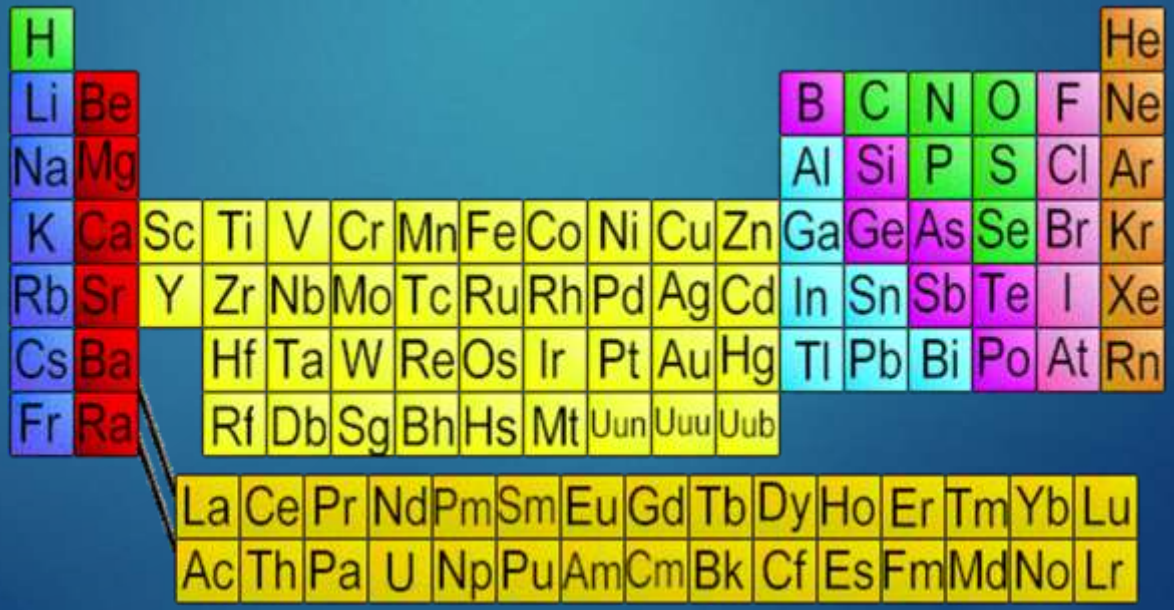
Elements and isotopes

MR. BANKS – 8TH GRADE SCIENCE

The elements

- The periodic table lists 118 different “Types of atoms each with distinct properties: mass, crystal structure, melting point, etc.
- The differences in the properties of elements are created by the internal structure of the atoms.



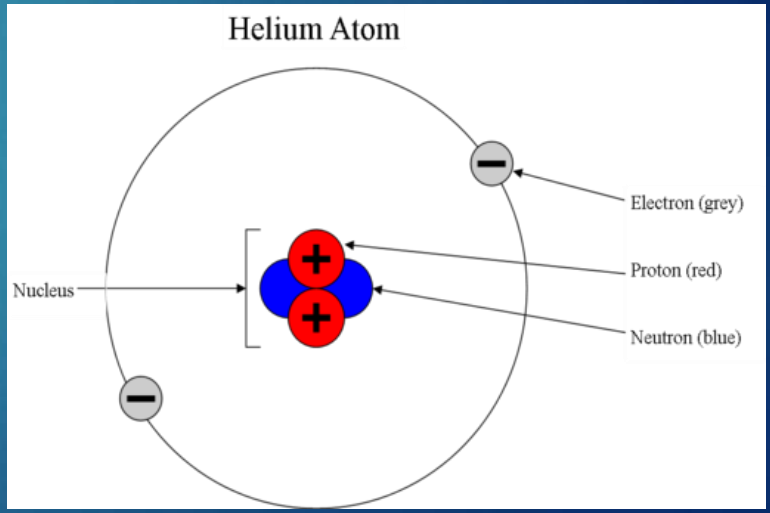
Subatomic masses and charges

Particle	Mass (kg)	Mass (amu)	Charge
Electron	9.10939×10^{-31}	0.00055	-1
Proton	1.67262×10^{-27}	1.00728	+1
Neutron	1.67262×10^{-27}	1.00728	0

