* The number line is helpful for organizing and comparing whole numbers. The farther to the right, the greater the value.

Properties of Whole Number Addition

1. closure
The sum of any 2 whole numbers is always a whole number.

2. commutative (commute = exchange)
ex: $3 + 2 = 2 + 3$

3. associative
ex: $3 + (7 + 5) = (3 + 7) + 5$

4. Identity property of addition
ex: $5 + 0 = 5$ and $0 + 5 = 5$
* 0 is called the additive identity element
Identity = Identical = Same

ex 1 Which property is illustrated?

a) $(3 + 2) + 8 = (2 + 3) + 8$ commutative

b) $5 + 10$ is a unique whole number closure

c) $(6 + 3) + 1 = 6 + (3 + 1)$ associative

Mastering Basic Addition Facts

There are several strategies to help kids master basic addition facts.

1. Counting On (Counting Up)
You start at one addend and count up the other addend.

ex: 4 + 2 → 4, 5, 6

Start

Count up 2 more

4 + 2 = 6
addends sum

* In Kindergarten, my son could find 7+3 easily, but struggled with 3+7. Why do you think this happened?
He didn't understand the commutative property.

2. Doubles Benchmark
If a child can master the addition in pairs (3+3, 6+6, 7+7, ...) then this knowledge can be extended to doubles +1, doubles +2, ...

ex: 6 + 7 = (6 + 6) + 1

6 + 8 = (6 + 6) + 2

3. Making Ten (Compatible Numbers)
You can split up one of the addends in order to "make ten" then add in the leftovers. (This extends to any multiple of 10.)

ex: $8+5 = 8+(2+3) = (8+2)+3$

ex: $13+9 = (13+7)+2 = 20+2$

Whole Number Addition Algorithms

1. Standard Algorithm

```
  1 7 6
+ 2 4 5
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  4 2 1
```
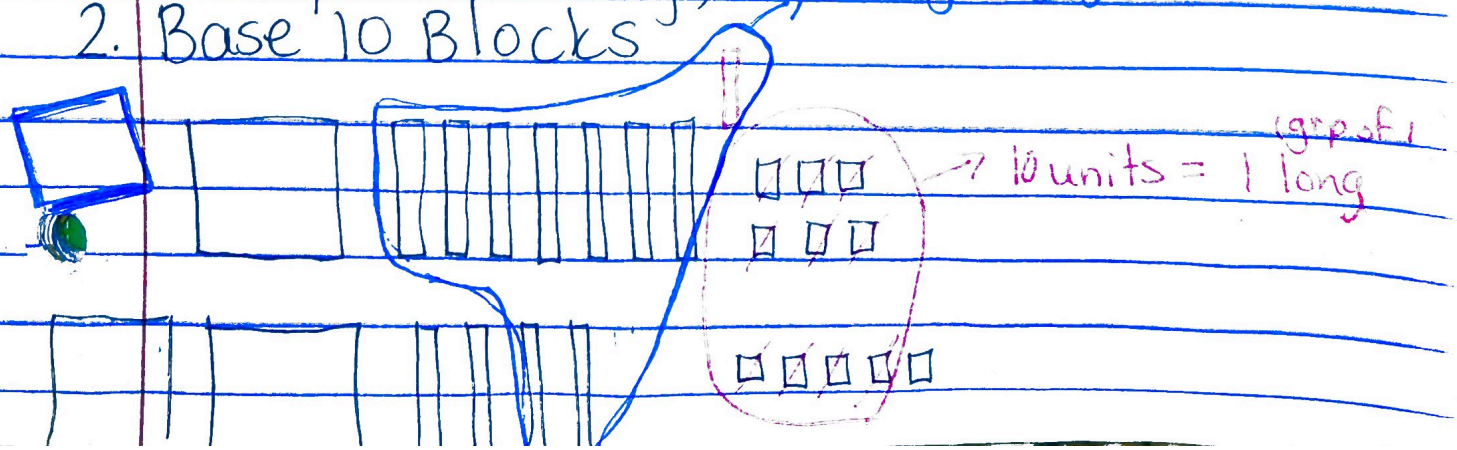

represents 1 group of 10

represents 1 group of 100

(To explain standard alg.)

2. Base 10 Blocks



3. Partial Sums

$$
\begin{array}{r}
176 \\
+\ 245 \\
\hline
11 \quad \leftarrow 6+5 \\
110 \quad \leftarrow 70+40 \\
+\ 300 \quad \leftarrow 100+200 \\
\hline
421
\end{array}
$$

* This technique emphasizes place value.

