

Oxidation Numbers

Na⁺¹

Ca⁺²

B⁺³

N⁻³

O⁻²

F⁻¹

K⁺¹

Mg⁺²

Al⁺³

Essential Standard 2.2

Understand chemical bonding and chemical interactions.

Learning Objective 2.2.1

Infer valence electrons, oxidation numbers, and reactivity of an element based on its location in the periodic table.

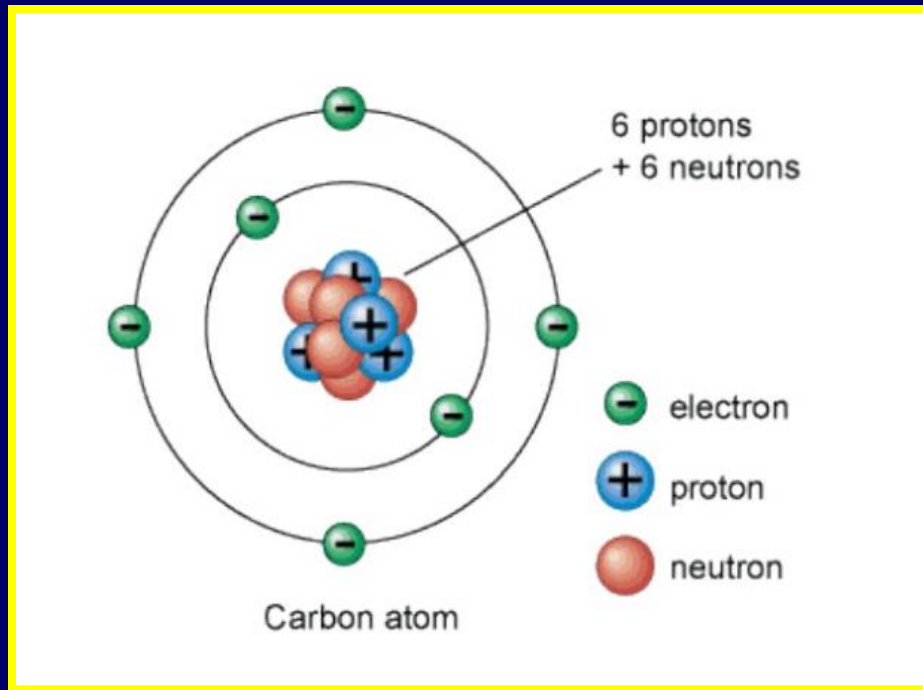
I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can explain what an ion is.
- I can describe how reactive an element is based on its position on the periodic table.
- I can determine whether an atom will gain or lose electrons during chemical reactions.
- I can determine the oxidation number for any element based on its position on the periodic table.

Atomic Structure

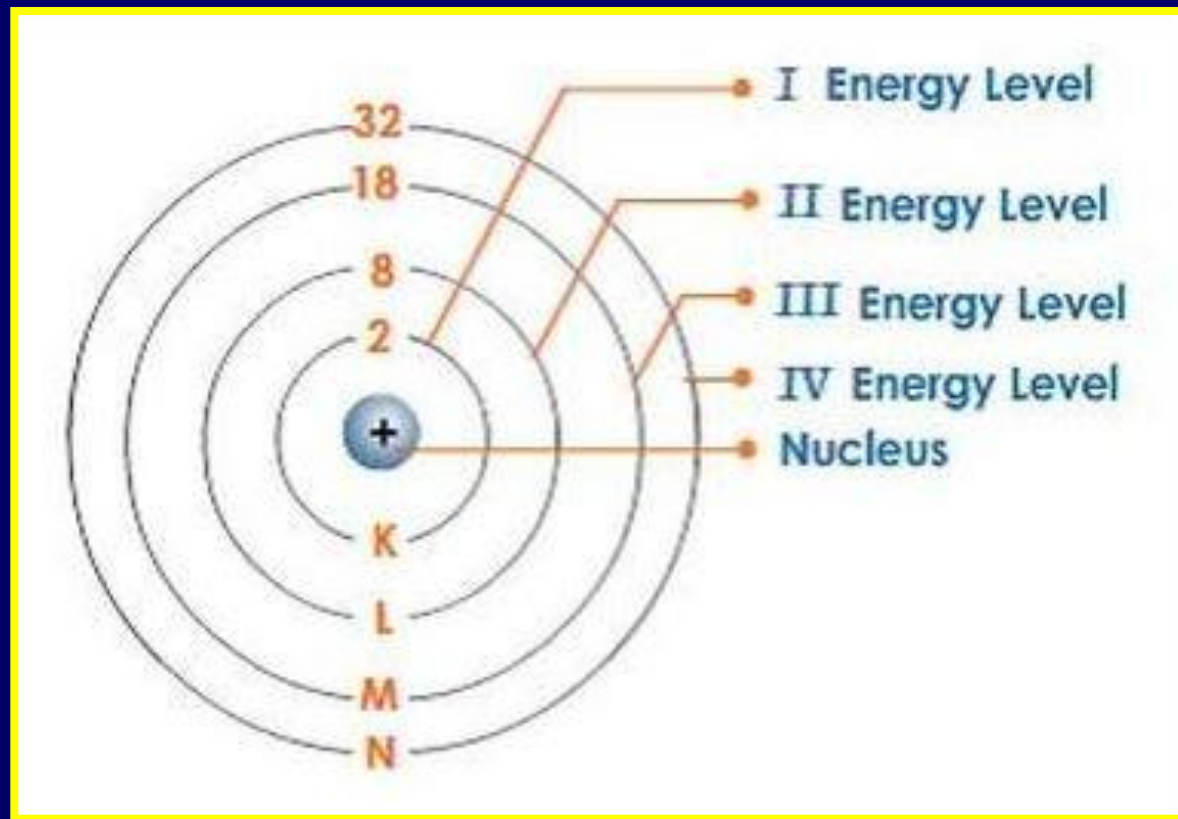
Recall that the nucleus of any atom contains positively charged protons and neutrally charged neutrons.



