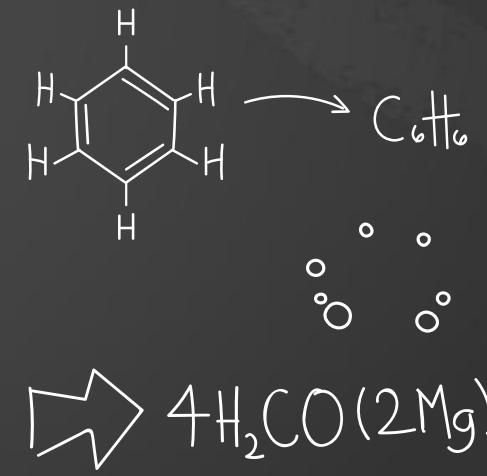
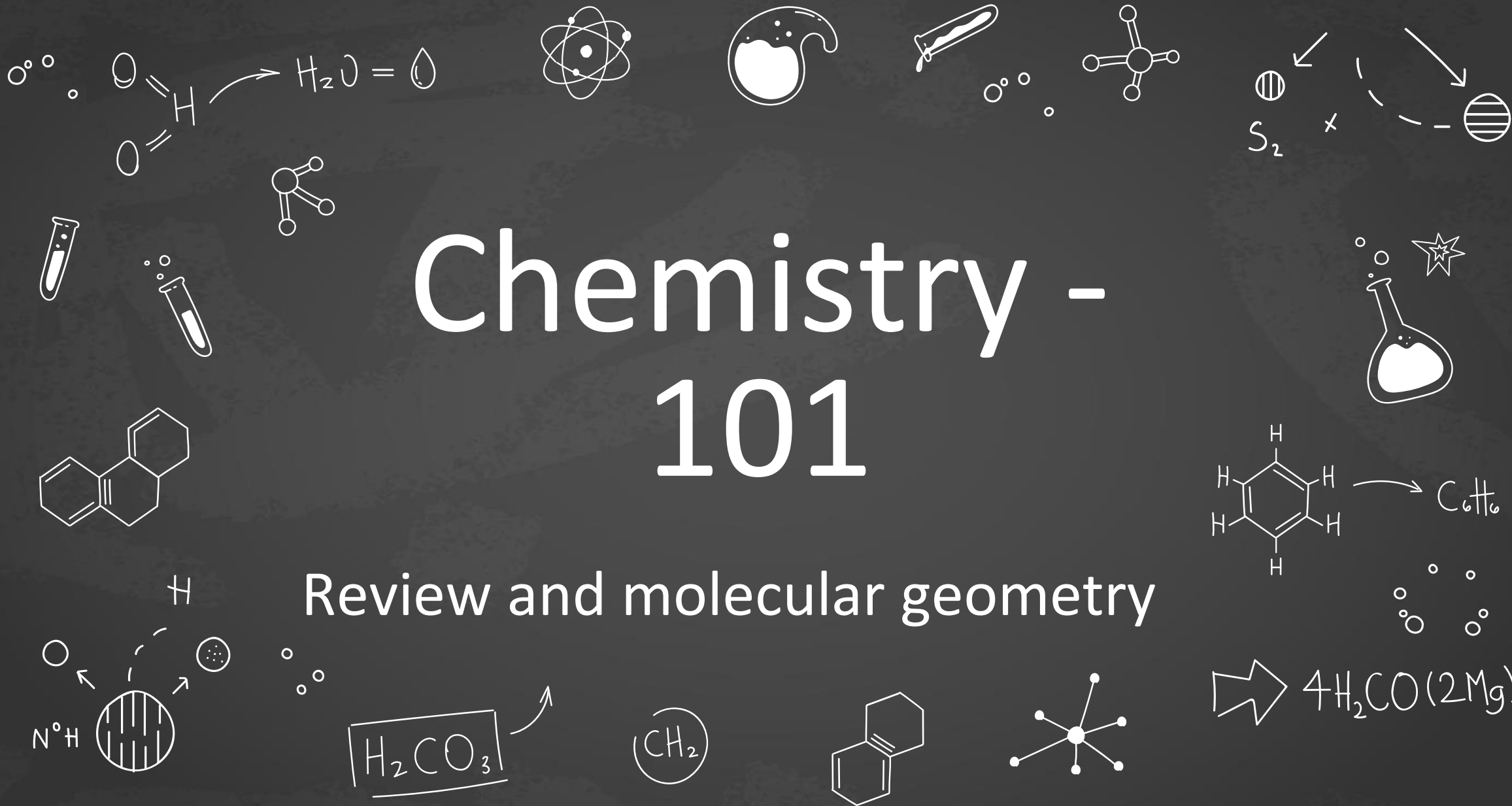


# Chemistry - 101

Review and molecular geometry



The valence is the number of electron pairs that binds the atom with other atoms

| Element | Valence         | Element | Valence    |
|---------|-----------------|---------|------------|
| H       | I               | Ba      | II         |
| Na      | I               | O       | II         |
| K       | I               | Zn      | II         |
| Ag      | I               | Sn      | II (IV)    |
| F       | I               | Pb      | II (IV)    |
| Cl      | I (III, V, VII) | Fe      | II, III    |
| Br      | I (III, V, VII) | Cr      | III, VI    |
| I       | I (III, V, VII) | S       | II, IV, VI |
| Hg      | I, II           | Al      | III        |
| Cu      | I, II           | N       | III (IV)   |
| Be      | II              | P       | III, V     |
| Mg      | II              | C       | IV         |
| Ca      | II              | Si      | IV (II)    |

The oxidation state, which may be positive, negative or zero, is the hypothetical charge that an atom would have if all bonds to atoms of different elements were 100% ionic, with no covalent component.

