

Atomic structure

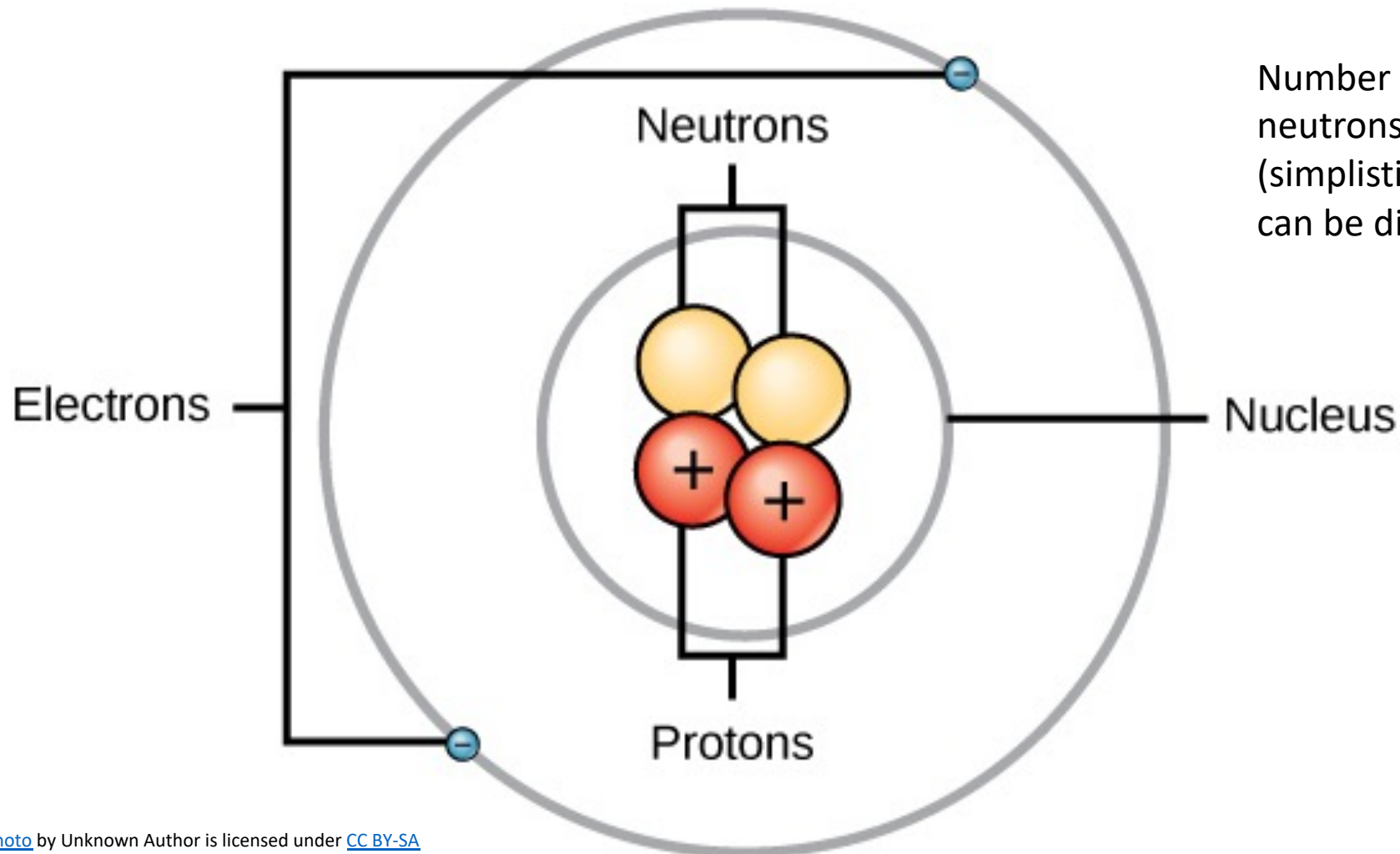
What are the building blocks and the building rules?

What is the difference between different atoms? Why do the atoms connect the way they connect and not in some different way?

Why water has this structure (two hydrogen atoms one oxygen atom)?

Chemistry is the study of how atoms are joined together to make everything in universe.

