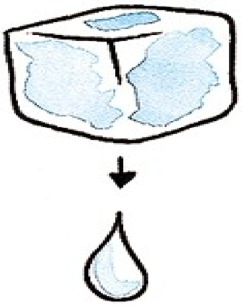
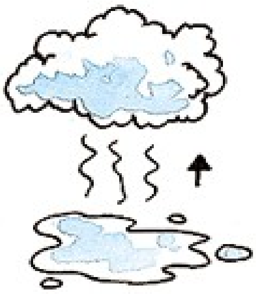
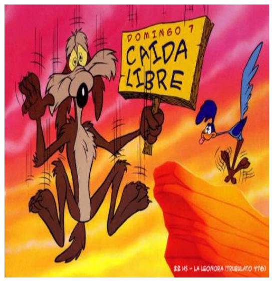
Lesson 1: # SCIENCE: MEASURE. SCIENTIFIC METHOD

1. CHEMICAL AND PHYSICAL CHANGES.

We can see that all things are continuously changing. There are two types of changes in the environment: **chemical and physical**.

a) Physical changes: They are those changes that **DO NOT produce** a new substance. If you break a bottle, you still have glass. Some common examples of physical changes are; breaking, crushing, cutting , bending and changes states, such as melting, freezing, condensing, etc....

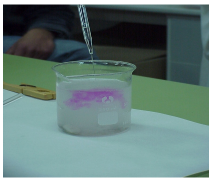





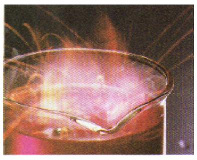
b) Chemical changes: They are changes that result in the **production of another substance.** If you burn a paper , you are carrying out a chemical reaction that releases carbon. Common examples of chemical changes that you may be somewhat familiar with are; digestion, respiration, photosynthesis, oxidation, burning and decomposition.

Sometimes strange changes occur and indicate that new substances are being formed:

- Emergence of new colors. (Example colorless + colorless → pink)



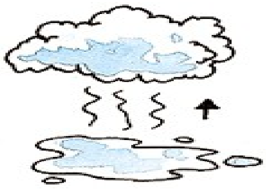
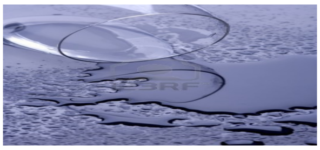
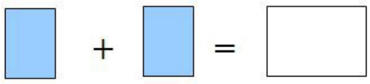
- Heat release. (Example cold + cold → hot)




- Emergence of gases (sometimes with odor **) or/and smoke** (Example: solid + liquid → gas)


Activity 1 . Explain if the following processes are chemical or physical.

PROCESS	PHISICAL OR CHEMICAL ? WHY?
	

Activity 2 . Determine if each change is a physical or chemical. Match the correct answers.

Tearing clothes
Lighting a match
Chewing food **Physical change**
Breaking a stick
Rusting nail
Sawing wood
Oxidizing food for energy **Chemical change**
Stretching a rubber band
Burning gas in a stove
Melting ice cream

Activity 3 . Find three examples of Chemical and Physical Changes in everyday life. Explain why each of these changes are either chemical or physical.

2. THE MATTER AND ITS PROPERTIES.

MATTER:

- Matter is anything that has **mass** and **volume**. It can be weighed and occupies a place in space.

-Its properties serve to **identify** and **measure** substances. Scientists are only concerned for the measurable things.

- Matter has two types of properties.

a) **Characteristic properties:**

- They serve to **identify** the substances.
- They **DON'T depend** on the amount of substance.
- Examples: Colour, taste, smell, density, boiling point, freezing point..

b) **Non Characteristic properties:**
- They do not serve to **identify** the substances.
- Examples: Length, surface, volume, mass, temperature, …...

Characteristic properties serve to **identify** and classify substances. They don't depend on the amount of substance. Characteristic properties would be :

Colour

Hardness (dureza) It is the resistance of a substance to be scratched (rayado). It can be **hard (**difficult to be scratched) or soft (easy to be scratched)

Density It indicates how tightly packed the substances are. It is calculated by dividing the mass by the volume.

$$d = \frac{m}{V}$$

Freezing/melting point and **boiling/condensing point** are the temperatures at which the matter change its state. For example the melting point of water is 0 ºC.

Solubility . It is the ability of a substance to dissolve . The substance which is being dissolved is called **solute** (soluto) and the substance in which the solute is dissolved into is called **solvent** (disolvente).

