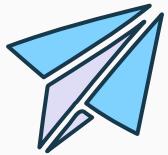
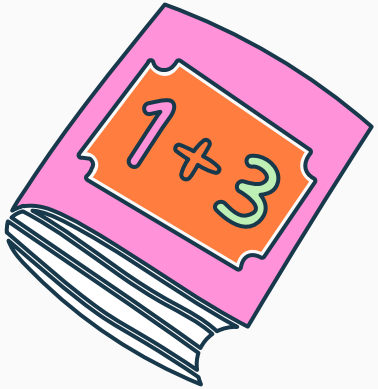
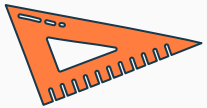
ESC Club

Basics of Pre-Algebra







Hi there!

If you have any questions, email me at:
jpengzhao@gmail.com

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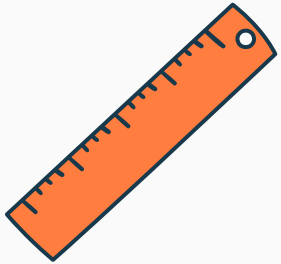


01

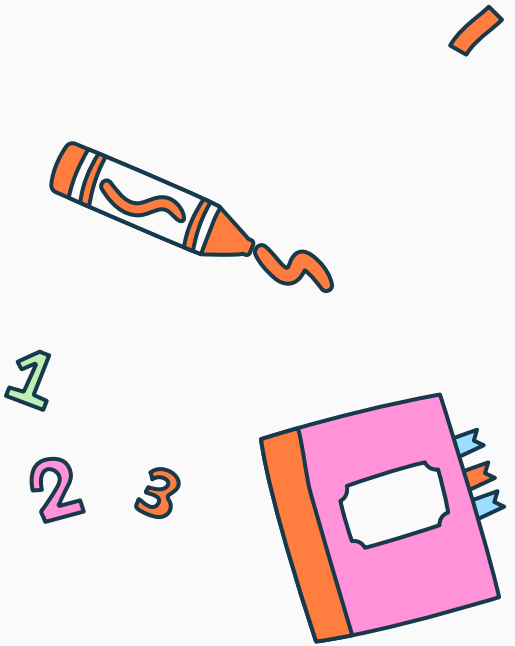
Rational Numbers

2+2

Teaching Goals

We are going to answer these questions:

- What's a rational number?
- What are whole numbers, natural numbers, integers, fractions, mixed numbers, and decimals?
- What's a percentage?
- How do you convert between fractions, percentages, and decimals?



DEFINE CONCEPTS

Natural Numbers

The numbers we use to count.
Does not include 0.
(1, 2, 3, 4... and so on)

Whole Numbers

All the natural numbers but 0 is also a whole number.
(0, 1, 2, 3, 4... and so on)

DEFINE CONCEPTS

Integers

Includes all the whole numbers but also includes their opposites.
(... -3, -2, -1, 0, 1, 2, 3 ...)
Continues forever in both directions.

Rational Numbers

Rational number include all integers and decimals. Any number that can be written as a fraction is a rational number.

DEFINE CONCEPTS

FRACTIONS

All rational numbers that are not integers can be written as fractions. Another way to write division instead of the ÷ sign. Can also be thought of as the answer to a division problem. A fraction consists of 2 parts, a numerator and a denominator. The numerator is at the top of the fraction, and the denominator is at the bottom of the fraction.
(Ex: ¾ = the answer of 3 ÷ 4, ½ = the answer of 1 ÷ 2
Numerator of ¾ is 3, and the denominator of ¾ is 4.)

MIXED NUMBERS

A way of writing an integer and a fraction together. Note that when the integer is negative, it also implies that the fraction is negative
(Ex: $3\frac{3}{4} = 3 + \frac{3}{4}$
$-2\frac{1}{2} = -2 - \frac{1}{2}$)

