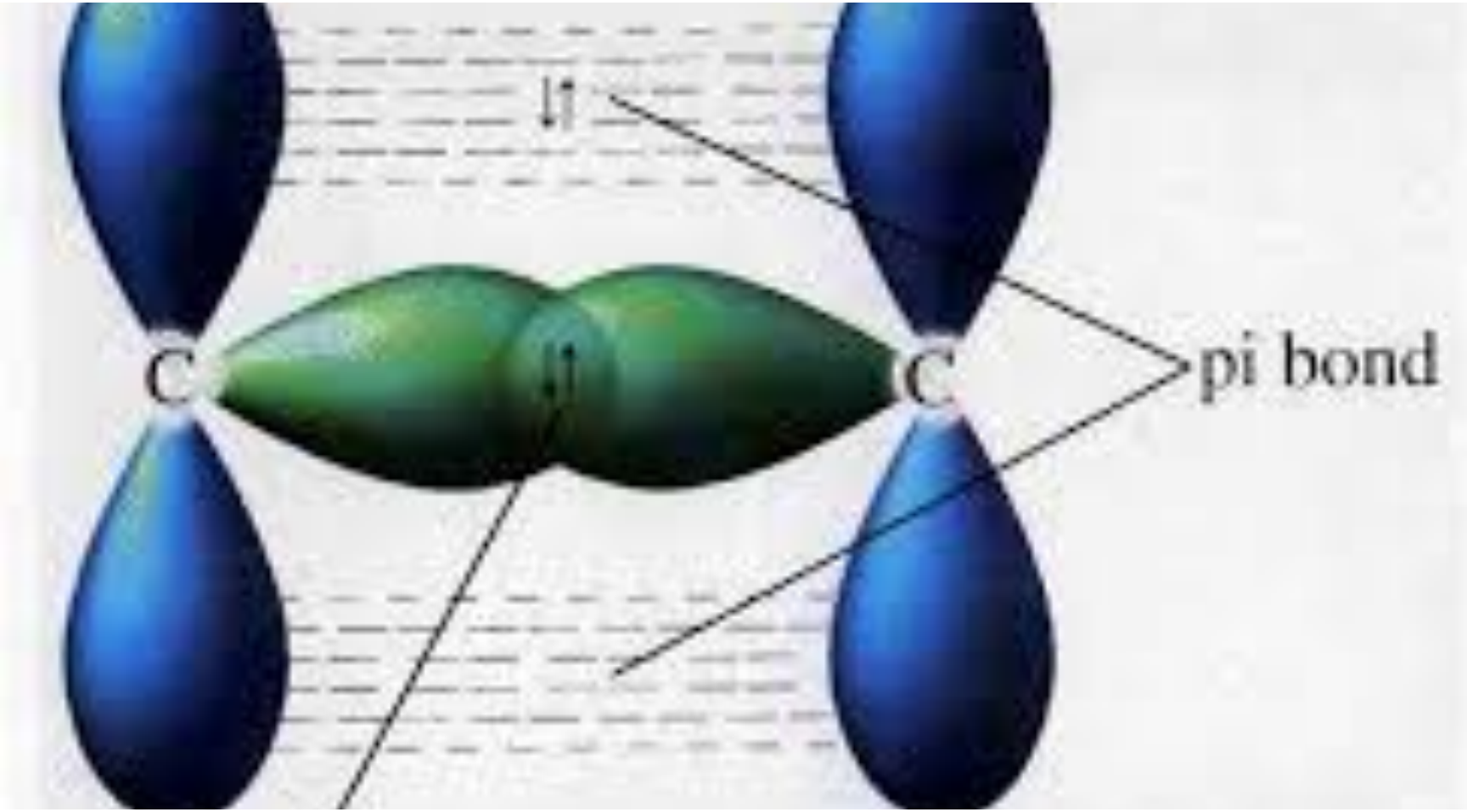
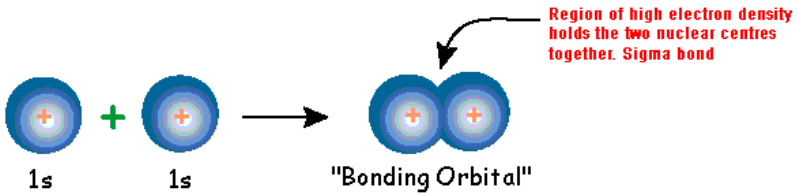
Sigma and pi bonding