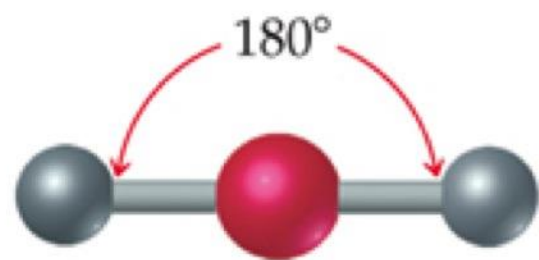
| Element | Electronegativity | Element | Electronegativity |
|---------|-------------------|---------|-------------------|
| Cs      | 0.79              | H       | 2.20              |
| K       | 0.82              | C       | 2.55              |
| Na      | 0.93              | S       | 2.58              |
| Li      | 0.98              | I       | 2.66              |
| Ca      | 1.00              | Br      | 2.96              |
| Mg      | 1.31              | N       | 3.04              |
| Be      | 1.57              | Cl      | 3.16              |
| Si      | 1.90              | O       | 3.44              |
| B       | 2.04              | F       | 3.98              |
| P       | 2.19              |         |                   |

# *Molecular geometry*

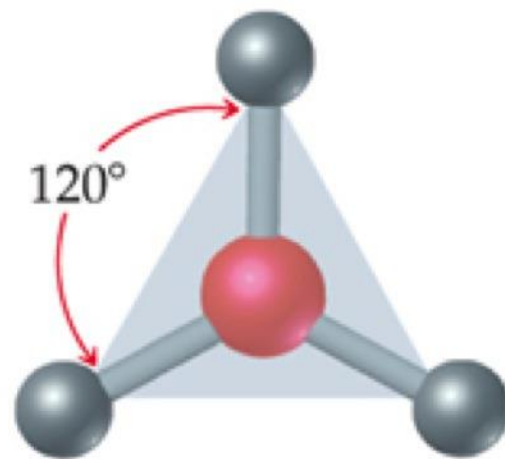
## *Valence shell electron pair repulsion (VSEPR) theory*

- Molecular geometry is the 3D arrangement of atoms within a molecule
- Chemical bonds and unbonded electron pairs or single electrons in a molecule repel, so they try to stay as far as possible from each other.
- The repulsion between unbound electrons (u.e.) is stronger than repulsion between bound electrons (b.e.). The repulsion decreases in the row:

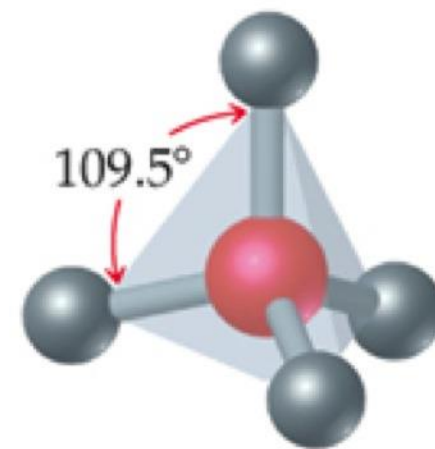
$$(u.e. / u.e. > u.e. / b.e. > b.e. / b.e.)$$