DEFINE CONCEPTS

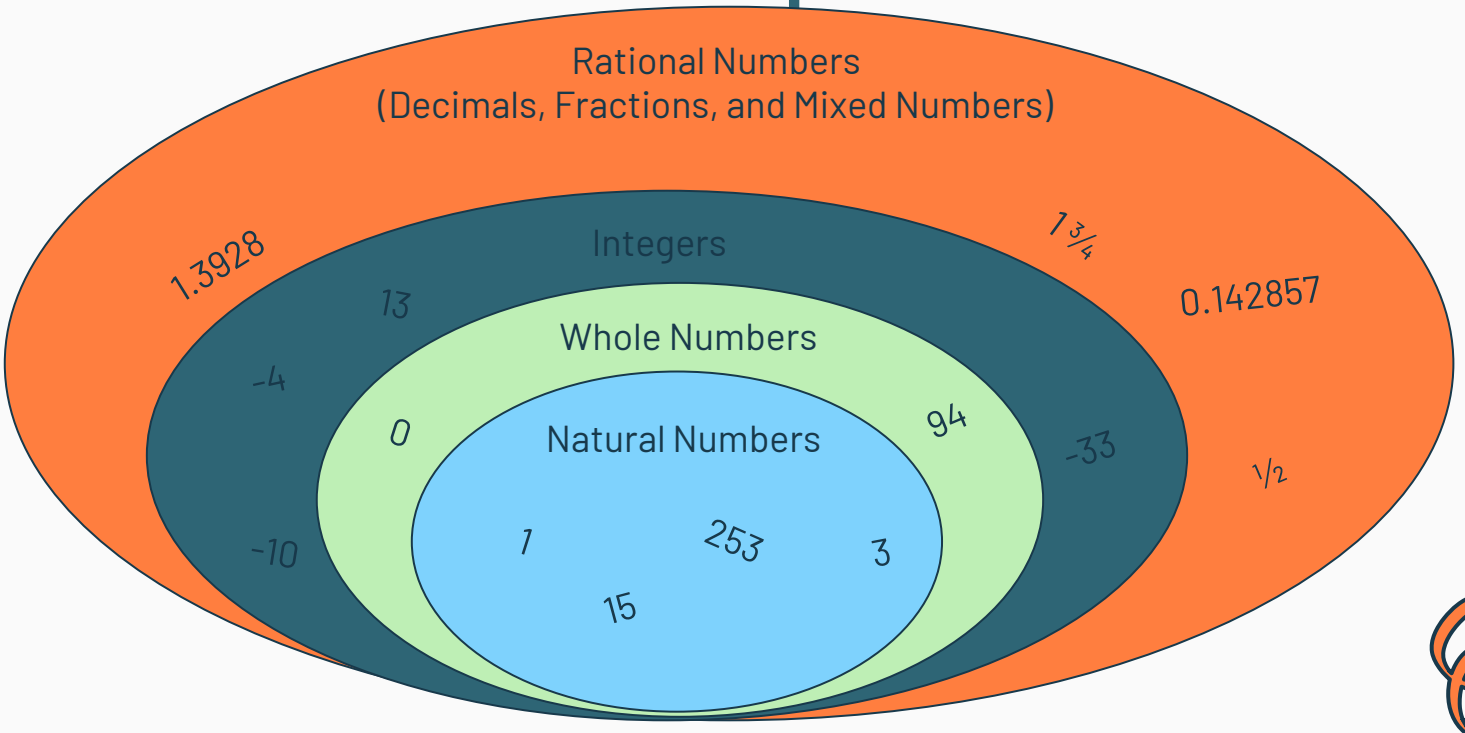
Decimals

The numbers between integers. Decimals are just integers with a decimal points and more digits after. Those digits represent part of a whole.
(Ex: 1.5, 2.9, and 13.4 are all decimals.)

Percentages

Another way to write decimals. 1% (1 percent) is equal to 0.01, 1/100, and 1 out of 100. Can also be thought as the way to write grades, though percentages can go above 100%, which is equivalent to 1. A decimal percentage is also ok. For example, 15.5% is still a percent.

To Recap...


Rational Numbers
(Decimals, Fractions, and Mixed Numbers)
1.3928
1 3/4
0.142857
Integers
13
-4
Whole Numbers
0
94
-33
Natural Numbers
1/2
-10
1
253
3
15

Reminders

The denominator of a fraction can never be 0

This results in the fraction being something divided by 0, which is undefined.

Fractions are numbers

They are not just another way of writing division. They are numbers which can be plotted on the number line. This also means that every fraction has a decimal equivalent. (Ex: ½ = 0.5, ¾ = 0.75, 1 ⅖ = 1.4)

Natural Numbers ≠ Whole Numbers

Natural Numbers are not Whole Numbers! Whole numbers include 0, which natural numbers don't.

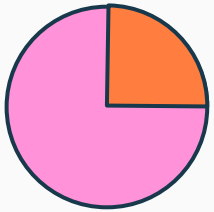
Extra: Repeating Decimals

There is a special type of decimal. These decimals go on forever in a pattern. (Ex: 1.2323232323...)
To denote the pattern, a line is put above the repeating section to say that the sections goes on forever. (Ex: 1.23 = 1.23232323232323...) These number ARE rational. Decimals that can't be written as repeating decimals are not rational and are irrational.

Lets Convert

Fraction -> Decimal (to 2 decimal places)

1/4

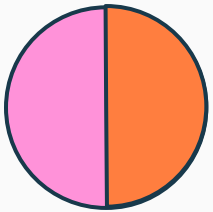


Turn fraction into mixed number. Turn denominator of fractional part to 100 and put numerator after the decimal point. (or you can just divide)

(Ex: ½ = 50/100 = 0.50
1 ½ = 1 + ½ = 1 + 50/100 = 1.50
¼ = 25/100 = 0.25)

Decimal -> Percentage

½

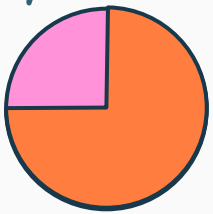


Move decimal point 2 digits to the right, and add a percent sign

(Ex: 0.1237 -> 1.237 -> 12.37 - > 12.37%
1.52 -> 15.2 -> 152 -> 152%
0.5 -> 5 -> 50 -> 50%)

Percentage -> Fraction (also only to 2 decimal places)

¾



Write the fraction as percentage divided by 100. Then simplify.

(Ex: 25% = 25/100 = ¼
150% = 150/100 = 3/2
75% = 75/100 = ¾)

Practice!

Convert 1.3 to a percent

Answer:

130%

Convert 15.4% to a fraction

Answer:

77/500 (simplified)

 (Challenge)

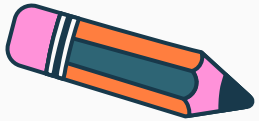
Convert 13/8 to a decimal

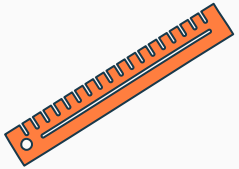
Answer:

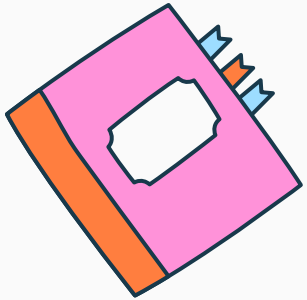
1.625 (use long division)

02

Exponents



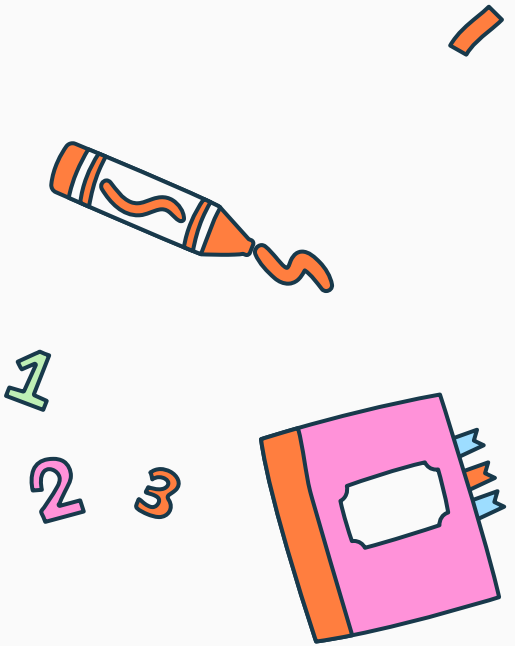




Teaching Goals

We are going to answer these questions:

- What is an exponent?
- How do exponents work?
- What is a square root and how do they work?



