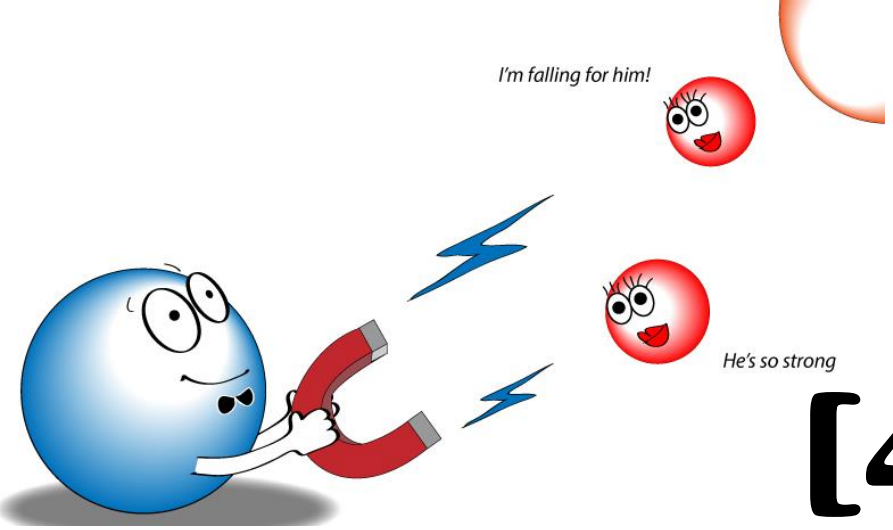
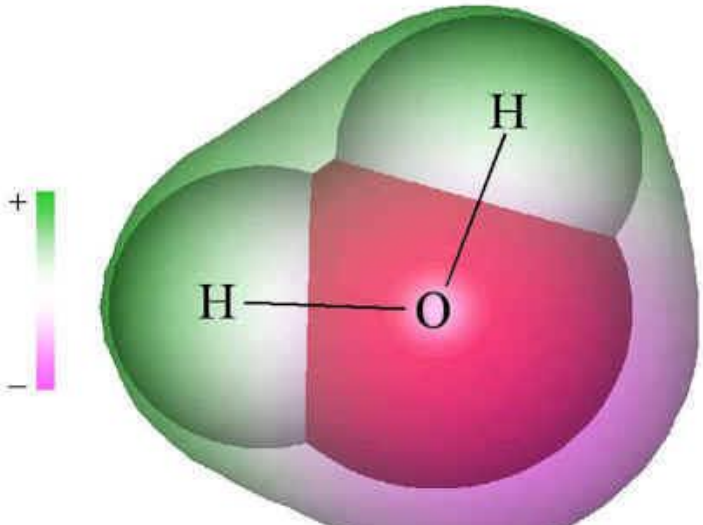


[4.4] Electronegativity and Polarity

This may be review, but it will help you on your quiz at the end of the class

Hebden Textbook pg. 199-201



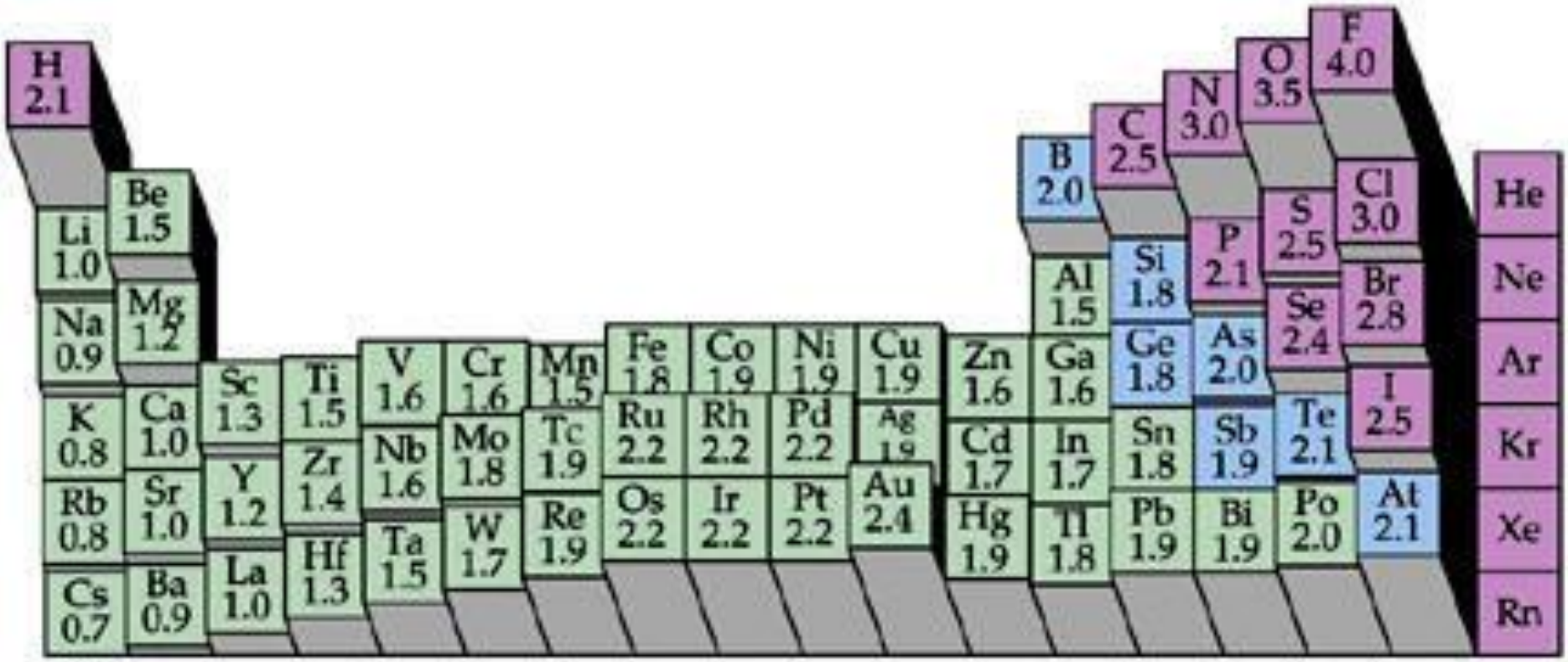
What is electronegativity?