Non-characteristic properties (propiedades generales) serve to **measure** the substances, but **NOT** to identify them . They would be the weight (peso), length (longitud), etc .

Activity 4 . Indicate if the following properties are characteristic or non-characteristic.

PROPERTY	TYPE?	PROPERTY	TYPE?
Solubility		Flammability	
Temperature		Thermal conductivity	
Melting point		Length	
Density		Surface	
Weight		Colour	
Electric conductivity		Taste	

Activity 5 . There are three equal containers with **water**, **alcohol** and **olive oil.** Indicate which is which.



PROPERTY	Characteristic?	A	B	C
MASS		3 Kg	4 Kg	3 Kg
COLOUR		Colourless	Colourless	Yellow
Flammability/ Combustibilidad	YES	NO	YES	YES
SUSBTANCES				

Which properties have helped you to identify the substances? Why?

Which property has not served you to identify the substances? Why?

The table below shows the main characteristic properties

SUNSTANCE	Water	Silver	Gold	Mercury	Lead	Iron	Alcohol
Density (Kg/L)	1	10,5	19,2	13,6	11,3	7,8	0,9
Freezing point (º C)	0	962	1064	-38,5	328	1539	-117,3
Boiling point (ºC)	100	2162	2856	357	1750	2740	78,4

Activity 6 . Indicate whether the following bodies are of the same substance.

	A	B	C
MASS	500 g	25 Kg	0,1 Kg
VOLUME	0,5 L	25 L	0,1 L
DENSITY (Kg/L)			
SUBSTANCE			

Activity 7 . A king gave an amount of gold to a jeweler to make him a crown. The crown he created had a mass of 3200 g and a volume of 200 mL. Did the jeweler deceive the king by not using all of the gold?

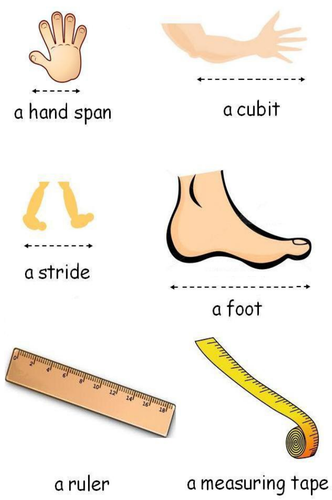
CORONA DE ARQUÍMEDES INTERACTIVA

CROWN	MASS	VOLUME	DENSITY	¿ GOLD ?
	3200 g	200 mL		

Activity 8 . A jewel is made up of diamonds and another is made up of glass. Could you easily identify each one?

Explain it.

Activity 9 . Could you easily identify the difference between sugar and white sand? Explain it.



3. MEASURE.

A **physical magnitude** is a body's property that **can be measured** and it is used to study and describe it. Measuring is to compare one magnitude with a pattern (una medida patrón).

The choice of units is arbitrary. We can define different units to measure the same magnitude. Thus, for example, as a unit of length has been used in different places and times the meter, yard, mile, inch, stadium, ...

However, this is not practical when it comes to exchange information among scientists, so in 1960 was accepted the International System of Units (SI).

The SI is the modern form of the metric system. It is the world's most widely used system. It was established as the legal system in Spain in 1967. The SI has chosen 7 fundamental units.

Magnitude	Unit	Symbol
Length (longitud)	Meter	m
Mass (masa)	kilograme	kg
Time (tiempo)	second	s
Temperature	Kelvin	K
Electric current (intensidad de corriente)	ampere	A
Luminous intensity	Candela	cd
Amount of matter	mole	mol

All the rest of units can be obtained from only this 7 units. So, they are called derived units. For instance, speed unit is m/s, or power (potencia) unit is W (Watt), that is $kg.m^2/s^3$.

Let's meet some of the following quantities:

• Length is defined as the distance between two points. Its SI unit is the meter (m), and has had several definitions, from the ten-millionth part of the quadrant of a meridian to the current one: the distance traveled by light in a vacuum to 1/299,792,458 seconds.

• Mass: is a property of matter which is defined as the amount of matter that a body contains. The mass of a body can interact with the inertia, or difficulty in changing its speed, and weight or attractive force between the body and the Earth. Its unit is the kilogram (kg), which is the mass of a platinum iridium cylinder kept at the International Bureau of Weights and Measures (Sèvres, France). It is the only unit defined by an object.