DEFINE CONCEPTS

Exponents

A faster way of writing multiplication. There is a base and a exponent. It is written as base^exponent where ^ is the exponent symbol. Usually though, the exponent is written as a small number on top of the base like this -> 10^{10}
This means the the base is multiplied the exponent amount of times.
Saying ___ (1) is a power of ___ (2) means that there is a number where (2)^something = (1)
To find a number when (a number)^(something) = number, we generally use logarithms, but for now, guess and check will be good enough, since logarithms are very complex.
Ex: 10^2 = 10 * 10 = 100, so 100 is a power of 10
5^3 = 5 * 5 * 5 = 125, so 125 is a power of 5

Practice!

What is 3^3

Answer:

27

What is 8^2

Answer:

64

 (Challenge)

6^(a number) is 216. What is this number?

Answer:

3

DEFINE CONCEPTS

Square Root

Fast way to say what number squared (to the power of 2) is this number? Symbol: √
(Ex: √25 = 5, since 5^2 = 5 * 5 = 25
√100 = 10, since 10^2 = 10 * 10 = 100)
Another kind of root is a cube root. It is a way to say: what number cubed (to the power of 3) is this number? Symbol: $\sqrt[3]{}$
(Ex: $\sqrt[3]{8}$ = 2, since 2^3 = 2 * 2 * 2 = 8
$\sqrt[3]{27}$ = 3 since 3^3 = 3 * 3 * 3 = 27)
(Square roots and cube roots will be much easier after we learn about prime factorization)

Practice!

(Challenge)

What is $\sqrt{49}$?

Answer:

7

What is $\sqrt{144}$?

Answer:

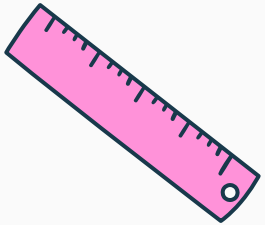
12

What is $\sqrt[3]{512}$?

Answer:

8 (guess and check)

1+3



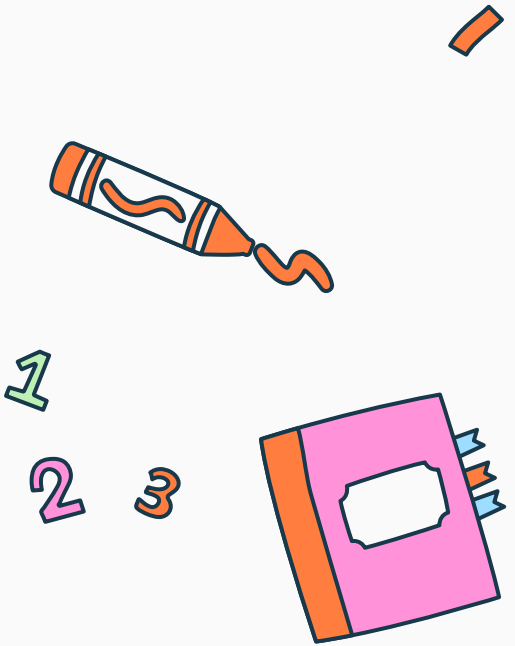
03

Variables

Teaching Goals

We are going to answer these questions:

- What is a variable?
- How are variables used?
- What is a linear equation?
- How do you solve linear equations?



DEFINE CONCEPTS

Variables

A variable is a letter which acts like a placeholder for a blank space. A variable can any letter of the alphabet.

Linear equation

A equation using a variable that it only to the first power .
(Ex: 2(x + 3) = 14
5x+4=20)
The 5 in front of the x is a coefficient and means that it is just 5 * x. A linear equation can have 1 solution, infinitely many solutions, or no solution.

How do you solve a linear equation? (Variable on one side)

This is an example of how to solve one.

Say our equation is $2(x + 4) = 3(1 - 4)$ (the parentheses are another way of writing multiplication, $3(1-4)$ is really $3 * (1-4)$)

1. Simplify the equation
    a. $2x + 8 = 3(-3)$
    b. $2x + 8 = -9$
2. Isolate the variable
    a. You can multiply, divide, add, or subtract something from the equation, but YOU MUST DO IT ON BOTH SIDES
    b. $2x + 8 = -9$
    $- 8 \quad -8$ (I am subtracting 8 on both sides to get the variable by itself)
    a. $2x = -17$
    b. $2x/2 = -17/2$ (I will divide both sides by 2 to get rid of the coefficient)
    c. $x = -17/2$

How do you solve a linear equation? (Variable on both sides)

This is an example of how to solve one.

Say our equation is $x(3/4 - 4) = x/2 + 4/2$

1. Simplify the equation
   a. $\frac{3}{4}x - 4x = x/2 + 4/2$
   b. $4(\frac{3}{4}x - 4x) = 4(x/2 + 4/2)$ (multiplying both sides b 4 gets rid of the fractions)
   c. $3x - 16x = 2x + 8$
   d. $-13x = 2x + 8$ (you can add and subtract variables with coefficients like adding and subtracting numbers, but only if they have the same variable)
2. Isolate the variable
   a. You can multiply, divide, add, or subtract something from the equation, but YOU MUST DO IT ON BOTH SIDES
   b. $-13x = 2x + 8$
      $-2x \quad -2x$ (Subtract 2x from both sides to isolate the variable)
   a. $-15x = 8$
   b. $-15x/-15 = 8/-15$ (Get rid of the coefficient)
   c. $x = -8/15$

Practice!