4. Lattice Addition

$$
\begin{array}{r}
176 \\
+\ 245 \\
\hline
421
\end{array}
$$

This is a compressed version of partial sums.

5. Left to Right Addition

$$
\begin{array}{r}
176 \\
+\ 245 \\
\hline
300 \quad \leftarrow 100+200 \\
110 \quad \leftarrow 70+40 \\
+\ 11 \quad \leftarrow 6+5 \\
\hline
421
\end{array}
$$

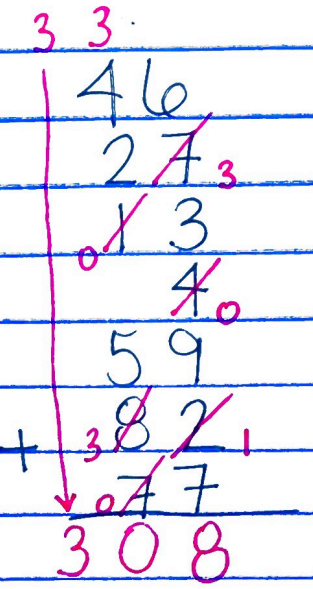
$$
\begin{array}{r}
176 \\
+\ 245 \\
\hline
3\,X\,1 \\
42
\end{array}
$$

* Kids read left to right, so it makes sense that they would try to do math left to right.

* I've noticed that when kids use base 10 blocks, they tend to combine the largest ones first.

6. Scratch Addition

This algorithm is useful when adding a bunch of numbers. Each "scratch" represents 10.



end 3-2 part 1

Adding in Bases Other than 10

ex 2 Add

a)
$$\begin{array}{r} {\scriptstyle 1\ 1\ 1} \\ 423_{five} \\ +\ 34_{five} \\ \hline 1012_{five} \end{array}$$

b)
$$\begin{array}{r} {\scriptstyle 1\ 1} \\ 864_{twelve} \\ +\ T97_{twelve} \\ \hline 173E_{twelve} \end{array}$$

c)
$$\begin{array}{r} {\scriptstyle 2\ 3} \\ 231_{four} \\ 2_{four} \\ 13_{four} \\ 12_{four} \\ 10_{four} \\ +\ 2_{four} \\ \hline 221_{four} \end{array}$$

scratch method
each scratch represents a group of 4

Mental Addition Techniques

1. Compatible Numbers

ex 3 Add

a) $120 + 94 + 36 = 120 + 130 = \boxed{250}$

b) $120 + 50 + 35 + 80 + 50 = 200 + 100 + 35 = \boxed{335}$

c) $45 + 71 + 16 + 10 + 9 + 45 = 100 + 80 + 16 = \boxed{196}$

2. Adding From the Left

ex 4 Add

a) $58 + 25 \Rightarrow$

$50 + 20 = 70$

$8 + 5 = 13$

$70 + 13 = 83$

b) $72 + 49 \Rightarrow$

$70 + 40 = 110$

$2 + 9 = 11$

$110 + 11 = 121$

3. Substitution (Breaking up + Bridging)

ex 5 Add

a) $127 + 38 = (127 + 3) + 35$

$= 130 + 35 = 165$

b) $84 + 47 = (84 + 6) + 41$

$= 90 + 41 = 131$

OR

$= (84 + 16) + 31$

$= 100 + 31 = 131$

4. Trading off (Compensation)

ex 6 Add

$$\begin{array}{r} 65 \\ +\ 38 \\ \hline \end{array} \Rightarrow \begin{array}{r} 65 + 5 \\ +\ 38 - 5 \\ \hline \end{array} \Rightarrow \begin{array}{r} 70 \\ +\ 33 \\ \hline 103 \end{array}$$

* This is very similar to breaking up + bridging.

Estimating Whole # Addition

There are 3 ways to estimate addition.

1. Front end estimation

ex:
$$\begin{array}{r} 236 \\ 141 \\ +\ 680 \\ \hline \end{array}$$

200 + 100 + 600 = 900

2. Grouping to nice numbers

ex:
$$\begin{array}{r} 47 \\ 28 \\ 13 \\ 52 \\ +\ 9 \\ \hline \end{array}$$

about 50 (47, 13)

about 100 (28, 52)

The sum is about 150.

3. Rounding

ex: 47 + 28 + 13 + 52 + 9

Rounds to: 50 + 30 + 10 + 50 + 10 = 150

end 3-2