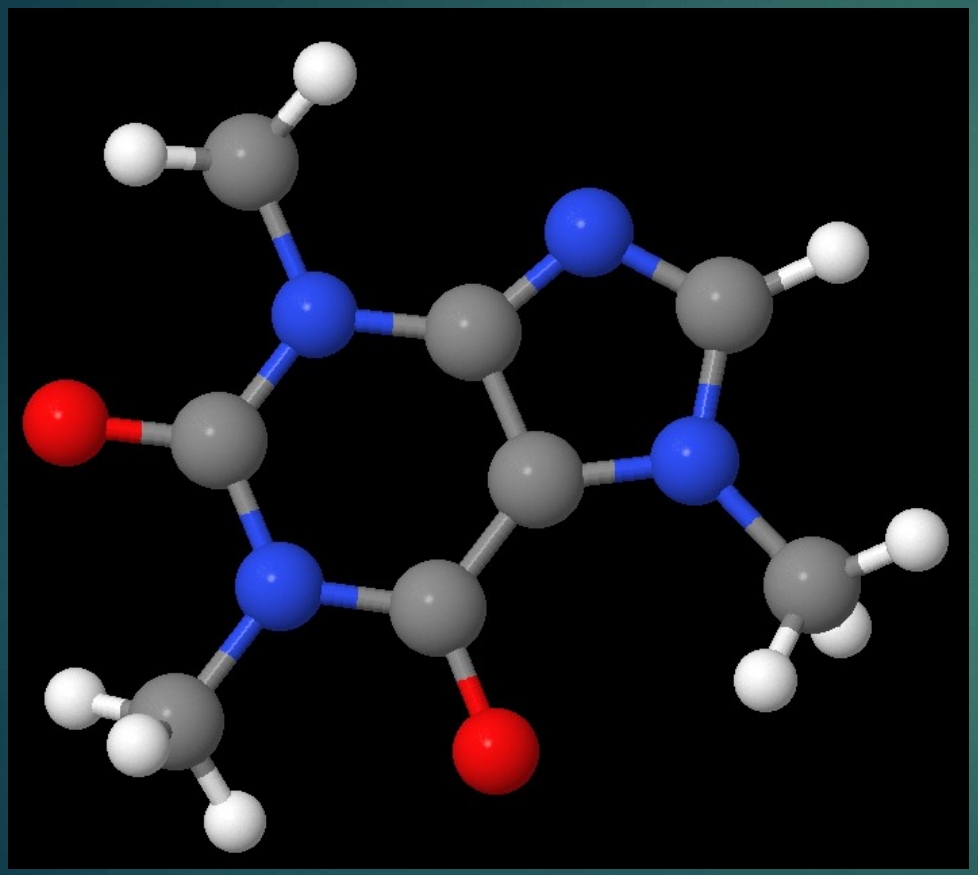
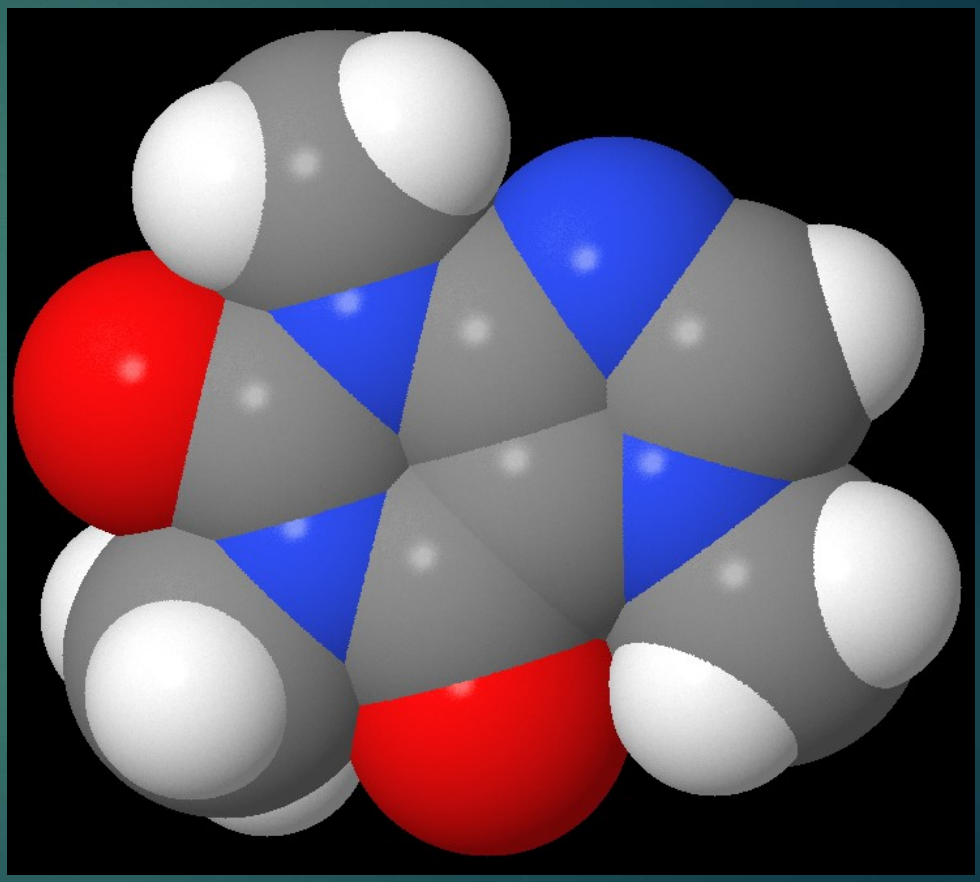
Molecular Compounds