- **Electronegativity**: the ability of an atom to attract **bonding electrons** to itself.

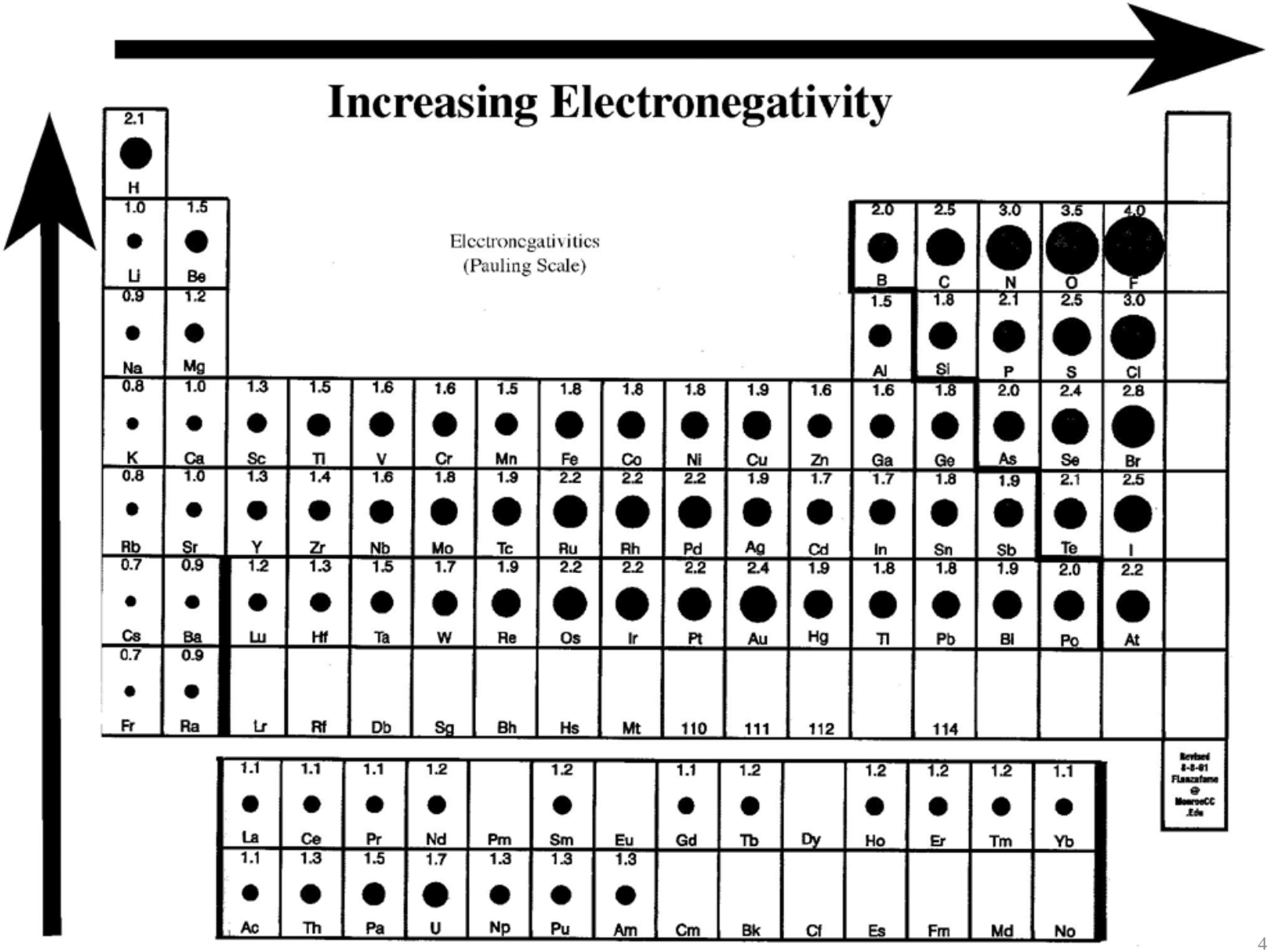
Li	Be	B											C	N	O	F
1.0	1.5	2.0											2.5	3.0	3.5	4.0
Na	Mg	Al											Si	P	S	Cl
0.9	1.2	1.5											1.8	2.1	2.5	3.0
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br
0.8	1.0	1.3	1.5	1.6	1.6	1.5	1.8	1.8	1.8	1.9	1.6	1.6	1.8	2.0	2.4	2.8
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I
0.8	1.0	1.2	1.4	1.6	1.8	1.9	2.2	2.2	2.2	1.9	1.7	1.7	1.8	1.9	2.1	2.5
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At
0.7	0.9	1.1–1.2	1.3	1.5	1.7	1.9	2.2	2.2	2.2	2.4	1.9	1.8	1.8	1.9	2.0	2.2
Fr	Ra	Ac	Th	Pa	U	Np–No										
0.7	0.9	1.1	1.3	1.5	1.7	1.3										