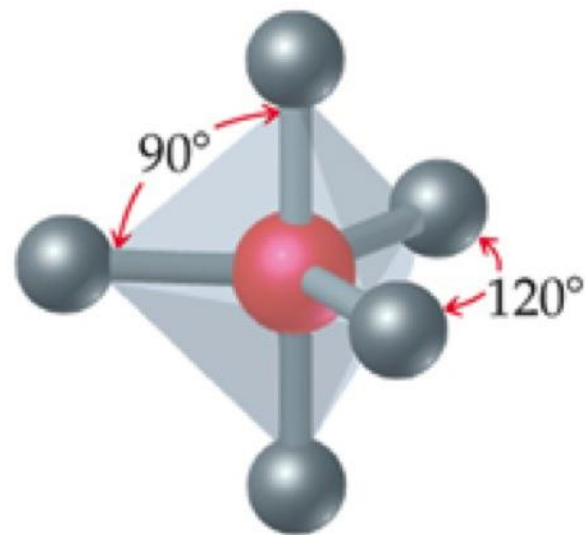
Linear



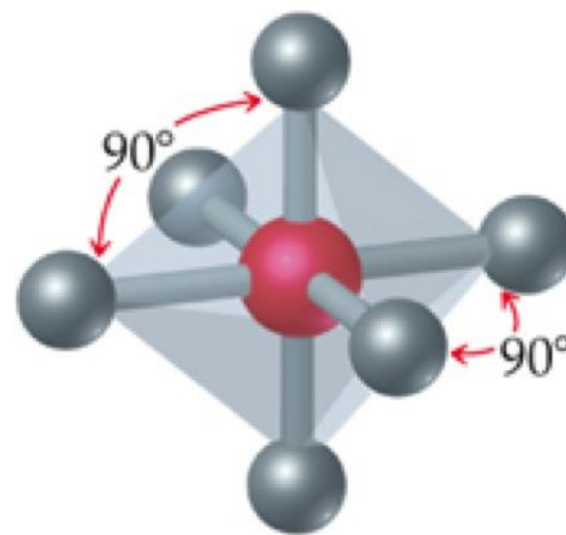
Trigonal planar



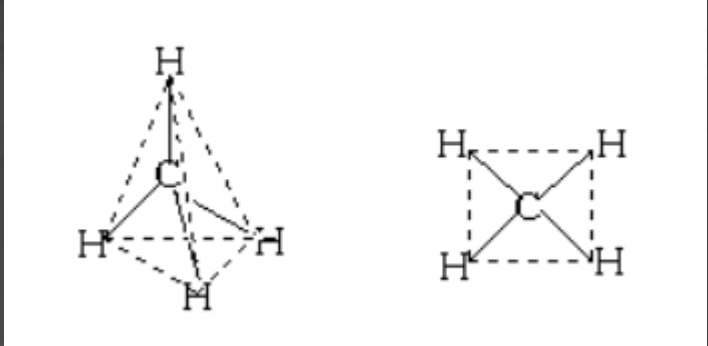
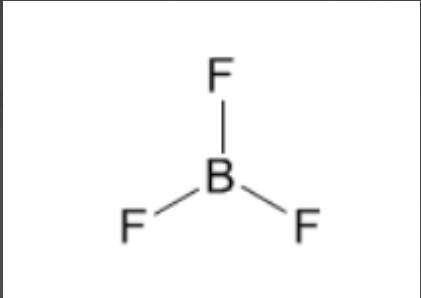
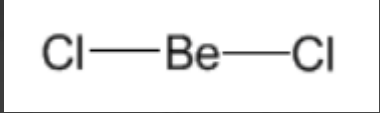
Tetrahedral



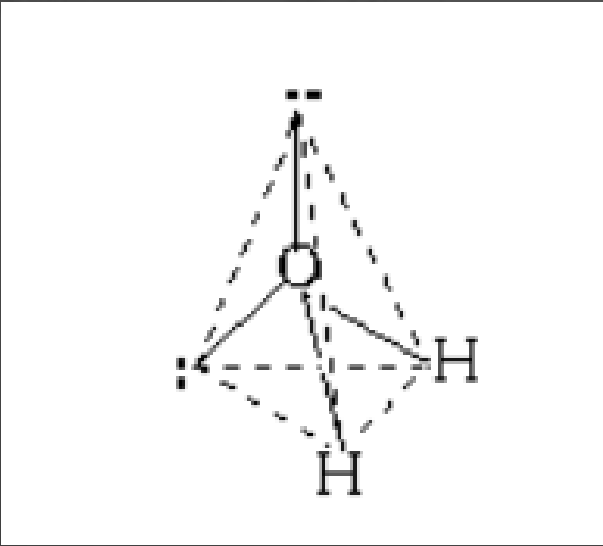
Trigonal bipyramidal



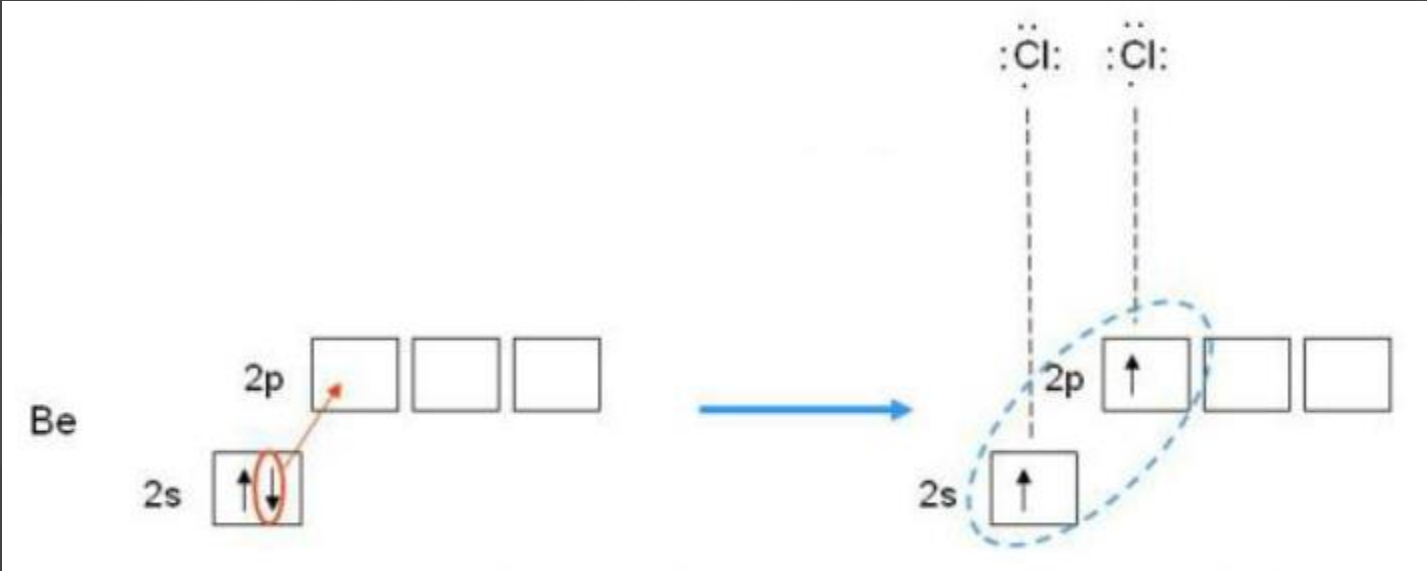
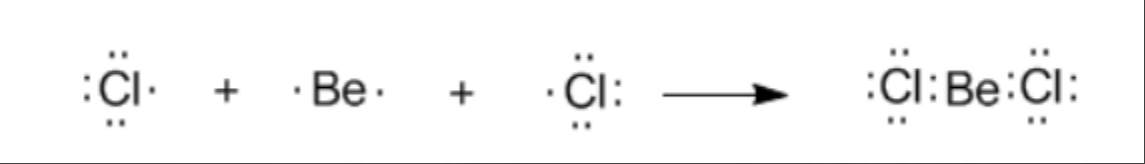
Octahedral



