What is Atom?

An atom is the smallest constituent unit of ordinary matter that has the properties of a chemical element. Every solid, liquid, gas, and plasma is composed of neutral or ionized atoms. Atoms are very small; typical sizes are around 100 pm.

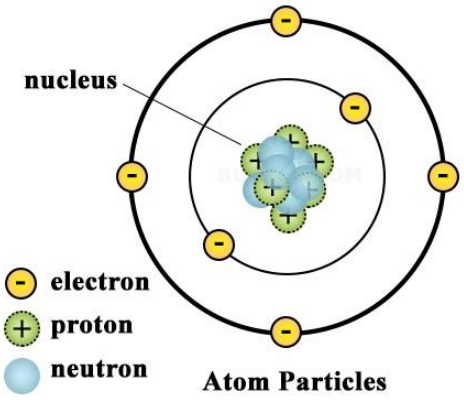
In simple term atoms are building blocks. If you want to create a language, you'll need an alphabet. If you want to build molecules, you will need atoms of different elements. Elements are the alphabet in the language of molecules. Each element is a little bit different from the rest.

What is Molecule?

A molecule is an electrically neutral group of two or more atoms held together by chemical bonds. Molecules are groups of atoms bonded together in the same way that words are groups of letters. An "A" will always be an "A" no matter what word it is in. A sodium (Na) atom will always be a sodium atom no matter what compound it is in. While the atoms have different masses and organization for each element, they are all built with the same parts.

What is inside Atoms?

Even though many super-tiny atomic particles exist, you only need to remember the three basic parts of an atom: **electrons, protons, and neutrons**. What are electrons, protons, and neutrons? Electrons are the smallest of the three particles that make up atoms. Electrons are found in shells (there are multiple shells in most of the atoms) that surround the nucleus of an atom. Protons and neutrons are found in the nucleus. They group together in the center of the atom. That's all you have to remember. Three easy pieces!



For any neutral atoms the total number of electron is equal to the total number of protons.

Among these basic three particles electron is negatively charged and has very less mass compared to protons and neutrons. Protons are positively charged and neutrons are neutral in charge. Both protons have similar mass.

There are almost 120 known elements in the periodic table. (117 as of now) Chemists and physicists are trying to make new ones every day in their labs. The atoms of different elements have different numbers of electrons, protons, and neutrons. Every element is unique and has an atomic number. That number tells you the number of protons in every atom of the element. The atomic number is also called the proton number.

What are the relative charge and mass of protons electrons and neutrons?

	Proton	Neutron	Electron
Relative charge	+1	0	-1

	Proton	Neutron	Electron
Relative mass	1	1	0

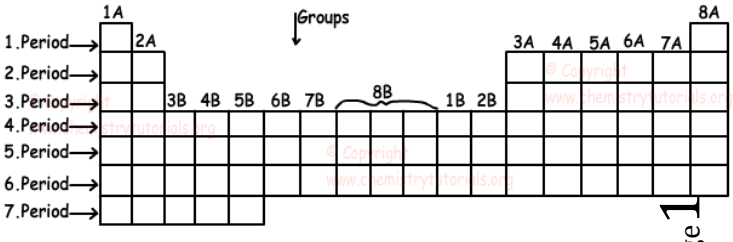
What is Atomic and mass number?

Atomic number is the number of protons in an atom and mass number is the number of neutrons plus the number of proton for an atom. If an atom has **p** number of protons and **n** number of neutrons, then **atomic number = p** and **mass number = p + n**.

For example carbon has atomic number of 6 and mass number of 12. So it has 6 protons, 6 electrons (as number of proton = number of electrons) and 6 (12-6=6) neutrons.

What is periodic table?

Periodic table is an organized table with multiple rows and columns where all the elements are organized by their atomic number, electron configurations, and recurring chemical properties.



Rows of the periodic table are called **period**s.

Columns of the periodic table are called **groups**.

