Covalent Bonding

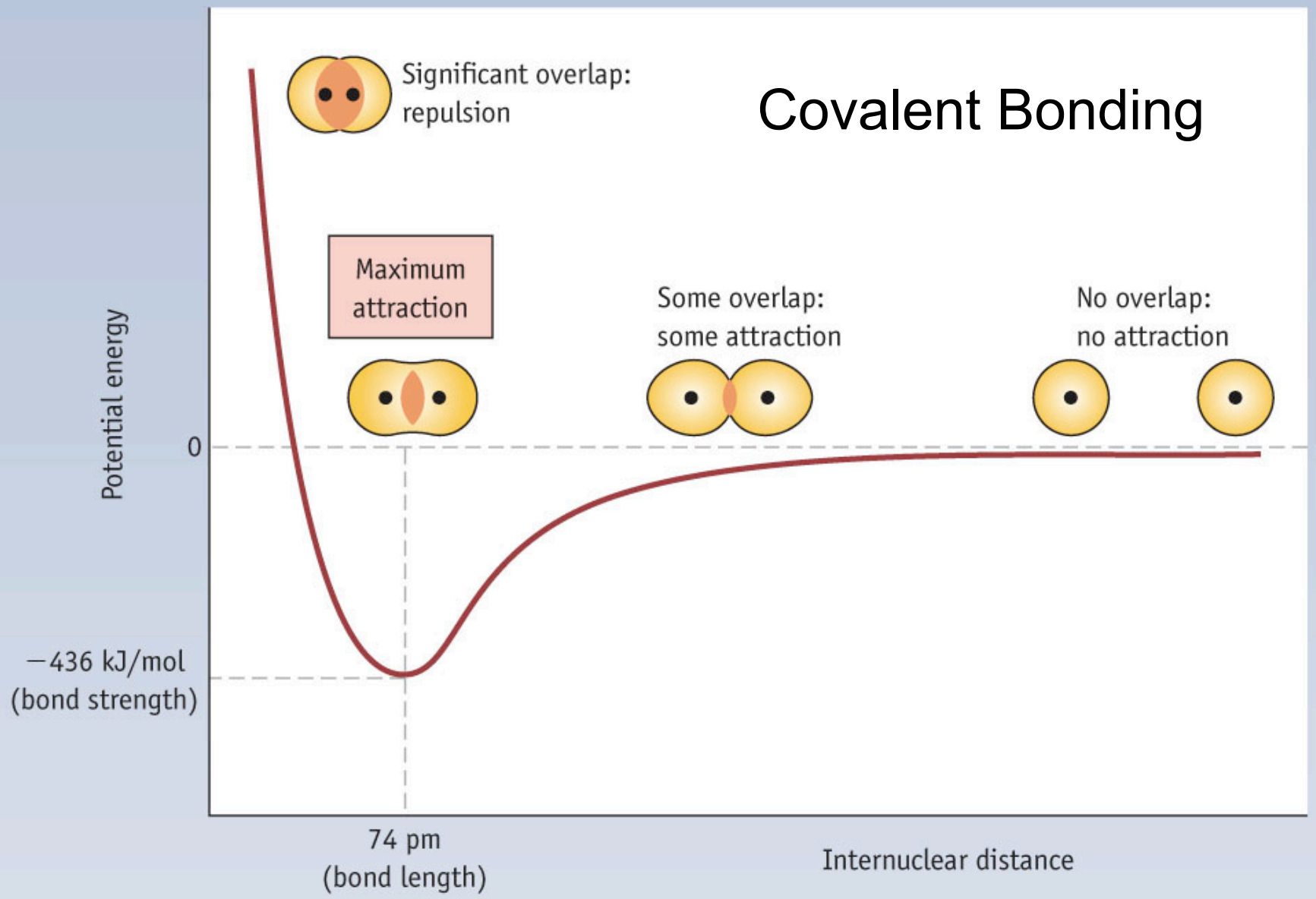


Fig. 9-1, p. 406