Most of the mass in an atom is in the nucleus

Atomic number

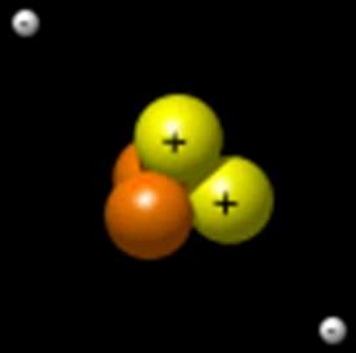
- The atomic number represents the number of protons in the nucleus of an atom.
  - The atomic number sets the order that elements are arranged on the periodic table.
- Each element has a specific number of protons inside its nucleus.
  - Of the *naturally* occurring elements,
    - Lowest, Hydrogen (H) Z = 1
    - Highest, Uranium (U) Z = 92



Hydrogen

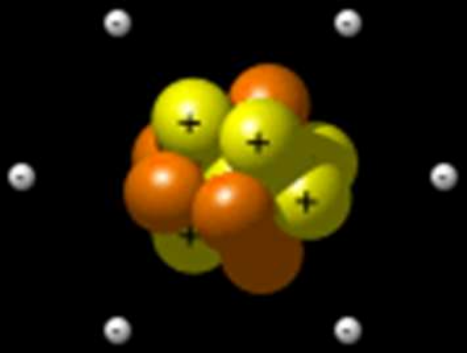
1 proton
1 electron
0 neutrons

Helium



2 protons
2 electrons
2 neutrons

Carbon



6 protons
6 electrons
6 neutrons

Adding a proton makes a new kind of atom!

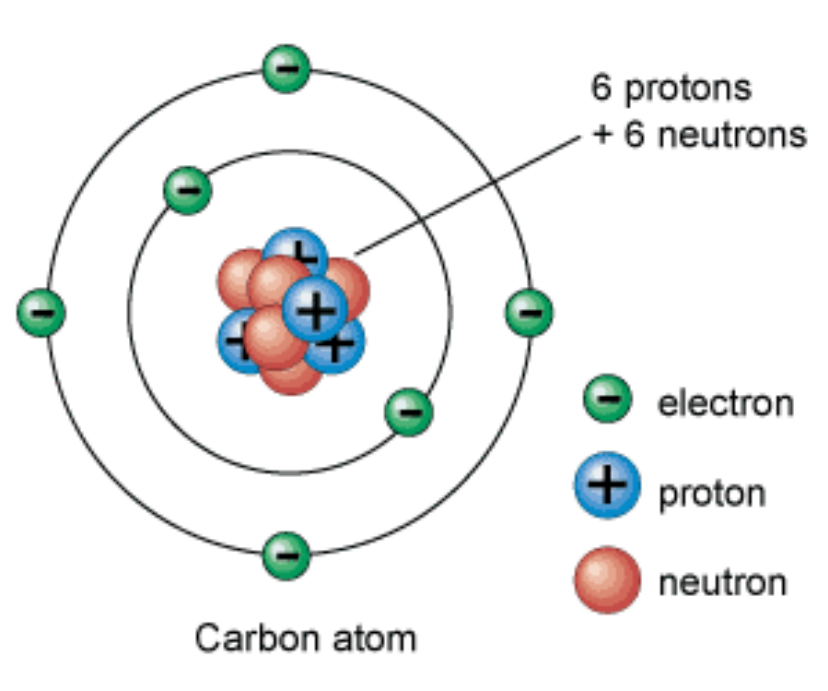
Mass number

- The mass number is the sum of the protons and neutrons in the nucleus of an atom.
  - Mass number = # of protons + # of neutrons

- You can use the mass number and atomic numbers to find the number of neutrons in an atom.
- # of neutrons = mass number – atomic number

