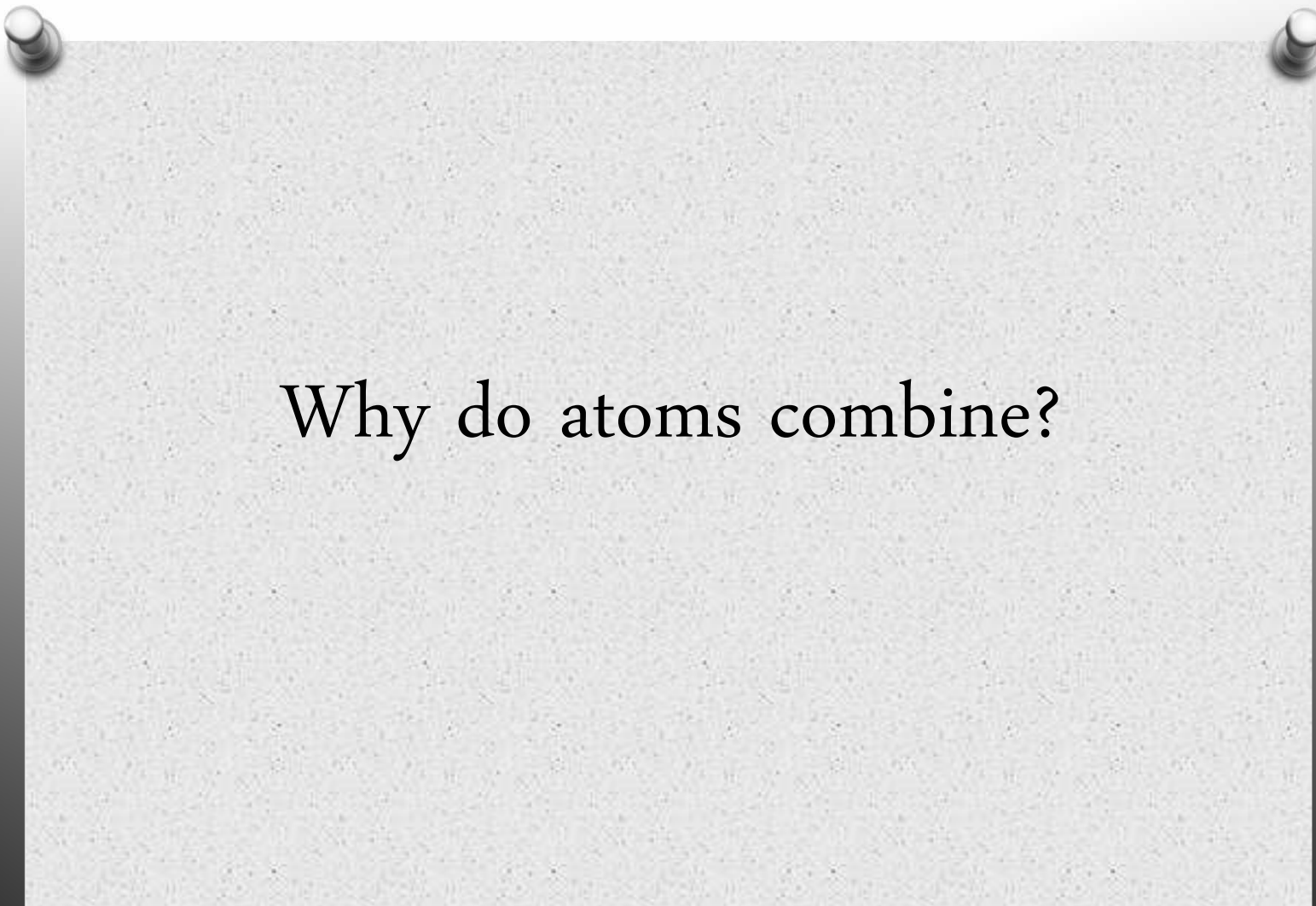




Why do atoms combine?

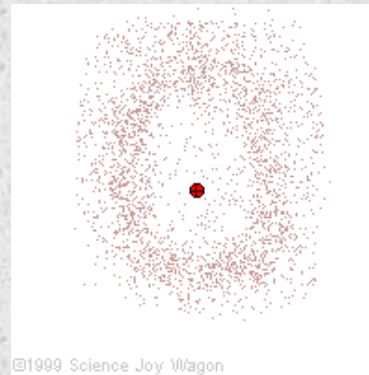
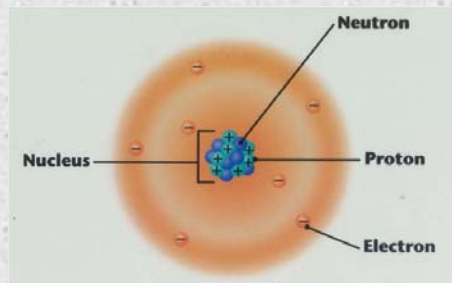
# Objectives

- Compare the relative amounts of energy of electrons in an atom
- Compare and contrast ionic and covalent bonds
- Distinguish between compounds and molecules
- Identify the difference between polar and nonpolar covalent bonds
- Interpret chemical shorthand

# Atomic Structure

- Did you know that all matter, even solids, contain mostly empty space? How can this be?
- We know that at the center of every atom is the nucleus containing protons and neutrons. This represents most of the atom's mass.
- But the rest of the atom is empty except for the electrons, which are extremely small.