Negatively charged electrons orbit around the nucleus.

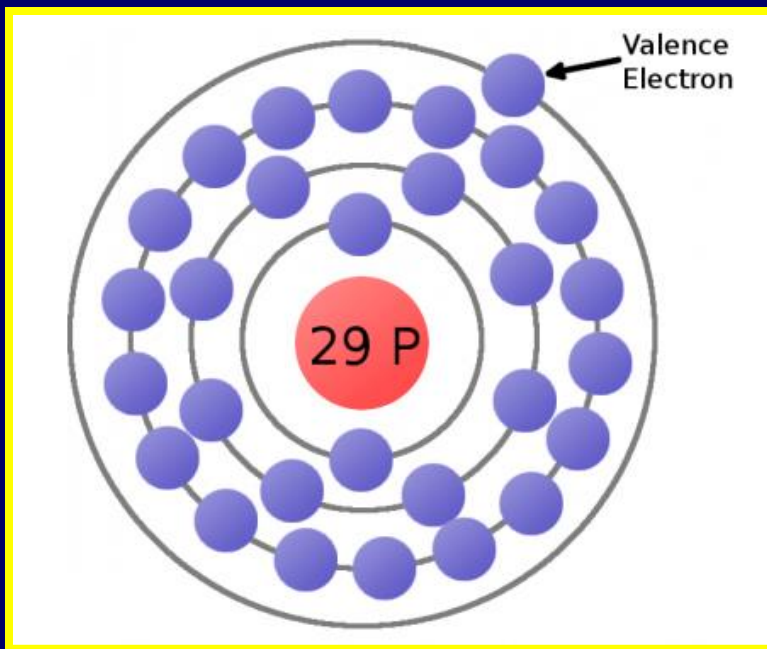
Electron Arrangement

Recall that electrons orbit the nucleus of each atom in specific energy levels.



Valence Electrons

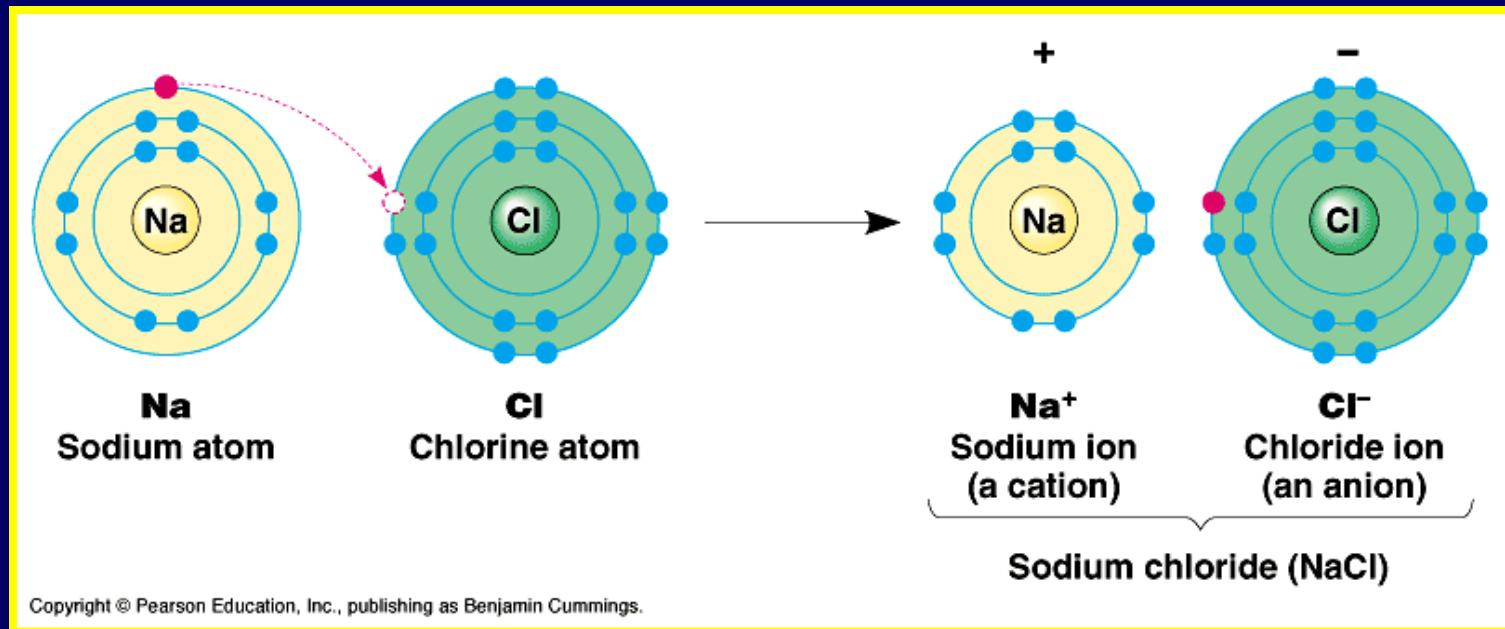
Recall also that the electrons closer to the nucleus are held very tightly to the nucleus and cannot be removed easily.



However, the outer electrons, called valence electrons, are not held as tightly to the nucleus.