Electronegativity Trend

- Electronegativity **increases** as you go from **left to right**
- Electronegativity **increases** as you go **from bottom to top**

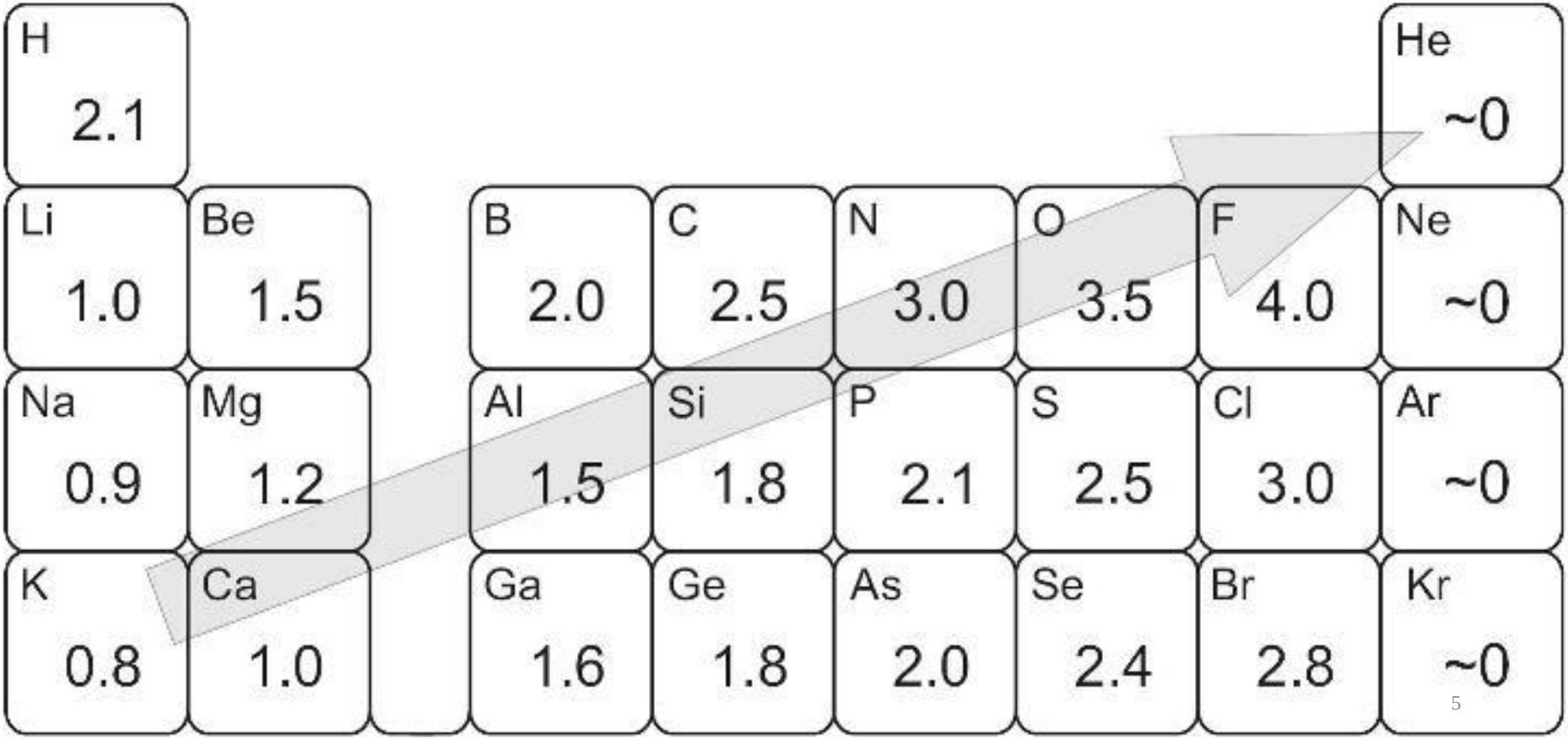


Electronegativity Trend



Electronegativity Chart

You will be given these values on the test/ exam ☺

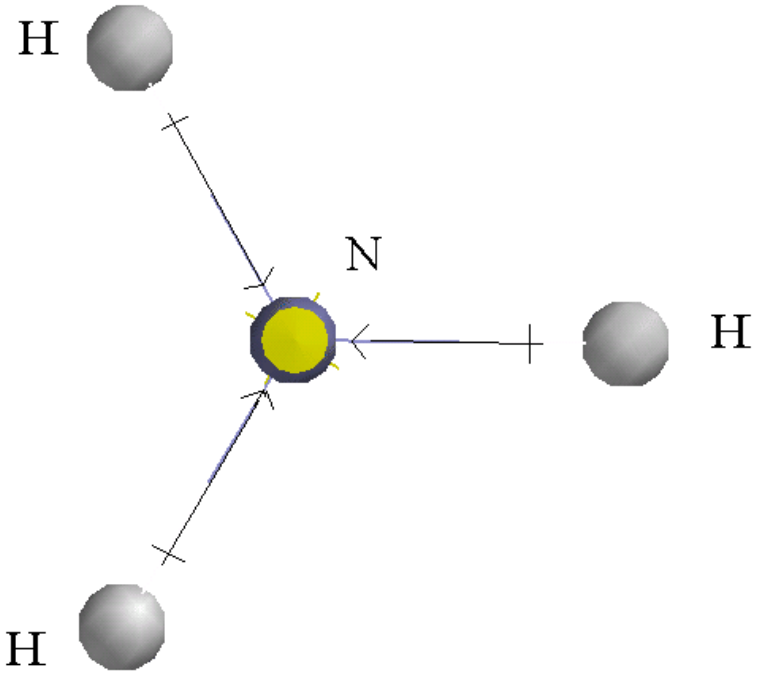


Electronegativity Difference

