**Where are the electrons and what are they doing?**

Bond →

Orbitals →

Use periodic table to assign electron configuration (e- config)
# Electron Configuration (e-config)

<table>
<thead>
<tr>
<th>Column Rep*</th>
<th>H</th>
<th>B</th>
<th>C</th>
<th>N</th>
<th>O</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total #e-</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Full e-config</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong># of Valence e-</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Valence e-config</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Orbital Diagram</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lewis dot (atom)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lewis dot (molecules)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Representative atom for a column on the periodic table.
**Valence Bond Theory**
- Covalent bonds formed by sharing of e- through interactions of (hybrid) orbitals

Ex. Hydrogen, $H_2$

**Sigma ($\sigma$) bond**
- Direct orbital overlap
- Localized e- sharing
- AKA Single bond

Ex. Chloroform

**Hybridization** = combining s & p orbitals to allow an atom to make the desired numbers and type of bonds

**Unhybridized Carbon Atom**

$$
= \begin{array}{c}
2s \\
2p_x \\
2p_y \\
2p_z \\
1 - s \\
3 - p \text{ orbitals}
\end{array}
\rightarrow
\begin{array}{c}
\text{hybridization}
\end{array}
\begin{array}{c}
\text{sp}^3 \text{ Hybridized Carbon Atom}
\end{array}

$$

**sp$^2$ Hybridized Carbon Atom**

$$
\begin{array}{c}
\text{hybridization}
\end{array}
\begin{array}{c}
3 - \text{sp}^2 \text{ hybrid orbitals}
\end{array}
\begin{array}{c}
1 - \text{p orbital unhybridized}
\end{array}
\begin{array}{c}
\text{trigonal planar}
\end{array}
$$

**Pi ($\pi$) Bond**
- Delocalized e- sharing between p orbitals

**sp Hybridized Carbon Atom**

$$
\begin{array}{c}
\text{hybridization}
\end{array}
\begin{array}{c}
2 - \text{sp}^2 \text{ hybrid orbitals}
\end{array}
\begin{array}{c}
2 - \text{p orbitals unhybridized}
\end{array}
\begin{array}{c}
\text{linear}
\end{array}
$$
### Valence Bond Theory

<table>
<thead>
<tr>
<th>Hybridization</th>
<th>$sp^3$</th>
<th>$sp^2$</th>
<th>$sp$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>$H$ $\overset{1}{\text{H}}\overset{1}{\text{C}}\overset{1}{\text{H}}$</td>
<td>$H$ $C=\overset{1}{\text{C}}\overset{1}{\text{H}}$</td>
<td>$H$ $C=\overset{1}{\text{C}}\overset{1}{\text{H}}$</td>
</tr>
<tr>
<td>$#$ charge clouds*</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Orbitals</td>
<td><img src="image1" alt="sp$^2$ carbon" /></td>
<td><img src="image2" alt="sp$^2$ carbon" /></td>
<td><img src="image3" alt="sp$^2$ carbon" /></td>
</tr>
<tr>
<td>e-config</td>
<td><img src="image4" alt="sp$^2$ carbon" /></td>
<td><img src="image5" alt="sp$^2$ carbon" /></td>
<td><img src="image6" alt="sp$^2$ carbon" /></td>
</tr>
<tr>
<td>Orbital Diagram</td>
<td><img src="image7" alt="sp$^3$-$sp^3\sigma$ bond" /></td>
<td><img src="image8" alt="sp$^3$-$sp^3\sigma$ bond" /></td>
<td><img src="image9" alt="sp$^3$-$sp^3\sigma$ bond" /></td>
</tr>
<tr>
<td>Shape</td>
<td>Tetrahedral</td>
<td>Trigonal Planar</td>
<td>Linear</td>
</tr>
<tr>
<td>Bond Angles</td>
<td>109.5</td>
<td>120</td>
<td>180</td>
</tr>
<tr>
<td>More examples!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Charge cloud = atom or lone pair around central atom; NOT the number of bonds!
### Representations of Organic Molecules

<table>
<thead>
<tr>
<th>Line-Bond (Lewis)</th>
<th>Condensed</th>
<th>Skeletal (zig-zag)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Lewis Structure" /></td>
<td>CH₃CH₂CH₂CH₃</td>
<td><img src="image2" alt="Zig-zag Structure" /></td>
</tr>
<tr>
<td><img src="image3" alt="Condensed Structure" /></td>
<td>CH₂CHC(CH₃)₃</td>
<td></td>
</tr>
<tr>
<td><img src="image4" alt="Skeletal Structure" /></td>
<td><img src="image5" alt="Depro-Provera" /> (depot-injected contraceptive)</td>
<td><img src="image6" alt="&quot;Fictitious molecule&quot;" /> (for training purposes only!)</td>
</tr>
</tbody>
</table>

Indicate the hybridization (sp³, sp², or sp) of every C, O, and N atom...

Next time... Polarity, Formal Charge, Resonance
** Take ~30 min to skim Chapter 2.1-2.6 before lecture, use Reading Questions!