~109°

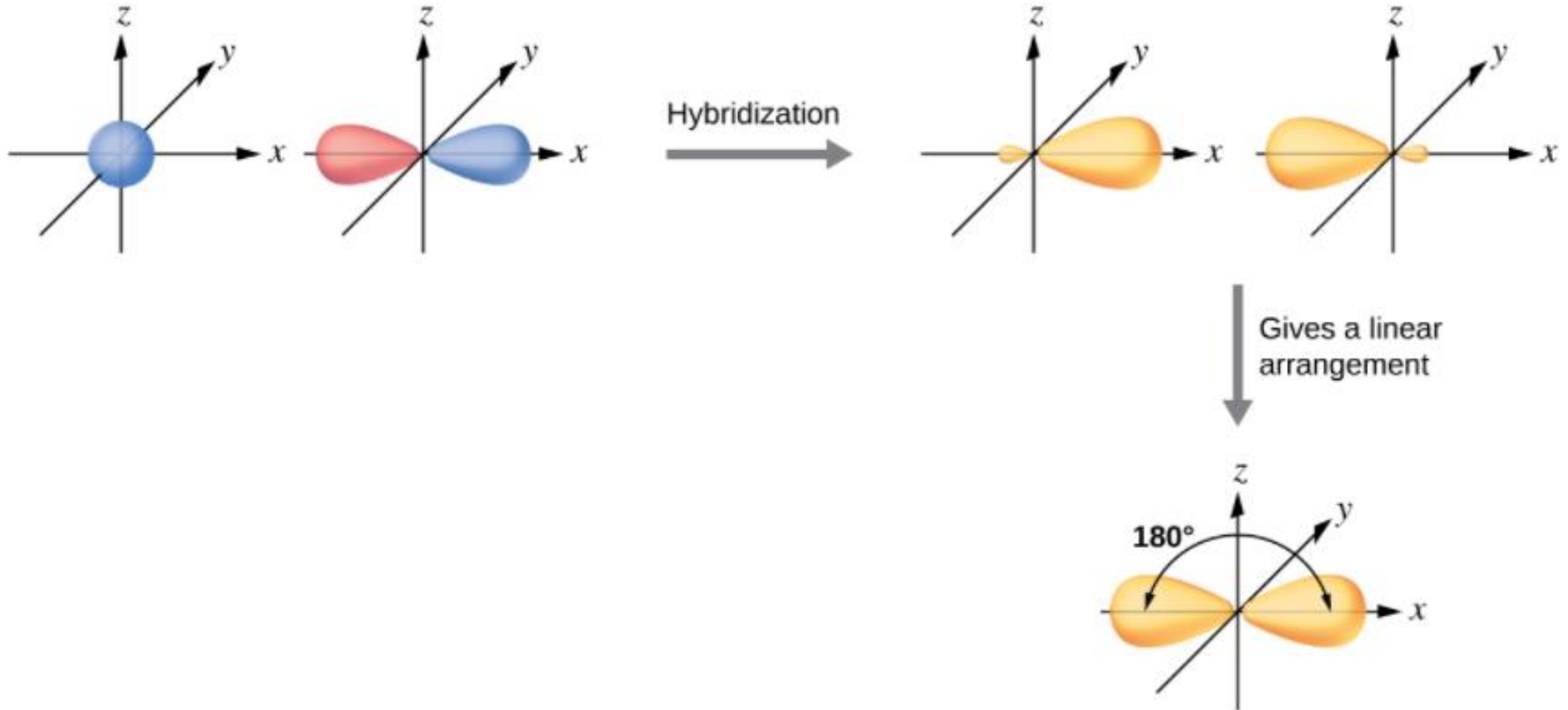


~105°

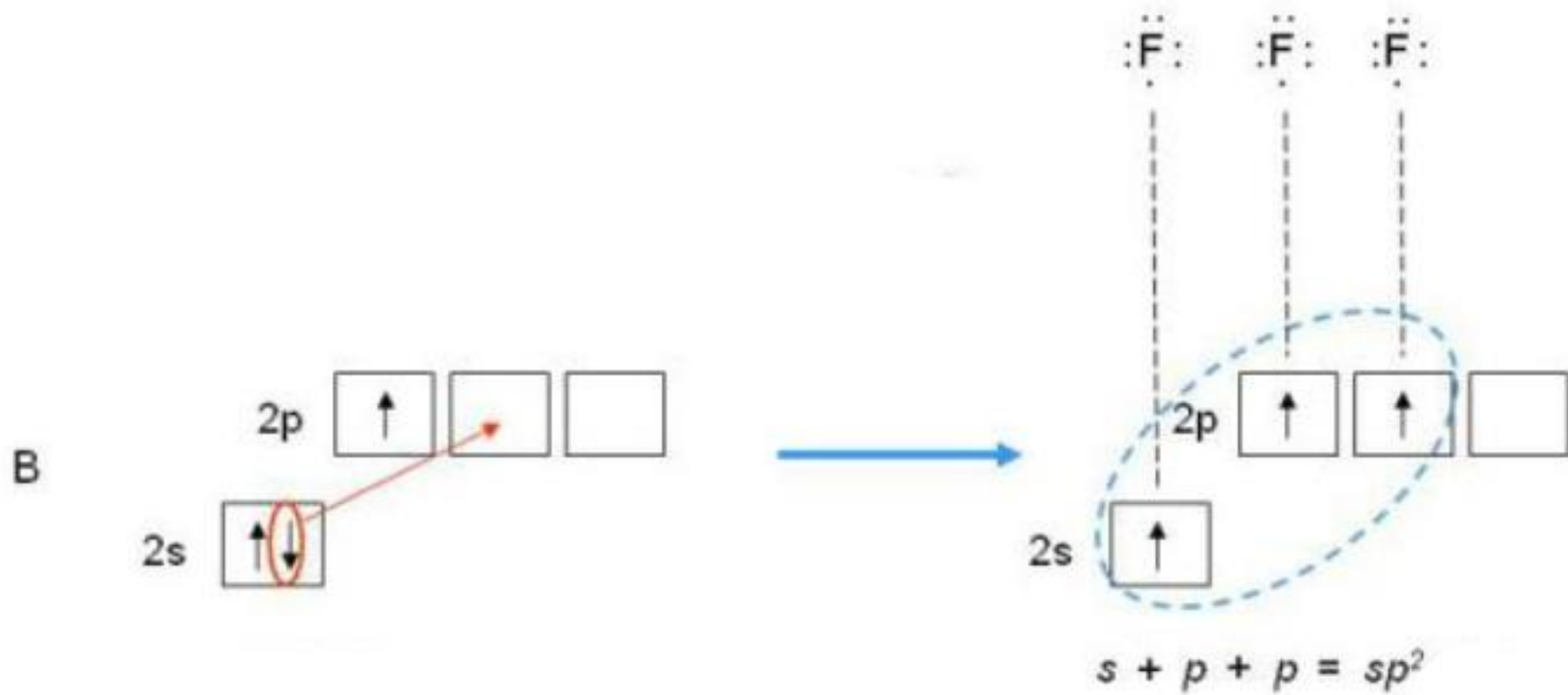


# Linear combination