- **Electronegativity difference (ΔEN)** is the difference in electronegativities of two bonded atoms or ions.

Example: The electronegativity difference for N-H:

ΔEN of N-H = 3.0 – 2.1
= 0.9



Practice Problems

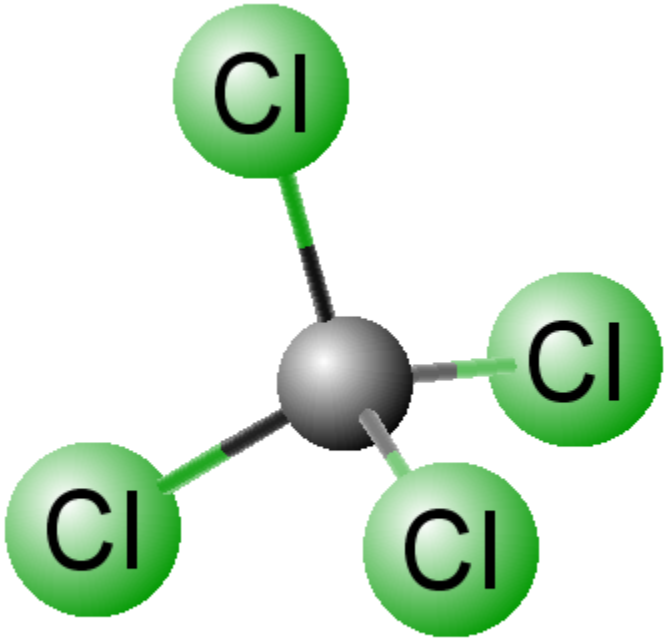
What are the ΔEN of the following bonds:

1. C-H =

2. O-H =

3. H-H =

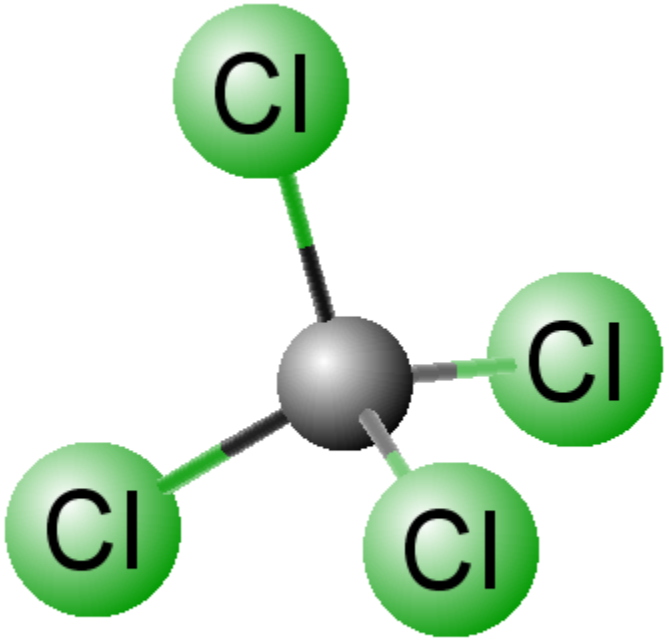
4. Ca-F =



Practice Problems

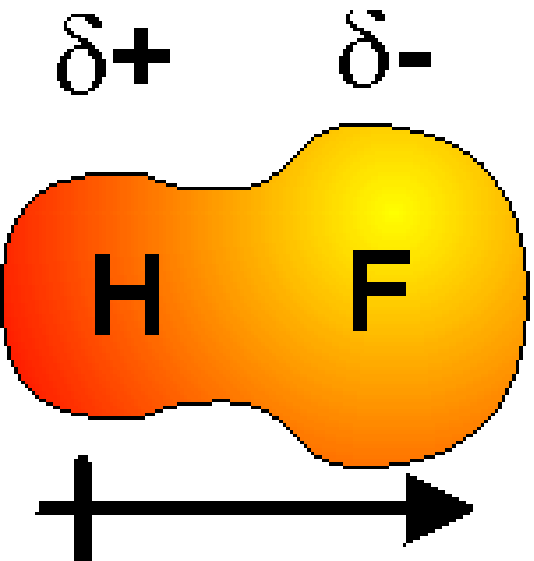
What are the ΔEN of the following bonds:

