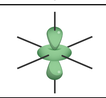
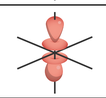
PERIODIC TABLE AND ELECTRON CONFIGURATION

15-16 year-olds

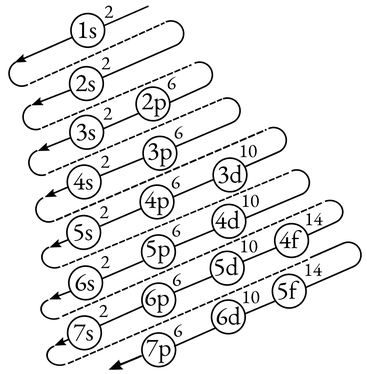
Rodrigo Alcaraz de la Osa. Translation: Rodrigo Alcaraz de la Osa and Alicia Sampedro (@AliciaInfoFyQ)

Electron Configuration

The **electron configuration** is the **distribution** of the **electrons** of an **atom** into **atomic orbitals** (s, p, d y f). **Möller's diagram** helps us to know the **order** in which the different **orbitals** should be **filled**, following the **arrows**.

Orbital	Shape	Maximum number of electrons
s		$2\,e^-$
p		$6\,e^-$
d		$10\,e^-$
f		$14\,e^-$

Images adapted from https://www.coursehero.com/sg/general-chemistry/quantum-theory/.



Möller's diagram. Adapted from https://commons.wikimedia.org/wiki/File:Diagrama_de_Configuraci%C3%B3n_electr%C3%B3nica.svg.

Ground state

State of **minimum energy**. Electrons ***follow*** **Möller's diagram**.

Excited state

Orbitals are not **filled** following **Möller's diagram**.

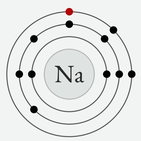
Forbidden state

Any **orbital** has **more electrons** than **allowed** $\left(\begin{array}{cccc} s & p & d & f \\ 2 & 6 & 10 & 14 \end{array}\right)$.

Valence Electrons

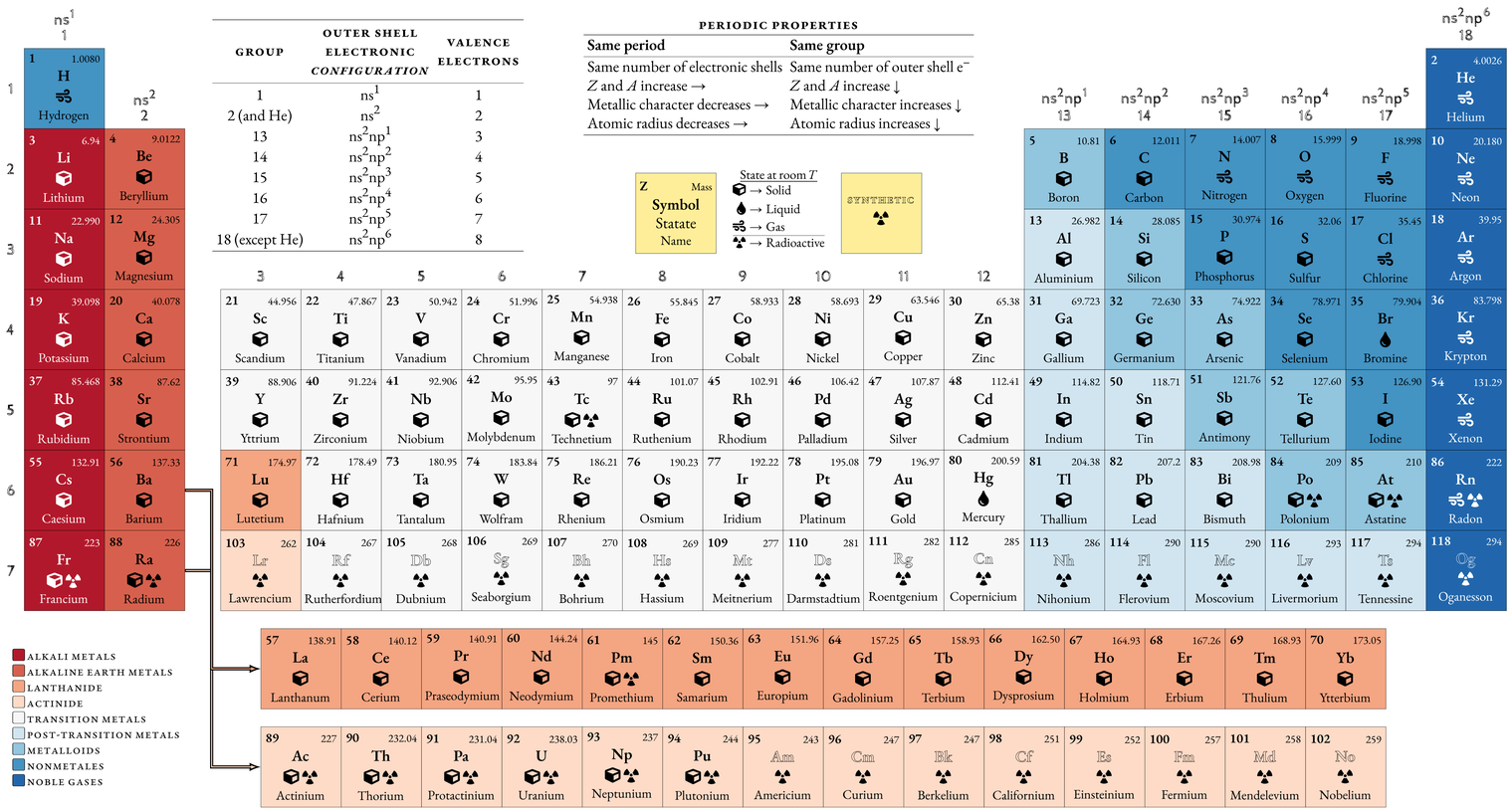
Valence electrons are those of the **outer shell** of an **atom**, being **responsible** for the **interactions** between **atoms** and the **formation** of chemical **bonds**.

