

Laws in science

There are many **laws** in science – sometimes known as '*laws of nature*'.

The term '*law*' is normally used for a *regular pattern* that has been observed, and which is believed to be a reliable finding, i.e. something that always happens. (Laws must be 'obeyed').

Often laws are described in terms of mathematical relationships – so that they can be easily represented in formula and graphs.

Laws are not really the same as facts

'Pure water always boils at 100°C at atmospheric pressure.'

'Salt dissolves in water'

Although these statements are general – they are always expected to apply – they refer to *specific examples* (water, salt), where laws normally refer to more *general classes* (e.g. all gases, all planets etc.)

Laws are similar to principles

Some scientific ideas are described as principles, and these are general ideas. They are often quite similar to laws, in that describe relationships that are thought to always apply:

- an object floating in a fluid displaces its own weight of the fluid (Archimedes' principle)
- during any collision the total momentum of the colliding bodies remains constant (principle of conservation of momentum)

Laws are not really the same as theories

Theories may be closely linked to laws, but normally a theory is an explanation, whereas a law just describes the pattern.

Some examples of laws in science:

Hooke's law: *the extension of a loaded spring or wire is directly proportional to the applied load (up to a certain point)*

Hooke's law can be explained in terms of theories about the forces between the particles considered to make up the metal.

Ohm's law: *the current passing through a metallic conductor is directly proportional to the p.d. across the conductor (if other conditions are kept constant)*

Ohm's law can be explained in terms of theories about the effects of electrical fields, the structure of metals, the nature of electrical current in metals.

The gas laws:

Boyle's law: *the product of the pressure and volume ($P \times V$) of a fixed mass of gas at constant temperature is constant;*

Charles' law: *the volume of a fixed mass of a gas at constant pressure is increased by the same amount for each degree increase in its temperature;*

The pressure law: *the pressure of a fixed mass of a gas of fixed volume is increased by the same amount for each degree increase in its temperature*

The gas laws may be explained through kinetic theory, in terms of the properties of gas molecules

The periodic law: *if the chemical elements are arranged in atomic number, then similar chemical properties are found in elements separated by the same number of places.*

The periodic law is explained by atomic theory, and quantum theory, which relate the structures of atoms to the way they interact in forming molecules etc.

Coulomb's law: *the force between two charged particles is directly proportional to the product of the masses, and inversely proportional to the square of the distance between them*