- o The exact placement of electrons cannot be determined other than understanding they travel in an area of space around the nucleus called the electron cloud. They DO NOT travel in a predictable path.



<http://www.youtube.com/watch?v=kYkD-dcupAU>

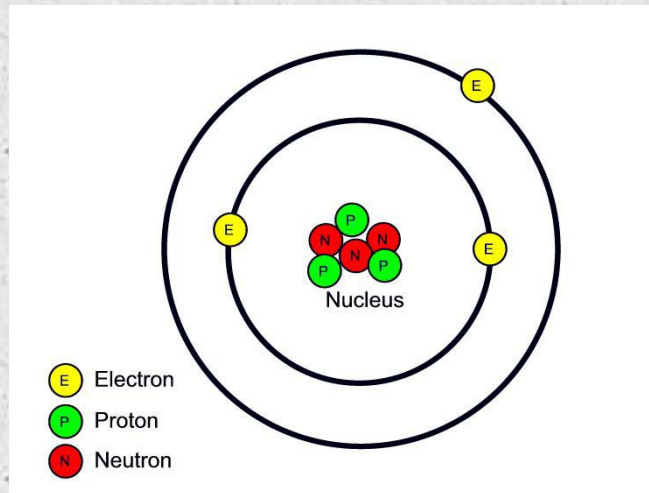
<http://www.youtube.com/watch?v=ofp-OHlq6Wo>

<https://www.youtube.com/watch?v=vr0Hiled-8Q>

<https://www.youtube.com/watch?v=yqLlglaz1LO>

# Bit of a review

- The number of protons and electrons is always the same for a NEUTRAL atom of a given element.



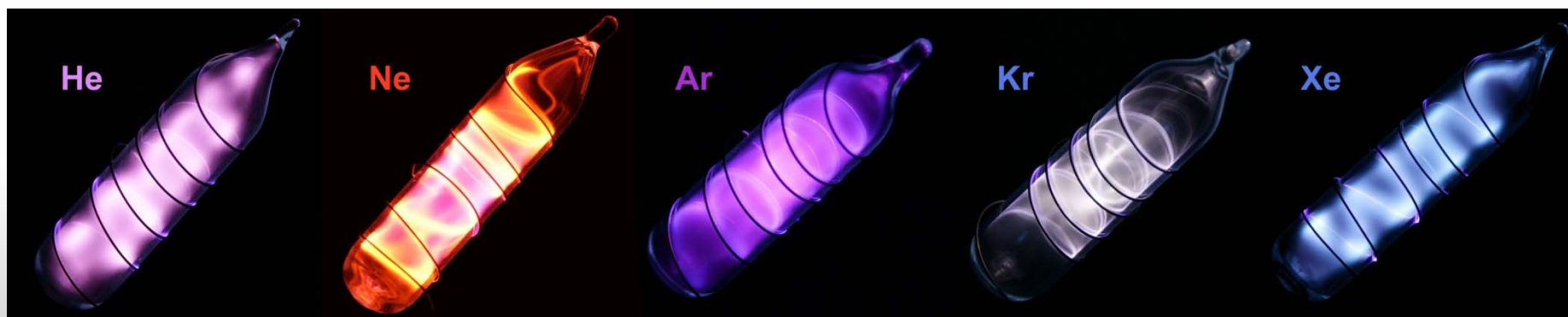
# **ELECTRON ARRANGEMENT**

- o The number and arrangement of electrons in the electron cloud of an atom are responsible for many of the physical and chemical properties of that element.**
- o Each energy level in an atom represents a different amount of energy.**

# Number of Electrons

- o (Review) The farther an energy level is from the nucleus, the more electrons it can hold.
- o Ex. 1<sup>st</sup> level holds 2 electrons
- o 2<sup>nd</sup> level holds up to 8
- o 3<sup>rd</sup> level holds up to 18
- o 4<sup>th</sup> level holds up to 32 electrons

- **Electrons closest to the nucleus have the lowest amount of energy and are said to be in energy level one.**
- **Electrons farthest from the nucleus have the highest amount of energy and are easiest to remove.**
- **We can determine the maximum number of electrons that occupy a level by the formula  $2n^2$**



