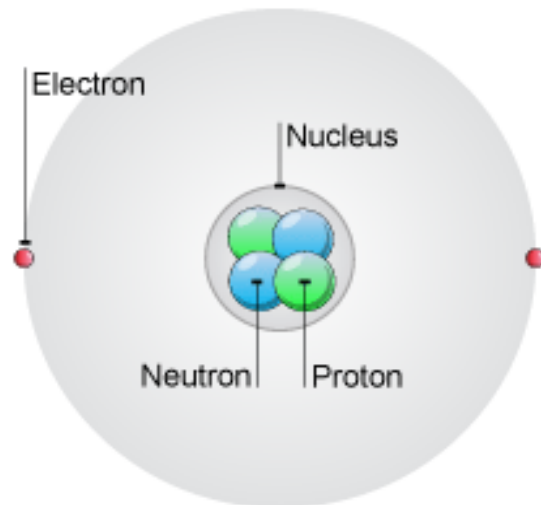


Chemical bonds

- **The structure and physiological processes of the body are based to a large degree, on the properties and interactions of atoms, ions and molecules.**
 - **In order to understand how living organisms are built from inanimate matter, therefore, it is crucial to know how the chemical bonds that hold atoms together in molecules are formed.**
- Atom:** is the smallest unit of matter that still retains its distinctive chemical properties.

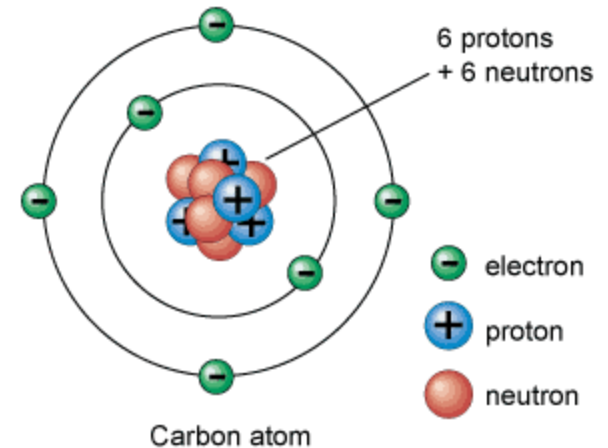
- Each atom has its centre a dense, positively charged nucleus, which is surrounded at some distance by a cloud of negatively charged electrons.



- **The nucleus consists of two kinds of subatomic particles:**

a) Protons (positively charged)

b) Neutrons (electrically neutral)