Molecular Compounds

CBLT2: Define, explain and model molecules, molecular compounds and the different types of covalent bonds with electron dot and structural diagrams.

Be able to define, explain, identify or provide examples of each of the following:

- Covalent Bond
- Molecule
- Diatomic Molecule
- Molecular Compound
- Molecular Formula
- Noble Gas Configuration
- Single Covalent Bond
- Structural Formula
- Unshared Pair
- Double Covalent Bond
- Triple Covalent Bond
- Coordinate Covalent Bond
- Polyatomic Ion

Textbook Practice – For each question asking for the dot structure, also draw the structural diagram (with lines)

- Page 216 #s 1 – 3, 6
- Page 220 #s 7, 8
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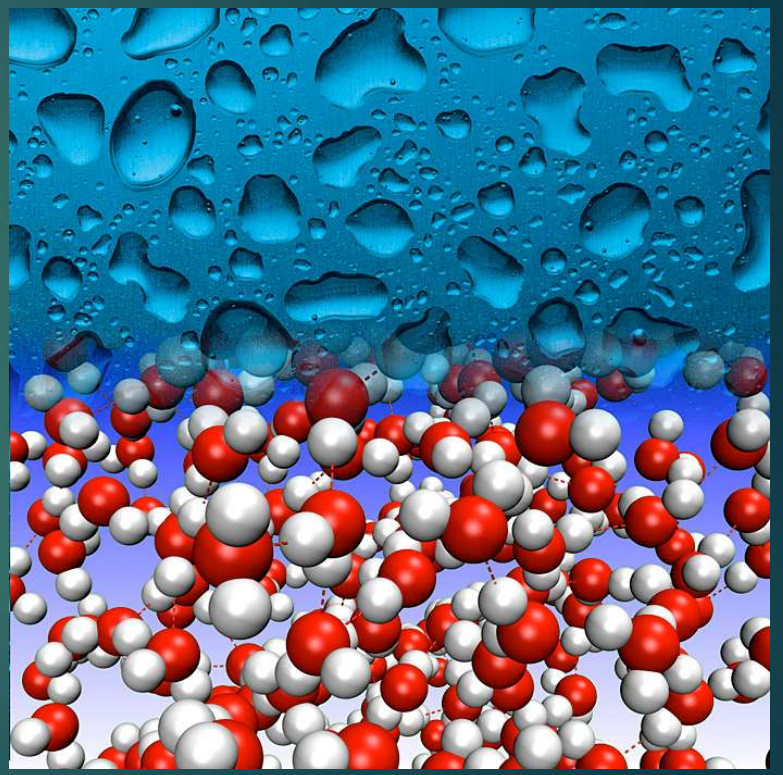
- Page 229 #s 13 – 16, 20, 21
- Page 247 – 249 #s 39 – 48, 63, 64, 70, 73, 79, 80