**The Noble Gases- are ‘happy atoms’.**

**The elements in Group 8 (Noble Gases) have 8 electrons in their outer energy level, and do not combine easily with other elements. They are called “stable” atoms.**

**Helium is also stable, with 2 electrons in its one energy level.**

**Because they are so stable, they are used to protect filaments in lightbulbs and they are used to produced colored light in signs.**

# **Halogens (Group 7)**

- o All members of this family need one electron to obtain a stable outer energy level.**
- o The easier it is for a halogen to gain this electron to form a bond, the more reactive it is. Fluorine is the most reactive because its outer energy level is closest to the nucleus.**

# **Alkali Metals (Group 1)**

- o Find Lithium and sodium on your periodic table.**
- o How many valence electrons do they each have?**
- o They are very reactive because it is easy for them to give away an electron. The easier it is to remove an electron, the more reactive the atom is. (Watch how reactive they are!)**

<http://www.youtube.com/watch?v=QSZ-3wScePM>

- o **Alkali metals form compounds that are similar to each other.**
- o **The reactivity increases as you move down the periods. Do you know why?**
- o **The outer energy levels are farther from the nucleus. Less energy is needed to remove an electron from an energy level farther from the nucleus.**
- o **Soo... Cesium in period 6 is more reactive than sodium in period 3.**

# **How Elements Bond**

- o IONIC BONDS- Loss and Gain**

- o When elements bond, they don't readily break apart. (Can you imagine if your table salt separated into sodium and chlorine while you were shaking it on your fries?)**

# **4 WAYS TO BOND**

- o Losing electrons**
- o Gaining electrons**
- o Pooling electrons**
- o Sharing electrons with another element**