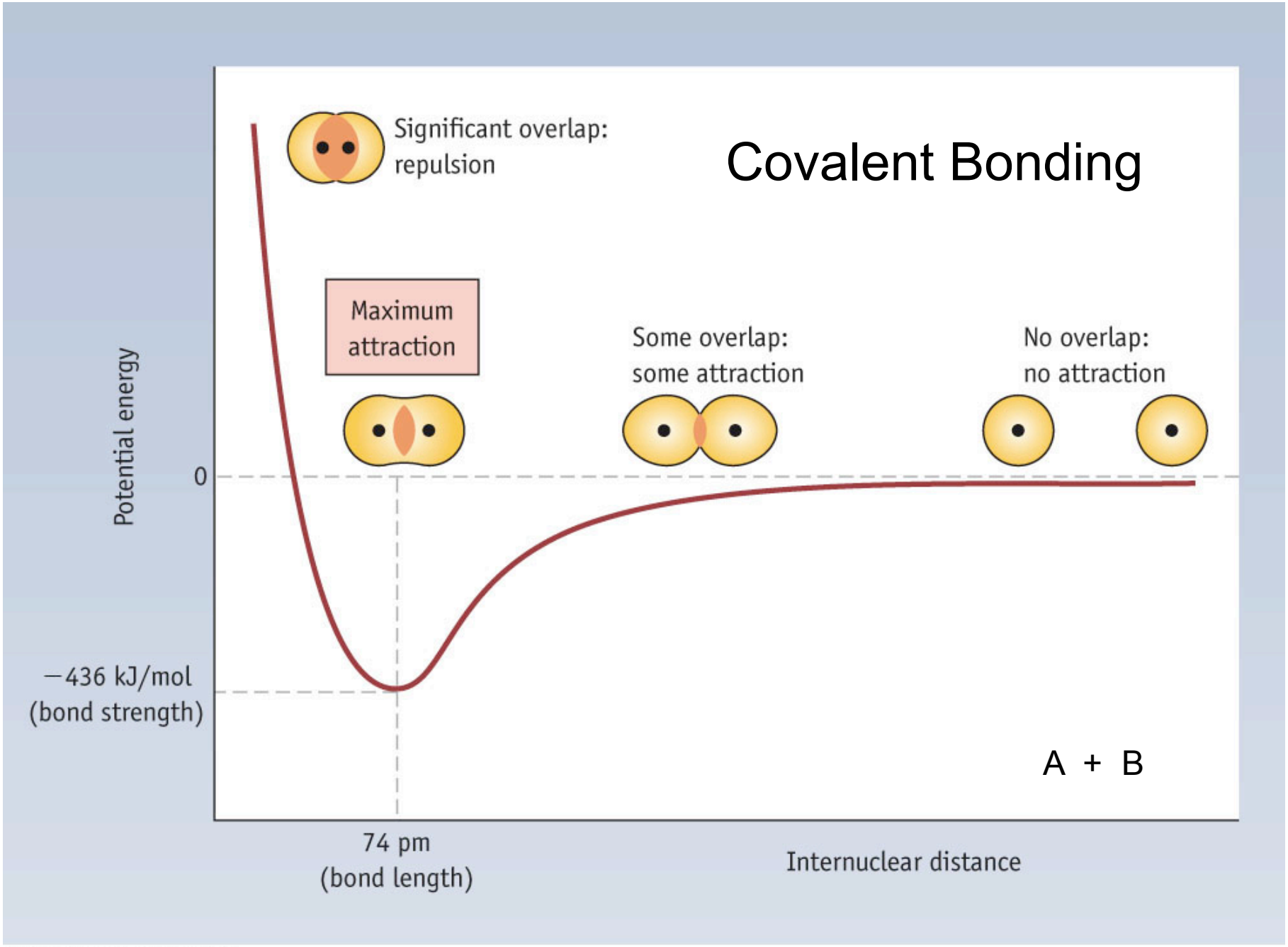


Fig. 9-1, p. 406