• Time: This is a difficult quantity to define, although it is relatively easy to measure. His unit in the SI is the second (s), the definition escapes this level.

The derived quantities are obtained by mathematically combining the base units. Let see some of them:

• Surface quantity (derived from length). This is an extension of two dimensions. Its SI unit is the square meter (m^2), which is defined as a square of 1 m side. There are no apparatus for measuring surfaces directly, so we calculate them using known geometric formulas, as the rectangle.

• Volume: is also derived from the length. It is an extension in three dimensions and is related to the dimensional space of bodies. Its SI unit is the cubic meter (m^3), defined as the space occupied by a cube whose edge is 1 meter. We must remember that 1 m^3 are 1000 liters or 1 dm^3 = 1 L, as they often will use either one way or another to express volumes.

• Speed: represents the distance travelled in unit time. In its definition involves two different magnitudes. Its SI unit is the meter per second, whose symbol is the m / s.

Other derived quantities are density, acceleration, force, energy, pressure, etc..

Activity 10. ¿Cuáles son las unidades fundamentales del SI? ¿Qué magnitud miden? Construye tres unidades derivadas.

Sometimes, the SI unit is not suitable to use in a particular measure. Imagine we want to know the mass of a cell or the distance between the Earth and the Sun. Do you think it is appropiate to use kg and m units, respectively?

Obviously, no. In the first case, it would be useful to seek a unit much smaller, or submultiple. In the second, it would take a larger unit, or multiple. Adaptamos nuestras unidades de medida a lo que queremos medir.

Múltiplos			Submúltiplos	
Deca (da)	$10 = 10^1$		Deci (d)	$10^{-1} = 0,1$
Hecto (h)	$10^2 = 100$		Centi (c)	$10^{-2} = 0,01$
Kilo (k)	$10^3 = 1000$		Mili (m)	$10^{-3} = 0,001$
Mega (M)	10^6		Micro (μ)	10^{-6}
Giga (G)	10^9		Nano (n)	10^{-9}
Tera (T)	10^{12}		Pico (p)	10^{-12}

We are going to use conversion factors to change units. Normally, to get the SI units. A conversion factor is a fraction with different units in the numerator and denominator but they are equivalent. For example, we know that 1 L is 1000 mL, so that the conversion factor to convert a volume in L to mL, and after to microliters are:

$$3\,\cancel{L}\bullet\frac{1000\,mL}{1\,\cancel{L}}=3.000\,m\,\cancel{mL}\bullet\frac{1000\,\mu\,L}{1\,\cancel{mL}}=3.000.000\,\mu\,L$$

And whose inverse fraction is used to go from mL to L. To convert one unit to another should be multiplied by the appropriate factor to remova the old unit and the new unit appears.

We will also use scientific notation very often, you know, the expression of a large or small number by a decimal number, with one integer, multiplied by a power of 10. So, the size of an atom can be 0.000000000145 m, which is expressed in scientific notation as $1{,}45.10^{-10}$ m and the radius of the Earth is 6375000 m, expressed as $6{,}375.10^{6}$ m.

Express the next values in scientific notation:

- distance to Madrid form Ares 598 km in m $\quad 598\,\cancel{km}\bullet\frac{1000\,m}{1\,\cancel{km}}=598.000\,m=5{,}98.10^{5}\,m$

- length of an amoeba 250 μm a m $\quad 250\,\cancel{\mu m}\bullet\frac{1\,m}{1.000.000\,\cancel{\mu m}}=0{,}000250\,m=2{,}5.10^{-4}\,m$

You must pay attention with the square and cubic units:

a flat of 75,3 m^2, how many cm^2 has? $\quad 75{,}3\,\cancel{m^2}\bullet\frac{10.000\,cm^2}{1\,\cancel{m^2}}=753.000\,m=7{,}53.10^{5}\,m$

You can use various factors together (be careful: the two original units have to disappear):

The speed of a car is 90 km/h in m/s $\quad 90\frac{\cancel{km}}{\cancel{h}}\bullet\frac{1.000\,m}{1\,\cancel{km}}\bullet\frac{1\,\cancel{h}}{3.600\,s}=25\frac{m}{s}=2{,}5.10^{1}\frac{m}{s}$

Remember: 1 L is 1 dm^3. So:

If one day it rains 15 L/m^2. How many cubic meters of water have fallen in 1 km^2?