Solve the linear equation,
$x=5-3x$

Answer:

$x=5/4$

Solve the linear equation,
$x/4+3x/2=16/5$

Answer:

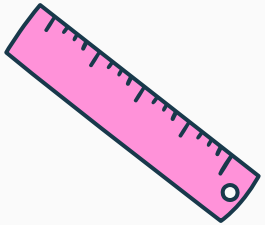
$x=64/35$

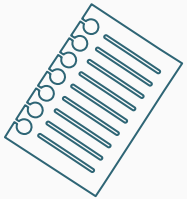
(Challenge)

Solve the linear equation, $3(8+x)/x=6(4+x)/x$

Answer:

No solution ($x=0$ does not work, because the fraction has a denominator of x)





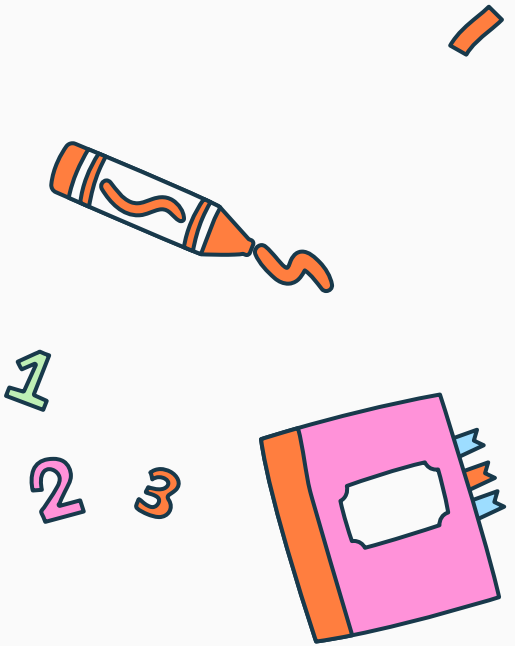
04

Inequalities

Teaching Goals

We are going to answer these questions:

- What is an inequality?
- What are the 4 inequality symbols?
- How do you solve inequalities with variables?
- How do you graph these inequalities?



DEFINE CONCEPTS

Inequality

An inequality is a comparison of 2 expressions (a combination of number and operations without an equal sign). There are 4 symbols that can be used in a inequality. The greater than (>), less than (<), greater than or equal to ($\leq$), and the less than or equal to symbol ($\geq$).

(Ex: $3 < 5$, $5 > 3$, $4 \leq 4$, $2 \geq -3$)

Inequalities can have zero solutions (where the variables cancel out and resulting equation is false)
Or infinitely many solutions (where the variables cancel out and resulting equation is true).

How do you solve a inequality with variables?

This is an example of how to solve one.

We will be solving the inequality $3x + 3 > 2(x + 7)$

1. Simplify
    a. $3x + 3 > 2x + 14$
2. Isolate the variable
    a. $3x + 3 > 2x + 14$
    $-3 \quad -3$
    a. $3x > 2x + 11$
    $-2x \quad -2x$
    a. $x > 11$

Note: When working with inequalities, if you divide both sides by a negative number, the inequality sign must be flipped. If the inequality sign is not flipped, the inequality won't be correct

Ex:

$-2x < 3$

$-2x/-2 > 3/-2$ (notice how the less than changed to a greater than)

$x > -3/2$

How do you graph these inequalities?

We can graph inequalities using a number line. We will be using x > 7 as an example.

1. Number lines don't have have 0. Put the answer in the middle of the number line
2. Going up and down, write numbers that go in a sequence.
   (Ex: 1, 2,3... 2, 4, 6, 8.... 1/2, 2/2, 3/2, 4/2....)
1. Put a circle on the answer. If the inequality has 'or equal to', fill in the circle. Otherwise, leave it blank.
2. Draw an arrow in the direction of the inequality symbol. If it is a less than sign, draw it to the left. If it is a greater than sign, draw it to the right.

Practice!

Solve the inequality,
$3x - 2 \leq 5$

Answer:

$x \leq 7/3$

Solve the inequality,
$3x/2 - 5/4 > 13/6$

Answer:

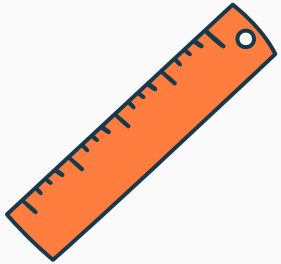
$x > 2$

 (Challenge)

Solve the inequality,
$4+6(x + 3) \leq 3/2(4x + 10)$

Answer:

No solutions
(after simplifying inequality is $22 \leq 15$, which is false)



05

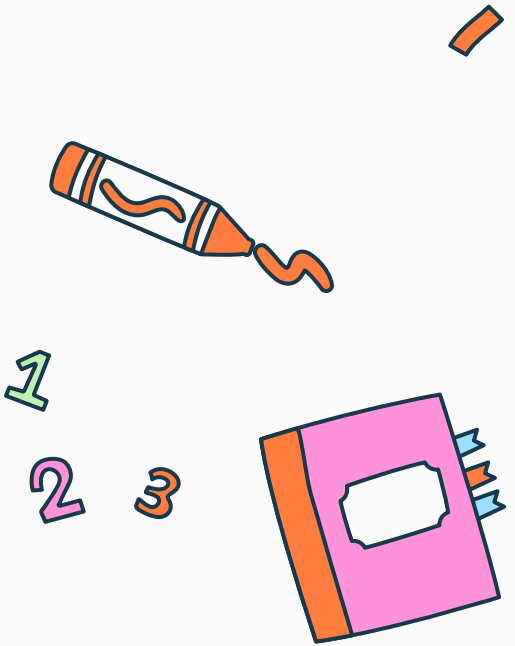
Prime and Composite

2+2

Teaching Goals

We are going to answer these questions:

- What are factors?
- How do you find the factors of a number?
- What are prime and composite numbers?
- How do you find prime numbers?



DEFINE CONCEPTS

Factor

A factor of a number is a number that can be multiplied by another number to get the original number.
(Ex: 2 is a factor of 6, since 2 * 3 = 6
5 is a factor of 10, since 5 * 2 = 10)
1 is a factor of any number.