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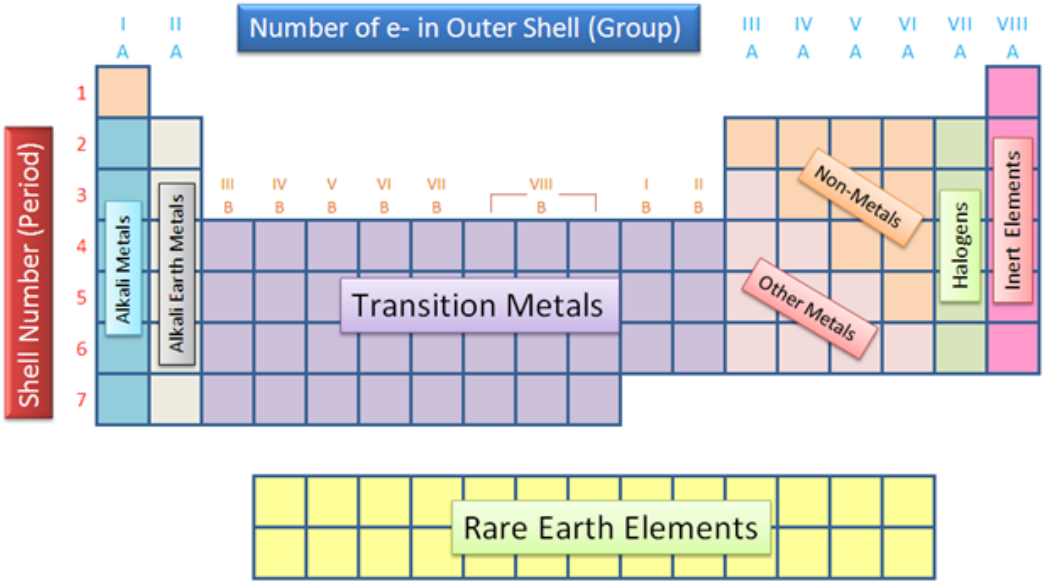
For any element the period number shows number of shell it has and the group number shows number of electrons in the outermost shell. So if an element has group number 5 and period number of 3, there are three shells of electrons and 5 electrons in the outer most shell.
Some groups have common names. The periodic table outline shows the group structure and names of some common groups. Note that group 8A are often called group 0 and named noble gas.



For any atoms it is preferable to have full outermost shell (for most of the elements you need it is 8). This is because it makes them like noble (inert gas) which is a more stable state. So sometimes they gain, loose or share electrons to get full outermost shell. This rule is called octet rule.

What is isotope?

Isotopes are atoms of same element having same number of protons and electrons but different number of neutrons. I.e. they have same atomic number but different mass number.
For example, most carbon atoms have 6 protons and 6 neutrons, giving it a mass of 12 amu (amu is unit of relative atomic mass). This isotope of carbon is called "carbon twelve" (carbon-12). But the atomic mass of carbon in the periodic table is listed as 12.011. The mass is not simply 12, because other isotopes of carbon have 5, 7, or 8 neutrons, and all the isotopes and their abundance are considered when the average atomic mass is reported. Carbon-14 actually has 8 neutrons (2 extra). C-14 is considered an isotope of the element carbon.

Some common elements

H—Hydrogen: involved in the nuclear process that produces energy in the sun
He—Helium: used to make balloons fly
C—Carbon: found in all living organisms; pure car-bon exists as graphite and diamonds
N—Nitrogen: used as a coolant to rapidly freeze food
O—Oxygen: essential for respiration (breathing) and combustion (burning)
Si—Silicon: used in making transistors and solar cells
Cl—Chlorine: used as a disinfectant in pools and as a cleaning agent in bleach
Ca—Calcium: necessary for bone formation
Fe—Iron: used as a building material; carries oxygen in the blood
Cu—Copper: a U.S. penny is made of copper; good conductor of electricity
I—Iodine: lack in the diet results in an enlarged thy-roid gland, or goiter
Hg—Mercury: used in thermometers; ingestion can cause brain damage and poisoning
Pb—Lead: used for X-ray shielding in a dentist office

Some elements exist in diatomic form (two atoms of such an element are bonded), and are technically mole-cules. These elements include hydrogen (H_2), nitrogen (N_2), oxygen (O_2), fluorine (F_2), chlorine (Cl_2), bromine (Br_2), and iodine (I_2).