of atomic orbitals (LCAO) – hybridization

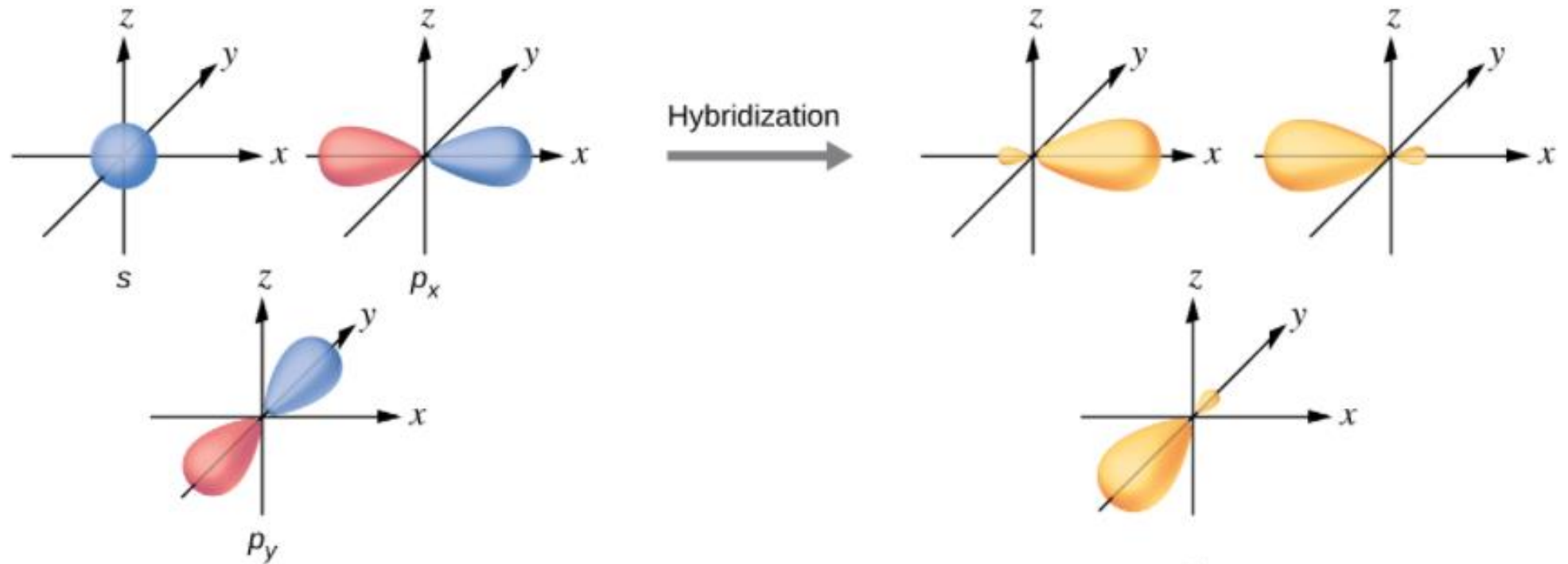
## 1. sp hybridization