Molecular Compounds

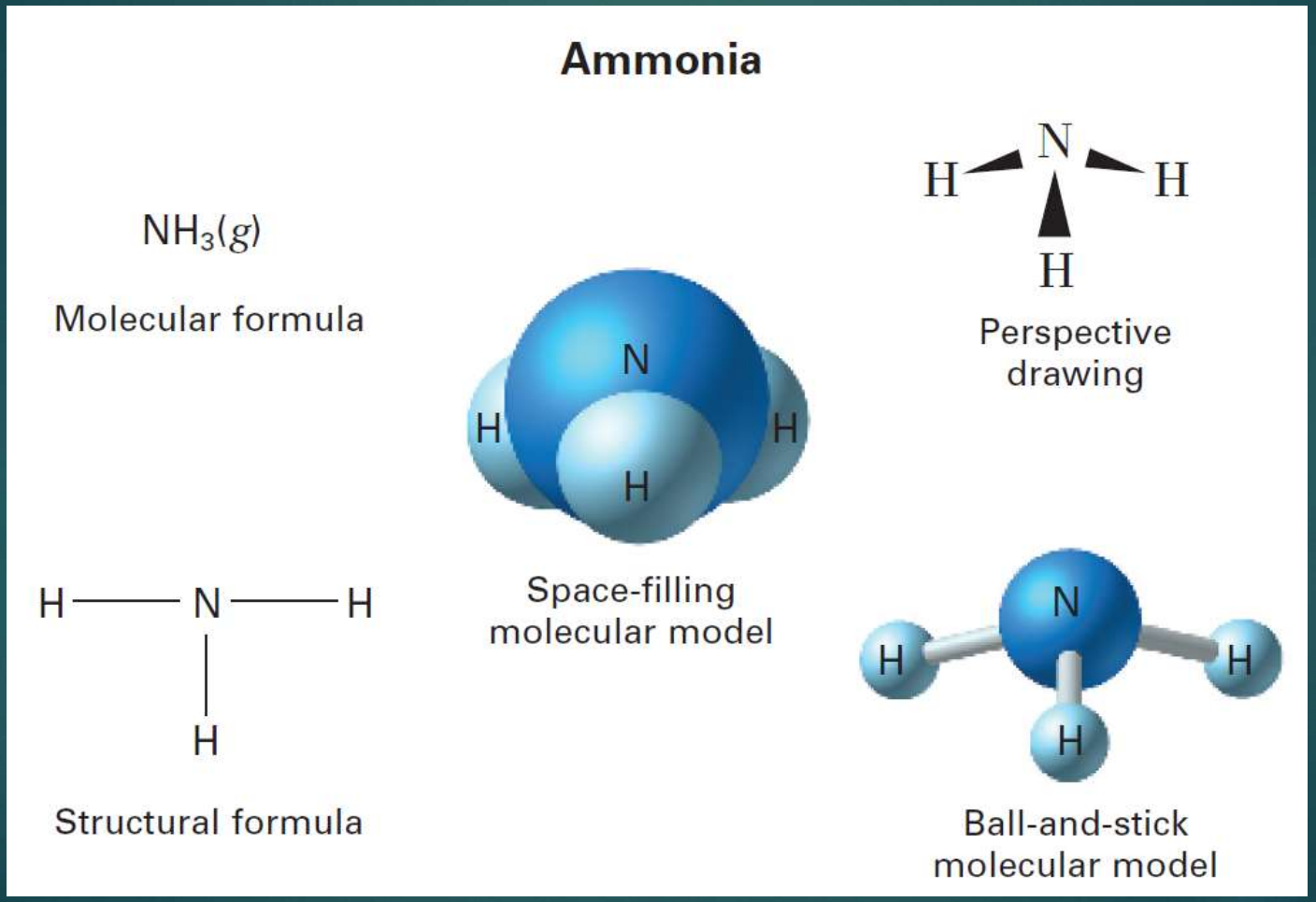
- Formed through the sharing of electrons between non-metal atoms.
- A bond formed through the sharing of electrons is called a covalent bond.
- Exist as individual molecules with a chemical formula.
  - CH_4, CO_2, N_2O, CO