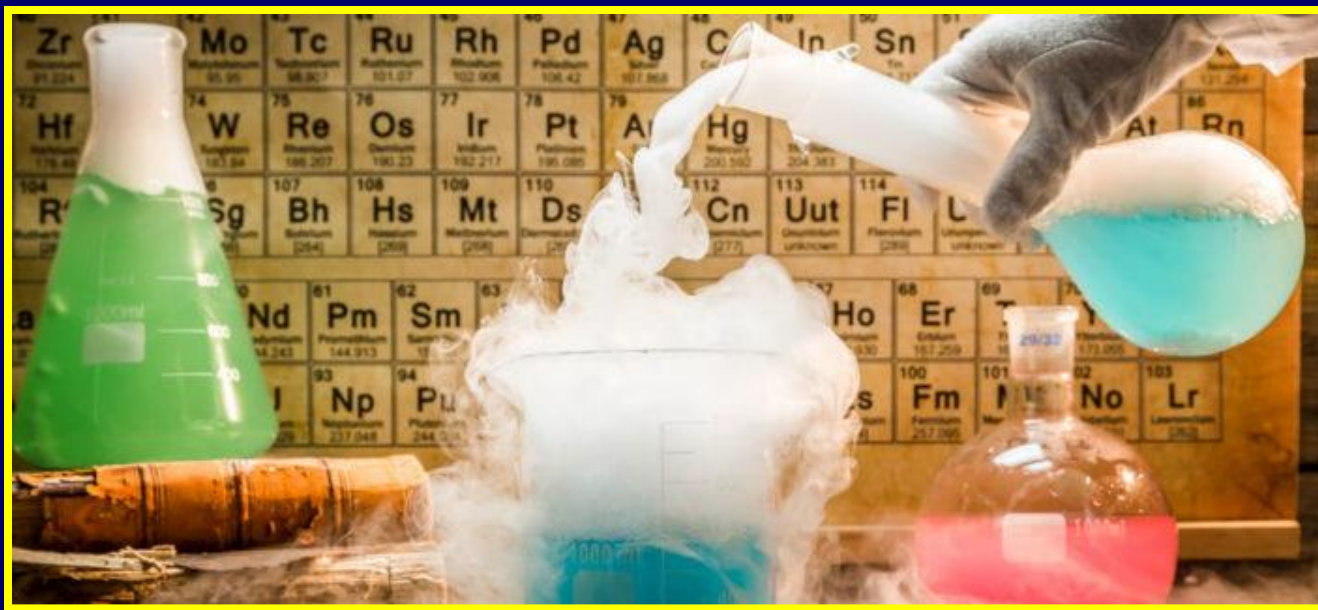
Electron Transfer

Because the valence electrons are not held as tightly to the nucleus, they can leave that atom during chemical reactions.



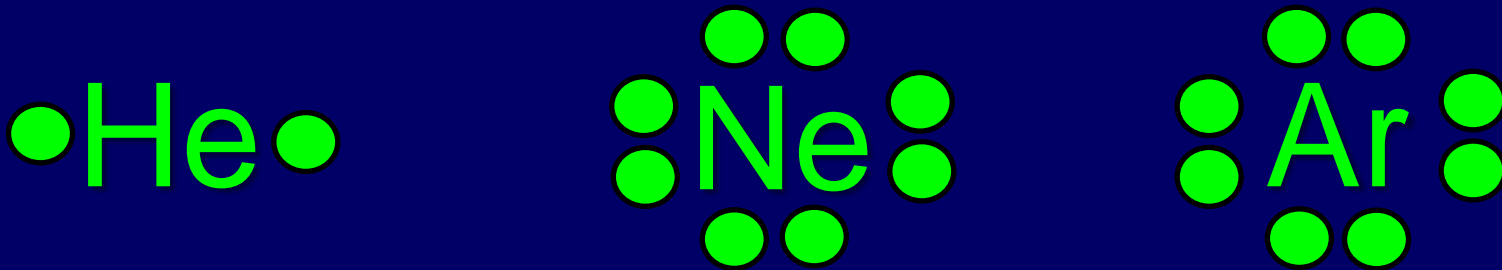
Chemical Reactions

In fact, all chemical reactions occur as a result of valence electrons either being transferred to other atoms or being shared by other atoms.



Atom Stability

Atoms are considered stable and will not react with other elements, when their outer energy level is full.



All the noble gases have full outer valence shells, so they are very stable and will never react with other atoms.

Hydrogen & Helium

Because hydrogen and helium have only one energy level, they can only hold 2 valence electrons.



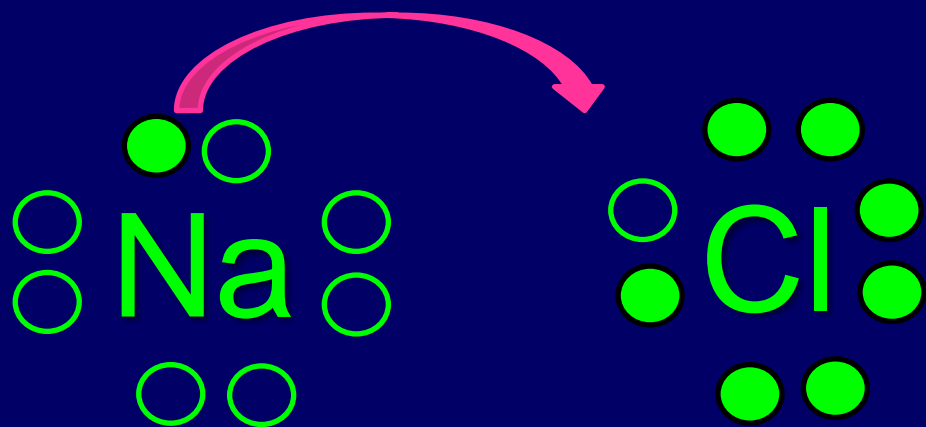
Helium already has 2 valence electrons, so its outer energy level is full and it will never react with other elements.



But hydrogen only has 1 valence electron, so it will react with other elements.

Octet Rule

All the other elements want to have 8 valence electrons.