DEFINE CONCEPTS

Prime Number

A number that only has 2 factors, 1 and itself.
(Ex: 5, 7, 11, 13)

Composite Number

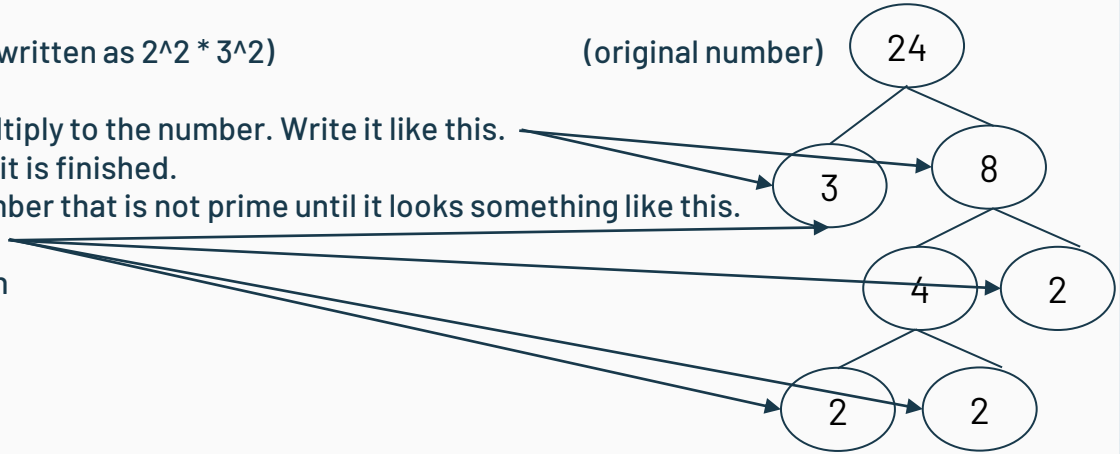
A number that has more than 2 factors
(Ex: 4, 6, 8, 51)

1 is neither prime nor composite

How do you find the factors of a number?

The factors of a number is found using a method called prime factorization.
Every number has a prime factorization, or a way of writing it as a multiplicative sequence of prime numbers. Usually this is written from least to biggest. If a prime number needs to be multiplied more than once, it is normally written using exponents.
(Ex: 10 can be written as 2 * 5, 36 can be written as 2^2 * 3^2)
We will use 24 as an example

1. Write the find 2 numbers that multiply to the number. Write it like this.
2. If one of those numbers is prime, it is finished.
3. Repeat the process for every number that is not prime until it looks something like this.
4. Find every number at the bottom and write it out as a multiplication expression (2^3 * 3)



How do you find prime numbers?

Since there are much more composite numbers than prime numbers, prime numbers are very hard to find. There is a way to find prime numbers that are relatively small, called the sieve of Eratosthenes. We will be finding all the primes from 1 to 100.

1. Get a hundreds chart.
2. Go through each of the numbers. For each number:
    a. Check if it is prime, using prime factorization.
    b. If prime: leave it blank, shade in all other multiples of that prime. Else, move on to the next number.
3. In the end, all of the numbers that are not shaded (besides 1) are prime
4. From 1 - 100, there are 26 primes

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

THANKS!

Do you have any questions?

jpengzhao@gmail.com

ICON PACK

ALTERNATIVE RESOURCES

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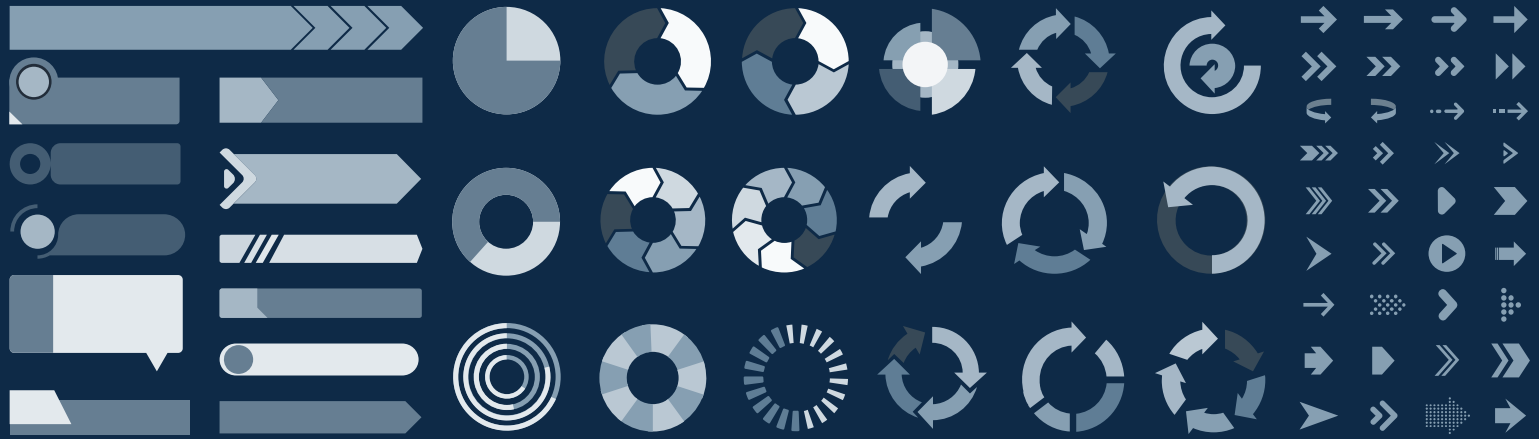