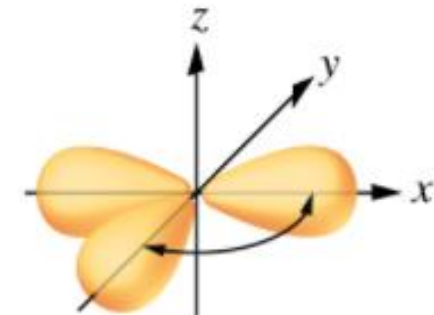


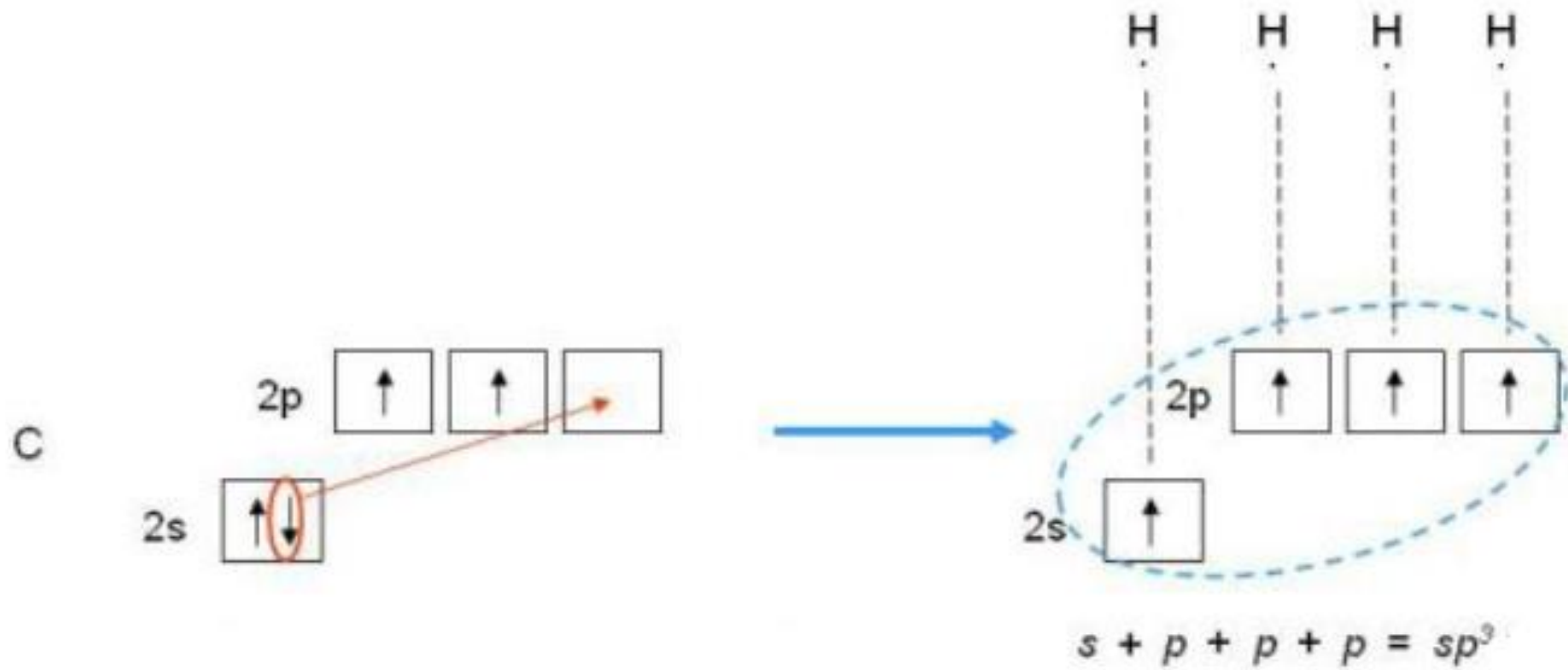
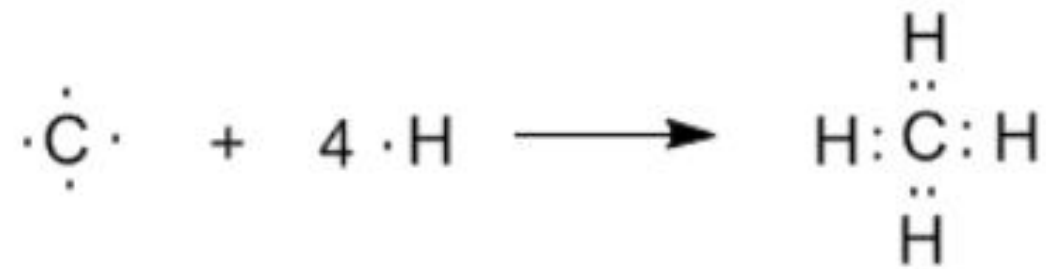