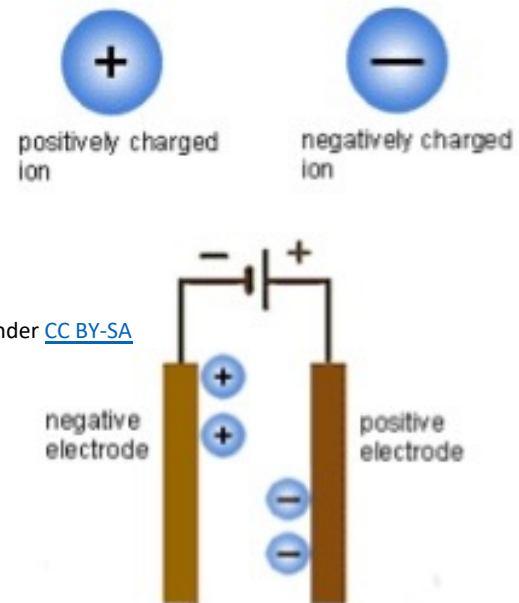
Atomic composition



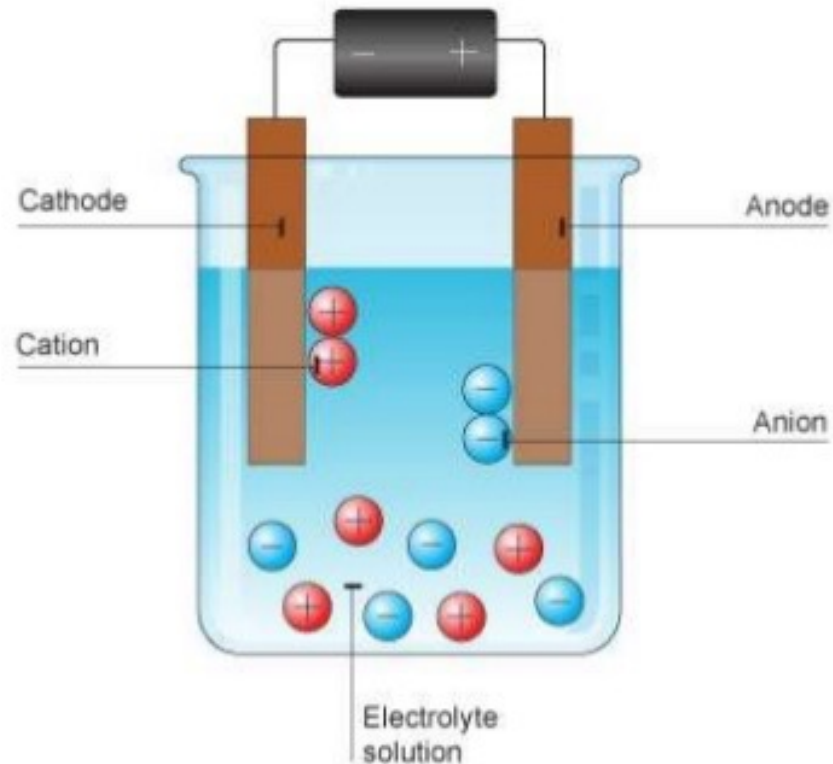
Number of protons = Number of neutrons = Number of electrons (simplistic version, number of neutrons can be different).

With the discovery of electricity and creating battery chemists were able to separate substances

Don't **PANIC** - **P**ositive is **A**node, **N**egative is **C**athode.