1 m^3 = 1.000 dm^3 = 1.000 L $\quad 15\frac{\cancel{L}}{\cancel{m^2}}\bullet\frac{1\,m^3}{1.000\,\cancel{L}}\bullet\frac{1.000.000\,\cancel{m^2}}{1\,km^2}=15.000\frac{m^3}{km^2}=1{,}5.10^{4}\frac{m^3}{km^2}$

Como cada m^3 de agua pesa 1 tonelada, en un km^2 caen 15000 toneladas de agua.

Los factores de conversión equivalen a las reglas de 3, pero con numerador y denominador representando a magnitudes diferentes. Para resolver la cuestión, escribimos el dato que aparece en la

pregunta, colocando el resto de la información como factor de conversión, escribiéndolo en el orden adecuado para que las unidades del dato aparezcan en el denominador.
Un coche consume 6,5 L de gasoil cada 100 km. ¿Cuándo gasta en 75 km?

$$75\,\cancel{km}\bullet\frac{6{,}5\,L}{100\,\cancel{km}}=4{,}875\,L$$

If each liter costs 1,35 €, how many € have you spent in these 75 km?

$$4{,}875\,\cancel{L}\bullet\frac{1{,}35\,€}{1\,\cancel{L}}\approx 6{,}58\,€$$

Activity 11. Express in SI units, and in scientific notation:

12 hm . = m	0,089 cA
56 mmol	78 cg

6 t (t is the symbol of a ton, which is 1000 kg, and should not be Tm confused with the terámeter, which is a unit of length)

800 cm^2	60 mm^3
207 dam^2	33 cL
0.06 dam^3	2 km/min

Sol: $1{,}2.10^3$ m, $8{,}9.10^{-4}$ A, 6.10^6 kg, 8.10^{-2} m^2, 6.10^{-8} m^3, $2{,}07.10^4$ m^2, $3{,}3.10^{-4}$ m^3

Activity 12. Using conversion factors, performs the following transformations, expressing the result in scientific notation:

La moneda antes en España era la peseta. 6 € equivalían a 1.000 pesetas. Una blusa que cuesta 36 €, ¿cuántas pesetas costaba?

A dozen of oranges weighs 1520 grams and cost 1.74 euros. How many oranges could we buy with 10 euros? How much do those oranges weigh?
If you buy 5 kg of oranges market, how much would they cost? If you choose to pay in the Swiss Franc, how much it will pay if you know that 1 euro = 1.59 Swiss franc?

A bus is able to move at a constant speed of 72 km/h. How long would I take to drive 490 km? How far would it get in 20 minutes?

We know that a military aircraft can get to move at a speed of 2700 km/h. Knowing that mach 1 is the speed of sound in air (340 m/s), would you know what is the average speed of the plane in mach?

One person likes bottled water and takes a daily amount of 75 cL. Determine the amount of bottled water drunk in a year, expressing the result in m^3. If 1.5 L of bottled water costs 0.48 €, how much money does he spend in one year?
Numerous scientific evidence has shown that there is a total of 18 g of water $6.02 \cdot 10^{23}$ water molecules. How many molecules are there in a glass of water 120 grams? How would weigh $4.25 \cdot 10^{22}$ water molecules?

A room measures 4.5 m long, 3.2 m wide and 2.9 m high. What air mass will there be in, it is known that in these conditions the air weighs 1 mL of air 1.31 g?

Light is able to move with a speed of 300,000 km/s. However, there are distances in the Universe so big that the distances are measured in light years. A light year is the distance that light can travel in a year.
(A) How many km are there in one light year?

(B) Often in Astronomy an upper unit is used to measure distances called 'parsec'. A parsec is 3.26 light years. The Andromeda Galaxy is the nearest galaxy to ours, and is located 2.2 million light years. How many km and how many parsec are there in that distance?

© Express the distance to the Andromeda galaxy in Megaparsecs.

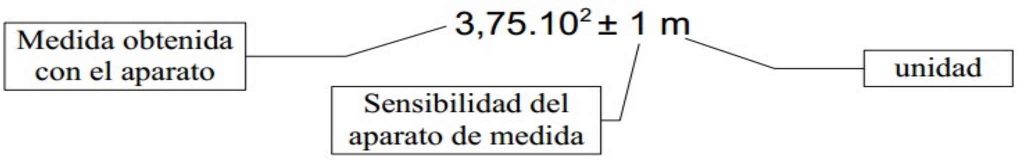
A day it rained 114 L/m^2. How many m^3 of water fell in a athletics field 238 m long and 195 m wide?

