# SCIENCE

It's an organized structure that includes methods, principles, laws, and concepts, it also includes scientific theories and an organized way of research

The thing differentiating between science and art, is testing, as **SCIENTIFIC METHODS** establish **facts** by **testing and experimenting**

**In more details**

- You stumble across a phenomenon in nature and start to view it, that's called **observation**
- You start to describe the phenomenon, that's called a **law**
- You try to recreate the phenomenon, that's called **experiments**
- You try understand why the phenomenon happened, that is called a **Theory**
- When you reach a repeated result and evaluated a phenomenon, you come up with a fact, this is called a **CONCLUSION**

When we experiment and test an observable occurrence, we create a statement that describes said occurrence

This statement is called a **LAW**

Of course, describing something is not enough for most people, we need to UNDERSTAND what is going on, so we created an explanation of that occurrence, that is what we call a **SCIENTIFIC THEORY**

When you find repeating patterns and trends between variables, like the linear relation between potential difference and electric current, we interpret these relations using graphs or data sheets, this is the **RELATIONSHIPS BETWEEN VARIABLES**, it's called a **CORRELATION**

**A correlation is the way that variables are related and they have two types**

- **Positive ->** when one increase, another does too
- **Negative ->** when one decrease, another does too

When you're doing research and come up with a value, the range of possibilities for the actual true value creeps up on you, this uncertainty that there is a range of possible values within the true value of the measurements is called **SCIENTIFIC UNCERTAINTY**

You can decrease it by doing more research and getting more values and getting the average

In 1960, the **International System of Units (SI)** was created

It was based on the **M.K.S (metric system)**

## Fundamental Units

| | |
|---|---|
| mass | Kilogram (kg) |
| length | Meter (m) |
| time | Second (s) |
| temperature | Kelvin (k) |
| Electric current | Ampere (a) |
| Amount of substance | Mole (mol) |
| Luminous intensity | Candela (cd) |
| Plane angle | Radian (rad) |
| Solid angle | Steradian (sterad) |

## Derived Units

| | |
|---|---|
| area | Square meter ($m^2$) |
| volume | Cubic meter ($m^3$) |
| speed | Meter per second (m/s) |
| acceleration | Meter per second square ($m/s^2$) |
| Weight, force | Newton (N) |
| pressure | Pascal (Pa) |
| Energy, work | Joule (J) |

A standard unit system was helpful because **It allowed scientists from all across the world to work together without having to translate each system**

There are **2 TYPES** of quantities

## Fundamental Quantities (Basic)

- They are the most basic quantities that can't be defined by other quantities
- Like **Mass**, **Length** and **Time**, you can't define them using speed or something, it's a central quantity that works with other quantities to define stuff like force, or density

## Derivative Quantities

- They are quantities that can be defined by other quantities (fundamental ones)
- Like **Speed**, or **force**, they are just fundamental quantities like mass, length and time working together

# Prefixes

They are used as multipliers for units

Like 1 **kilo**meter = 1000 meters

And 1 **milli**meter = .001 meters

| Prefix | Symbol | Numerical Multiplier | Exponential Multiplier |
|---|---|---|---|
| **yotta** | Y | 1,000,000,000,000,000,000,000,000 | $10^{24}$ |
| **zetta** | Z | 1,000,000,000,000,000,000,000 | $10^{21}$ |
| **exa** | E | 1,000,000,000,000,000,000 | $10^{18}$ |
| **peta** | P | 1,000,000,000,000,000 | $10^{15}$ |
| **tera** | T | 1,000,000,000,000 | $10^{12}$ |
| **giga** | G | 1,000,000,000 | $10^{9}$ |
| **mega** | M | 1,000,000 | $10^{6}$ |
| **kilo** | k | 1,000 | $10^{3}$ |
| **hecto** | h | 100 | $10^{2}$ |
| **deca** | da | 10 | $10^{1}$ |
| **No prefix** | | 1 | $10^{0}$ |
| **deci** | d | 0.1 | $10^{-1}$ |
| **Centi** | c | 0.01 | $10^{-2}$ |
| **Milli** | m | 0.001 | $10^{-3}$ |
| **Micro** | µ | 0.000001 | $10^{-6}$ |
| **Nano** | n | 0.000000001 | $10^{-9}$ |
| **Pico** | p | 0.000000000001 | $10^{-12}$ |
| **Femto** | f | 0.000000000000001 | $10^{-15}$ |
| **Atto** | a | 0.000000000000000001 | $10^{-18}$ |
| **Zepto** | z | 0.000000000000000000001 | $10^{-21}$ |
| **yocto** | y | 0.000000000000000000000001 | $10^{-24}$ |

NOTES!