Molecular Compounds

- Relatively low melting and boiling points.
  - Many are liquids or gases at room temperatures.
  - Exist as individual molecules.
- Commonly represented with a molecular formula (how many of each atom). CH_4, N_2O, H_2O



Representing Molecular Compounds

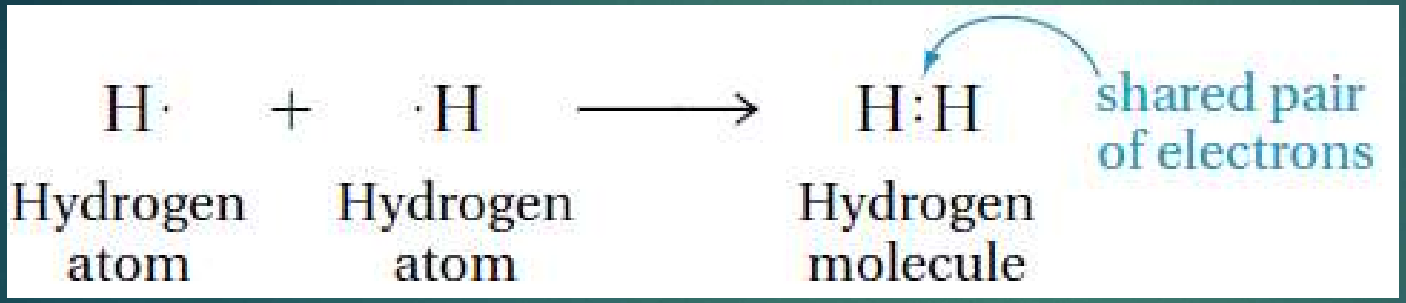


Covalent Bonds

- A covalent bond is formed when electrons are shared between two non-metals.
- Occurs so that atoms can attain the electron configuration of a noble gas (octet rule).
- Single covalent bond
- Double covalent bond
- Triple covalent bond
- Coordinate covalent bond

Single Covalent Bond

- Two atoms held together by share one pair of electrons.
  - Each atom supplies one electron for a total of two.



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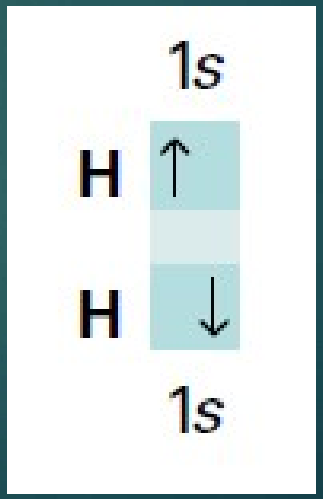
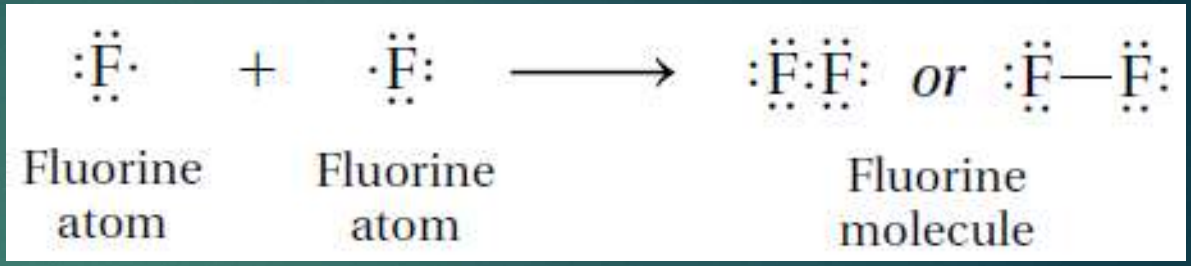
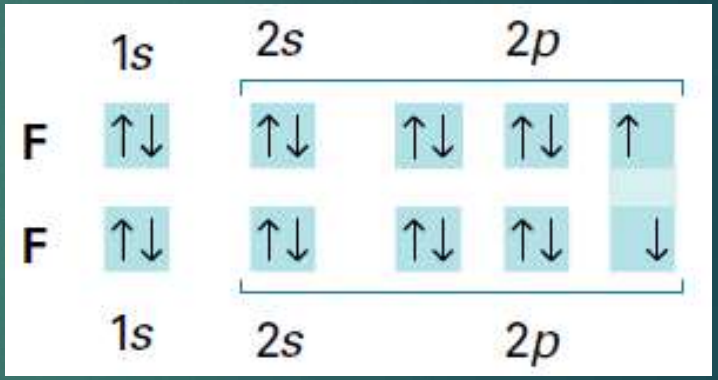


Single Covalent Bond: Structural Formula

- Fluorine needs one more electron to complete the octet; which it can get from another fluorine atom.
- Structural formula: Covalent bonds are represented as dashed lines.