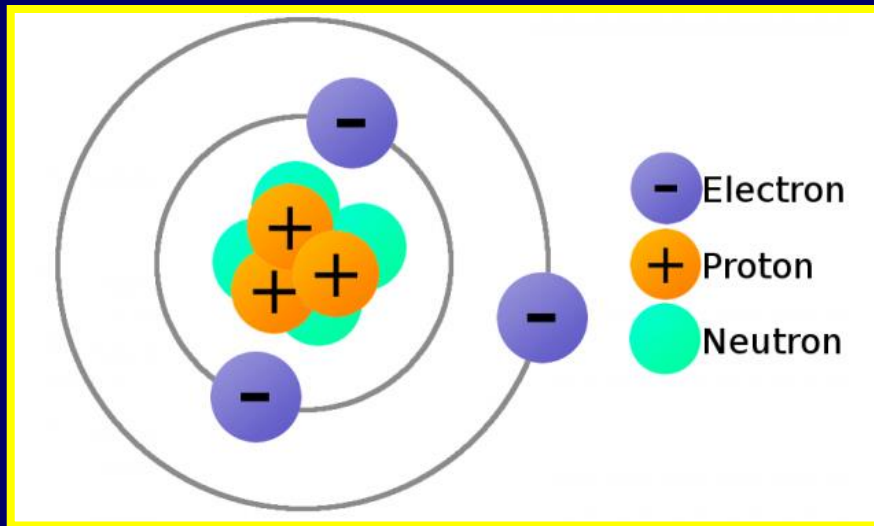


This is called
the
Octet Rule

In order to meet the octet rule, atoms can gain, lose, or share electrons.

Neutral Charge

Recall that elements contain the same number of positively charged protons and negatively charged electrons.

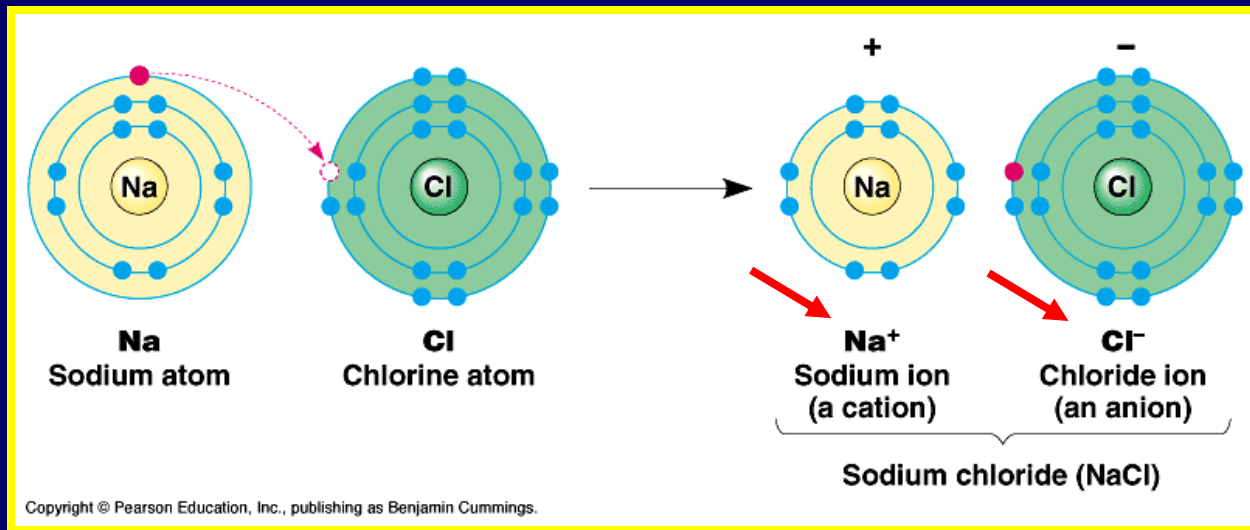


3 + Protons
3 - Electrons

Since the charges balance each other out, elements have a neutral charge.

Atoms with a Charge

When an atom loses an electron or gains an electron it develops a charge.



Charges can be either positive or negative.

Ions

Atoms with a charge are called ions.

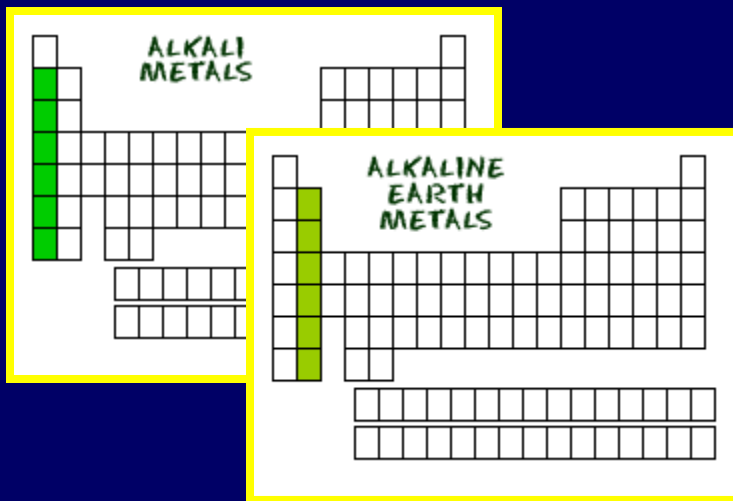


If an atom loses an electron, it will develop a positive charge.

If an atom gains an electron, it will develop a negative charge.

Metals → Positive Ions

Only metals will lose electrons to form positive ions.



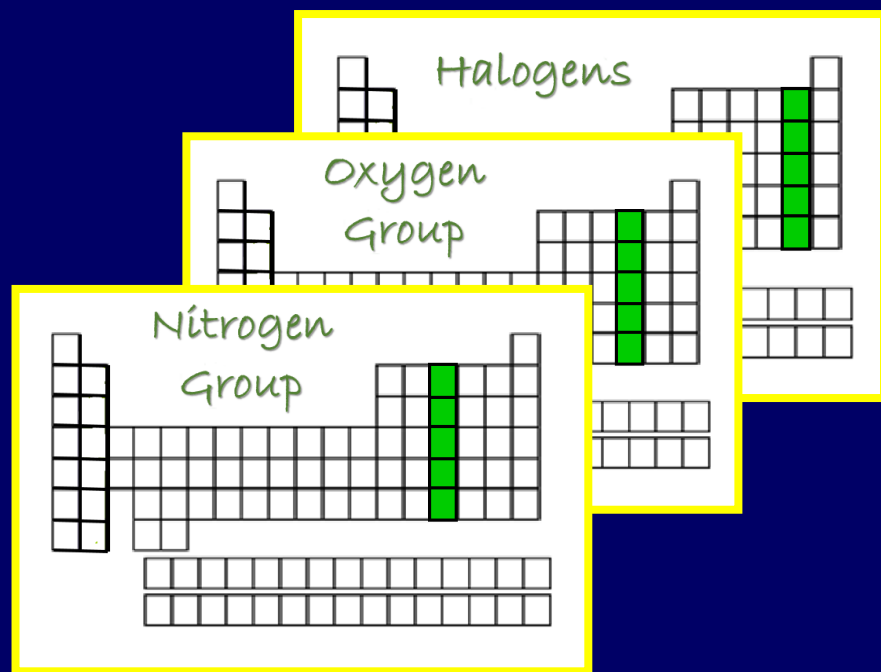
Some metals lose their electrons more easily than others and are said to be more reactive.