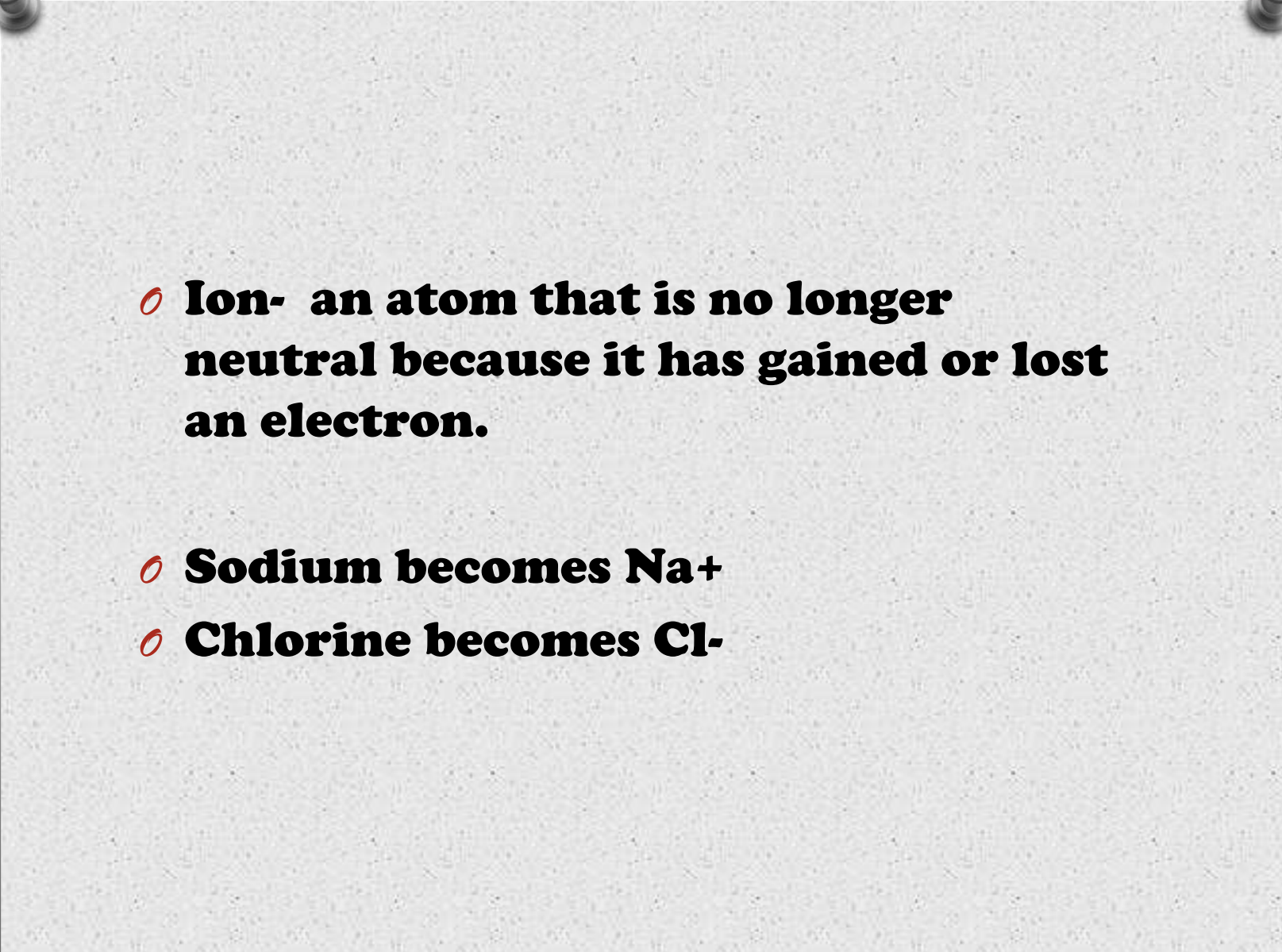
# An Example

- o Sodium, a group 1 element, can react violently when added to water or chlorine.
- o Chlorine is a greenish poisonous gas and sodium is a shiny, soft, and very reactive metal., but when they react, they form sodium chloride (salt)
- o Why?
- o [http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#sodium\\_chlorine\\_react](http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#sodium_chlorine_react)

# IONS- A question of Balance

- o [http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#ionic\\_bond\\_in\\_sodium\\_chloride](http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#ionic_bond_in_sodium_chloride)
- o The protons in the sodium and chloride are attracted to the electrons of the other atom's electrons- and brings them closer together.
- o At some point, the electron from Na is transferred to Cl.
- o When sodium loses an electron and becomes more balance, something else changes. The **CHARGE** of the atom.

- Now it becomes a **POSITIVELY** charged atom because there is one more **PROTON** than electrons.
- Chlorine become **NEGATIVELY** charged because it **GAINS** an electron, and has one more electron than protons.



**o Ion- an atom that is no longer neutral because it has gained or lost an electron.**

**o Sodium becomes  $\text{Na}^+$**

**o Chlorine becomes  $\text{Cl}^-$**

# BOND FORMATION

- o The positive sodium ion and the negative chloride ion are **STRONGLY ATTRACTED** to one another.
- o This attraction forms and **IONIC BOND**.
- o The ions are more stable when they are bonded than as individual atoms

# In your ISN

- **Create a Bohr model of Sodium and Chlorine. Write a caption under each picture to describe the process of ionic bonding.**
- **[http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#ionic\\_bond\\_in\\_sodium\\_chloride](http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#ionic_bond_in_sodium_chloride)**
- **We can also show this using a Lewis Dot Structure**
  - **Create a Lewis structure to illustrate the Ionic Bond**

# Explore

Use the magnifying glass to look at the structure of the salt two forms of salt.

o [http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#ionic\\_bond\\_in\\_sodium\\_chloride](http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#ionic_bond_in_sodium_chloride)