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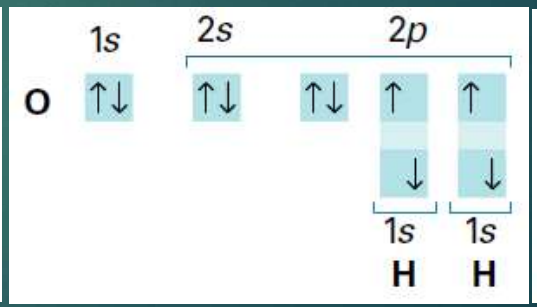
Unshared Pairs of Electrons

- Atoms want to have 8 electrons, but they don't all have to partake in covalent bonding.
- Such pairs of electrons are called unshared pairs.
- Influence other aspects of the molecule like its shape and interaction with its brethren molecules.

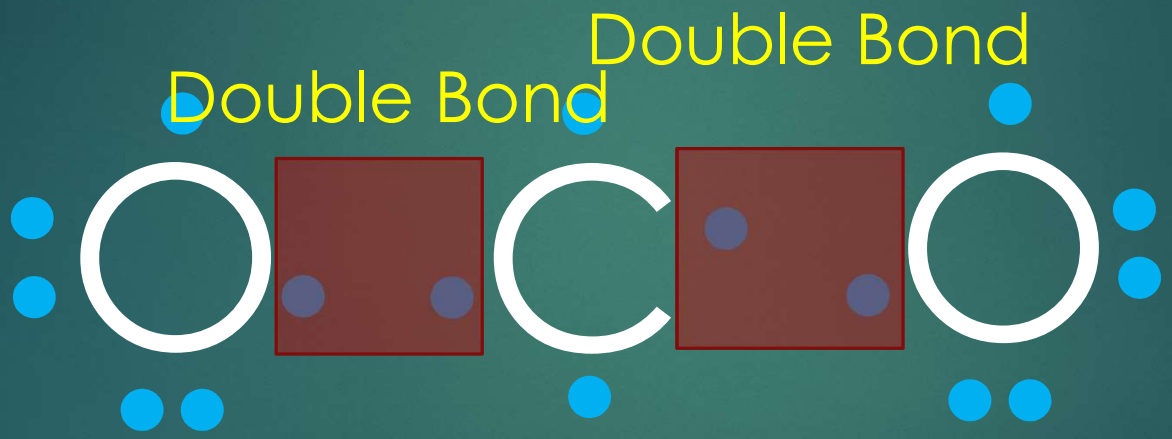


Review

- Page 216 #s 1 – 3, 6
- Page 220 #s 7, 8

Double Covalent Bond

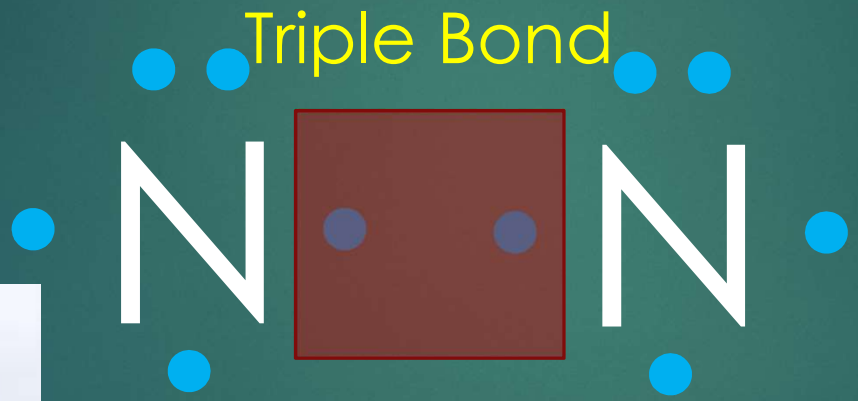
- Atoms share two electrons each, for a total of four, creating two pairs of electrons. Ex: CO_2