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Organic and Inorganic Molecules

Molecules are often classified as organic or inorganic. Organic molecules are those that contain both carbon and hydrogen. Examples of organic compounds are methane (natural gas, CH_4), glycine (an amino acid, NH_2CH_2COOH), and ethanol (an alcohol, C_2H_5OH). Inorganic compounds include sodium chloride (table salt, NaCl), carbon dioxide (CO_2), and water (H_2O).

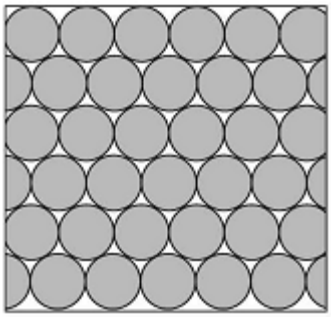
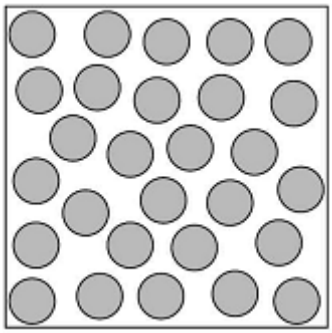
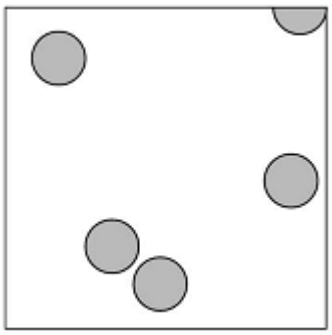
What is matter?

Matter is everything around you. Atoms and molecules are building block of matter. Matter is anything that has mass and takes up space.

What are the states of matter?

Matter is held together by intermolecular forces—forces between different molecules. Three common states of matter are **solid, liquid, and gas**. Matter is an atom, a molecule (compound), or a mixture.

Example of matters are given in the table below

	Solid	Liquid	Gas
Shape	Fixed	Takes shape of container	Takes shape of container
volume	Fixed	Fixed	Takes volume of container
arrangement	regular, ordered	Unordered	Unordered
Motion	Vibrates keeping mean position	Moves freely insides its boundary	Can move very freely
Density	Highest	Less than solid	Least
Inter molecular Force	Very strong	Less than solid	Least
Examples	diamonds (carbon atoms), ice (water molecules), metal	Mercury, vinegar , per-fume	Helium, water vapor, air
			

What are the Changes in matter?

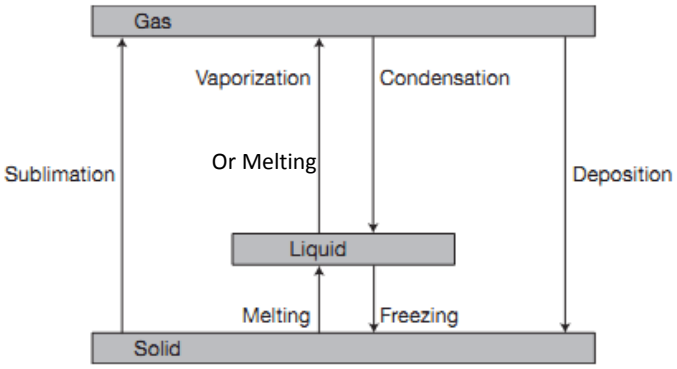
Changes in matter can be of two types. Physical changes and chemical changes. It is important to understand the difference between chemical and physical changes. Some changes are obvious, but there are some basic ideas you should know. Physical changes are usually about states and physical states of states. Chemical changes happen on a molecular level when you have two or more molecules that interact. Chemical changes happen when atomic bonds are broken or created during chemical reactions. The basic difference is that in physical changes the molecules does not changes but during a chemical change the molecules generally changes.