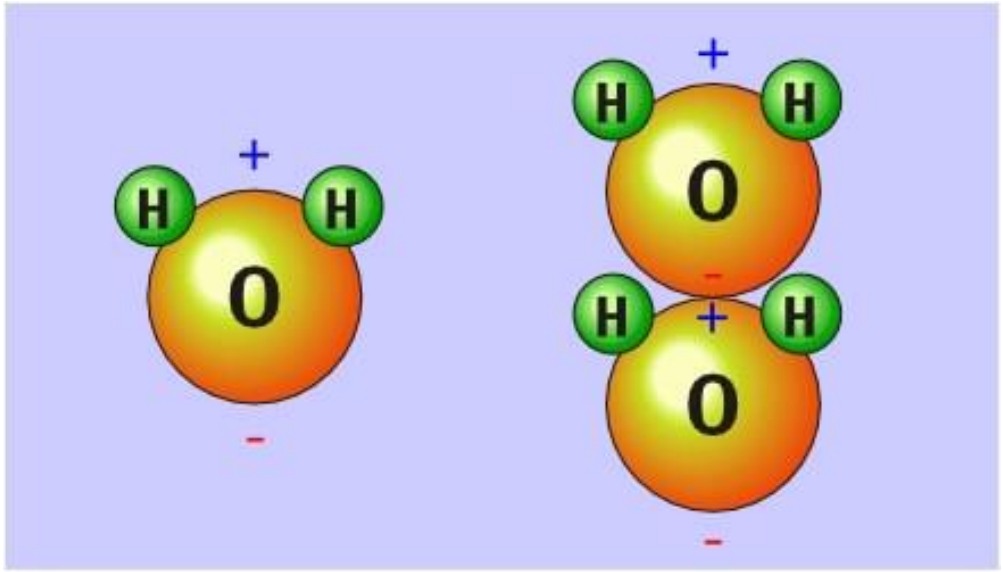
1. C-H = **2.5-2.1 = 0.4**
2. O-H = **3.5 – 2.1 = 1.4**
3. H-H = **2.1 – 2.1 = 0**
4. Ca-F = **|1.0 – 4.0| = 3.0**



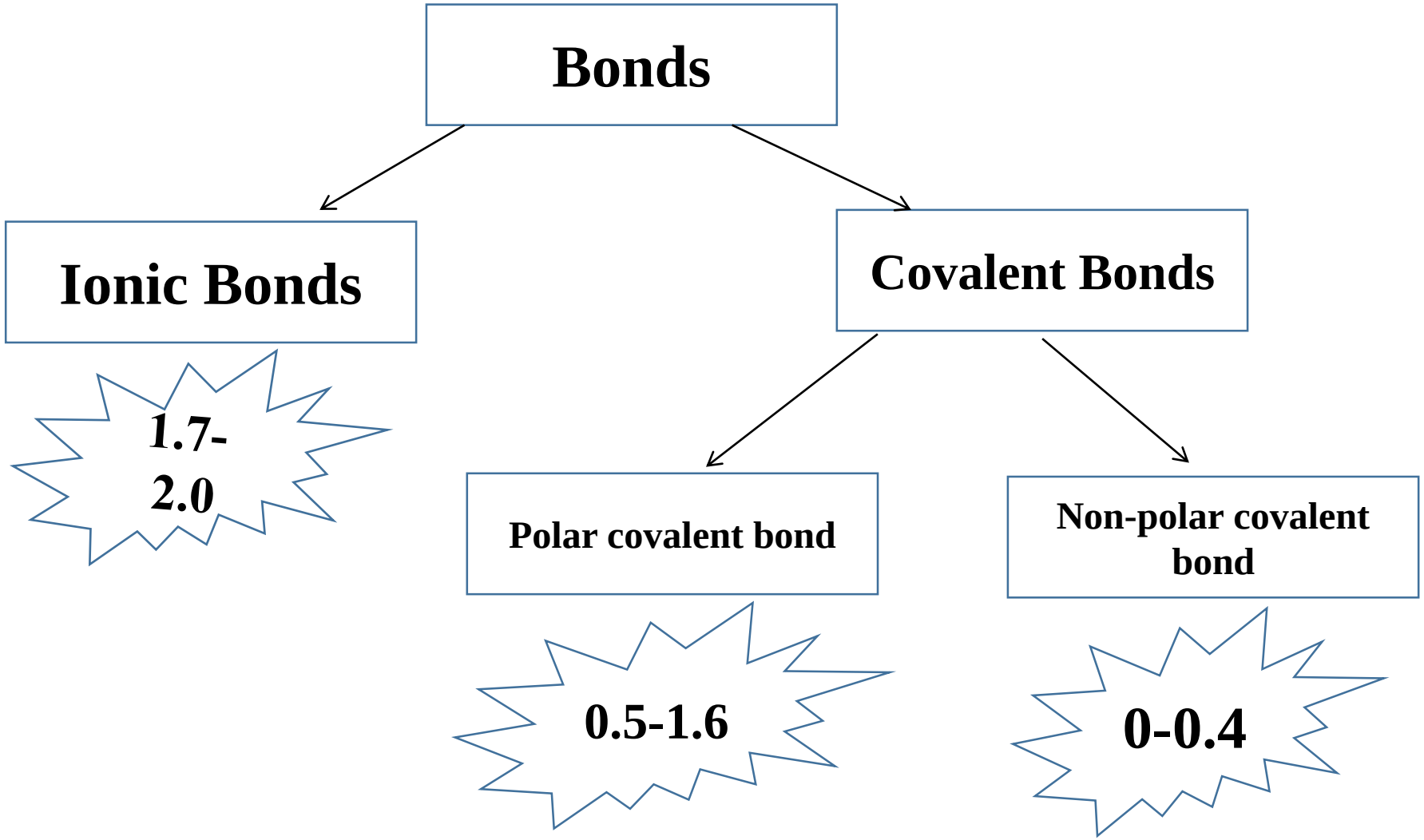
Electronegativity in Bonds

- Electronegativity can create localized charges in a molecule. These localized regions are called "**poles**" (**negative poles and positive poles**)
- **Negative poles** occur around the atoms with the **higher electronegativity**, because it tends to pull the electrons towards itself.
- **Positive poles** occur around the atoms with **lower electronegativity**, because they are do not attract the bonding electrons to themselves as much