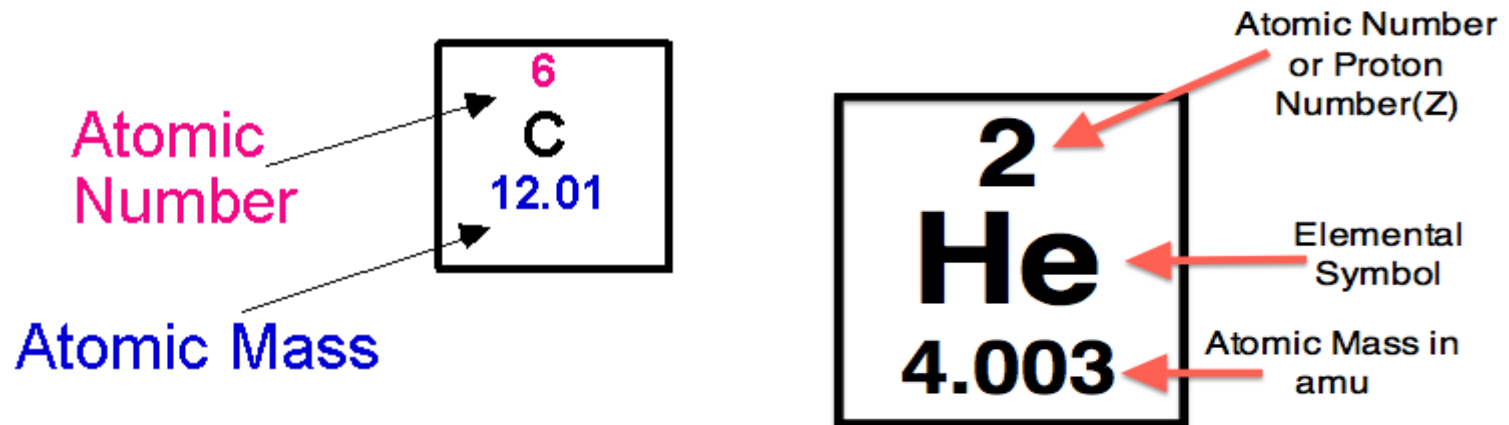
- **In a neutral atom:**

number of electrons = number of protons

- The number of protons present in atomic nucleus determine its atomic number.

Atomic number: is the number of protons

**(Atomic mass = number of protons + number of neutrons
or atomic weight)**



- **There are 92 naturally occurring elements, each differing from the others in the number of protons and electrons in its atoms.**
- **Living organisms, are made only a small selection of these elements, four of which-carbon (C), hydrogen (H), nitrogen (N), and oxygen (O)-made up 96.5% of an organism's weight.**
- **Electrons are in continuous motion around the nucleus.**

1																	18
1																	2
H																	He
3	4											5	6	7	8	9	10
Li	Be											B	C	N	O	F	Ne
11	12											13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
55	56	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
87	88	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
Fr	Ra	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub						

Metals

Metalloids

Nonmetals

Lanthanide series

Actinide series

57	58	59	60	61	62	63	64	65	66	67	68	69	70
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
89	90	91	92	93	94	95	96	97	98	99	100	101	102
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No

- **The electrons in an atom can exist only in certain discrete regions (discrete orbits) and that there is a strict limit to the number of electrons that can be accommodated in an orbit of a given type, a so called electron shell.**
- **The electrons closest on average to the positive nucleus are attracted most strongly to it and occupy the inner, most tightly bound shell.**

- **This innermost shell can hold a maximum of two electrons.**
- **The second shell is farther away from the nucleus, and its electrons are less tightly bound. This second shell can hold up to eight electrons.**
- **The third shell contains electrons that are even less tightly bound; it can hold up to eight electrons.**
- **The fourth and fifth shells can hold 18 electrons each.**
- **Atoms with more than four shells are very rare in biological molecules.**

- **The electrons of an atom fill the shells in order-the first before the second, the second before the third, and so on.**
- **An atom whose outermost shell is entirely filled with electrons is especially stable and therefore chemically unreactive.**

e.g helium with 2 electrons (and atomic number of 2)

- **Hydrogen by contrast, has only one electron (which leaves the outermost shell half-filled), so it is highly reactive.**

- **The atoms found in living tissues all have incomplete outer electron shells and are therefore able to react with one another to form molecules.**
- **Atoms with incomplete outer shells have a strong tendency to interact with other atoms so as to either gain or lose enough electrons (either by sharing or by transfer) to achieve a completed outermost shell.**

example:

- **H atom needs only one more electron to fill its shell (generally acquires it by sharing-forming one covalent bond with another atom.**

- **The other most common elements in living cells: C, N, and O, which have an incomplete second shell, P and S which have an incomplete third shell, generally share electrons and achieve a filled outer shell of eight electrons by forming several covalent bonds.**
- **The number of electrons an atom must acquire or lose (either by sharing or by transfer) to attain a filled outer shell is known as its valence.**

[i.e. The electrons in the incomplete outermost shell, participate in chemical reactions and form chemical bonds These outermost electrons are known as the valence electrons of the atom].

Atom	H	C	N	O	F	Cl	Br	I
Valence	1	4	3	2	1	1	1	1

The number of bonds that each atom can have is determined by the number of electrons needed to complete the outermost shell.(e.g hydrogen must obtain only one more electron-and can thus form only one chemical bond-to complete the first shell of two electrons. Carbon, by contrast, must obtain four more electrons-and can thus form four chemical bonds-to complete the second shell of eight electrons.