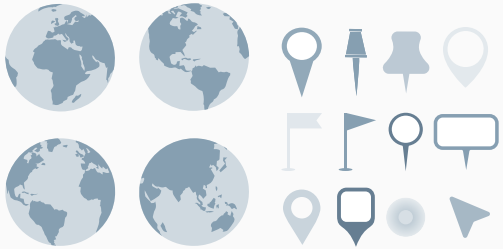

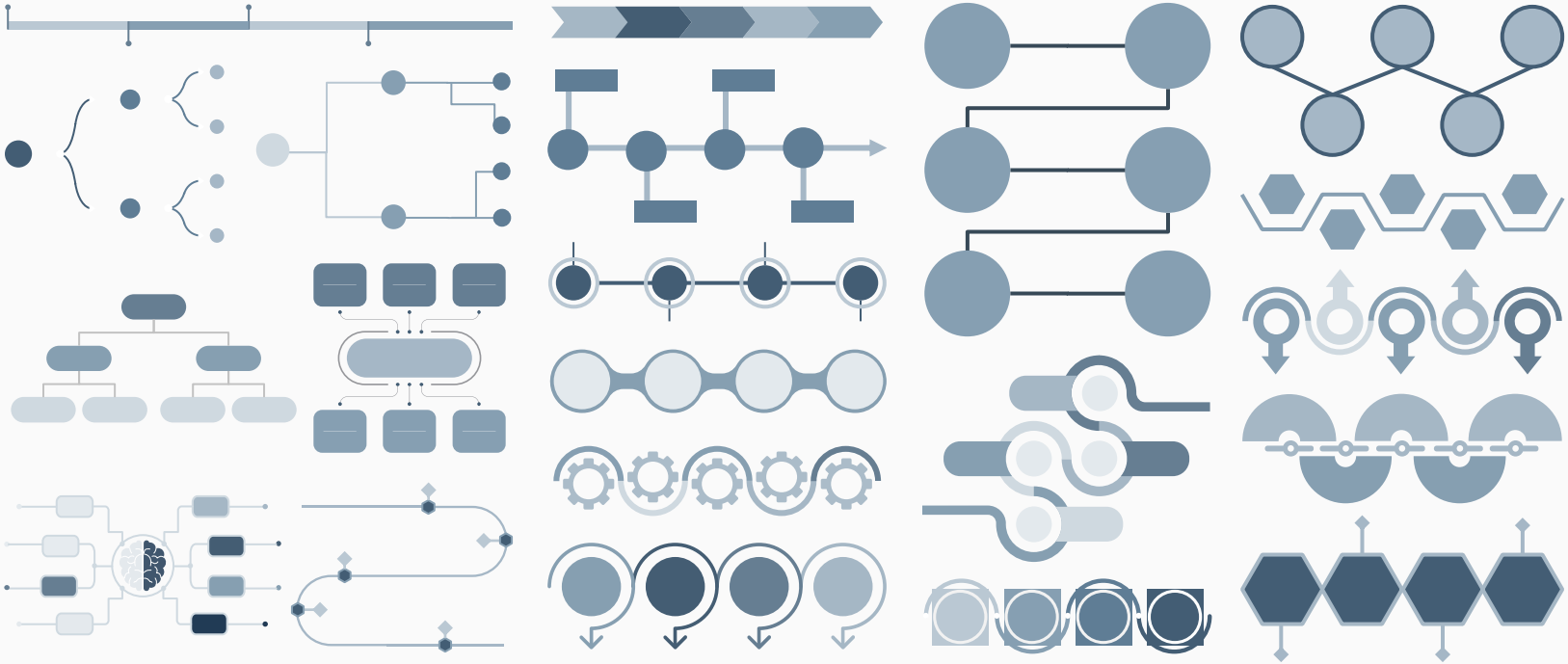

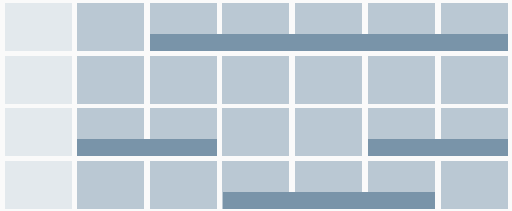


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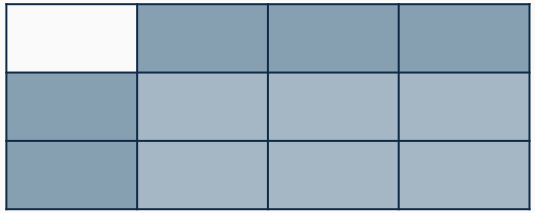
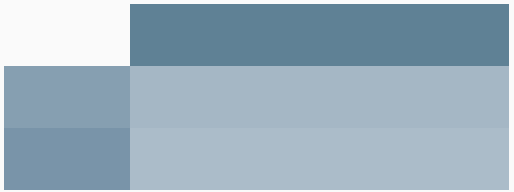
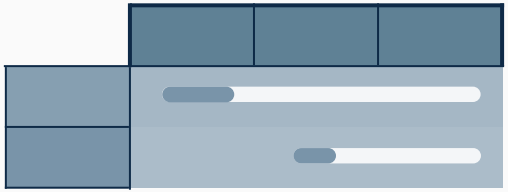
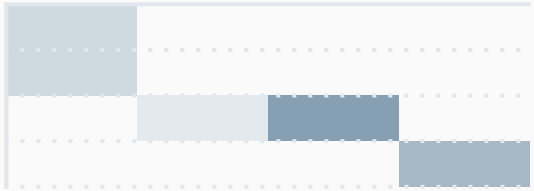
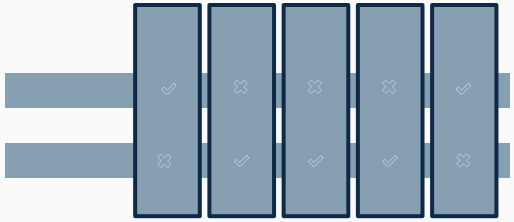
Task 1
Task 2
PHASE 2
Task 1
Task 2