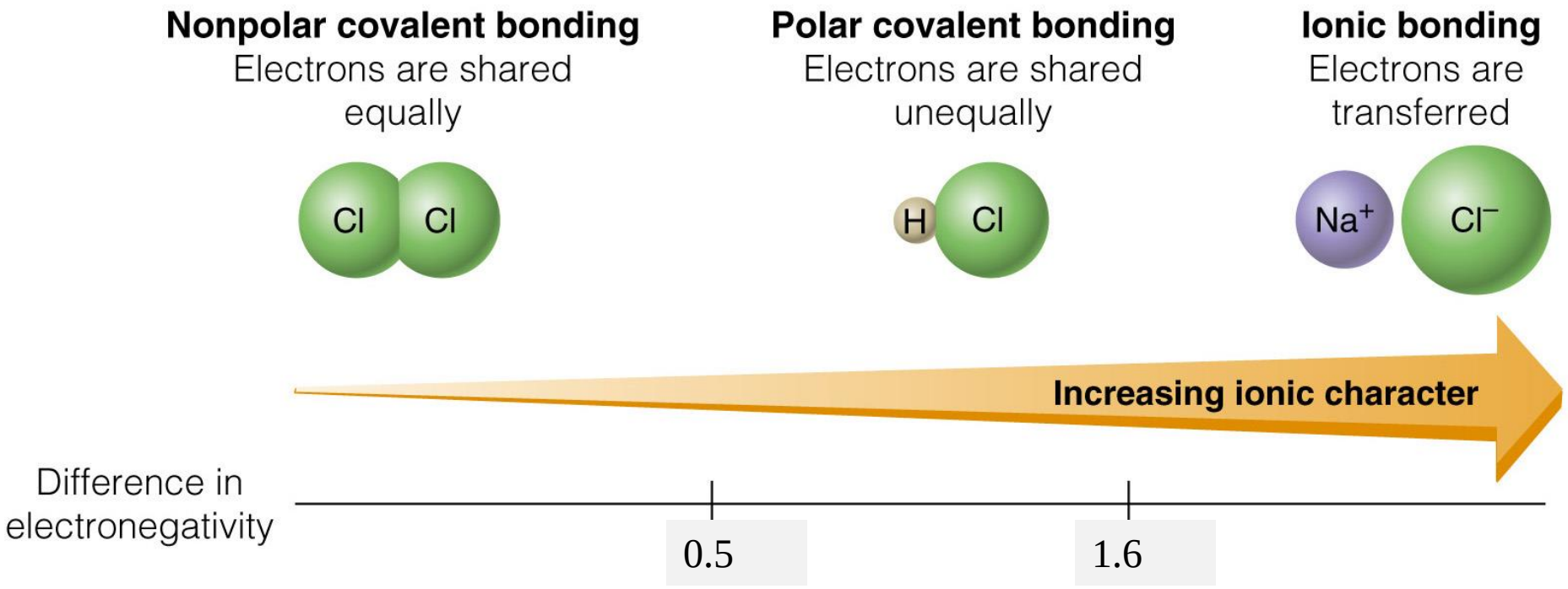




Electronegativity in Bonds

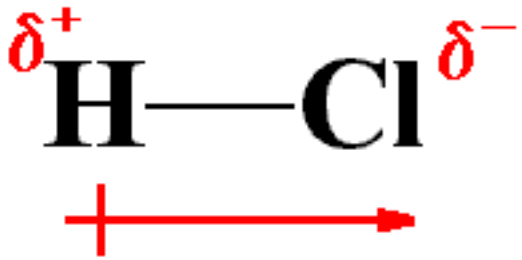


Electronegativity in Bonds

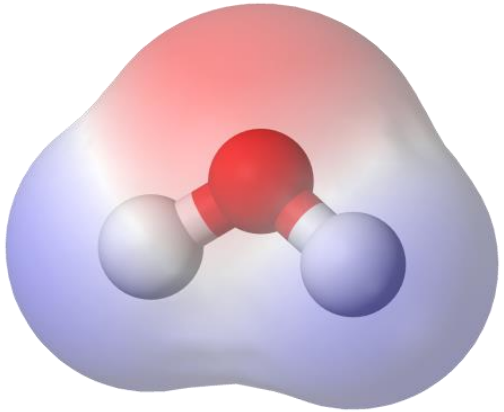


Molecular Polarity

- **Polar molecule:** a molecule in which there is an **uneven** distribution of electrons. This results in a positive charge at one end and a negative charge at the other end.
- **Non-polar molecule:** a molecule in which the electrons are **equally** distributed among the atoms, and therefore no localized charges.
- **Dipole moment:** contains a magnitude and direction in which charges are distributed. This is responsible for negative poles and positive poles



Dipole Moment has a Magnitude and a Direction



Determining Polarity

To figure out if a molecule is polar or non-polar, you must:

1. Draw it's structural formula

2. Look at the electronegativity differences of the individual bonds in the molecule

You try!