Cuando medimos algo tenemos que **expresar el resultado** de la medida con un **número** y la **unidad** correspondiente.

When we measure something we have to express the result With a number and unit. Nada es 2, si no que algo pesa 2 kg o tiene un volumen de 2 cm^3.

We never measure the exact value, but an approximation, because our measure appliances are not perfect. They have a minimum value and a maximum value of measurement. This is called measurement range. The minimum separation between two of their measures is what we call resolution or sensitivity. We can find the resolution taking 2 different values, substracting them and dividing by the number of divisions between these two values.

Result of a measurement must be always in this way:



You can never give a more or less sensitivity measure of the apparatus you are using to measure. If you have a thermometer that gives tenths of a degree, you can not say the temperature is 12.34 ° C and should mean that the temperature is 12 ° C (here you're rounding). You should say 12.3 ± 0.1 ° C. The amount of numbers that come before ± are called significant figures. Do not count if there is 0 on the left, but to the right. So 0.000034 cm has two significant figures, 0.1230 m and has 4.

In the problems we always give the result with the number of the least significant digits of data they give us. Normally one laboratory experiment is not enough, because the accuracy of our measuring equipment is not very good. We normally do the same experiment three or five times.

Normalmente en el laboratorio no se hace un único experimento, dado que la exactitud de nuestros aparatos de medida no es muy buena. Se llama **exactitud** a lo que nuestros aparatos se acercan al valor verdadero, mientras que la **precisión** de unas medidas es lo cerca que están unas de otras.

Cuando hacemos varias medidas de lo mismo, la **medida final** que pondremos será la **media de las medidas** que hemos efectuado. Lo que nos desviamos en cada medida del valor verdadero (si tenemos varias medidas, es el valor medio) es lo que se conoce como **Error absoluto**.

$$Error\ absoluto = |Valor\ medido - Valor\ verdadero|$$

Pero no es lo mismo desviarse 1 cm cuando medimos 5 cm que cuando medimos 1 km. Por eso, más importante que error absoluto es saber el error relativo, cuanto nos hemos desviado en portentaje, cuál es nuestro porcentaje de error.

$$Error\ relativo = \frac{Error\ absoluto}{Valor\ verdadero} .100$$

Así si hago 3 medidas del tiempo de caída de una piedra desde una altura de 2 m y obtengo los siguientes tiempos: 0,36 s, 0,39 s y 0, 42 s, tenemos:

Experimento	Tiempo (s)	Error absoluto	Error relativo
1	0,36	|0,36 – 0,39| = 0,03	0,03/0,39.100 = 8%
2	0,39	|0,39 – 0,39| = 0	0/0,39.100 = 0%
3	0,42	|0,42 – 0,39| = 0,03	0,03/0,39.100 = 8%
Media	0,39	0,02	5,00%

La medida será entonces: **0,39 ± 0,02 s** (puesto que la sensibilidad es 0,01, ponemos el error mayor, que es el que hemos cometido al realizar las medidas)

Activity 13. Normalmente para los cálculos tomamos el valor de la aceleración de la gravedad como 10 m/s^2 cuando su valor verdadero en Ares es 9,804 m/s^2. ¿Qué error absoluto y relativo cometemos al hacer esta aproximación?

Activity 14. Medimos la presión en la estación meteorológica del cole y nos da 1012 hPa. ¿Cuál es la sensibilidad del aparato? ¿Qué error absoluto y relativo estamos cometiendo en esa medida? ¿Cómo tendríamos que dar la medida?

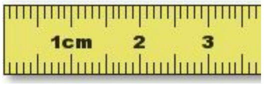
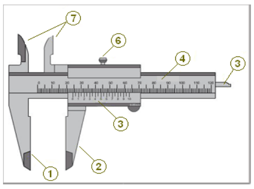
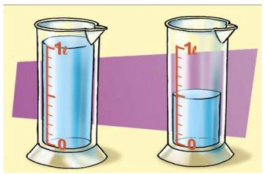
Activity 15. En un experimento de medida de la intensidad de corriente que pasa por un circuito hemos recogido los siguientes valores: 12 mA; 14 mA; 15 mA; 13 mA; 11 mA.

En una hoja de cálculo, halla el valor que tomamos como verdadero (expresado adecuadamente), el error absoluto y el relativo de cada medida.

INSTRUMENTS

They are used to measure the matter properties. They can be rulers, scales, chronometers, thermometers, test tubes, etc...