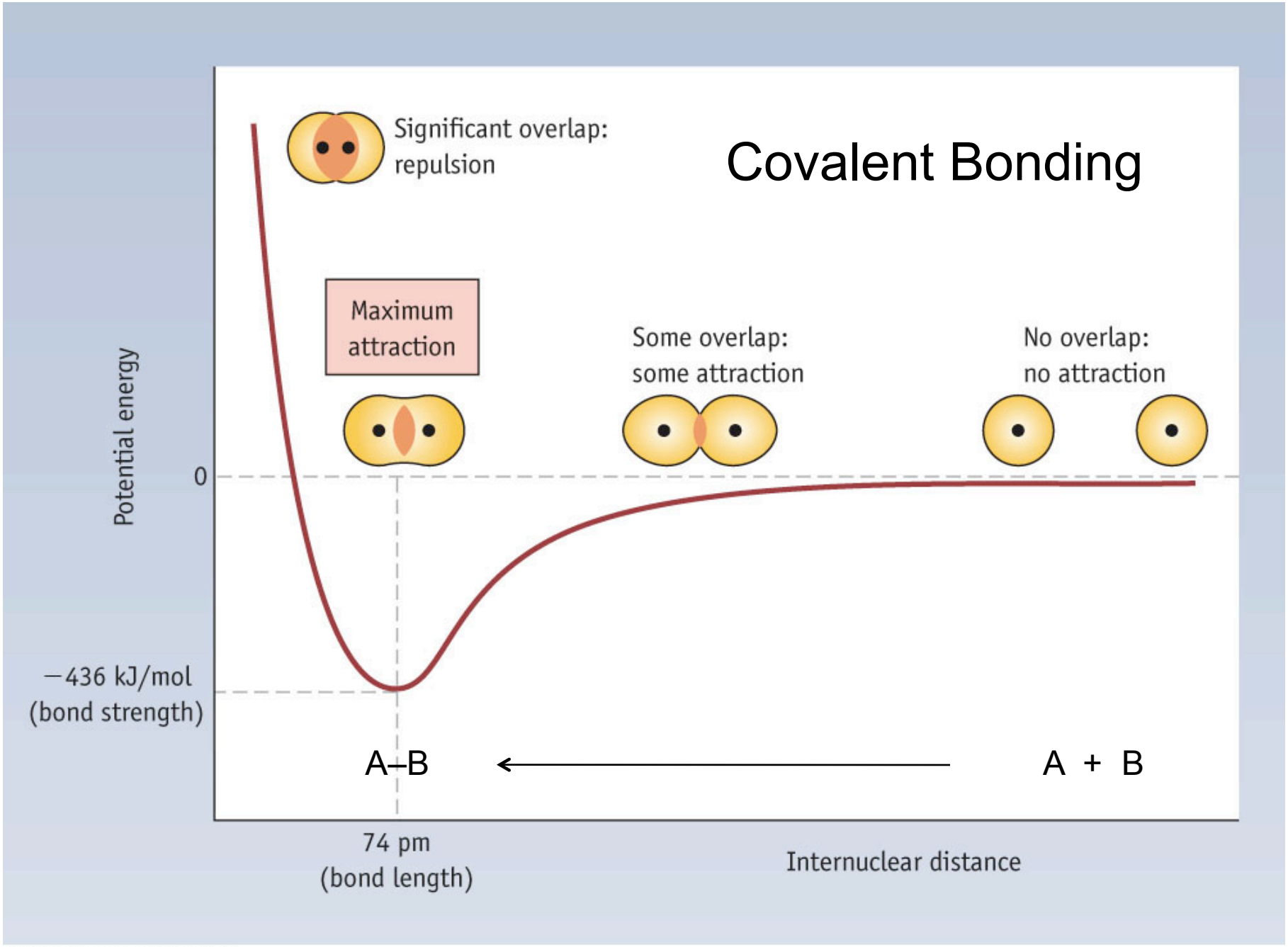
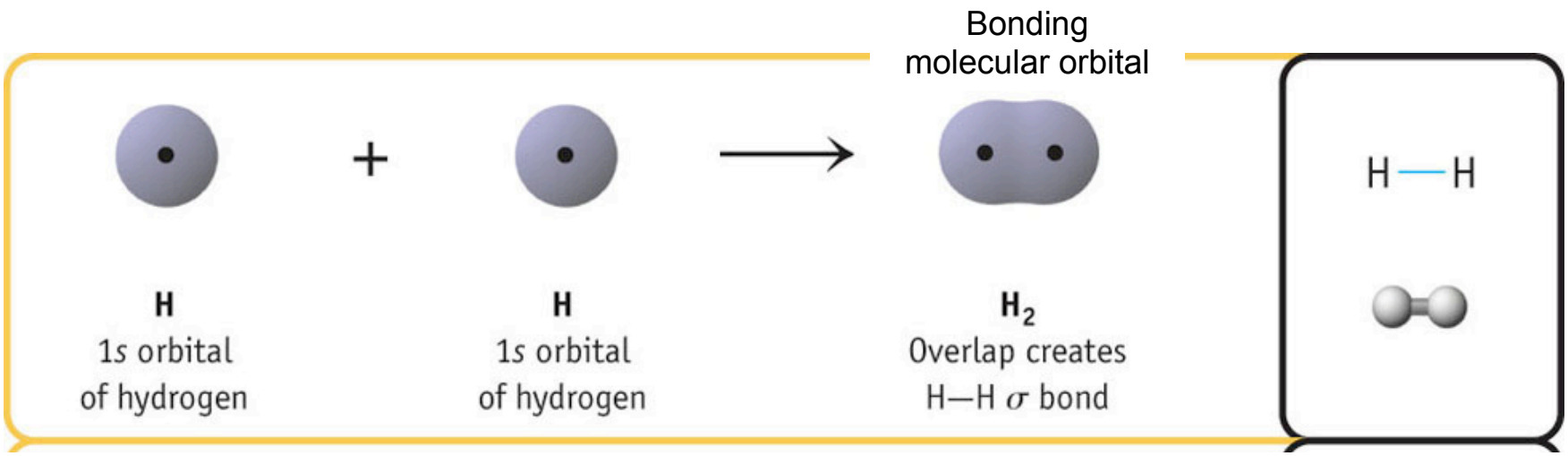