What are the physical changes?

When you step on a can and crush it, you have forced a physical change. However, you only changed the shape of the can. It wasn't a change in the state of matter because the energy in the can did not

change. Also, since this was a physical change, the molecules in the can are still the same molecules. No chemical bonds were created or broken.

When you melt an ice cube (H2O), you have a physical change because you add energy. In this example, you added enough energy to create a phase change from solid to liquid. Physical actions, such as changing temperature or pressure, can cause physical changes. No chemical changes took place when you melted the ice. The water molecules are still water molecules.



Some common physical changes involving changes in states of matter by adding or removing heat is shown in the diagram. Here upward arrow means adding heat and downward arrow means removing heat from the matter.

As heat is provided to solid the molecules in the solid starts to vibrate more and if enough heat is provided the vibration force is much more than the intermolecular forces and so the solid melts to become liquid where they can move freely inside their boundary.

When liquids are heated the molecules absorb more energy and moves faster. If enough heat is provided their kinetic energy becomes high enough to take them above the boundary of the liquid and becomes gas.

Examples of Physical Properties

- Density

Density is the physical property of matter which shows the relationship of mass and volume of the matter.

$$Density = \frac{Mass}{Volume}$$

- Boiling Point

Boiling point (BP) is the temperature when a liquid boils up to become gas.

- Melting Point

Melting point (MP) is the temperature when a solid melts to liquid.

- Conductivity
- Heat Capacity

Examples of Chemical Properties

- Valence
- Reactivity
- Radioactivity

Diffusion

Diffusion is the net movement of molecules or atoms from a region of high concentration (or high chemical potential) to a region of low concentration (or low chemical potential)

What are ions?

If an atom becomes charged by gaining or loosing electron(s) it is called ions.

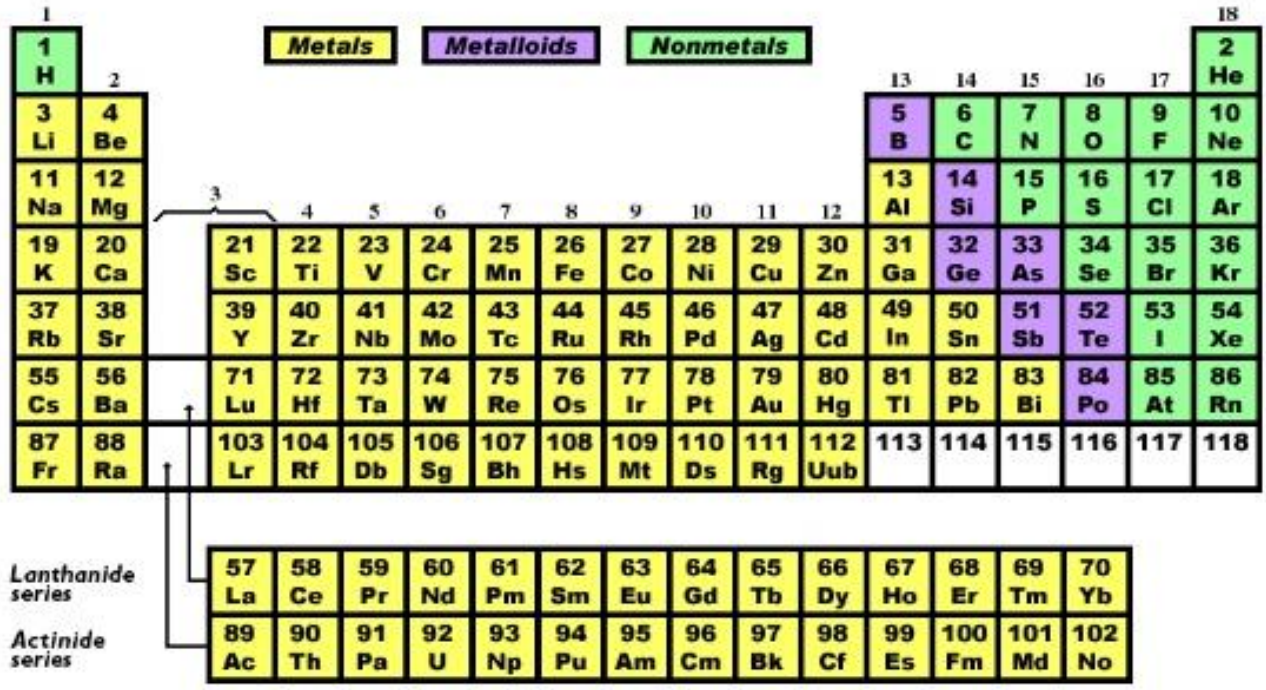
Loosing electron(s) makes an atom positively charged and is called cation(s). Name of the cations are same as name of their atoms.