Activity 16. Fill in the following table:

INSTRUMENT	Nombre (SP)	Name(UK)	Measures	SI Unit	Sensibility
				**m**	
		Ruler	Length	**m**	
	**Calibre** **o** **Pie de rey**			**m**	0,1 mm
				**Kg**	
				**s**	
	**Probeta**			**m^3**	
				**º C**	

The Scientific Method

How do physicists and chemists work?

Like other scientists, along more or less, a process, called the scientific method, which comprises the following steps:

1. Observation of the facts. We analize a fact that catches our attention and try to explain why it happens.

2. Elaboration of an hypothesis. We propose a possible explanation to the fact that we are watching.

3. Experimentation. We make experiments that help us to confirm the possible explanation we hypothesised or help us to refute. We try to simplify the problem, each time experiencing a variable.

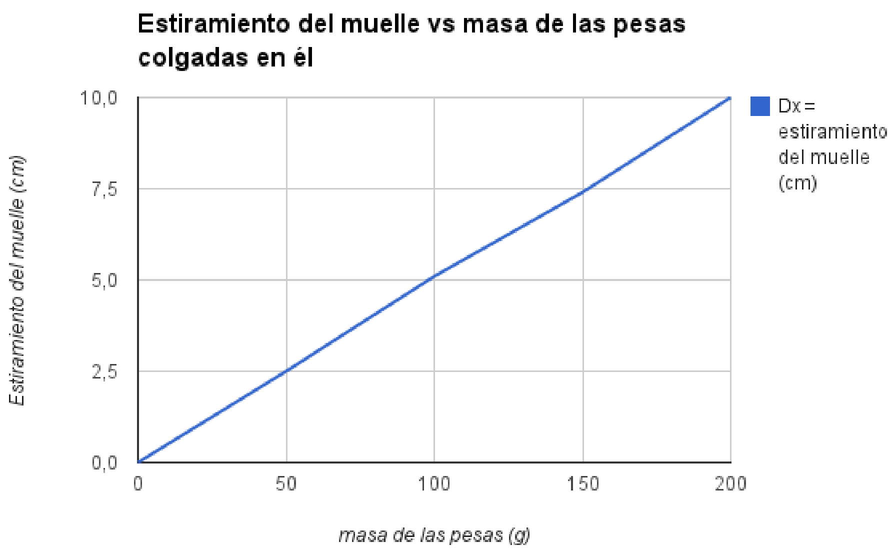
4. Getting Results. Expression of the ressults in tables and graphs. The results obtained in experiments are recorded in tables and graphs, we see trends in these data and how different variables are related. We say two variables are directly proportional if both increase or decrease proportionally, and say which are inversely proportional when one increases and the other decreases.

5. Conclusions. We extract conclusions from the various experiences we have conducted. If mathematical relations can be obtained , we get equations relating the variables.

Vamos a ver un ejemplo de aplicación de la parte final del método científico. Vamos a estudiar como se relaciona el aumento de la longitud de un muelle cuando de él se cuelgan pesas de distintas masas. Recogemos los datos experimentales en una tabla:

m = masa pesas (g)	L = longitud muelle (cm)	Dx = estiramiento del muelle (cm)
0	12,0	0,0
50	14,5	2,5
100	17,1	5,1
150	19,4	7,4
200	22,0	10,0

After, we represent all the data in a graphic, where the mass goes in the X axis and the enlargement of the spring in the Y axis. Then, we get:



Como veremos a continuación (páginas siguientes), podemos obtener con estos datos, directamente o a partir de la gráfica, en casos simples como éste, una ecuación que relaciona una variable con la otra.

La variable dependiente (cuyo valor depende de los valores que toma la otra variable, la independiente, que es arbitraria) se representa en el eje Y siempre.

Si la gráfica es una recta que pasa por (0,0) la ecuación resultante siempre es y = k . x, donde x es la variable independiente e y la dependiente. K la obtenemos tomando dos valores de y y restandolos entre ellos y dividiendo por los valores de x correspondientes con esos valores de y. Así si cojo los valores (50 , 2,5) y (200 , 10,0), hallo la k:

$$k=\frac{10{,}0-2{,}5}{200-50}=\frac{7{,}5}{150}=0{,}05\frac{cm}{g}$$

And the final expression is: Dx = 0,05 . m, where the Dx is the enlargement (the Y here, measured in cm) and the m the mass (the X here, in g).