σ and π bonding

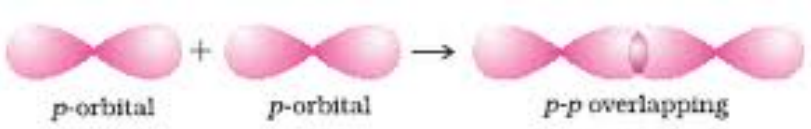
- σ bonding involves direct head-on overlap of orbitals. As a result the σ bond is stronger than a π bond.
- In a double bond(0_2) there is a σ and a π bond.
- In a triple bond (N_3) there is a σ and 2 π bonds.
- See pages 52 and 53 for more details

Hydrogen



- $1s^1$
- The one electron in the $1s^1$ is the only bonding electron
- There is a head-on overlap between two **s** orbitals. This is called a sigma bond.
- Make 2 s orbitals with balloons to demonstrate this. Each person in class blow up one balloon.

Chlorine



- Covalent bond
- $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p_x^2$, $3p_y^2$, $3p_z^1$

- The bonding electron is in the $3p_z^1$
- There is a head-on overlap between two **p** orbitals. This is called a sigma bond.

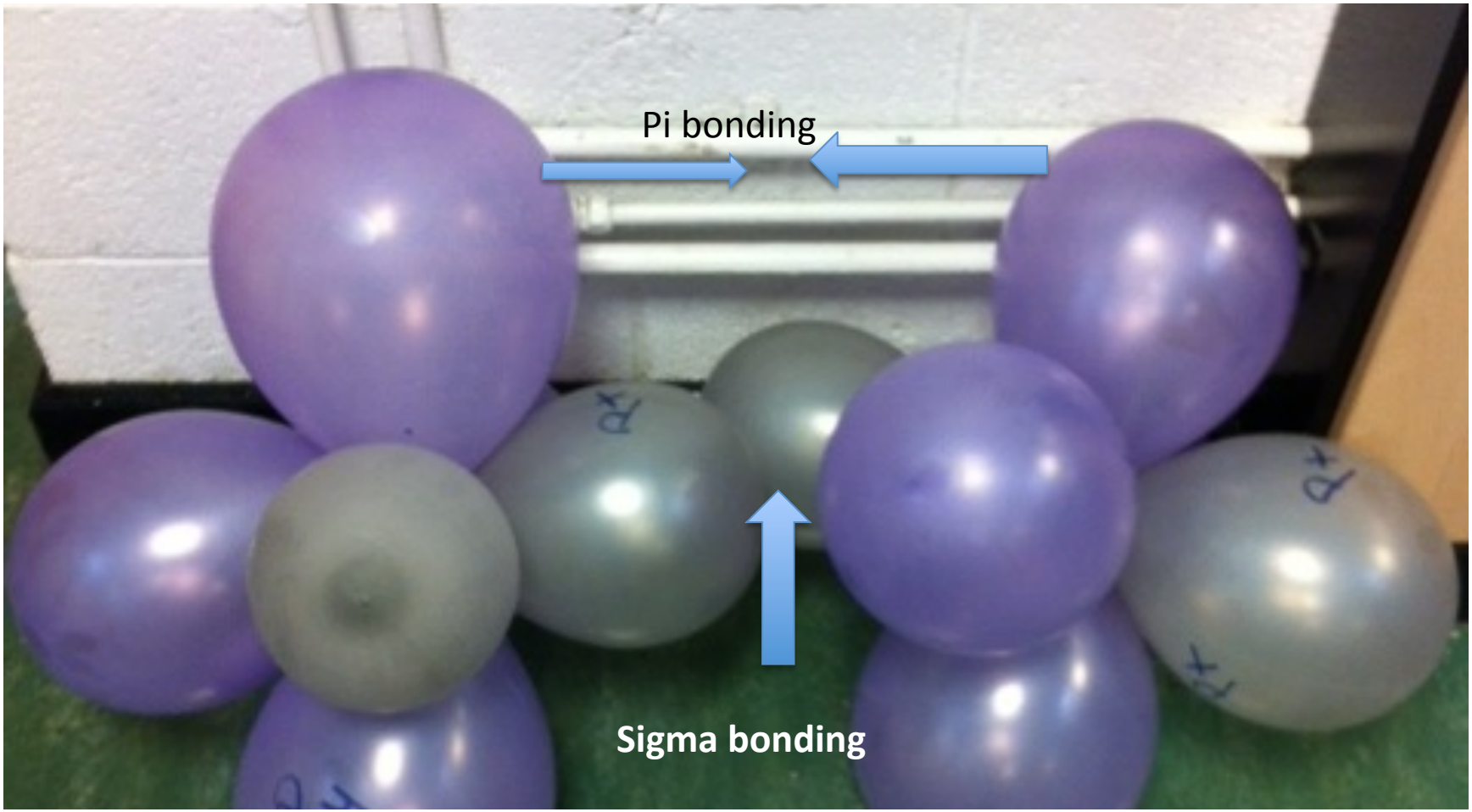