The alkali metals and the alkaline metals lose their valence electrons very easily and are the most reactive metals.

Nonmetals → Negative Ions

Only nonmetals will gain electrons to form negative ions.

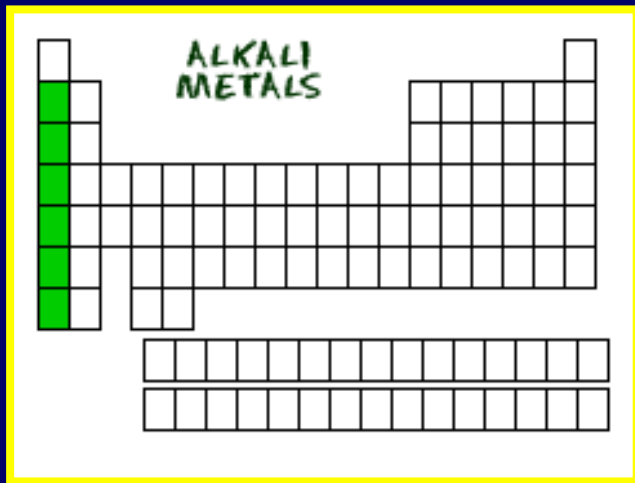
Nonmetals will gain enough electrons to meet the octet rule.



The halogen group only needs to gain one valence electron, making them the most reactive non-metals.

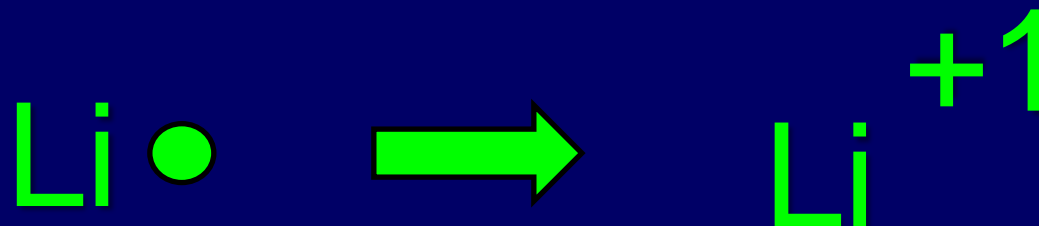
Oxidation Numbers

The specific charge an atom develops is called its oxidation number.

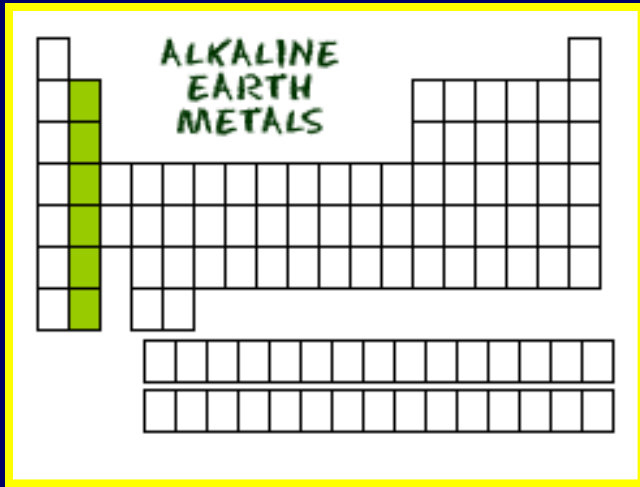


A periodic table with the first column of elements highlighted in green. The text "ALKALI METALS" is written in green above the highlighted column.

All the Alkali metals, with only 1 valance electron, will lose 1 electron and develop a +1 oxidation number.