You can now answer some questions like: what is the enlargement produced by a weight of 125 g? You only have to substitute in your formula: Dx = 0,05 . 125 = 6,25 cm.

Or another question like: if I want to produce an enlargement of 0,2 dm, what is the weight I have to hang in the spring?

Para resolverla has de pasar a las unidades correctas el dato que te dan. Por supuesto con factores de conversión: $0{,}2\,\cancel{dm}\bullet\frac{10\,cm}{1\,\cancel{dm}}=2\,cm$

Y ahora resolver la ecuación que nos queda si sustituimos: 2 = 0,05 . m; si despejamos:

m=2/0,05=40 g

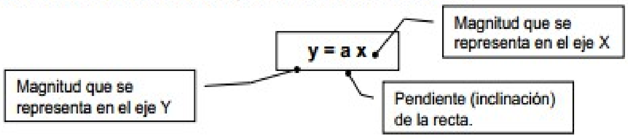
Activity 16. Measure in the laboratory how many grames weigh 5, 10, 15, 20 and 25 mL of milk. Make a table and a graph with grames in the Y axis and with the volume in the X axis. Obtain the ecuation ot the relationship between these two variables.

How many kg do 2,3 mL of milk weigh?

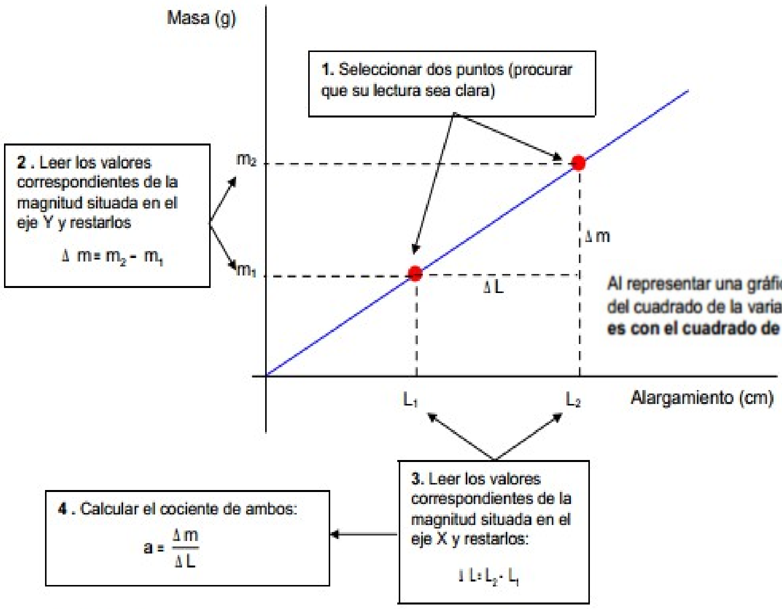
How many liters is the volume of 4 t of milk?

La gráfica puede servirnos para obtener la ecuación matemática que relaciona las variables que se representan en el eje X y en el eje Y:

Si la gráfica es una recta que pasa por el origen, su ecuación viene dada por:



Para calcular la pendiente de una recta:



Al representar una gráfica, si no nos sale recta, podemos probar a representar en función del cuadrado de la variable independiente. **Si así nos sale recta, es que la dependencia es con el cuadrado de la variable dependiente.**

Ejemplo 3

Supongamos que hemos obtenido (leyendo en la gráfica) los valores siguientes:
$m_1 = 80,0$ g $L_1 = 9,0$ cm $m_2 = 420,0$ g $L_2 = 25,0$ cm

Luego:

$$\Delta L = L_2 - L_1 = (25,0 - 9,0)\ \text{cm} = 16,0\ \text{cm}$$

$$\Delta m = m_2 - m_1 = (420,0 - 80,0)\ \text{g} = 340,0\ \text{g}$$

$$a = \frac{\Delta m}{\Delta L} = \frac{340,0\ \text{g}}{16,0\ \text{cm}} = 21,3\ \frac{\text{cm}}{\text{g}}$$

Ecuación:
m =21,3 L

- **Ecuaciones**

Tanto la Física como la Química usan muy a menudo expresiones o métodos matemáticos.

Una ecuación matemática nos puede servir para estudiar cómo varía una magnitud (llamada variable dependiente) cuando variamos otra (llamada variable independiente). Estudiaremos **relaciones directa o inversamente proporcionales**, de primer y 2º grado y para dos variables.