Isotopes

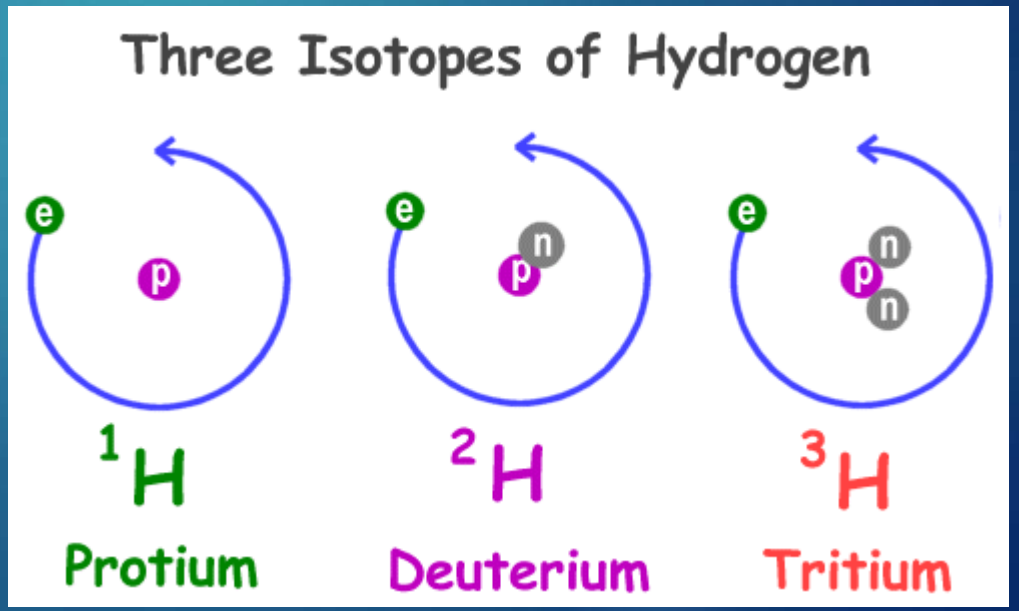
- Atoms of each element usually have the same number of protons and electrons (so the charges can cancel each other out).
- But atoms can have different numbers of neutrons, these are called isotopes.



Isotopes

- Hydrogen isotopes
  - "Protium" has 1 proton, 1 electron and 0 neutrons
  - "Deuterium" has 1 proton, 1 electron and 1 neutron
    - It is more massive than hydrogen but has similar chemical properties
  - "Tritium" has 1 proton, 1 electron and 2 neutrons

- All three isotopes are hydrogen.



Periodic table entries

Atomic Number:

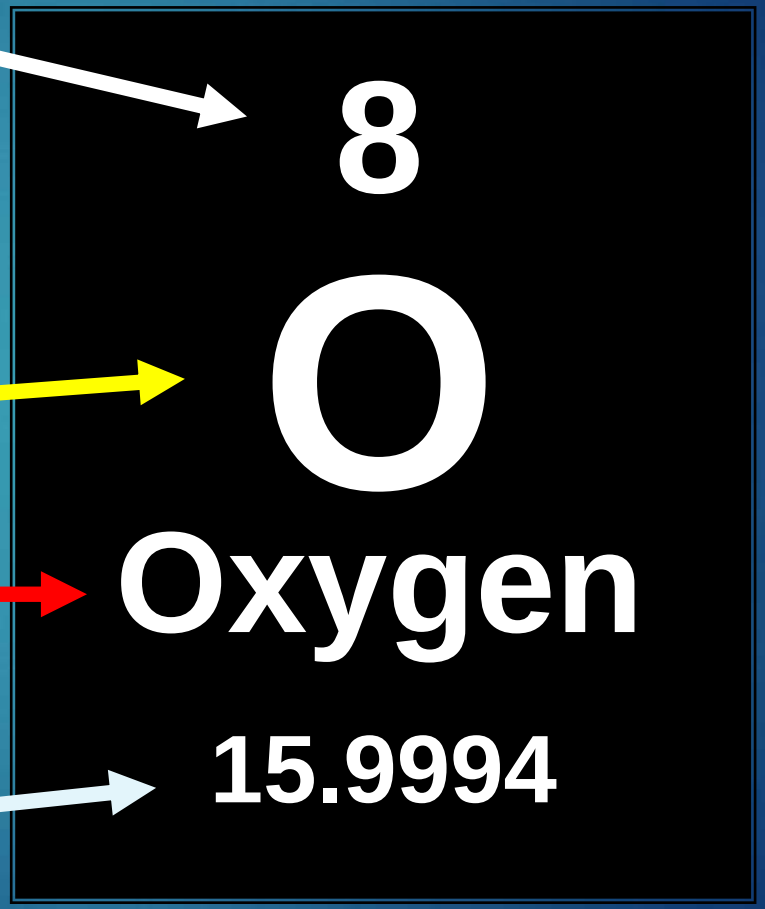
Number of protons and usually the number of electrons in an atom of that element.

Atomic Symbol:
An abbreviation for the element.