Examples

	GROUND (NEUTRAL)	GROUND (CATION)	EXCITED (NEUTRAL)	FORBIDDEN (NEUTRAL)
	$\overbrace{1s^2 2s^2 2p^6 \underbrace{3s^1}}^{11\ e^-}$ (1 valence e^-)	$\overbrace{1s^2 \underbrace{2s^2 2p^6}}^{10\ e^-}$ (8 valence e^-)	$\overbrace{1s^2 2s^2 2p^5 3s^2}^{11\ e^-}$	$\overbrace{1s^2 2s^2 2p^4 3s^3}^{11\ e^-}$
Sodium (Na)				

Periodic Table of Elements

The **periodic table of elements** arrange the **118 elements** known into **7 periods** (rows) and **18 groups** (columns), **order by its atomic number** Z.



Classification of Chemical Elements

Chemical elements can be classified into **metals**, **metalloids**, **nonmetals** and **noble gases**, according to their **physical** and **chemical properties**:

Metals

Shiny appearance, they are **good conductors** of **heat** and **electricity** and they can make **alloys** with other metals. Most of them are **solids** at room T (**Hg** is 💧).

Ion formation They tend to **lose electrons**, forming **cations** (⊕ charged ions). **Examples**: $Li \longrightarrow Li^+ + 1\,e^-$; $Mg \longrightarrow Mg^{2+} + 2\,e^-$; $Al \longrightarrow Al^{3+} + 3\,e^-$.

Metalloids

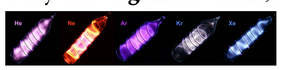
Breakable solids with a **metallic aspect** that are **semiconductors** and **behave like nonmetals**.

Nonmetals

Dull **appearance**, they are **bad conductors** of **heat** and **electricity** and they can be **breakable**. They can be **solids**, **liquids** or **gases** at room temperature.

Ion formation They tend to **gain electrons**, forming **anions** (⊖ charged ions). **Examples**: $Cl + 1\,e^- \longrightarrow Cl^-$; $O + 2\,e^- \longrightarrow O^{2-}$; $P + 3\,e^- \longrightarrow P^{3-}$.

Noble gases



He, Ne, Ar, Kr, Xe and ☢ Rn. **Odourless and colorless monoatomic gases** which **barely react** chemically, since they have **eight electrons** in their **outer shell**.