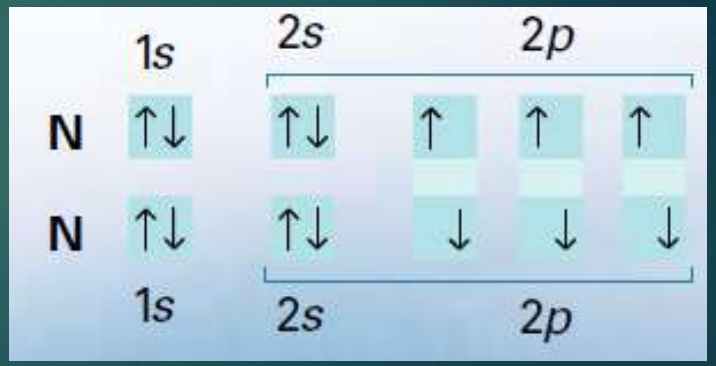
- Remember, only unpaired electrons will be contributed from each atom to form a bond.

Triple Covalent Bond

- Two atoms each provide three electrons, for a total of six, to create the triple bond.



:N⋮⋮N: *or* :N≡N:



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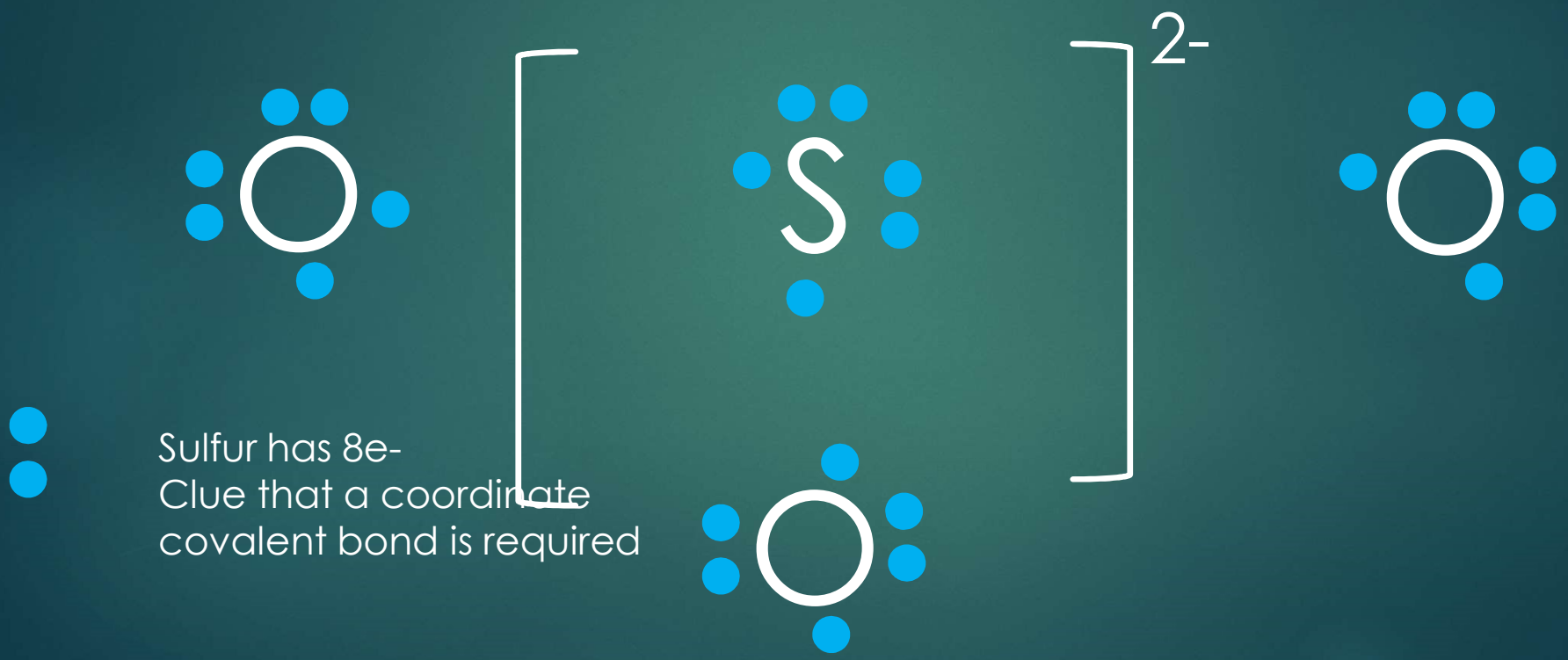
Coordinate Covalent Bond

- A bond in which one atom contributes both bonding electrons required for a covalent bond.