Oxygen

- Covalent bond
- Double bond
- $1s^2$, $2s^2$, $2p^2$
- The two electrons in the $2p^2$ are the bonding electrons
- The 2 electrons in the $2p^2$ are the bonding electrons
- $2p_x^1$, $2p_y^1$,
- Each of the bonding electrons are coming from a p orbital
- 1 sigma bond and 1 pi bond.
- Make 4 p orbitals with 8 balloons to demonstrate this.
- Each person in class blow up one balloon.

Nitrogen

- 3 bonds
- Triple bond
- $1s^2$, $2s^2$, $2p^3$
- The three electrons in the $2p^3$ are the bonding electrons
- $2p_x^1$, $2p_y^1$, $2p_z^1$
- Each of the bonding electrons are coming from a p orbital
- 1 sigma bond and two pi bonds
- Make 6 p orbitals with 12 balloons to demonstrate this.
- Each person in class blow up one balloon.

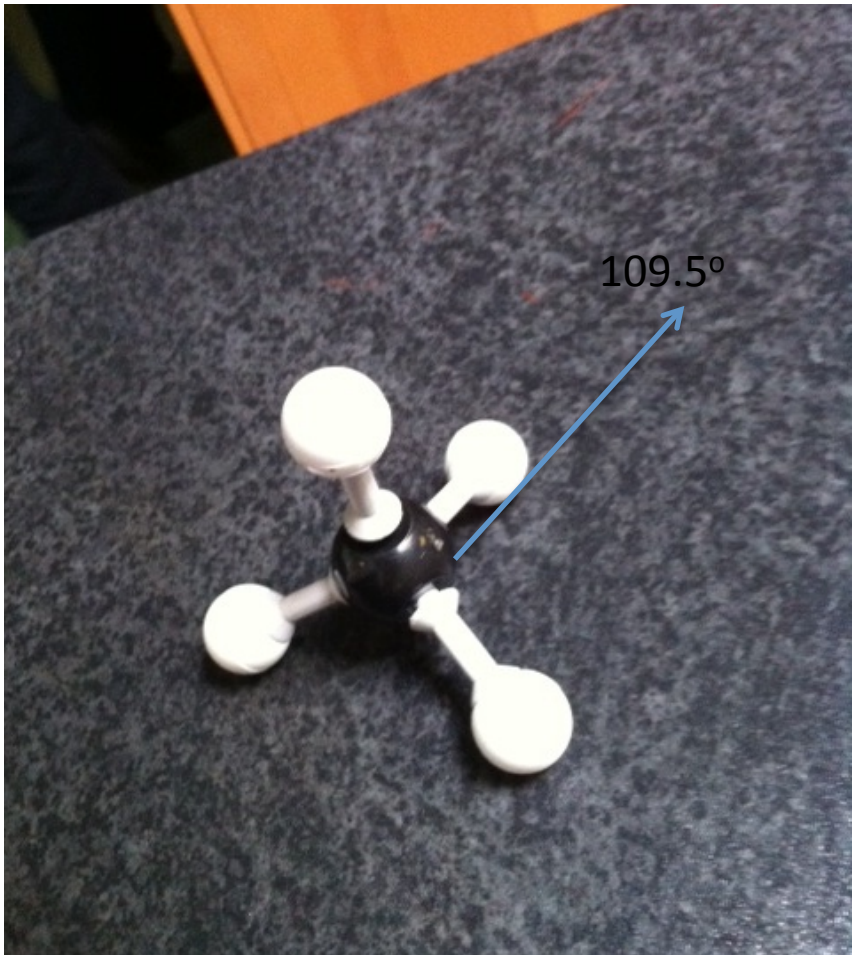
P-orbitals to demonstrate sigma and pi bonding