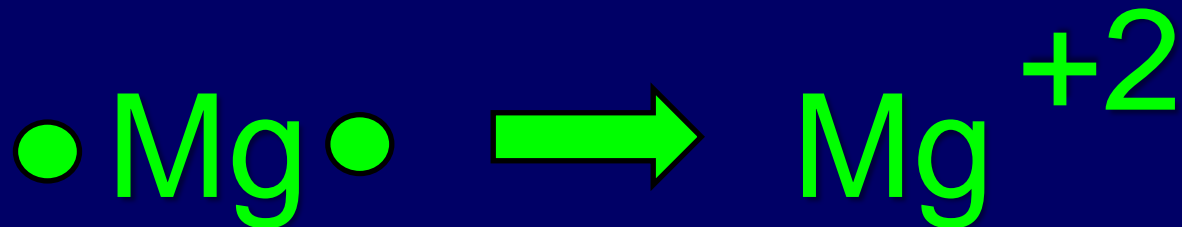


Alkaline Earth Metals

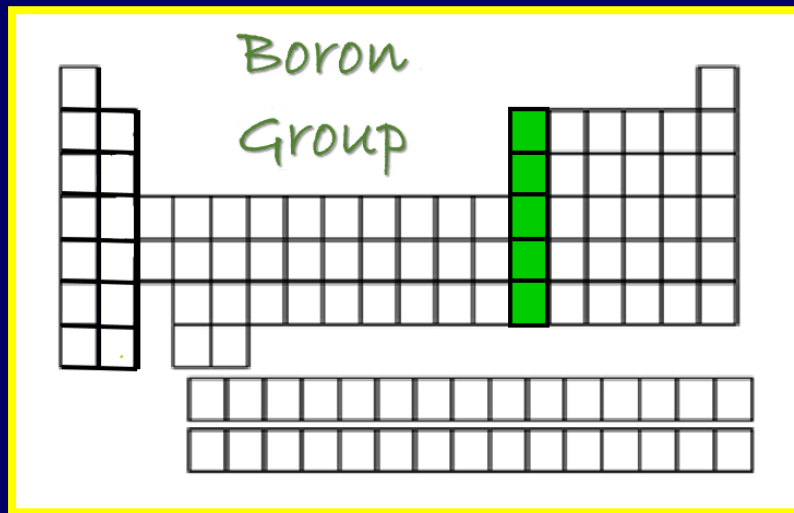


A periodic table diagram with the second column highlighted in green. The text "ALKALINE EARTH METALS" is written in the top left corner of the table area.

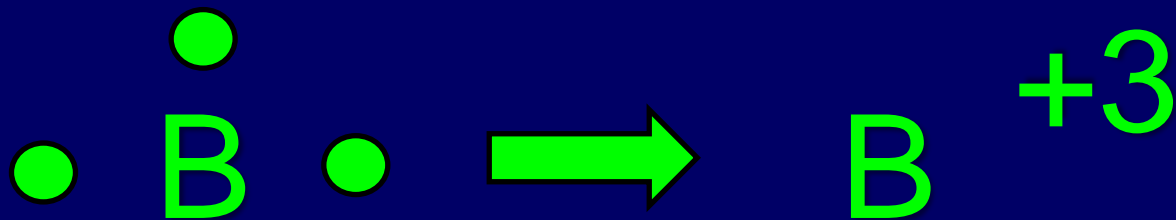
All the Alkaline Earth metals, with 2 valence electrons, will lose 2 electrons and develop a +2 charge.



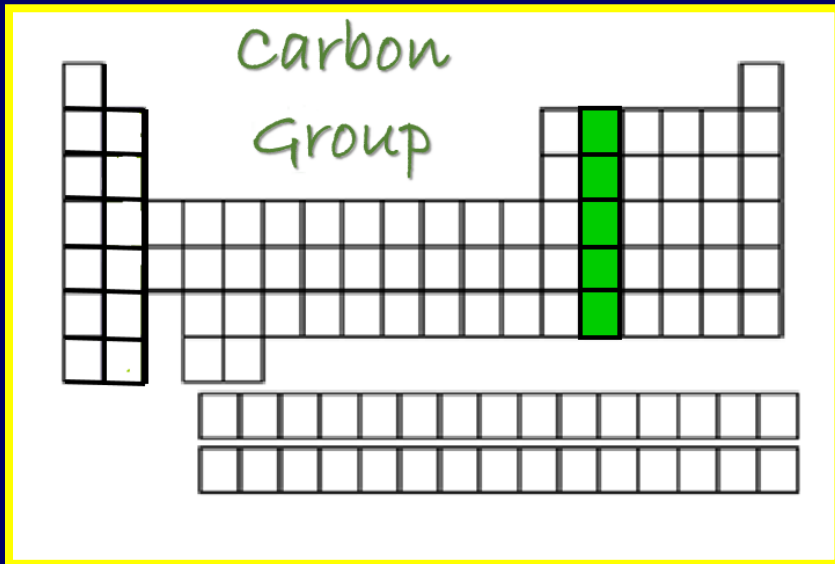
Boron Group



The Boron group, with 3 valence electrons, will lose 3 electrons and develop a +3 charge.



