8.1 The Nature of Covalent Bonding
> Intro to models and formulas
How do we know what compounds are made of?

MODELS of a substance show how atoms bond.

The CHEMICAL FORMULA of a substance shows what kind and number of atoms bond.

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> Molecular Models and Formulas

## Models and Chemical Formulas of Molecular Compounds



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A **molecular formula** is the chemical formula of a molecular compound.

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A **molecule** is group of atoms joined together by sharing electrons.







#### **Lewis Structure of a Compound**



The way the atoms of the molecule are connected is represented with dots and lines



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Period	1A	2A	3A	4A	5A	6A	7A	8A
1	Η·							He
2	Li	·Be·	٠ <u>₿</u> ٠	٠Ċ	٠Ņ	:Ö·	:Ë·	:Ne:
3	Na∙	∙Mg∙	٠Å	·Śi·	٠Ë٠	:Ş·	:Ċļ·	րr
4	K	∙Ca	Ga	Ge	As	Se	:Br	:K̈́r:



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Single electrons: can bond with other atoms.

**Pair of electrons:** orbital is full and cannot bond with another atom. These are nonbonded or lone pair electrons.

Examples: Nitrogen, Carbon



Slide 6 of 50 Two atoms held together by sharing a pair of electrons are joined by a single covalent bond.

> Single Covalent Bonds

The Nature of

**Covalent Bonding** 

8.2









#### > Single Covalent Bonds

# Another way to show the bonds is by drawing a dash (line) for every pair of shared electrons.

### This is called a STRUCTURAL FORMULA.

For example, the structural formula H - H,

in which a dash (-) replaces the pair of dots (:)



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> Single Covalent Bonds



The Nature of

**Covalent Bonding** 

8.2



Atoms form double or triple covalent bonds if they can attain a noble gas structure by sharing two pairs or three pairs of electrons.

$$\dot{O}$$
: +  $\dot{O}$ :  $\longrightarrow$   $\dot{O}$ :  $\dot{O}$ :  $or$   $\dot{O}$ = $\dot{O}$ :

Example:

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Oxygen Oxygen atom atom

Oxygen molecule

> Double and Triple Covalent Bonds



Oxygen molecule



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# **Octet Rule:**

- Atoms will have enough electrons to achieve noble gas configuration.
- H = 2 electrons
- Period 2 = 8 electrons
- Period 3 and higher can have more than 8 if necessary (10 or 12)



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#### **Lewis Dot Structures:**

# Two dimensional model of a molecular structure where bonds are shown as lines and lone pairs are written as two dots.



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#### Steps for Writing Lewis Dot Structures of Molecular Compounds:

- 1. Add up the valence electrons of all the atoms.
- 2. Connect the atoms around the central atom with a single bond. Central atom is usually written first in formula and is the usually the least electronegative. (It is not hydrogen)
- 3. Add remaining lone pair electrons.
- 4. Fill in remaining valence electrons using double or triple bonds to give every atom a full octet.
- 5. Double check that all valence electrons are accounted for.



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The Nature of > **Covalent Bonding** 

#### **Example:** F<sub>2</sub> Total valence electrons= 14





 $: \ddot{\mathbf{F}} \cdot + \dot{\mathbf{F}} : \longrightarrow : \ddot{\mathbf{F}} : \ddot{\mathbf{F}} : or : \ddot{\mathbf{F}} - \ddot{\mathbf{F}} :$ 

Fluorine atom

Fluorine atom

Fluorine molecule



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# **Example:** N<sub>2</sub>

Total valence electrons= 10



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**Example: CO<sub>2</sub>** Total valence electrons= 16

$$O = C = O$$

Remember, C and O must have 8 electrons. Also all v.e. must be accounted for...



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