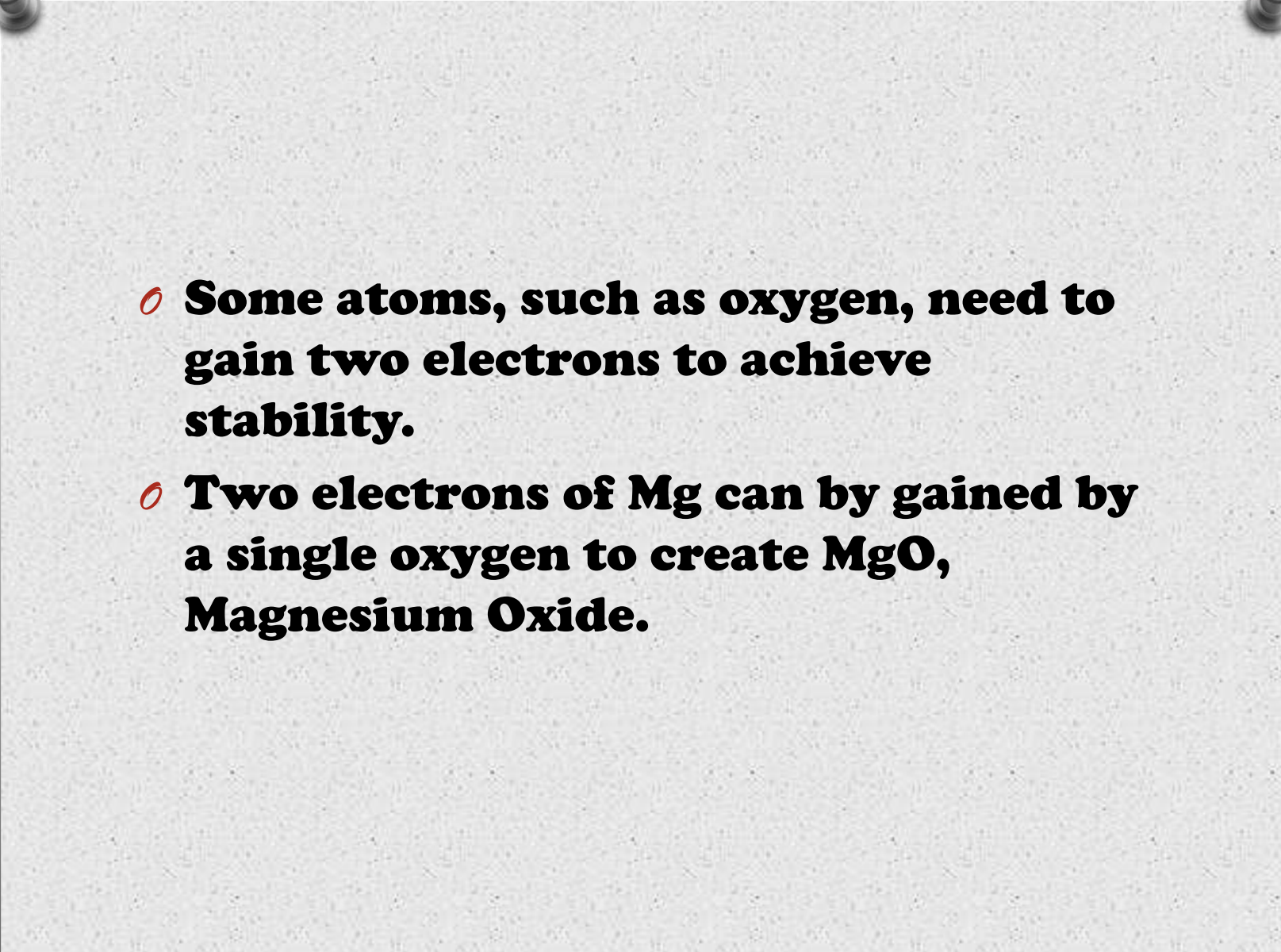
# COMPOUND

- When sodium and chlorine combine, and an ionic bond is formed, a new substance, SALT, is formed.
- **A COMPOUND** is a pure substance containing two or more elements that are chemically bonded.



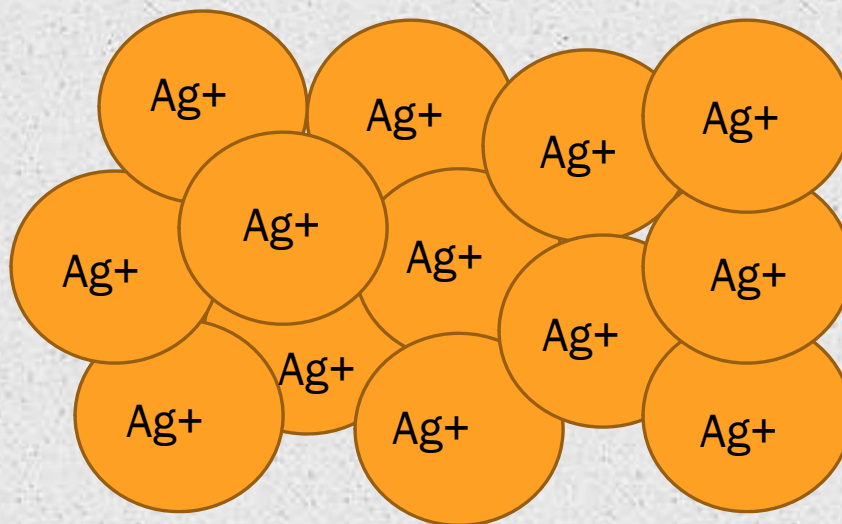
# **MORE GAINS AND LOSSES**

- o **Can elements lose more than one electron?**
- o **Find Magnesium on your periodic table.**
- o **Which group is it in?**
- o **(2) Which means it can lose two electrons to achieve a completed (stable) energy level.**
- o **These two electrons can be GAINED by TWO chlorine, each needing 1 electron to become stable to create  $\text{MgCl}_2$**

- 
- Some atoms, such as oxygen, need to gain two electrons to achieve stability.**
  - Two electrons of Mg can be gained by a single oxygen to create MgO, Magnesium Oxide.**

# **METALLIC BONDING POOLING**

- o Ionic bonding occurs with metals and non-metals.**
- o However, metals can bond with other metals, as well.**
- o In a metal, the electrons in the outer energy levels of the atoms are not held tightly to individual atoms.**
- o They move freely among all the ions in the metal, sharing a POOL of electrons**



**METALLIC BONDS** form when metal atoms **SHARE** their pooled electrons. This bonding affects the properties of metals.