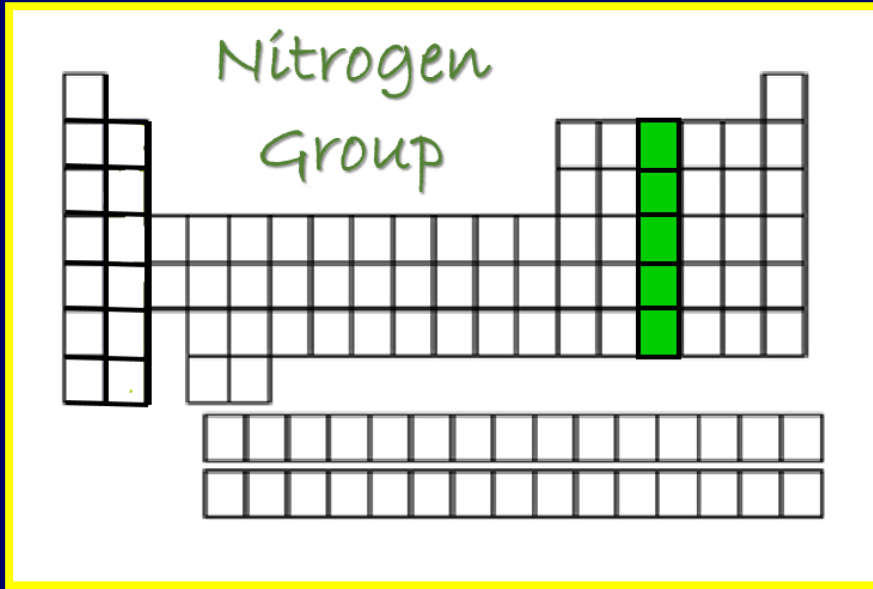
Carbon Group



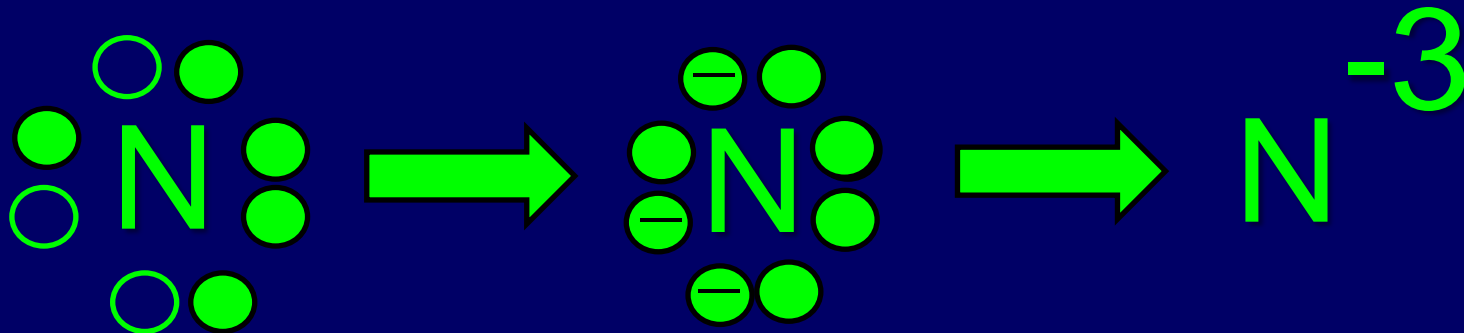
The Carbon group, with 4 valence electrons, behaves a little differently to meet the octet rule.

So, we aren't going to assign an oxidation number to the carbon group.

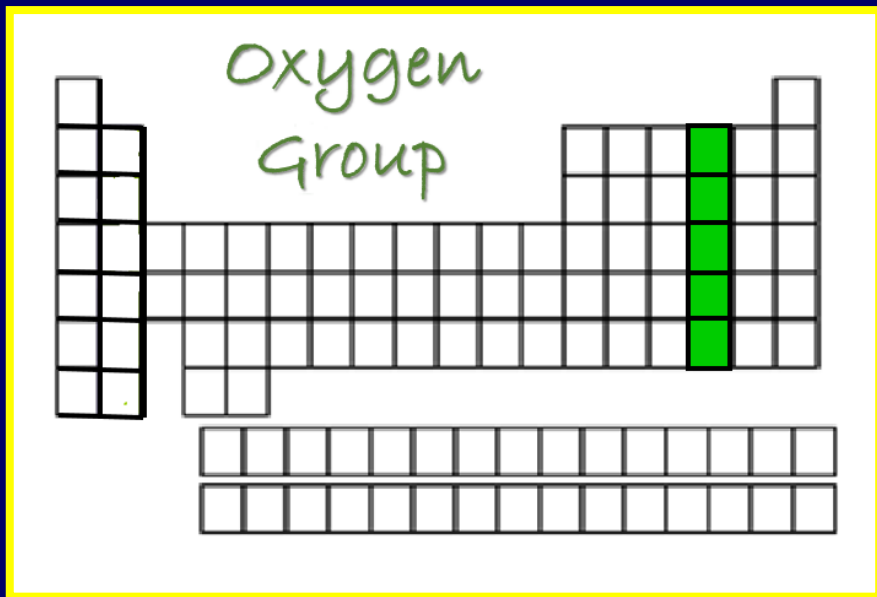
Nitrogen Group



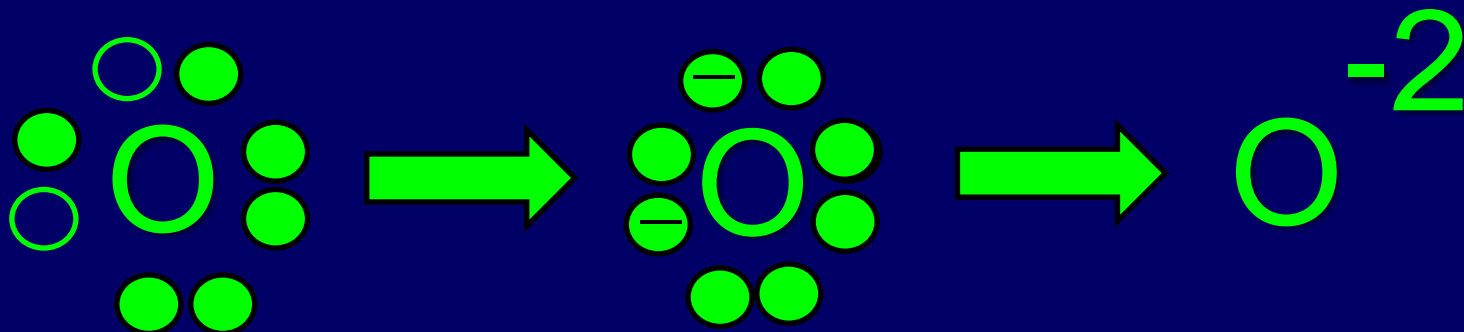
The nitrogen group, with 5 valence electrons needs 3 electrons, so they will gain 3 electrons and develop a -3 charge



