The 3-D shape of a molecule helps to determine its chemical and physical properties.

**Modeling 3-D Arrangement**
- Atoms and molecules are three dimensional (3-D)
- **Valence Shell Electron Pair Repulsion (VSEPR) Theory**
  - Break it down...
    - "Valence Shell"
    - "Electron Pair"
    - "Repulsion Theory"
  - This is a theory that allows for the prediction of the shape of a molecule by knowing the number of electron pairs around a central atom.

**Repulsion**
- Electron pairs, that exist in electron clouds, arrange themselves as far away from others as possible.
- Negative repels negative
Predicting Shapes of Molecules

Step 1. Draw a Lewis Dot Structure of the molecule

Sample Problems

a) BeF₂ (Exception - Be is stable at 4 e’s)
b) SnCl₂ (Exception - Sn is stable at 6 e’s)
c) BF₃ (Exception - B is stable at 6 e’s)
d) CH₄
e) NH₃
f) H₂O
g) CO₂

Simple Molecules

• Molecules that contain only two atoms are always linear

Lewis Dot Structure Review

• Follow these steps to check Lewis Dot Structure
  1. Count # of total electron spaces to fulfill octet rule
     • Add up all places for electrons (everything except Hydrogen will have 8 most of the time)
     • There can be some exceptions
  2. Count # of valence electrons
     • Add up total VE for each atom (i.e. CO₂ = 16 VE)
  3. Determine # of bonding electrons (# Spaces - # VE)
     • Number of "lines" (1 line equals 2 electrons)
  4. Determine # of "Unshared" or "Unbonded" electrons
     (# VE - # Bonding e)
     • Number of "dots"
Predicting Shapes

2. Count the number of bonding areas surrounding the central atom.
   - Single, double, and triple bonds all represent one bonding area.

3. Count the number of unshared pairs of electrons on the central atom.
   - Unshared pairs represent one electron cloud.

Identifying Shapes

<table>
<thead>
<tr>
<th>Number of Bonding Areas</th>
<th># of Unshared Pairs of Electrons</th>
<th>Shape</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>Linear</td>
<td>BeCl₂, HgCl₂</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>Trigonal Planar</td>
<td>BF₃</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>Tetrahedral</td>
<td>CH₄, SiCl₄</td>
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<tr>
<td>3</td>
<td>1</td>
<td>Trigonal Pyramidal</td>
<td>NH₃, PCl₃</td>
</tr>
<tr>
<td>2</td>
<td>1 or 2</td>
<td>Bent</td>
<td>H₂O, H₂S, SCl₂</td>
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</tbody>
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