**Ex.** When a metal is hammered into sheets or drawn into a wire, it does not break. Rather the pooled electrons tend to hold the atoms together. This is why metals conduct electricity so well. The electrons move from one atom to the other to transmit current.

# **COVALENT BONDS- SHARING**

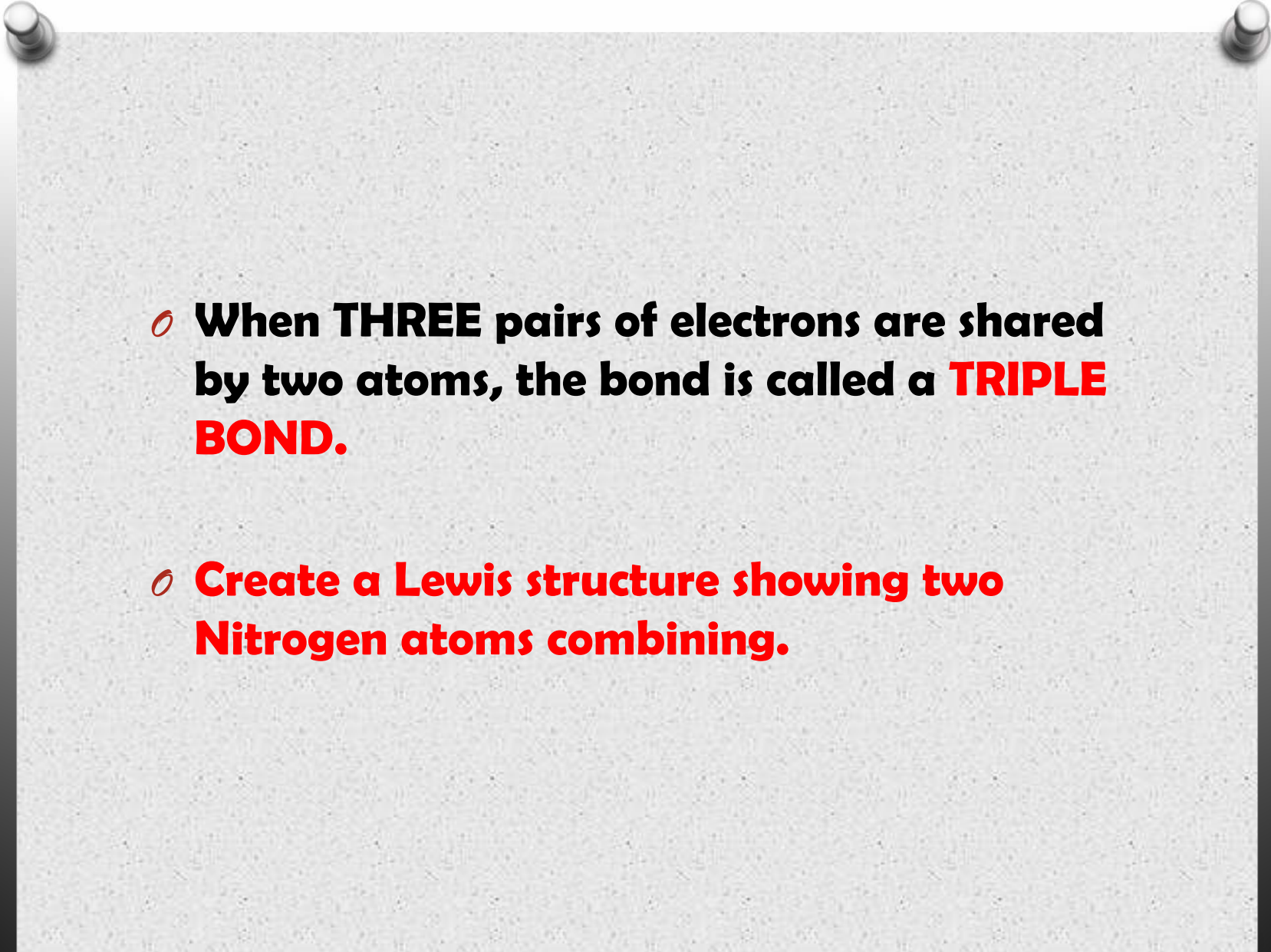
- o Some atoms are unlikely to lose or gain electrons because the number of electrons in the outer levels makes it difficult.**
- o Carbon, for example, has 4 valence electrons. To form a more stable structure, Carbon would need to either gain or lose 4 electrons. This takes a LOT of energy....soooooo.**

- o Many atoms become more stable by **SHARING** electrons.
- o **A COVALENT BOND** is a bond that forms between nonmetal atoms when they share electrons.
- o The electrons move freely between the outer energy levels, and each atom has a stable outer level some of the time.

- o The new compounds made by covalent bonds are called **molecular compounds**.
- o The neutral particle formed when atoms share electrons is called a **MOLECULE**.
- o A molecule is the basic unit of a molecular compound.
- o (Take a look at two hydrogen atoms...draw a Lewis structure showing this.)