VSEPR Theory

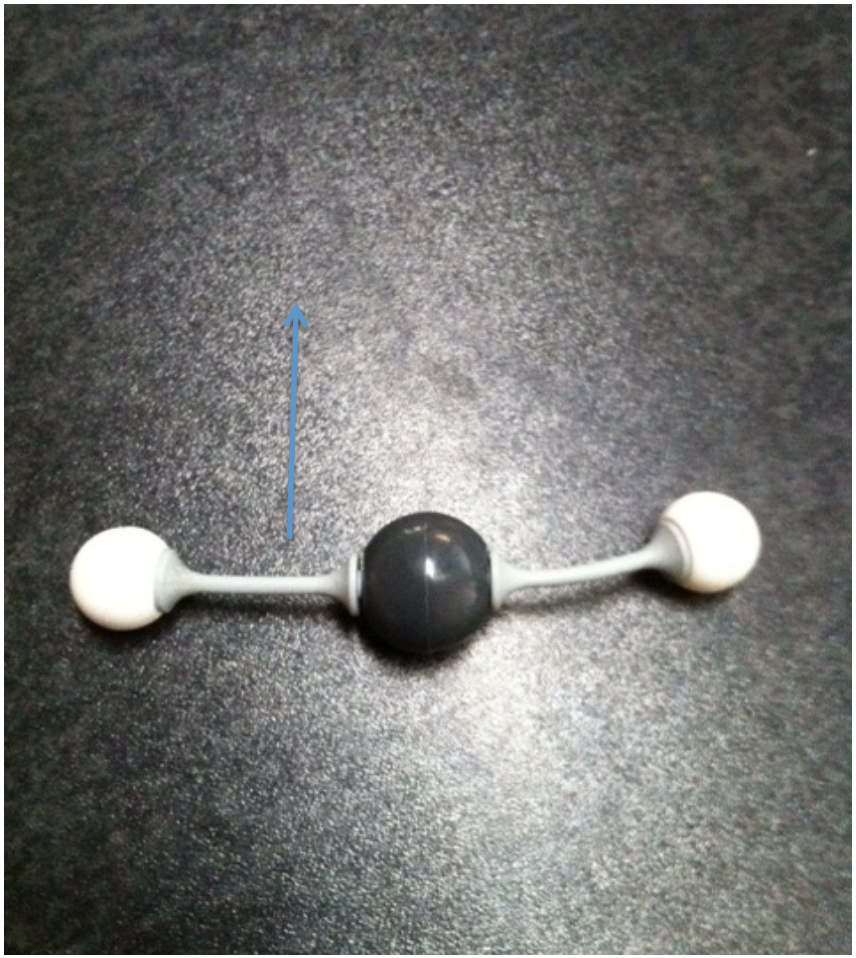
Valence Shell electron pair repulsion theory

Methane



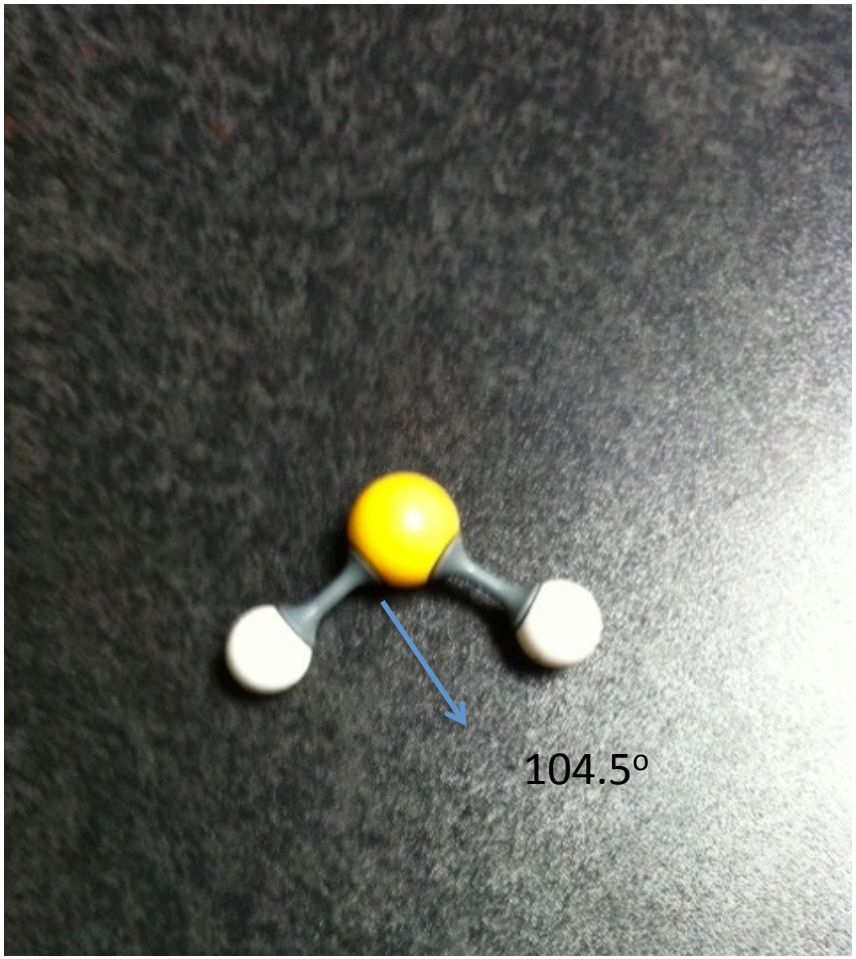
- CH_4
- Tetrahedral
- Bond angle 109.5^0
- No lone pairs
- 4 bonding pairs

