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Warm-Up | Covalent Bonding

Lesson Objectives

By the end of this lesson, you should be able to:

- Use the periodic table to determine the number of _____ available for bonding.
- Use the octet rule to predict covalent compounds.
- Construct _____ structures (in other words, Lewis structures) to illustrate the arrangement of electrons in covalent structures.
- Explain how covalent bonds affect the properties of covalent _____.

Science Practice: Develop and use electron-dot models, and explain their usefulness and limitations.

Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

	a type of bond formed from the overlap of *s*, *p*, or *d* orbitals of one atom with *s*, *p*, or *d* orbitals of another atom to allow the atoms to share two electrons
	a type of covalent bond involving one pair of electrons shared between two atoms
	a type of covalent bond involving two pairs of electrons shared between two atoms
	a type of covalent bond involving three pairs of electrons shared between two atoms
	a condition that results when two or more Lewis structures can be drawn from a molecular formula; the actual structure is a blend of the resonance structures

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Words to Know

	an overlap of *p*-orbitals of one atom with *p*-orbitals of another atom to allow additional sharing of electrons beyond those shared in a sigma bond
	a bond characterized by the equal sharing of bonding electrons between two atoms
	the electrons shared between two atoms joined in a covalent bond
	the general principle that atoms of nonmetals tend to be most stable when their valence shells are filled with eight electrons
	a condition of some atoms having empty *d*-orbitals that can be used for bonding, allowing for more than eight valence electrons to be involved in bonding
	the valence electrons in an atom that do not participate in bonding with another atom
	a bond characterized by bonding electrons having greater association with one atom than another atom

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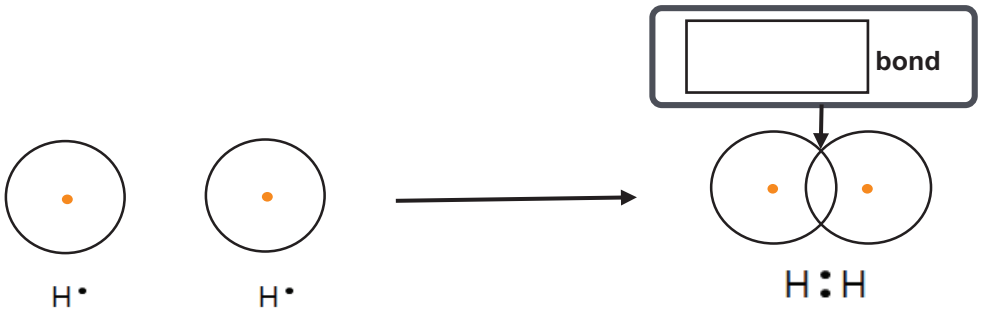
Slide 1

Lesson Question

Slide 2

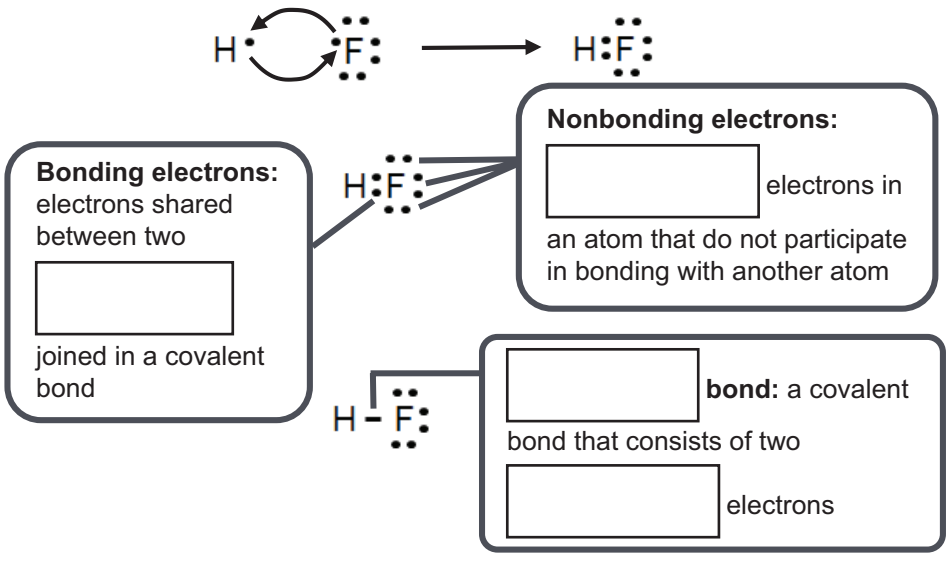
Orbital Overlap

Covalent bonds form when two _____ share valence electrons.



A sigma bond results from the direct _____ of an *s*, *p*, or _____ orbital of one atom with an _____, *p*, or *d* orbital of another atom.