When we go to square or cubic lengths

We multiply the multiplier's power by 2 (for square) and 3 (for cubic)

So 1 cubic meter = 10^6 cubic centimeters instead of 10^2

And 1 square meter = 1^6 square millimeters instead of 1^3

As for liters

1 cubic meter = $10^3$ liters

# HOW TO CONVERT BETWEEN QUANTITIES

# (1) Convert between prefixes

To convert from a prefix to a prefix we can use the exponential multiplier and put it in this formula

$$\frac{quantity\ number\ x\ current\ multiplier}{target\ multiplier}$$

So to convert from let's say 10 micrometers to nanometers we do this

$\frac{10\ x\ 10\text{^}-6}{10\text{^}-9}$ = 10000 nm

# (2) Convert between Units

## Length

- 1 mile (mi) = 1609 m = 5280 ft
- 1 yard = 3 ft
- 1 ft = 30.48 cm = 12 in
- 1 in = 2.54 cm

## Mass

- 1 Pound (lb) = 0.465 kg
- 1 ounces (oz) = 28.35 g
- 1 day = 86400s

## Time

- 1 h = 3600 s

## temperature units:

- **Celsius to Kelvin: K = °C + 273.15**
- **Kelvin to Celsius: °C = K - 273.15**
- **Celsius to Fahrenheit: °F = (°C * 9/5) + 32**
- **Fahrenheit to Celsius: °C = (°F - 32) * 5/9**
- **Kelvin to Fahrenheit: °F = ((K - 273.15) * 9/5) + 32**
- **Fahrenheit to Kelvin: K = ((°F - 32) * 5/9) + 273.15**

There are **3 TYPES** of variables

Let's imagine you're making lemonade

## INDEPENDENT VARIABLES

These are the values that you change

- Like **the amount of lemons** you add to the lemonade

## DEPENDENT VARIABLES

They are the values that change by the independent variables

- Like **the sourness of the lemonade**

## CONTROLLED VARIABLES

They are variables you can keep the same

- Like **the amount of water/sugar**

# CHEMISTRY

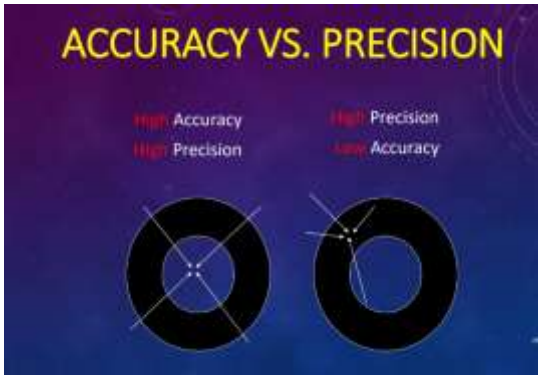
It’s a branch of science that studies the properties of matter and what changes (chemical/physical) occur to it, and chemical reaction

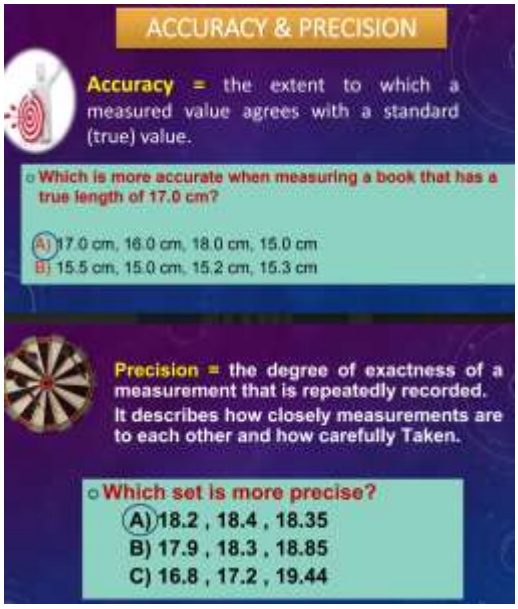
**Of course,** to do your testing/experimenting you will need to use tools, or in our case, they’re called **Instruments**, when we do our measuring

We have two types of results

- **Accurate results:** when we have the measured value be close to the true value
- **Precise results:** when multiple measurements give nearly identical values

The goal of science is to obtain measurements that are both precise and accurate, that will depend on the type of measurement




**Significant figures** are ways to make sure that you're not over-representing the amount of precision you have

You identify it by saying "which digits are really giving me the information I want"

**0.00<u>700</u>** -> if we said that this is in kilometers then the chosen part is 7.00 meters which is precise and not over-representing

**0.052** -> if we said that this is in kilometers then the chosen part is 52 meters which is not over-representing

**370.** -> 370 alone can mean 2 things, we can be exactly 370. or close to it like 369.9, but when we add the ., we specify that we are exactly 370