# DOUBLE AND TRIPLE BONDS

- Sometimes an atom shares more than one electron with another atom.
- EX. Carbon Dioxide- each oxygen atom shares two electrons with the carbon atom. This forms a double bond. (show Lewis structure)
- **A DOUBLE BOND** occurs when an atom shares more than one electron with another atom.

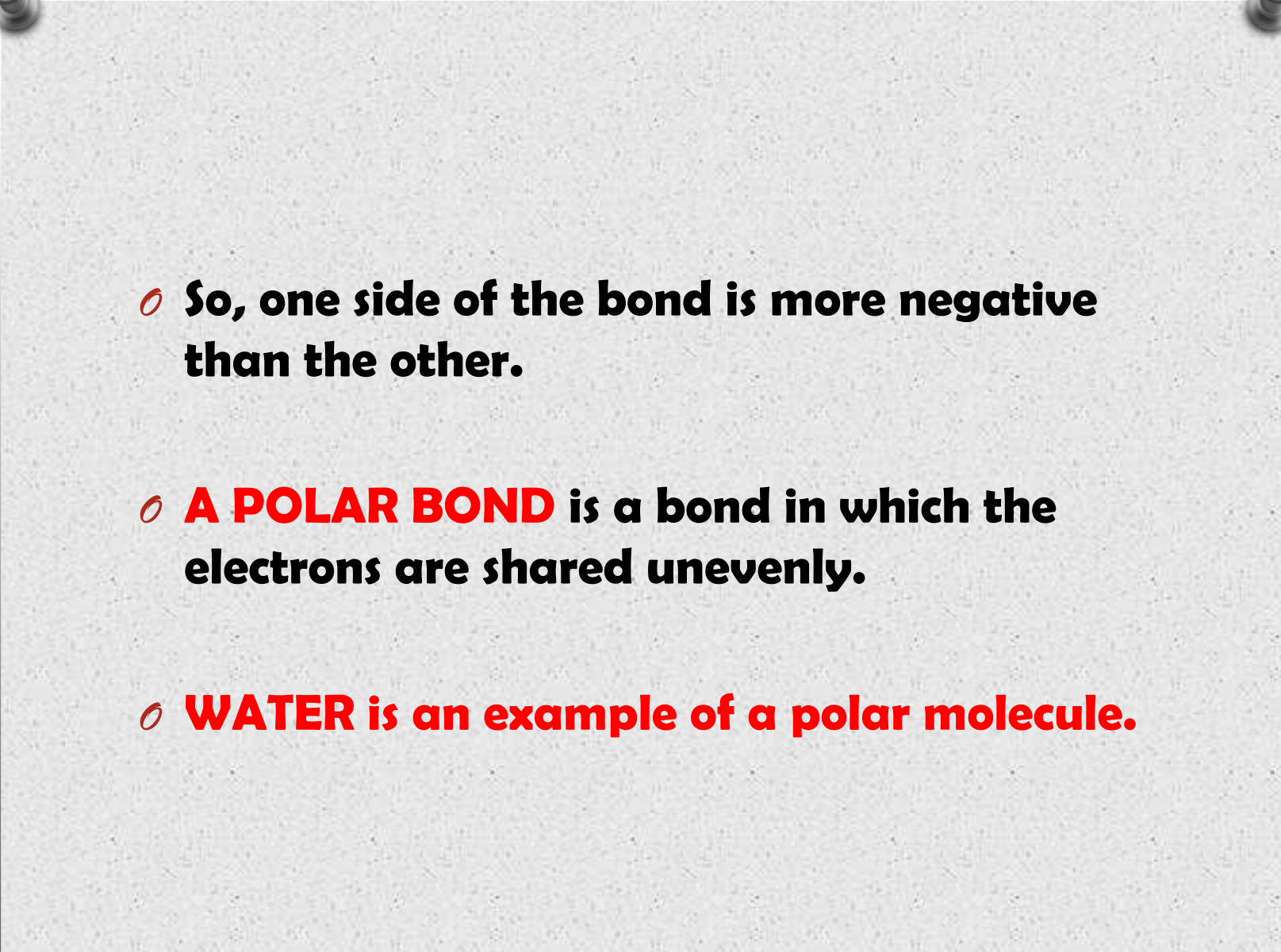


o When **THREE** pairs of electrons are shared by two atoms, the bond is called a **TRIPLE BOND**.

o Create a Lewis structure showing two Nitrogen atoms combining.