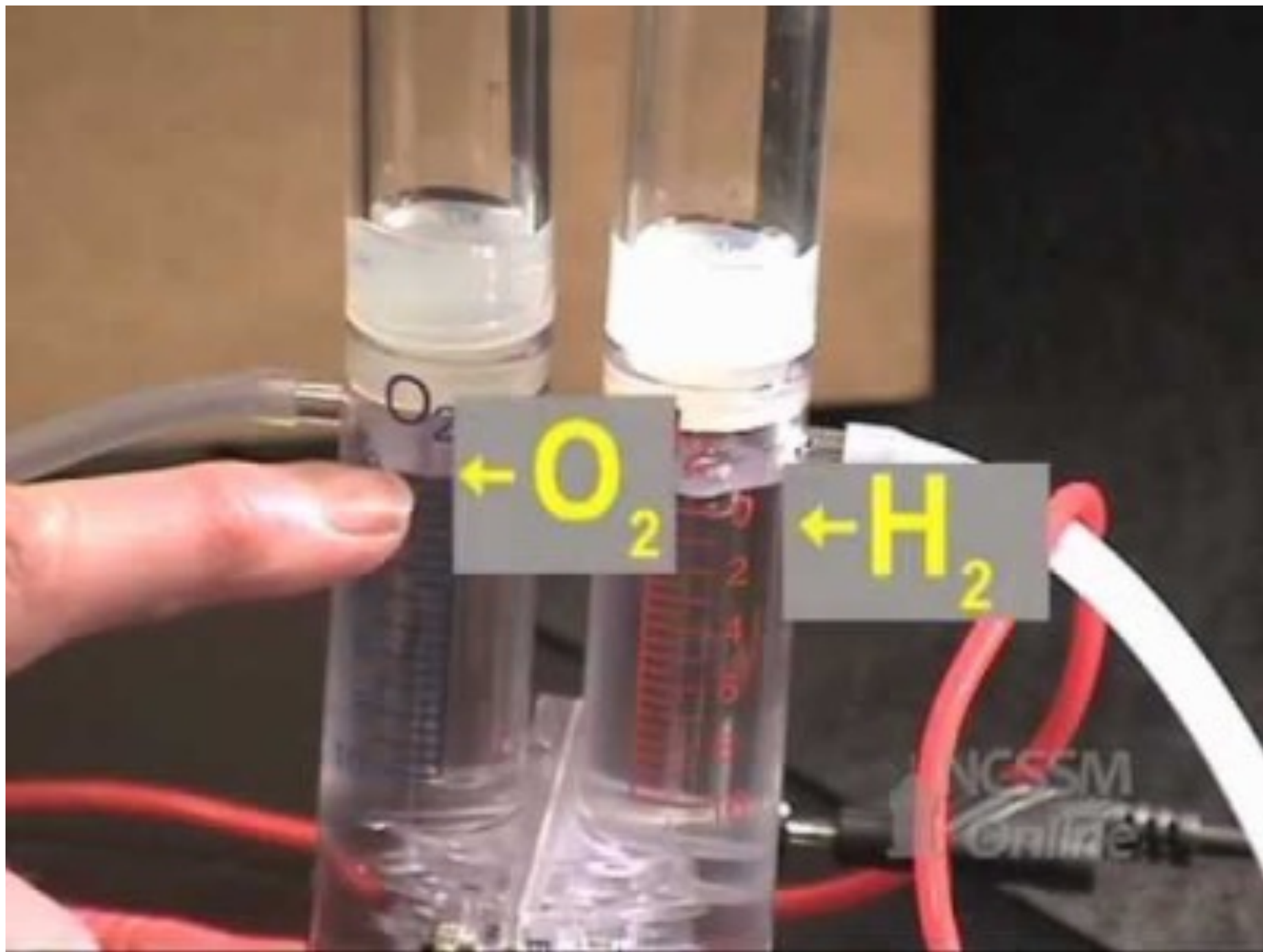


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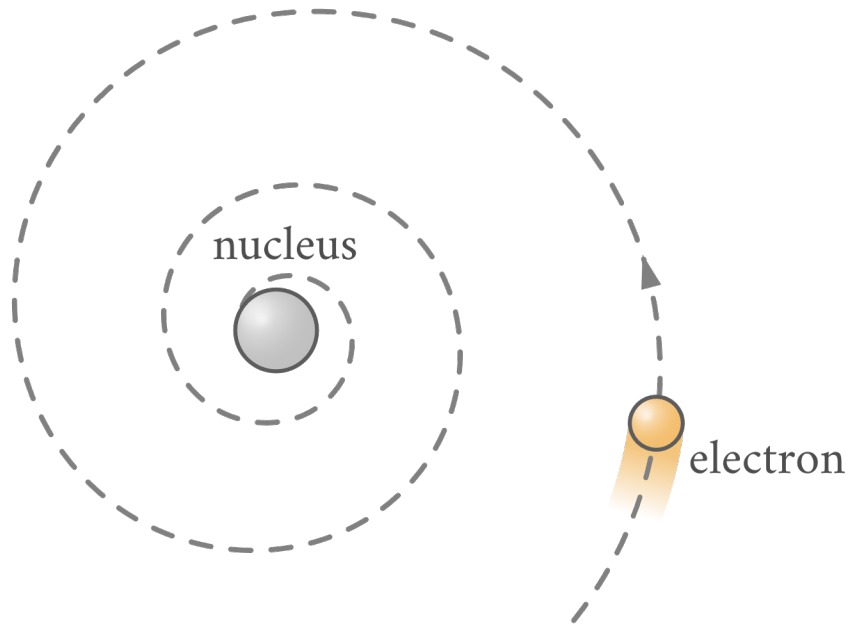