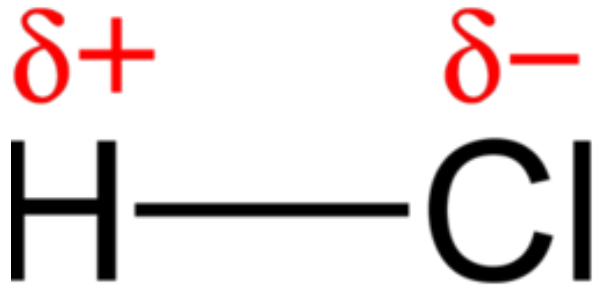
- **Is HCl polar or non-polar?**
- **Is CO_2 polar or non-polar?**

Is HCl polar or non-polar?

Is CO_2 polar or non-polar?

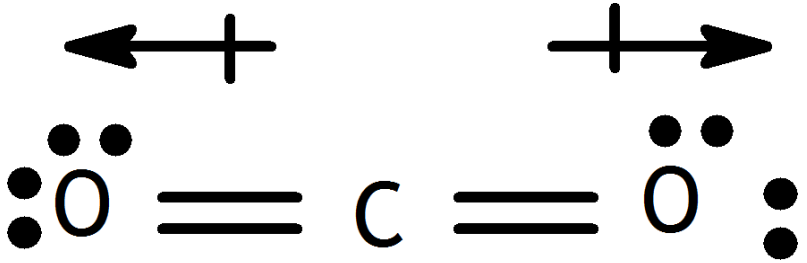
Is HCl polar or non-polar?

HCl is polar because there is unequal sharing of electrons with an electronegativity difference of 0.9



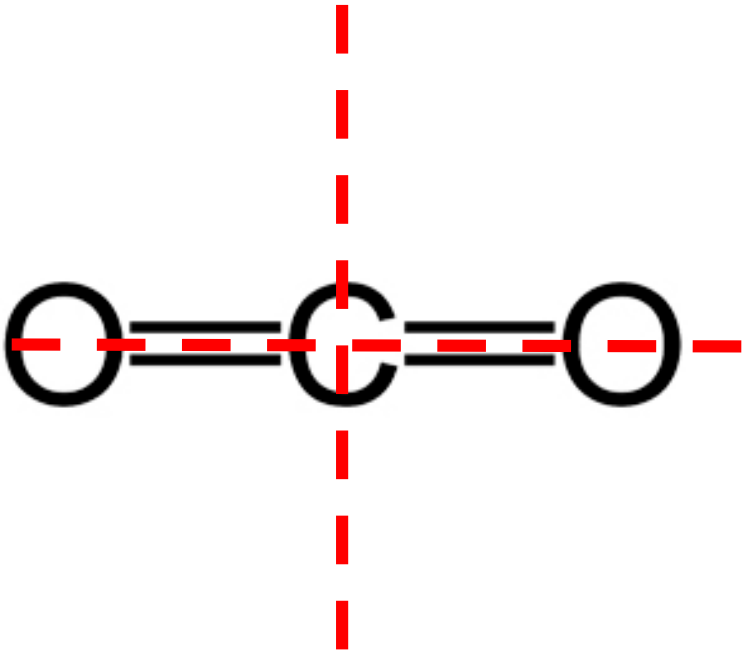
Is CO_2 polar or non-polar?

CO_2 is non-polar because there is equal sharing of electrons because both oxygen atoms are pulling at carbon's electrons **equally**



Polarity & Symmetry

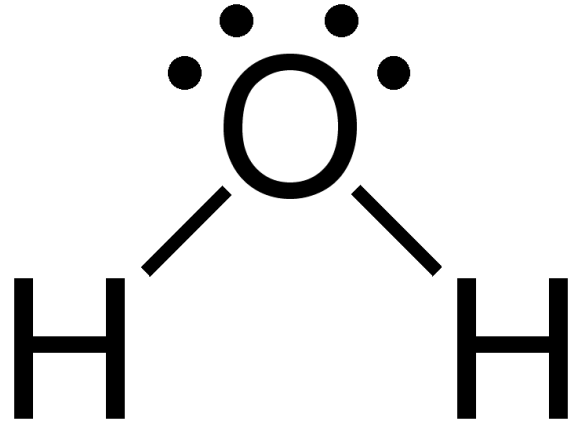
- Even if the individual bonds in a molecule are polar bonds, the overall molecule can be non-polar if it is **symmetrical.**
- If the molecule has **two** lines of symmetry, then the compound is non-polar



The C-O bond has an electronegativity difference of 0.8 but the molecule is **non-polar** because there are two oxygen on either end making the compound **symmetrical**