Beryllium chloride



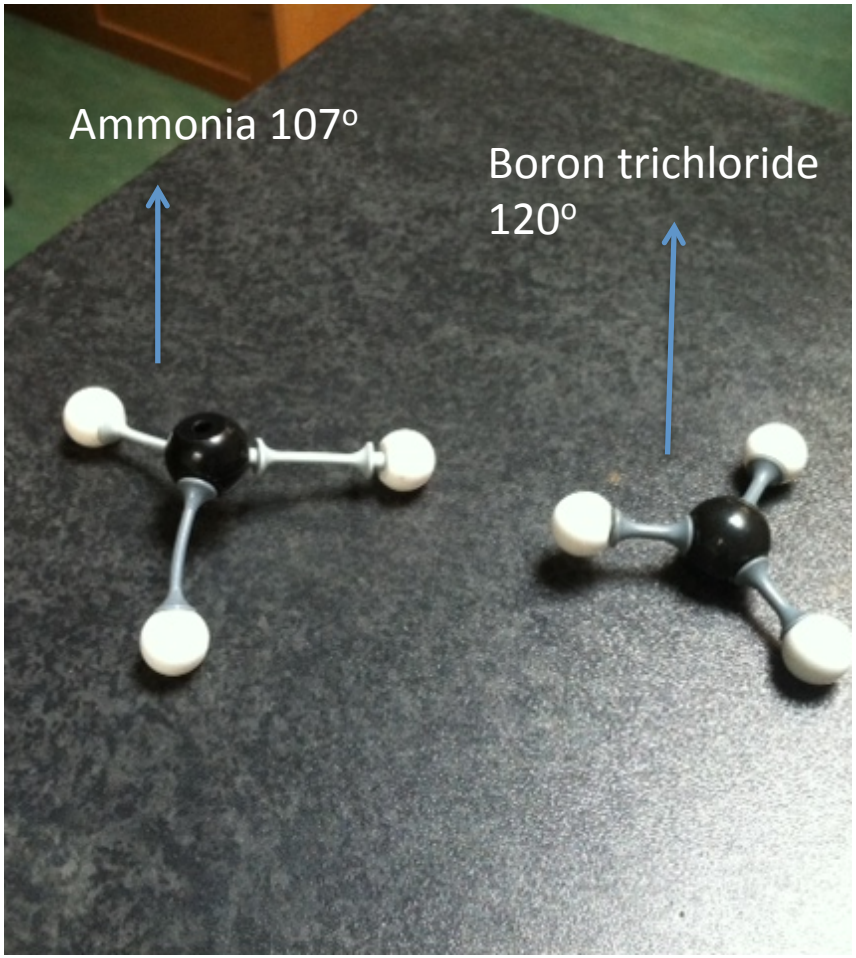
- 2 bonding pairs
- No lone pairs
- Linear shape
- Bond angle =180^{o}

Water



- V-Shaped
- Bond angle 104.5°
- 2 lone pairs
- 2 bonding pairs
- The 2 electrons of a lone pairs repel each other pushing the bonds closer together

Ammonia and Boron trichloride



- **Ammonia**
- 1 lone pair
- 3 bonding pairs
- Pyramidal
- Bond angle =107°
- **Boron Trichloride**
- No lone pairs
- 3 bonding pairs
- Trigonal planar
- Bond angle=120°