Electrolysis of water

<https://youtu.be/AgmxiSPub8E>



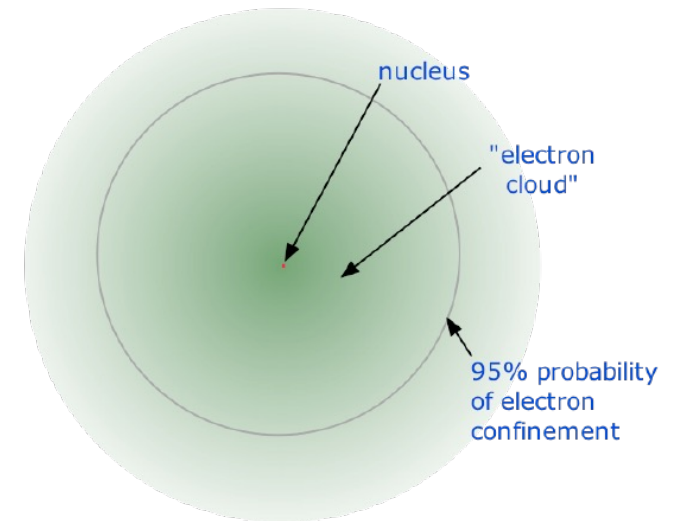
Let's take a closer look at atomic structure. What is important for chemists here?



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Atoms can gain or lose electrons or share it with other atom. That is how atoms combine chemically.

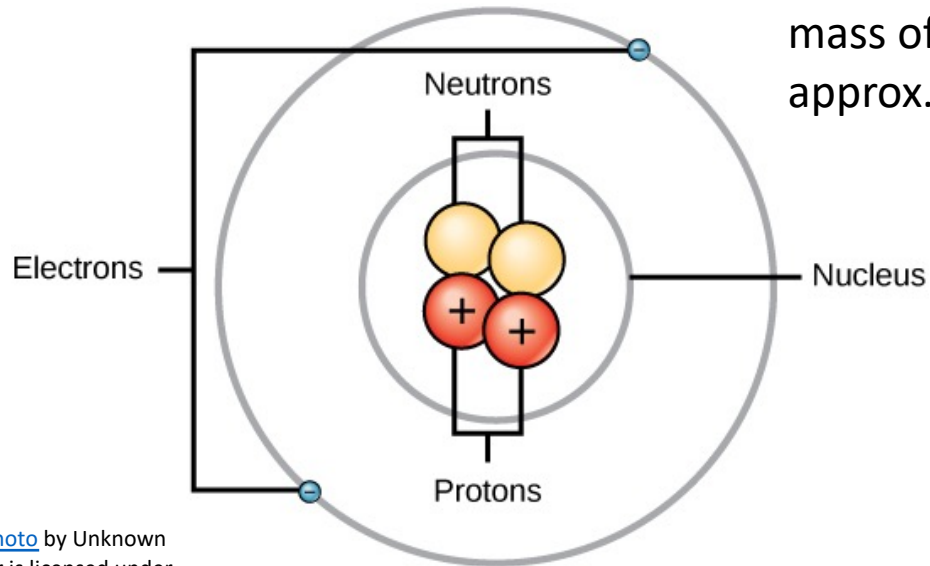
More realistic picture of an atom



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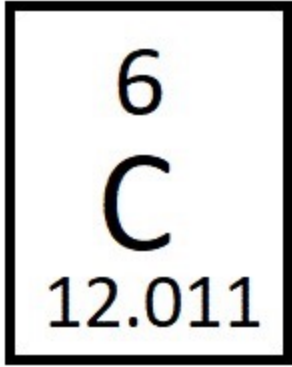
Atomic mass

- Atomic number – is the number of protons in nucleus
- Atomic mass ? Each proton and neutron has 1840 times the mass of an electron. Each proton and each electron weighs approx. 1 AMU



Particle	Mass	
	kg	AMU
PROTON	$1.673 \times 10^{-24} \text{g}$	1.00728
NEUTRON	$1.675 \times 10^{-24} \text{g}$	1.00867
ELECTRON	$0.00091 \times 10^{-24} \text{g}$	0.000549

Atomic mass unit, or AMU, to be precisely one-twelfth the mass of a ^{12}C atom. The common carbon atom has a mass of exactly 12.000000 AMU, by definition.