Polarity & Symmetry

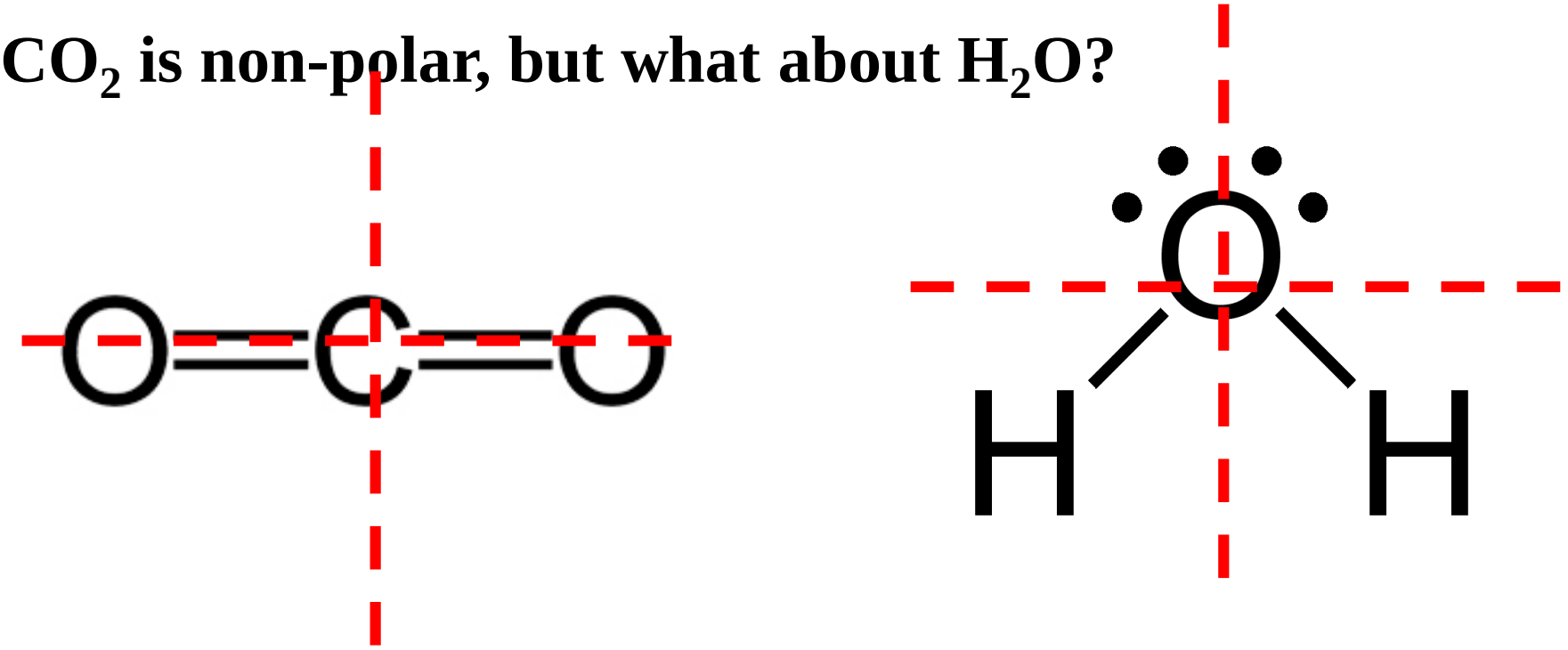
CO_2 is non-polar, but what about H_2O?



They both have a central element bonded to two other atoms of the same element.
They are both symmetrical.
But what is different?

Polarity & Symmetry

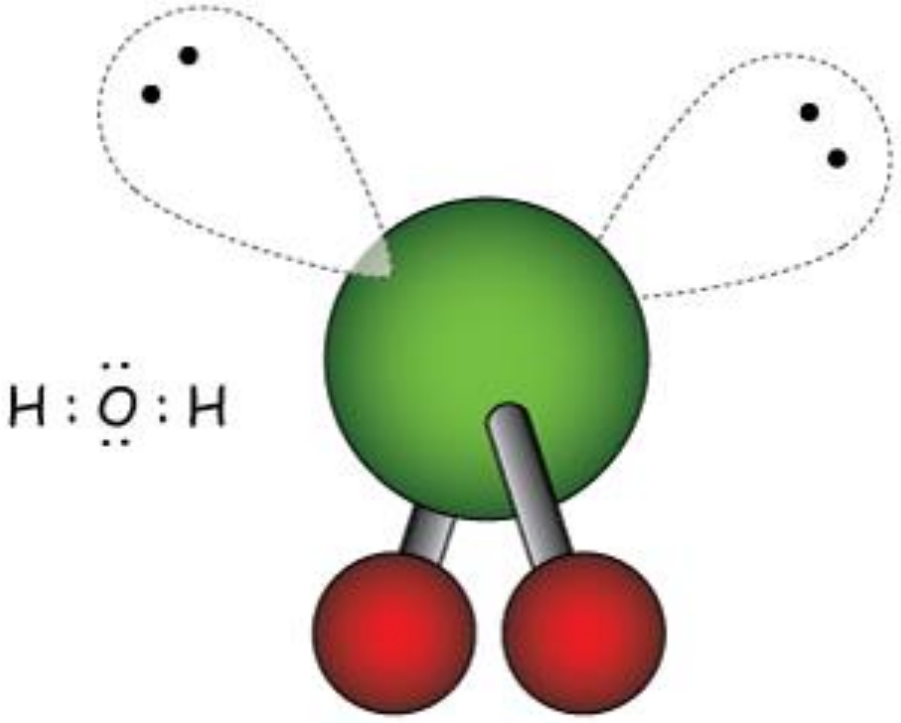
CO_2 is non-polar, but what about H_2O?



CO_2 has **two** lines of symmetry, but H_2O only has **one**, so H_2O is polar

Polarity & Lone Pairs

- Lone pairs can affect the magnitude of the dipole moment since they are more localized.
- As a result, the central atom has a high electron density, affecting the polarity of the molecule.
- Therefore, water is a **polar** molecule



Homework

- See attached sheet
- **Unit 4 Test will be next week so study mid-unit review sheet**
- Additional work problems in Student Workbook page 117-120