Bonding and Nonbonding Electrons



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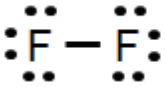
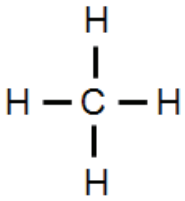
Equal and Unequal Sharing of Electrons

[ ] **bond**:

a [ ] characterized by the equal sharing of bonding electrons between two atoms



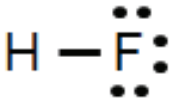


- Little or no difference in electronegativity: ≤ [ ]
- Equal sharing of electrons

[ ] **bond**:

a bond characterized by bonding electrons having greater association with one atom than another atom

- Atoms differ in electronegativity: ≥ [ ]
- Unequal sharing of electrons
- Partial [ ] develop



δ^+ δ^-

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Lewis Structures of Atoms

Lewis structures:

- use [ ] symbols.
- show [ ] electrons.

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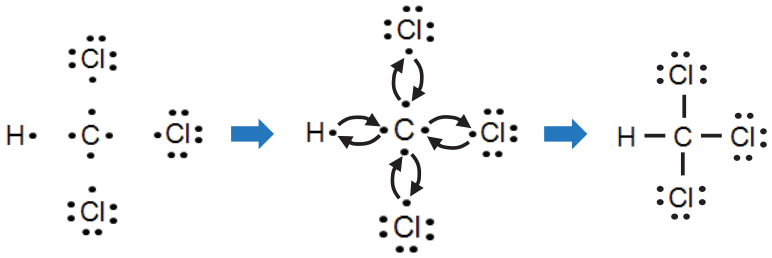
Slide 7

Drawing Lewis Structures of Molecules

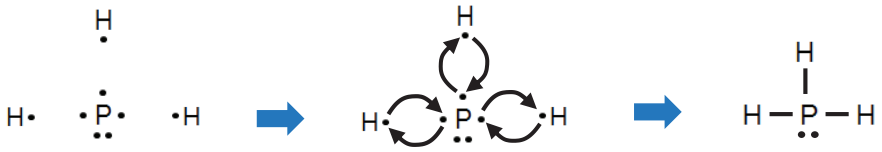
Draw the Lewis structure of [ ]:



1. Draw the Lewis symbols of the [ ] in the structure.
2. Form [ ] bonds between atoms.
3. Draw the [ ] structure with dashes to represent bonds.

Lines represent each bonding pair of [ ]. Dots represent [ ] electrons.

Applying the Octet Rule



1. Draw the [ ] symbols of the atoms in the structure.
2. Form covalent bonds between atoms.
3. The leftover electrons stay with the [ ] atom.

Octet rule: the general principle that atoms of [ ] tend to be most stable when their valence [ ] are filled

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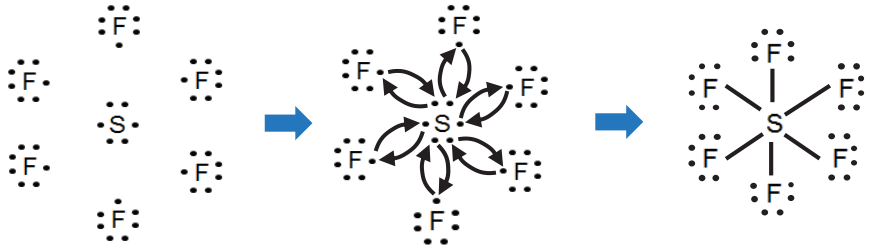
Exceptions to the Octet Rule



1. Draw the Lewis _____ of the atoms in the structure.
2. Form covalent bonds between atoms.
3. Any extra electrons stay with the _____ atom.

_____ **octet**: condition of some atoms having empty _____ -orbitals that can be used for bonding; allows for more than _____ valence electrons to be involved in bonding

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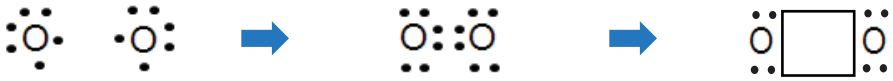
Double Bonds



1. Draw the Lewis symbols for the atoms.
2. _____ electrons must be shared between each _____.

Double bond: a type of covalent _____ involving _____ pairs of electrons shared between two atoms

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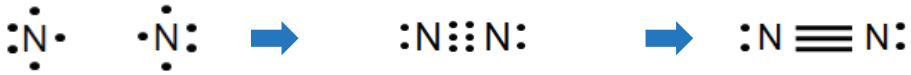
Triple Bonds



1. Draw the [ ] symbols for the atoms.

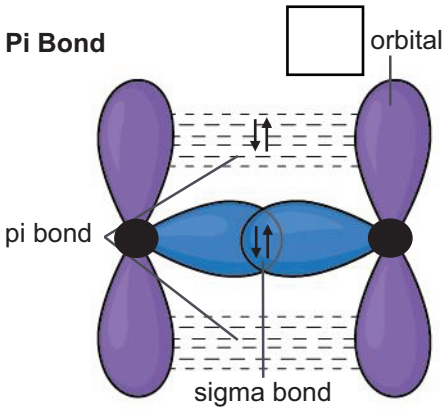
2. [ ] electrons must be shared between each [ ].