**10.0** -> 10 alone can mean 2 things, we can exactly be 10.0 or close to it like 9.9 , adding the . made us sure that it is 10 exactly

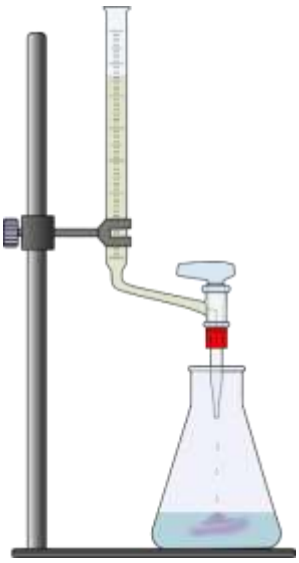
**705.001** -> the .001 made the value exactly 705.001

**37,000** -> we are not sure if it is exactly 37000 or close like 36999, so we are only gonna take the 37 as significant

## EXAMPLES OF INSTRUMENTS

- # Sensitive Balance
    - **It's used to precisely measure weight**

- 

- **Burette**
  - It’s a tall glass tube that has 2 hole
  - You fill the burette with liquid using the top hole
  - You extract the liquid using the buttom hole that is set with a valve to control the flow rate
  - You use it to measure the volume of liquid during calibration experiments
  - 

- **Beaker**
  - It’s a pot made with Pyrex glass and it has 2 types, either with grading or with a known grade
  - It’s graded from bottom to top

- It’s used to carry, mix, and store liquids
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# • Graduated Cylinder

- It’s a cylinder made with plastic or glass
- It has grading from top to bottom
- It’s used to measure the volume of liquids or objects that don’t dissolve in water
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# • Flasks

- It a glass object made from Pyrex glass and it has different types depending on the volume and use
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- It’s used for calibrating expirements
- 

- It’s used for Distillation and preparation processes
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- Volumetric flask -> calibrated to contain a precise volume at a certain temperature

# Pipette

- It’s a glass tube made to measure and contain a known amount of liquid and we get that liquid using a sucking tool

- This Photo by

- # PH meter
  - It’s a device made to measure the PH from 0 to 14, where 0 is the most acidic and 14 is the least
  - 


**Density** is the degree of compactness of a substance in a certain area

Or it’s the mass of an object in a certain area

So its law is mass/volume

**Specific gravity**

It’s the density of an object divided by the density of water

It has no units because it’s a ratio

It can be used to know wether an object will float or not

If its less than 1 it will flow

If its more it will submerge fully

If the S.G is let's say .5 then 50% of that object will float on water

**Quantitive Measurements** are measurements that include numbers and units or quantitive instruments like the ruler or timer

Sure, let's break down each of these terms:

1. **Atoms**: Atoms are the smallest unit of matter that retains the properties of an element[12]. They are composed of protons, neutrons, and electrons[2].
2. **Elements**: An element is a pure substance that cannot be broken down into any other substances[1]. It is made from just one type of atom[1]. For example, iron is an element made up of only iron atoms[1].
3. **Molecules**: A molecule is a group of two or more atoms that are chemically bonded together[34]. These atoms can be of the same element (like O2) or different elements (like H2O)[14].
4. **Compounds**: A compound is a substance formed when two or more elements are chemically bonded together[125]. The resulting compound has properties that are different from the individual elements. For example, water (H2O) is a compound made up of hydrogen and oxygen[1].
5. **Mixtures**: A mixture is made up of two or more substances — elements or compounds — that are mixed physically but not chemically[5]. This means they do not contain any atomic

bonds[5]. Mixtures can be separated into their component parts through physical methods[1].

Now, let's talk about some methods scientists use to create or separate these:

1. **Filtration**: This is a physical method used to separate mixtures. For example, if you have a mixture of sand and water, you can use a filter to separate the sand from the water[1].
2. **Distillation**: This is a process used to separate mixtures based on differences in boiling points. For example, if you have a mixture of alcohol and water, you can heat the mixture. The alcohol will boil and evaporate before the water, and it can then be collected and condensed back into a liquid[1].
3. **Chemical reactions**: These are used to create compounds. For example, if you heat iron and sulfur together, they react to form the compound iron sulfide[1].
4. **Chromatography**: This is a method used to separate mixtures based on differences in how quickly their components move through a mobile phase. For example, it can be used to separate different dyes in a mixture[1].
5. **Homogeneous and Heterogeneous Mixtures**: A homogeneous mixture is a mixture where the components that make up the mixture are uniformly distributed throughout the mixture. An example of this is a solution of sugar in water. A heterogeneous mixture is a mixture where the components of the mixture are not uniform or have localized regions with different properties. An example of this is a mixture of sand and water[6].