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For Carbon,
6 is atomic number

Can we tell the number of protons and electrons in the carbon?

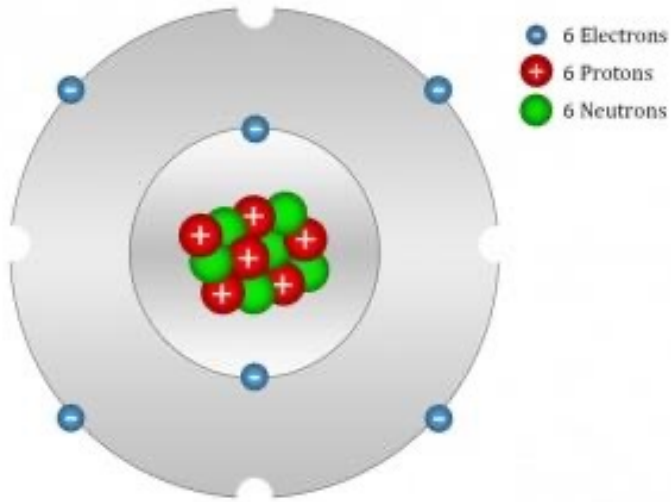
12.011 atomic weight

Atomic number defines an element, it is unique for every element. We define atomic number as number of protons in the elements. **Why not by the number of neutrons or electrons?**

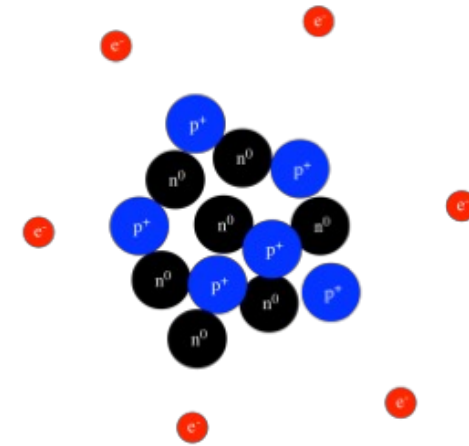
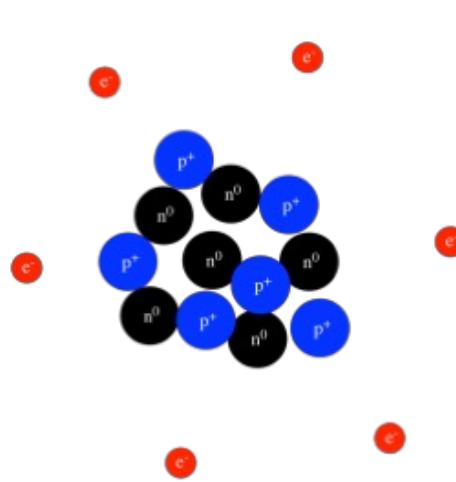
Atomic mass unit, or AMU, to be precisely one-twelfth the mass of a ^{12}C atom. The common carbon atom has a mass of exactly 12.000000 AMU, by definition.

Why atomic weight and atomic mass are not quite the same?

Isotopes



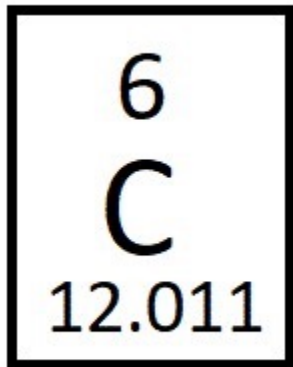
This is carbon (“C”) atom. It has
6 protons
6 neutrons
6 electrons.
We can write it as ^{12}C .



This atom has
6 protons
7 neutrons
6 electrons.
It is still a carbon
atom. We can write it
as ^{13}C .
In the nature this
carbon is present at
 $\sim 1\%$

When we talking about atomic weight, we are talking about average mass of the atom, counting all his isotopes. We call it **relative atomic mass A_r** .

The relative atomic mass A_r of an element is the average of the masses of the isotopes relative to the mass of 1/12 of an atom of carbon-12.



Hydrogen is the only element that has different symbols and names for its isotopes:

- 1H – protonium
- 2D – deuterium
- 3T - tritium