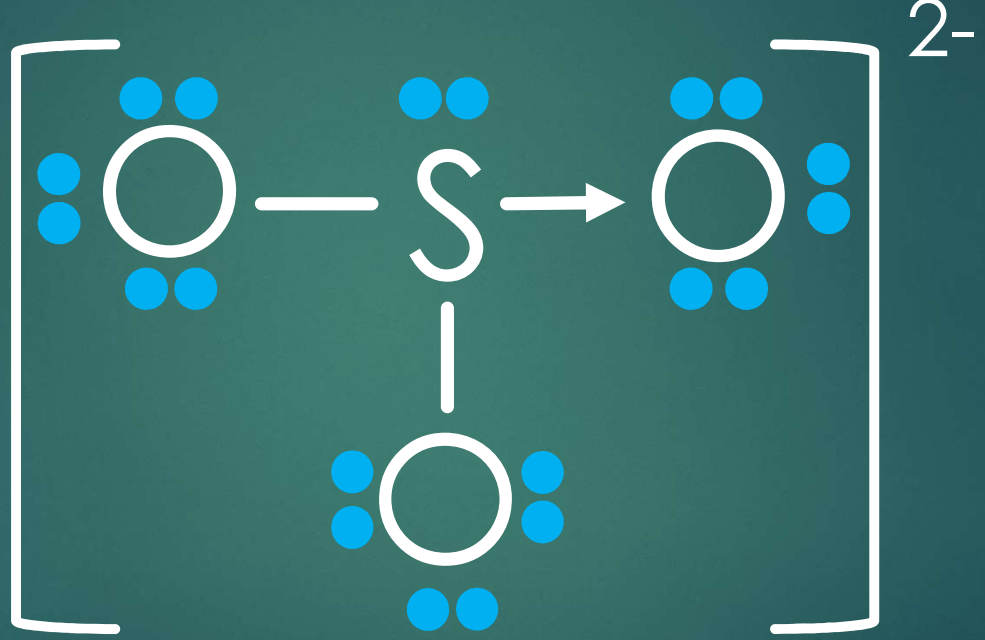
- Oxygen has no more unpaired electrons.
- However, being awesome, it will share a full pair!

Polyatomic Ions

- Atoms that covalently bond together to have an ionic charge. Ex: SO_3^{2-}, often have a coordinate covalent bond.



Polyatomic Ion: SO_3^{2-} Structural Diagram



Structural Diagram Algorithm

- Formula to calculate how many bonds are needed:
  - Have = Add up all the valence electrons including any electrons gained or lost by a polyatomic ion.
  - Want = Count up the total # of electrons to achieve a noble gas configuration (2 for hydrogen, 8 for all other elements).
  - Subtract the Want - Have; then divide by two (each bond is two electrons)
  - The answer is how many bonds to draw.
  - Fill in the rest of the valence electrons, don't forget any extra electrons if it is a polyatomic ion.

Example: Structural Diagram for HCN (Cyanic Acid)

- Given that C is the central atom.
- N – has 5 valence electrons, wants 8.
- C – has 4 valence electrons, wants 8.
- H – has 1 valence electron, wants 2.
- Have = 5 + 4 + 1 = 10
- Want = 8 + 8 + 2 = 18
- Math: (Want – Have)/2
  - = (18 – 10)/2 = 4 bonds required