Triple bond: a type of covalent bond involving [ ] pairs of electrons shared between two atoms

Orbital Overlap and Pi Bonds

pi bond (p)

- Overlap of *p*-orbitals of one atom with *p*-orbitals of another atom to allow additional sharing of electrons beyond those shared in a sigma bond
- The combination of [ ] and sigma bonds creates double and [ ] bonds.



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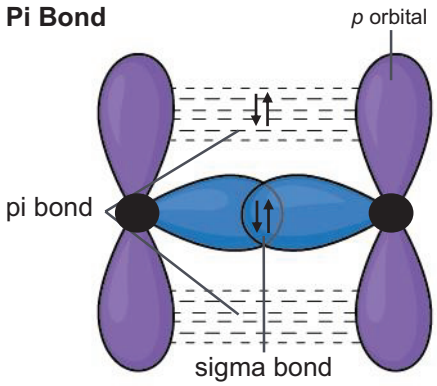
Orbital Overlap and Pi Bonds

[ ] bond:

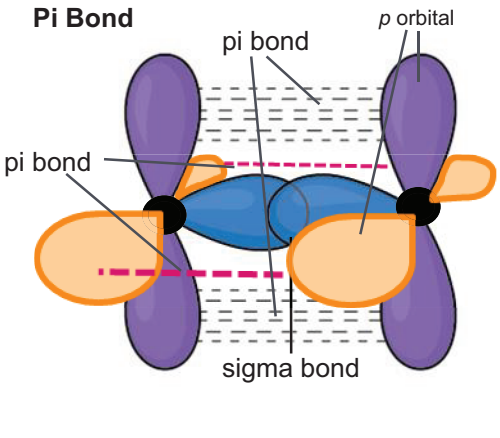
- One sigma bond (σ)
- One **pi bond** (π)
  - Overlap of two *p*-orbitals



Orbital Overlap and Pi Bonds

Triple bond:

- [ ] sigma bond (σ)
- [ ] pi bonds (π)
- Second pi bond oriented [ ] from the first



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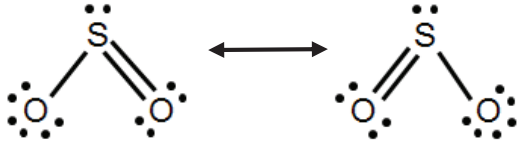
Resonance Structures

Resonance structures:

- result when two or more _____ structures can be drawn from a single _____ formula.
- are a blend of resonance structures.



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Properties of Covalent Compounds

Properties:

- are composed of _____.
- do not _____ in solution.
- are poor _____ of electrical charge.
- are poor conductors of heat.
- have low _____ points and boiling points.
- are gases or liquids at room temperature (if compounds are small).

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Summary | Covalent Bonding

Lesson Question

How do scientists predict whether a covalent bond will form?
How are covalent bonds illustrated?

Answer

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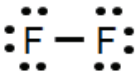
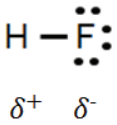
A Model for Covalent Compounds

- Covalent bonds result from two [ ] sharing valence electrons.
- Orbital [ ] allows atoms to share electrons.
- Depending on the atoms, electrons may be shared equally or unequally.
- Bonds may be [ ] or nonpolar depending on the degree of sharing.





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Summary | Covalent Bonding

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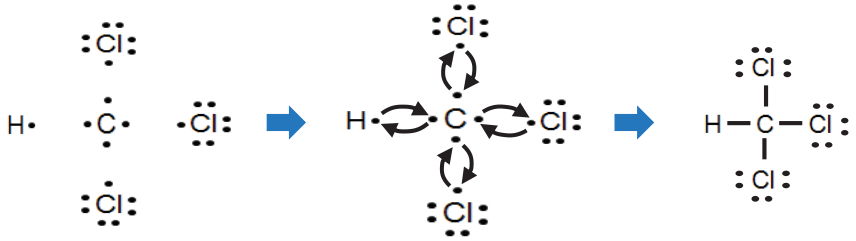
Simple Lewis Structures

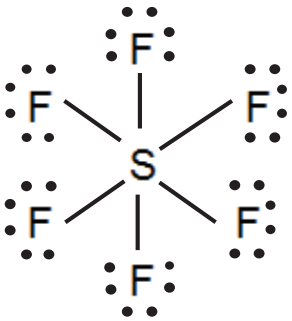
Follow the basic steps for drawing Lewis structures:



1. Draw the Lewis [ ] of the atoms in the structure.
2. Form covalent bonds between [ ].
3. Draw the final structure with dashes to represent [ ].

More Complex Lewis Structures

- Expanded [ ]
- [ ] bonds
- Triple bonds
- Resonance structures



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Slide 2

Properties of Covalent Compounds

- Covalent bonds are strong and do not break easily.
- Covalent compounds do not have strong intermolecular attractions.
  - [ ] forces exist between molecules, not between atoms within a molecule.
- As a result of these structural features, covalent compounds:
  - do not ionize in solution.
  - are poor conductors of electric charge.
  - are poor conductors of heat.
  - have low melting points and [ ] points.

Use this space to write any questions or thoughts about this lesson.

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