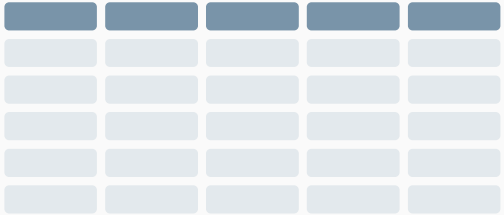


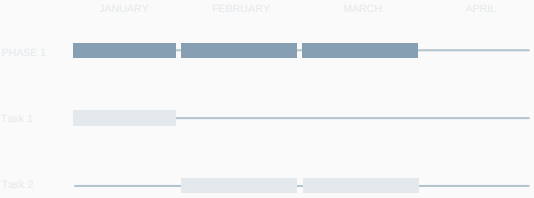











JANUARY
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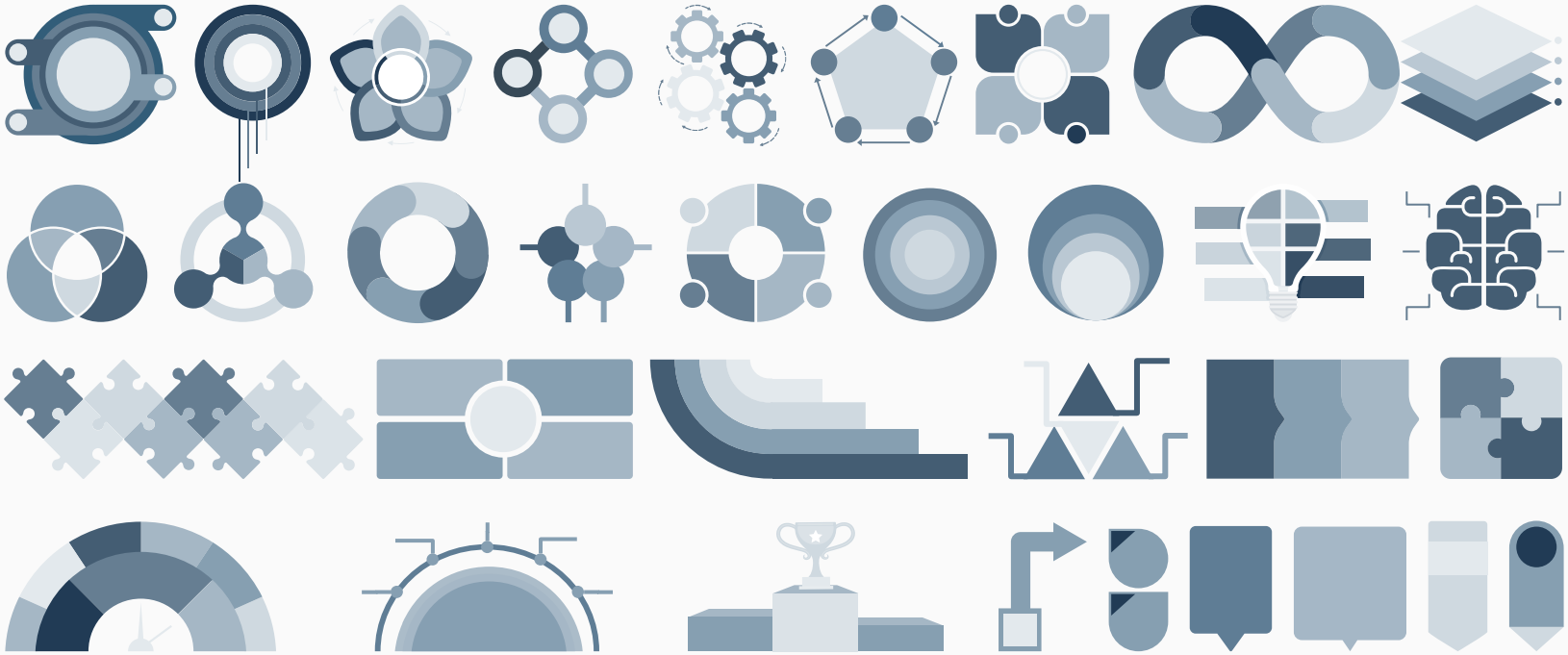
PHASE 1
Task 1
Task 2