Structural Diagram for HCN

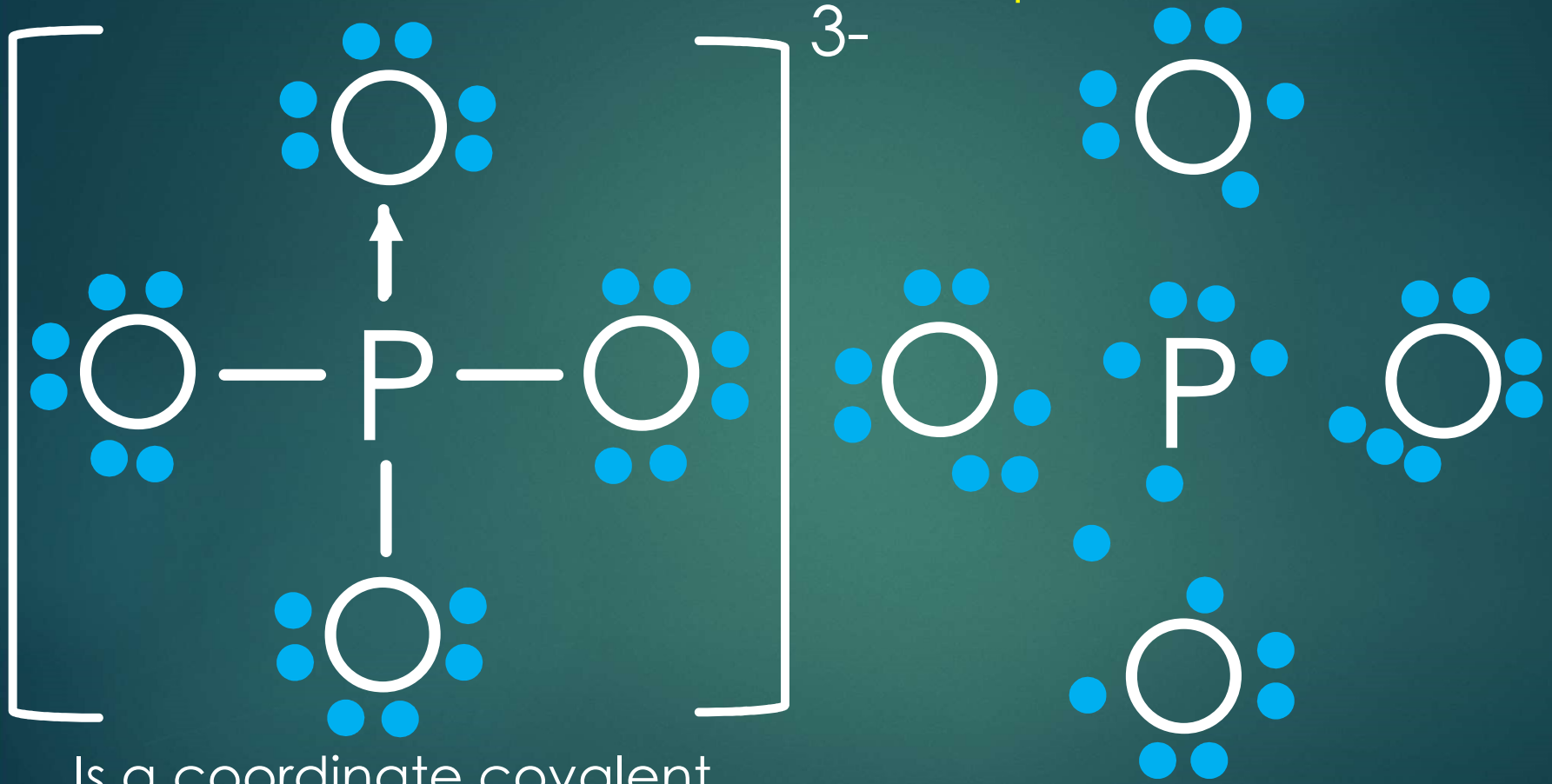
- The molecule requires 4 bonds

- H can't have more than two electrons
- Other bonds must be between C & N
- Add remaining electrons
- Check for coordinate covalent bonds

Structure Diagram for PO_4^{3-}

- Given that P is the central atom (surrounded by all O).
- P – has 5 valence electrons, wants 8
- O – has 6 valence electrons x 4, wants 8 x 4
- Anion Charge – 3 additional electrons
- Have = 5 + 6x4 + 3= 32
- Want = 8 + 8x4 = 40
- Math: (Want – Have)/2
  - = (40 – 32)/2 = 4 bonds required

Structure Diagram for PO_4^{3-}



Is a coordinate covalent bond necessary?

Learning Target Review

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