# **POLAR AND NONPOLAR MOLECULES**

- o Do atoms always share electrons equally?**
- o No, some have a greater attraction for electrons than others do.**
- o Ex. Chlorine attracts electrons more strongly than hydrogen does, so the electrons tend to spend more time near the chlorine atom.**



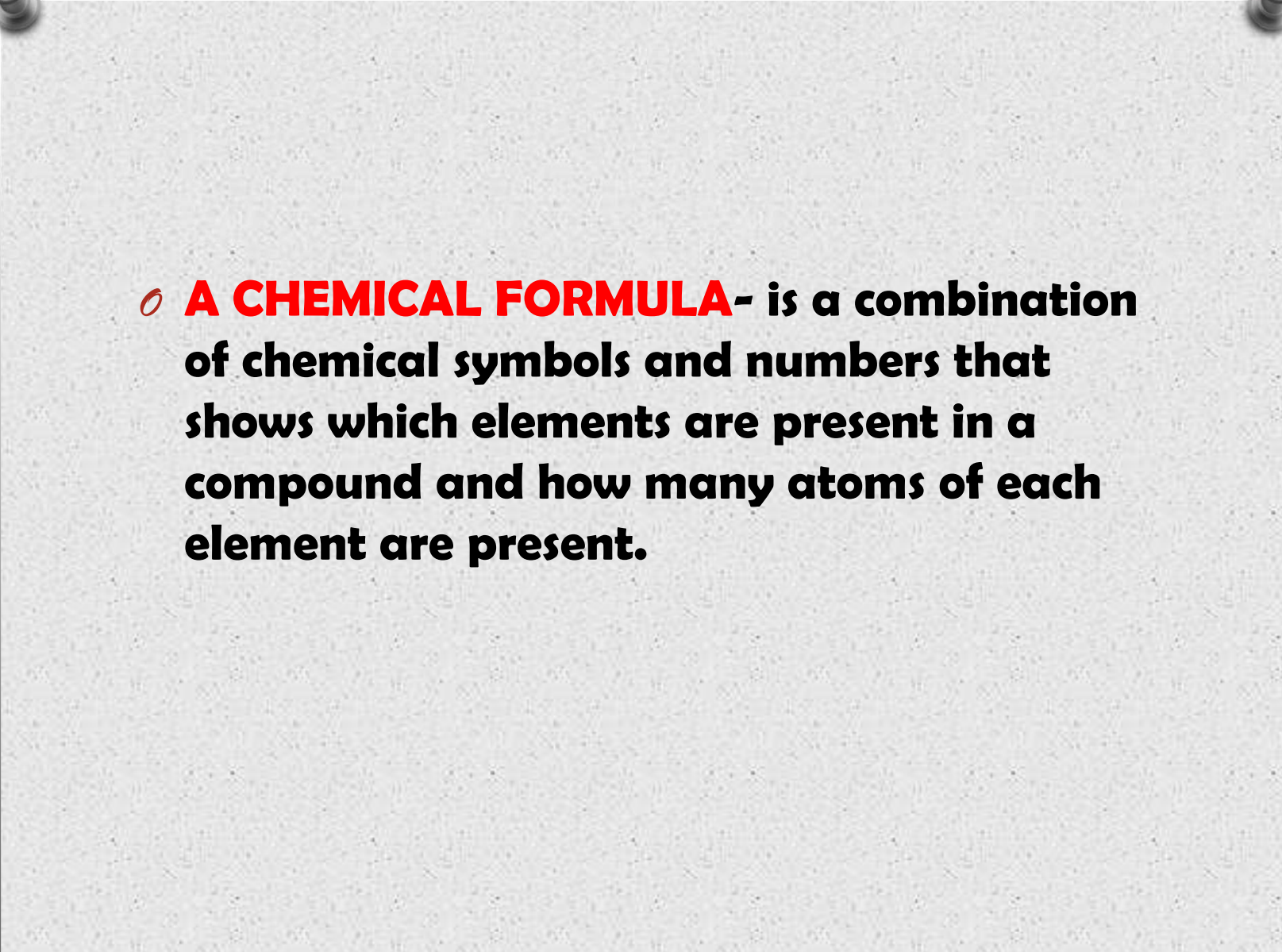
○ So, one side of the bond is more negative than the other.

○ **A POLAR BOND** is a bond in which the electrons are shared unevenly.

○ **WATER** is an example of a polar molecule.

# CHEMICAL SHORTHAND

- o **Symbols for atoms-symbols to represent the elements**
- o **Symbols for compounds- use element symbols and numbers**
- o **You are familiar with H<sub>2</sub>O**
- o **The 2 is called a 'subscript'**



o **A CHEMICAL FORMULA**- is a combination of chemical symbols and numbers that shows which elements are present in a compound and how many atoms of each element are present.

# Bond Formation

- o View this brief video about bonding...
- o Ionic bonds
  - o <http://www.youtube.com/watch?v=T40sM8-SXso>

Let's try our hand at Chemical Bonds