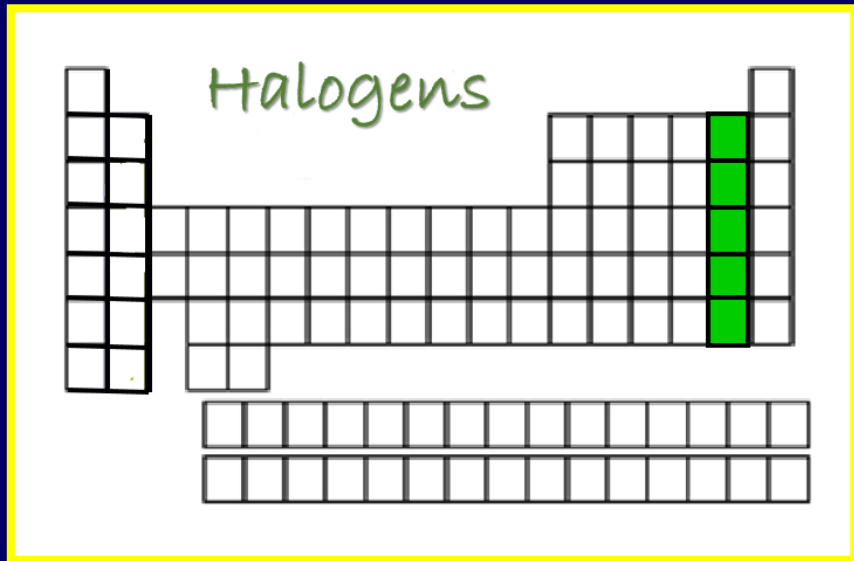
Oxygen Group



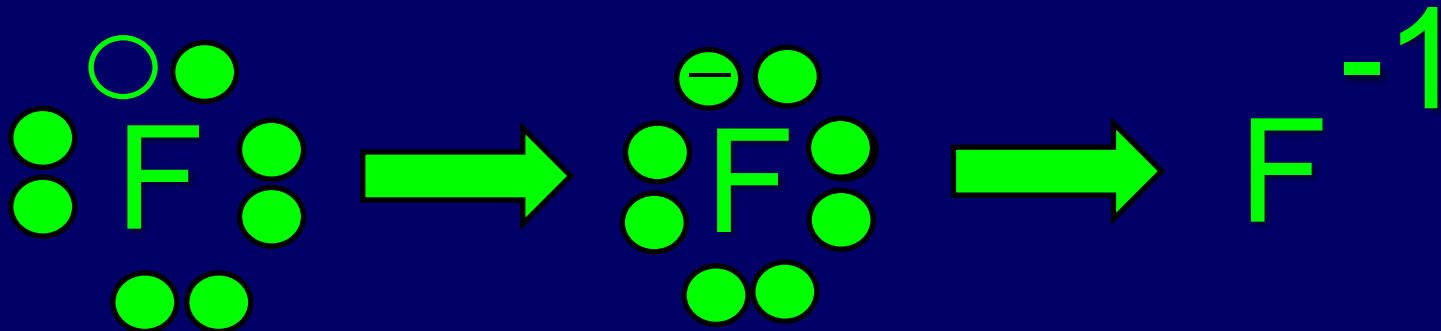
The oxygen group, with 6 valence electrons needs 2 electrons, so they will gain 2 electrons and develop a -2 charge.



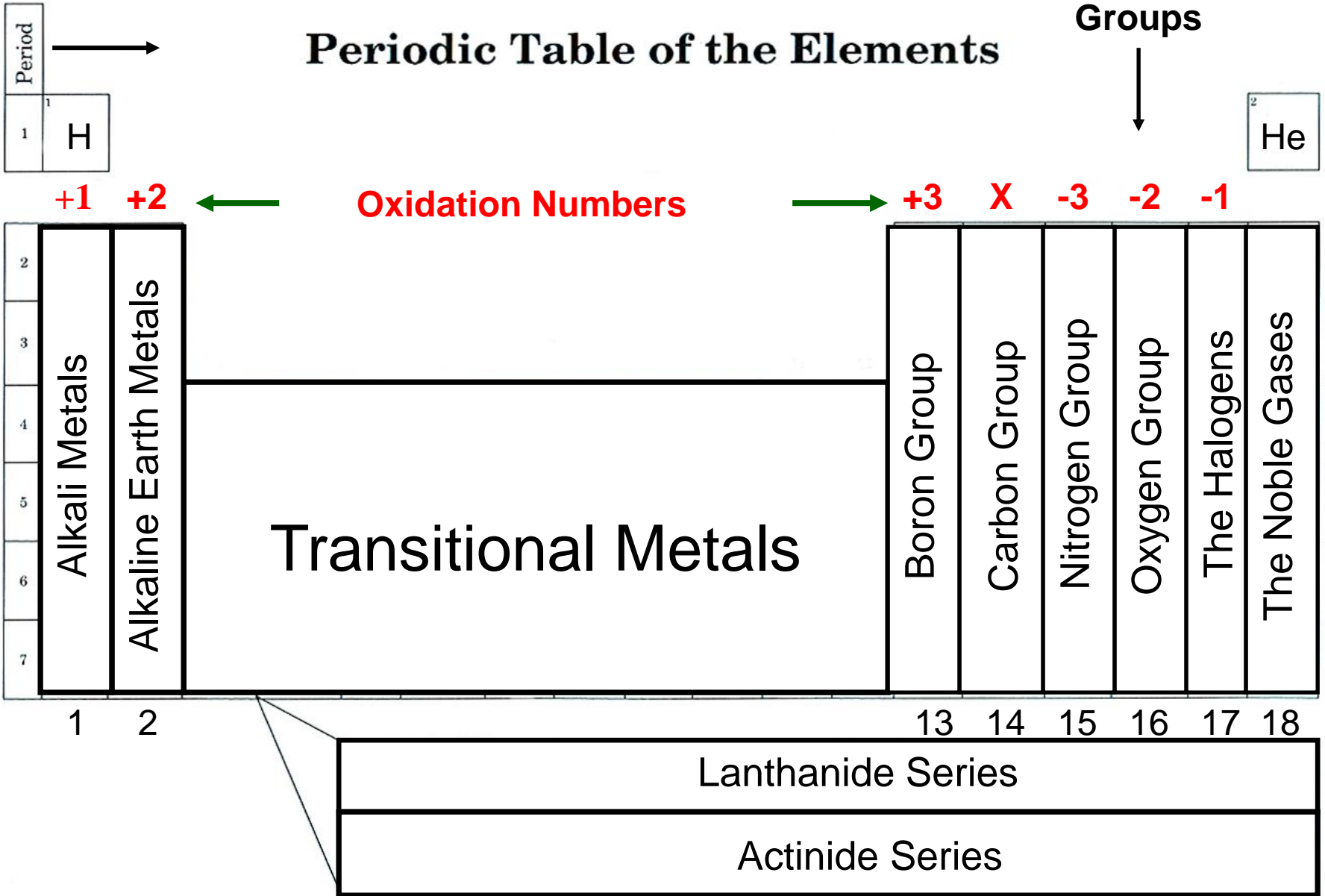
Halogens



The halogens, with 7 valence electrons needs 1 electron, so they will gain 1 electron and develop a -1 charge.



Periodic Table of the Elements



The End