En las relaciones **directamente proporcionales**, cuando **aumenta una de las variables, la otra también lo hace** (lo mismo, al disminuir el valor de una, también disminuye el de la otra). En las **inversamente proporcionales, al aumentar una disminuye la otra** o viceversa. Después de saber esto, hemos de ver en que grado son proporcionales, si es una proporcionalidad directa, tenemos que ver si la variable dependiente es proporcional a la primera o segunda potencia de la variable independiente (en la realidad, a cualquier función matemática).

Ejemplo de relación directa de primer grado.

Se sabe que la masa que se cuelga de un muelle (m) y lo que el muelle se estira (L) están relacionados mediante la siguiente ecuación, en la que L se expresa en centímetros y m en gramos.

$$\boxed{m = 20,1\ L}$$

a. ¿Qué masa debemos de colgar para que se produzca un alargamiento de 15,0 cm?
b. ¿Cuánto se alargará el muelle si se coloca una masa de 234,0 g?
c. ¿Qué representa el número 20,1?

Solución.

a. Como la ecuación nos da la relación matemática que existe entre m y L, contestamos a la primera pregunta sin más que sustituir el valor de L en la ecuación y efectuar la operación matemática que nos indica:

$$m = 20,1 \times 15,0 = 301,5\ \text{g}$$

b. Para responder a la segunda cuestión primero hemos de obtener L en función de m. Para ello primero despejamos L y después sustituimos el dato:

$$L = \frac{m}{20,1} = \frac{234,0}{20,1} = 11,6\ \text{cm}$$

c. 20,1 es la constante de proporcionalidad que relaciona la masa colgada (m) y lo que se estira el muelle (L). Representa los gramos (20,1) que hay que colgar para que el muelle se estire 1 cm:

$$\frac{m\ (\text{g})}{L\ (\text{cm})} = 20,1\ \frac{\text{g}}{\text{cm}}$$

Recibe el nombre de ***constante elástica del muelle.***

LINKS:

1)http://www.sky-web.net/science/balancing_chemical_equations_examples.htm
2)http://chemistry.about.com/od/lecturenotesl3/a/chemphyschanges.htm
3)http://www.chem4kids.com/files/matter_chemphys.html
4) http://www.virted.org/chemist/pcchange.html
5)http://www.lcc.ukf.net/KS3Chem/chemphychanges.htm#ce
6) http://www.ausetute.com.au/chemphys.html
7)http://www.bbc.co.uk/schools/ks3bitesize/science/chemical_material_behaviour/
8)http://answers.yahoo.com/question/index?qid=20080909034618AAM1FAv
9)http://www.iesnicolascopernico.org/FQ/3ESO/tema1.pdf
10)http://preparatorychemistry.com/Bishop_Study_Guide_8.pdf

Actividades de ampliación

1º Una piedra que empieza a caer, medimos su distancia al sitio desde dónde la dejamos caer, pasados distintos tiempos y obtenemos:

Tiempo (s)	0	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
Distancia (m)	0,00	0,05	0,20	0,45	0,80	1,25	1,80	2,45	3,20	4,05	5,00

¿Son las variables tiempo y distancia directa o inversamente proporcionales?

Representa gráficamente la distancia (eje Y, vertical) frente al tiempo (eje X). ¿Te sale una recta? Si no es así prueba a representar en función de t^2.
¿Cuál es la ecuación de la relación entre ellas? Acuérdate de hallar la pendiente de la recta y que y = a.x (ahora x es t^2).

¿Cuánto tiempo tarda la piedra en ponerse a 10 m de distancia del origen?

¿A qué distancia del origen se encontrará la piedra pasado un segundo ymedio?

2º Sabemos que al calentar un gas, manteniendo constante el volumen, la presión que ejerce el gas con el recipiente va aumentando. Los valores recogidos en varios experimentos fueron los siguientes:

Experimento	1	2	3	4
Temperatura (K)	300	450	600	700
Presión (hPa)	1012	1518	2024	2360

¿Qué variable es la independiente y cuál depende de la otra? La relación entre ellas, ¿es directa o inversamente proporcional?

Representa gráficamente estos puntos (p en función de v, de v2, de 1/v o 1/v2) hasta que obtengas una recta, y halla entonces la ecuación que relaciona estas variables.

¿Cuál será el valor de la presión a 400 K? Hállalo gráfica y analíticamente.

¿Qué temperatura existe cuando el gas ejerce una presión de 1750 hPa? Hállalo gráfica y analíticamente.