## 2. $sp^2$ hybridization

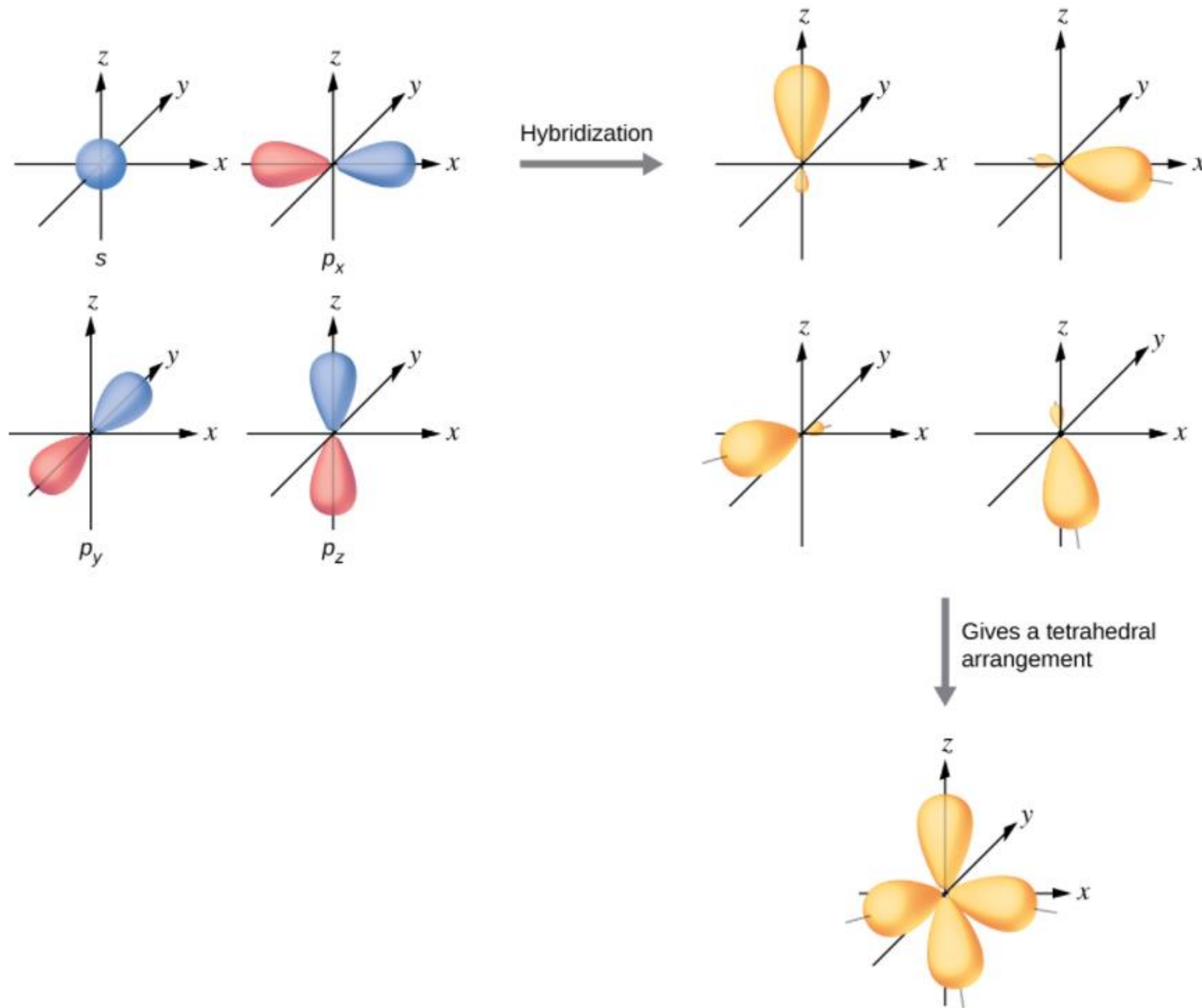




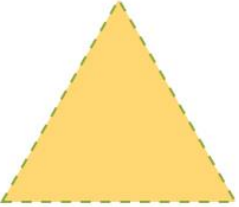
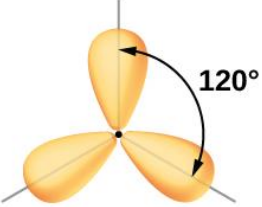
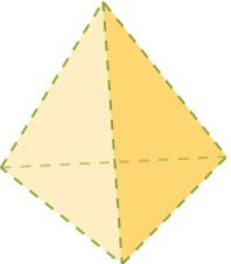
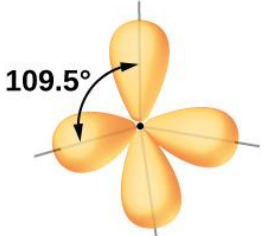
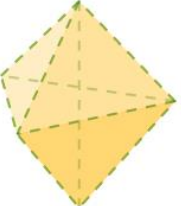
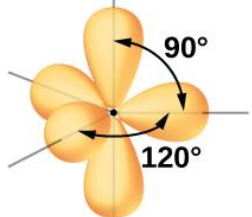
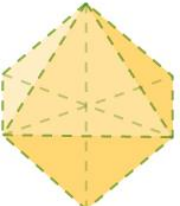
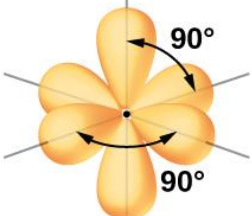
The number of hybrid orbitals is equal to the number of the original atomic orbitals.