Element Name

Atomic Mass

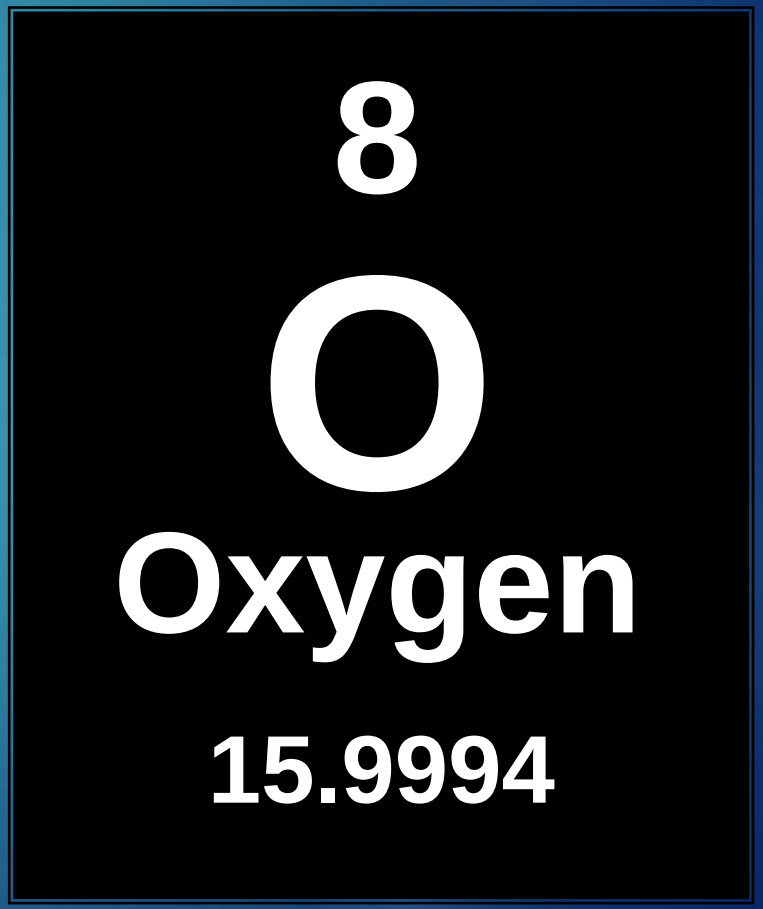
Number of protons + neutrons.



Atomic masses

- Atomic mass ≠ Mass number
  - They are close but not the same

- Most common oxygen isotope
  - 8 protons
  - 8 neutrons
  - Mass number = 16



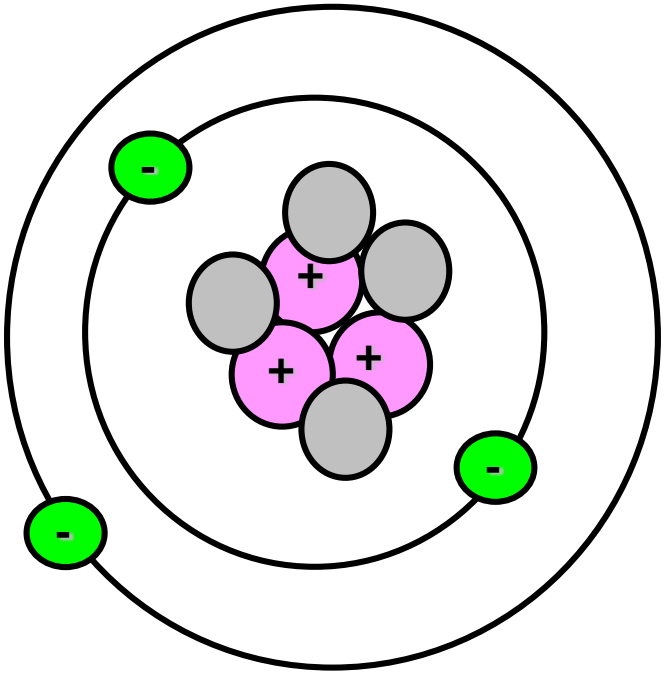
Atomic masses

Here's why

1. Mass number is the exact number for a single atom & atomic mass is an average of the masses of all isotopes
   - Hydrogen has a mass number of 1 (1 proton + 0 neutrons),
   - But an atomic mass: 1.00728 amu
2. Atomic masses are calculated based on the percentage of isotopes present in natural world
   - H=99.985%; D=.015%; T=trace
   - Atomic mass of H is: 1.00794

Lithium

Protons = 3
Electrons = 3
Neutrons = 4



3
Li
Lithium
7

Nitrogen

1. Write out and label the periodic table entry for the element
   a) *Name*
   b) *Symbol*
   c) *Atomic number*
   d) *Atomic mass*
2. Now draw out the atom
   a) *Protons*
   b) *Neutrons*
   c) *Electrons*

Protons = 7
Electrons = 7
Neutrons = 7

Nitrogen

1. Figure out how many of each are in the atom
   a) *Protons*
   b) *Neutrons*
   c) *Electrons*
2. Draw out the atom