...and our sets of editable icons

Educational Icons

Medical Icons

Business Icons

Teamwork Icons

Help & Support Icons

Avatar Icons

Creative Process Icons

Performing Arts Icons

Nature Icons

SEO & Marketing Icons


Text 1
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Add the title here
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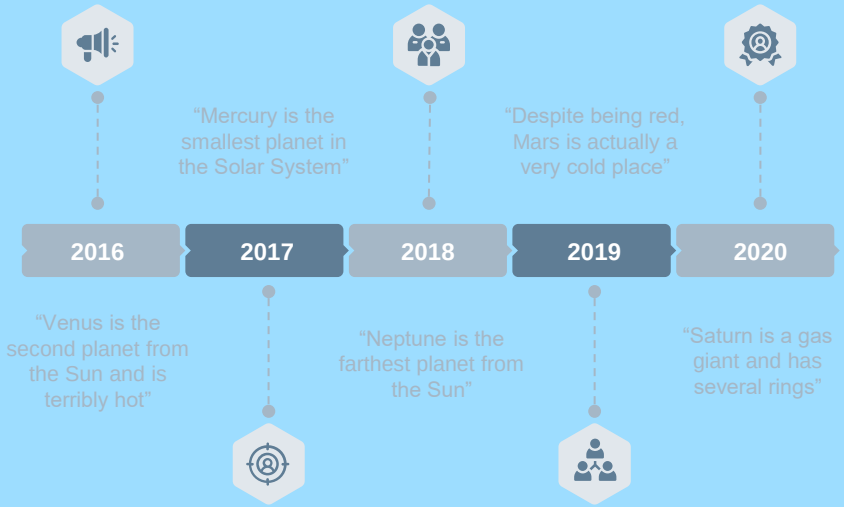
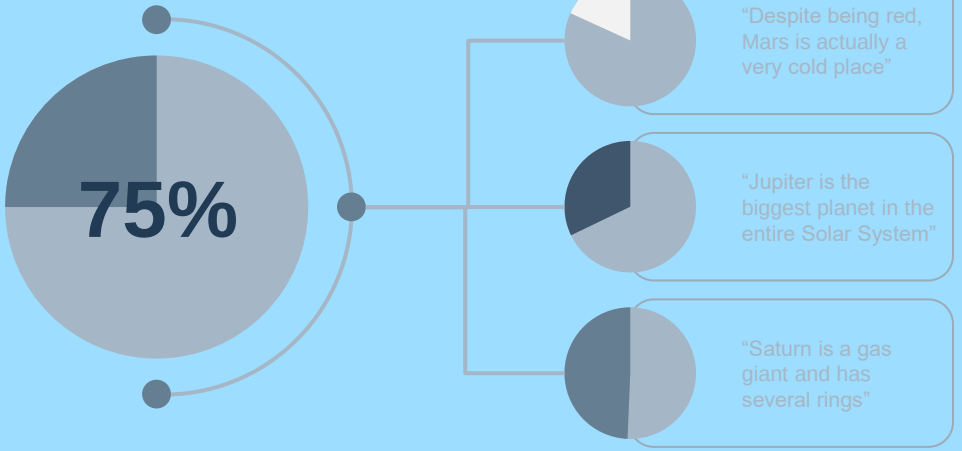
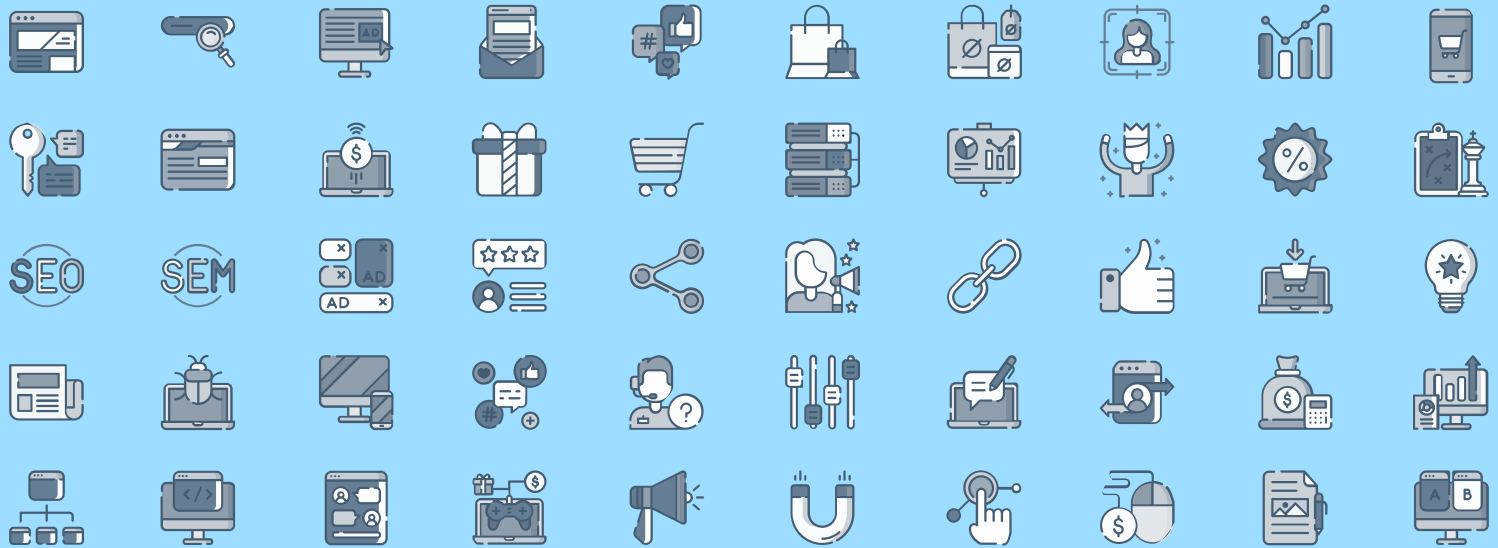

“Mercury is the smallest planet in the Solar System”
“Despite being red, Mars is actually a very cold place”
2016
2017
2018
2019
2020
“Venus is the second planet from the Sun and is terribly hot”
“Neptune is the farthest planet from the Sun”
“Saturn is a gas giant and has several rings”


75%
TITLE 1
“Mercury is the smallest planet in the Solar System”


75%
“Despite being red, Mars is actually a very cold place”
“Jupiter is the biggest planet in the entire Solar System”
“Saturn is a gas giant and has several rings”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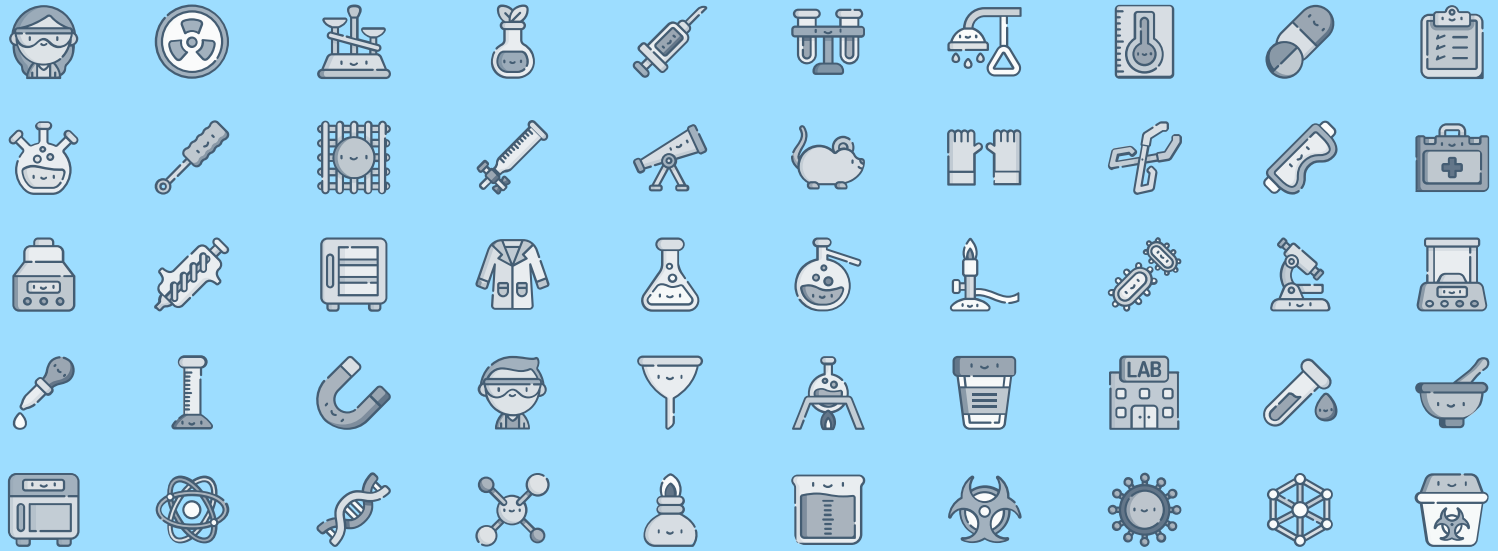
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