Gaining electron(s) makes an atom negatively charged and is called anion(s). Name of anions are slightly changed than the name of their atoms. Generally and –ide is added after the name.

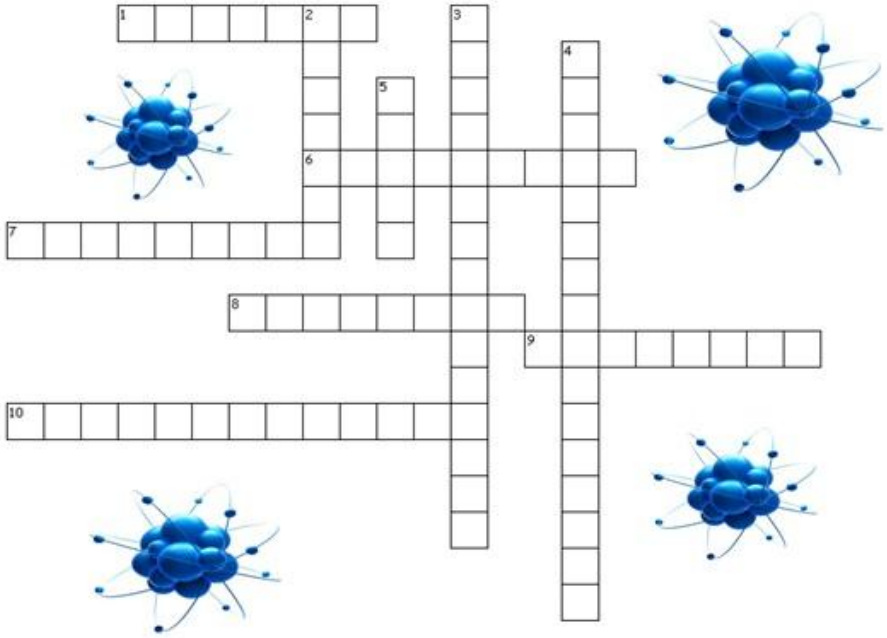
Oxygen → Oxide

Chlorine →Chloride

Modern organization of periodic table



Here is a fun task for you. Complete the crossword about atoms.



Across

1. positively charged parts of an atom
6. negatively charged parts of an atom
7. atoms are the building blocks for...
8. the number of electrons in atoms determine an element's ___ properties
9. neutrally charged parts of an atom
10. a chart which lists all of the known elements

Down

2. protons and neutrons are found in this part of an atom
3. type of force that holds the nucleus of an atom together
4. area of science that studies tiny particles like atoms
5. the word a'tomos comes from this language

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The Periodic Table of Elements

Groups 1	2											3	4	5	6	7	0
1 H hydrogen 1																	4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	*Elements of atomic number >110 are not shown here.*							

* *Elements in Lanthanide and Actinide series are not shown.*

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