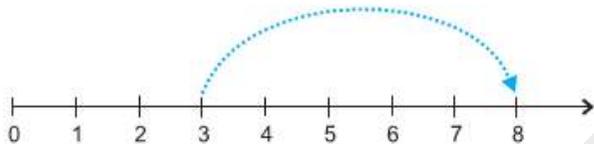


Natural Numbers and Whole - Numbers Including Patterns

- Natural numbers along with zero form the collection of whole numbers (**W**)
Thus, the numbers 0, 1, 2, 3,... form the collection of whole numbers
- Given any two whole numbers, the number on the right of the other number is the greater number.
- The number 0 is the first and the smallest whole number
- Every natural number has a successor.
- Every natural number except 1 has a predecessor.
- Every whole number has a successor
- Every whole number except zero has a predecessor

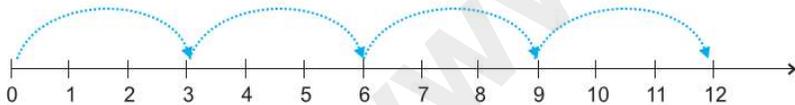
- **Addition** corresponds to moving to the right on the number line, whereas subtraction corresponds to moving to the left.

$$3 + 5 = 8:$$



- **Multiplication** corresponds to making jumps of equal distance starting from zero

$$4 \times 3 = 12$$



Closure property :

- Whole numbers are closed under addition and also under multiplication.
If a and b are any 2 whole numbers :
 $a + b$ is also a whole number and $a \times b$ is also a whole number
- Whole numbers are not closed under subtraction and under division
If $b > a$, $(b - a)$ is defined but $(a - b)$ is not defined (-ve answer)

Commutative property : (order is not important : a and b)

- Addition and multiplication are commutative for whole numbers
If a and b are any two whole numbers
 $a + b = b + a$ and $a \times b = b \times a$
- Subtraction and division are not commutative for whole numbers

Associative property : (order is not important in grouping : a and b and c)

- Addition and multiplication, both, are associative for whole numbers
For any 3 whole numbers , a, b and c :
 $a + (b + c) = (a + b) + c$ and $a \times (b \times c) = (a \times b) \times c$
 $200 + 196 + 104 = 200 + (196 + 104) = 200 + 300 = 500$
 $8 \times 1769 \times 125 = 8 \times 125 \times 1769 = 1000 \times 1769 = 17,69,000$
- Whole numbers are not associative for subtraction and division

Distributive property :

- Multiplication is distributive over addition for whole numbers
- For any 3 whole numbers , a, b and c :
 $a \times (b + c) = (a \times b) + (a \times c)$
 $5 \times 24 = 5 \times (20 + 4) = (5 \times 20) + (5 \times 4) = 100 + 20 = 120$

Commutativity, associativity and distributive properties of whole numbers are useful in simplifying calculations

$$(13 \times 102) = 13 \times (100 + 2) = 1300 + 26 = 1326$$

Role of 0 (Zero):

- Zero is the identity for **addition** of whole numbers
- If a is a whole number, $a + 0 = 0 + a = a$
 $a - 0 = a$ but $0 - a$ is not defined
- Product of a whole number with zero is again zero : , $a \times 0 = 0 \times a = 0$
- Division of a whole number by 0 is not defined
- if a is a whole number other than zero, then $0 \div a = 0$

Role of 1 (one):

- For any whole number, a , $a \times 1 = 1 \times a = a$: 1 is the identity for **multiplication** of whole numbers
- If a is any whole number other than zero, then $a \div a = 1$..
- If a is any whole number, then $a \div 1 = a$.
- For any 2 whole numbers a and b , if a is the successor of b , then b is the predecessor of a :
 $a = b + 1$ or $b = a - 1$

Patterns in Whole Numbers:

Every number can be arranged as a line;

The number 2 is shown as



The number 3 is shown as



.Some numbers like 4 or 9 can also be arranged as squares

The number 4 is shown as :



The number 9 is shown as :



Some numbers can be shown also as rectangles

The number 6 can be shown as a rectangle :  With 2 rows and 3 columns.

Some numbers can also be arranged as triangles.