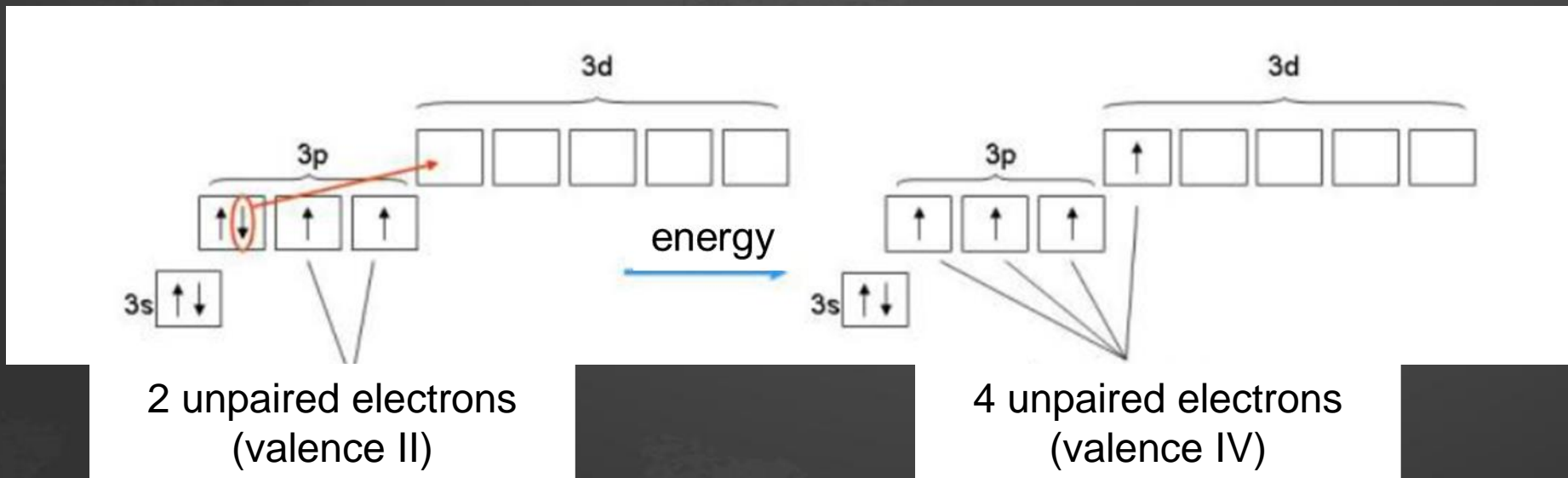
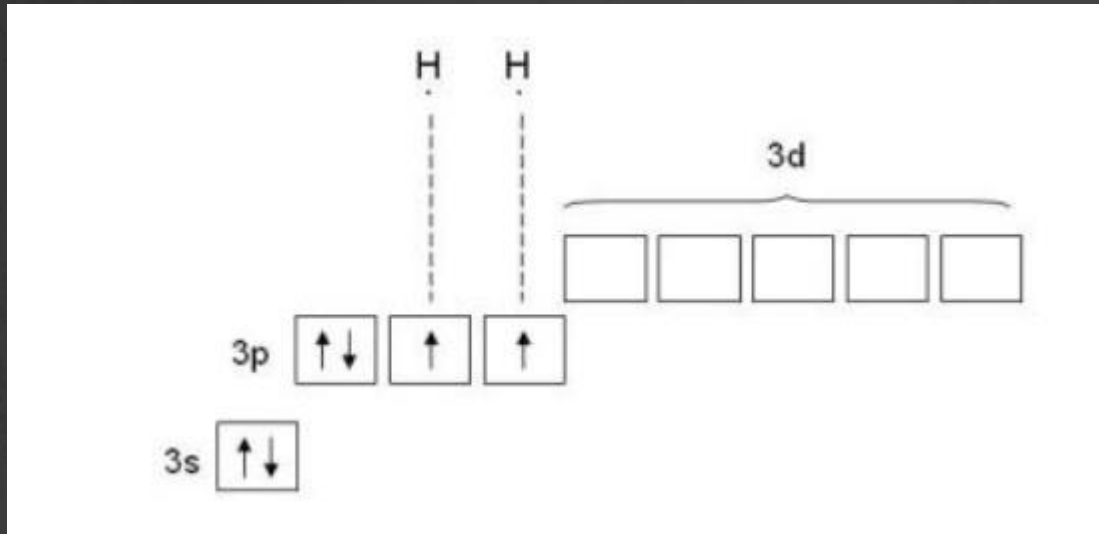


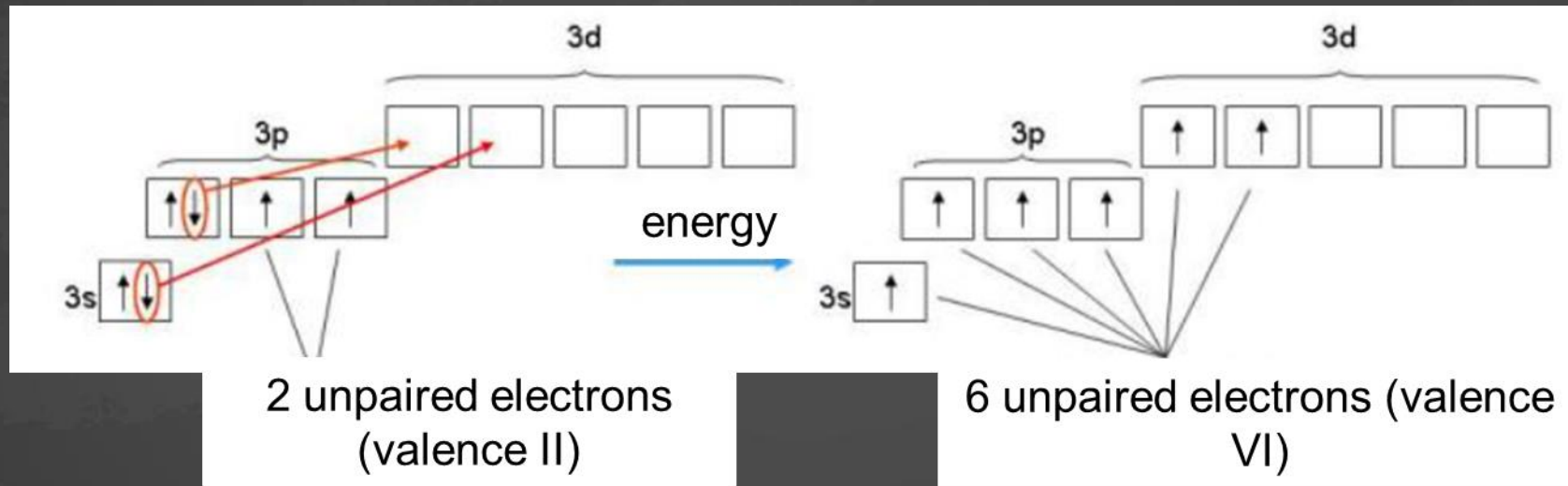
## 2. $sp^3$ hybridization



| Regions of Electron Density | Arrangement   |                      | Hybridization |   |
|-----------------------------|---|----------------------|---------------|---|
| 2                           |   | linear               | $sp$          |    |
| 3                           |   | trigonal planar      | $sp^2$        |    |
| 4                           |   | tetrahedral          | $sp^3$        |    |
| 5                           |   | trigonal bipyramidal | $sp^3d$       |   |
| 6                           |  | octahedral           | $sp^3d^2$     |  |

Let's consider  ${}_{16}\text{S}$





This class uses the materials from the following books:

Larry Gonick and Graig Criddle “The cartoon guide to chemistry”

Manyuilov and Rodionov “Chemistry for children and adults”

Kuzmenko, Eremin, Popkov “Beginnings of chemistry”