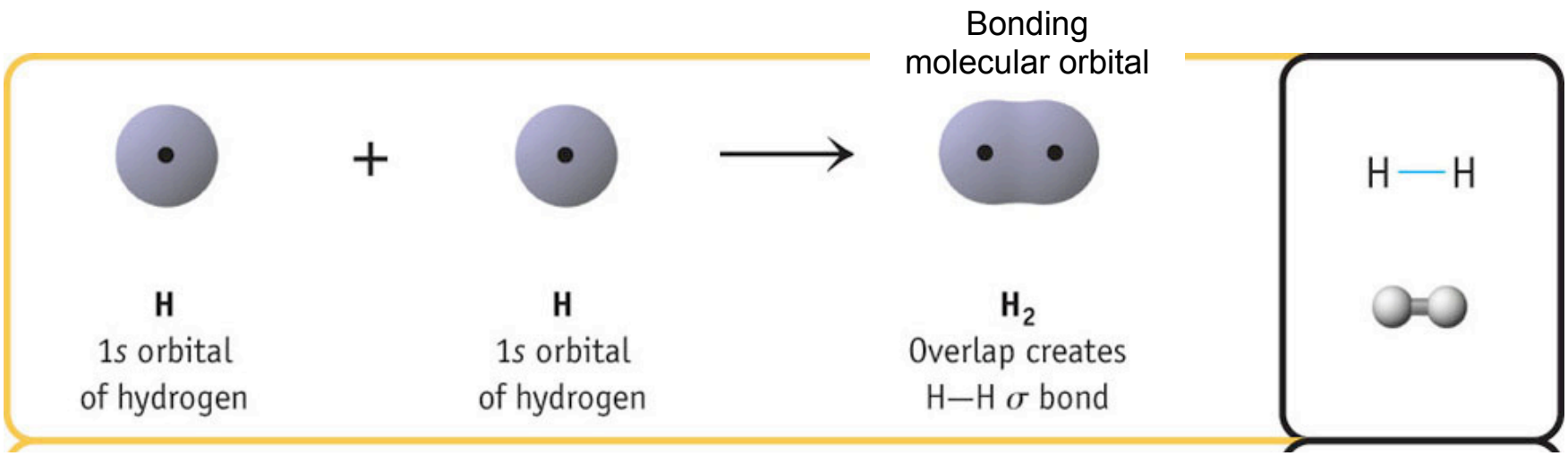


Fig. 9-1, p. 406

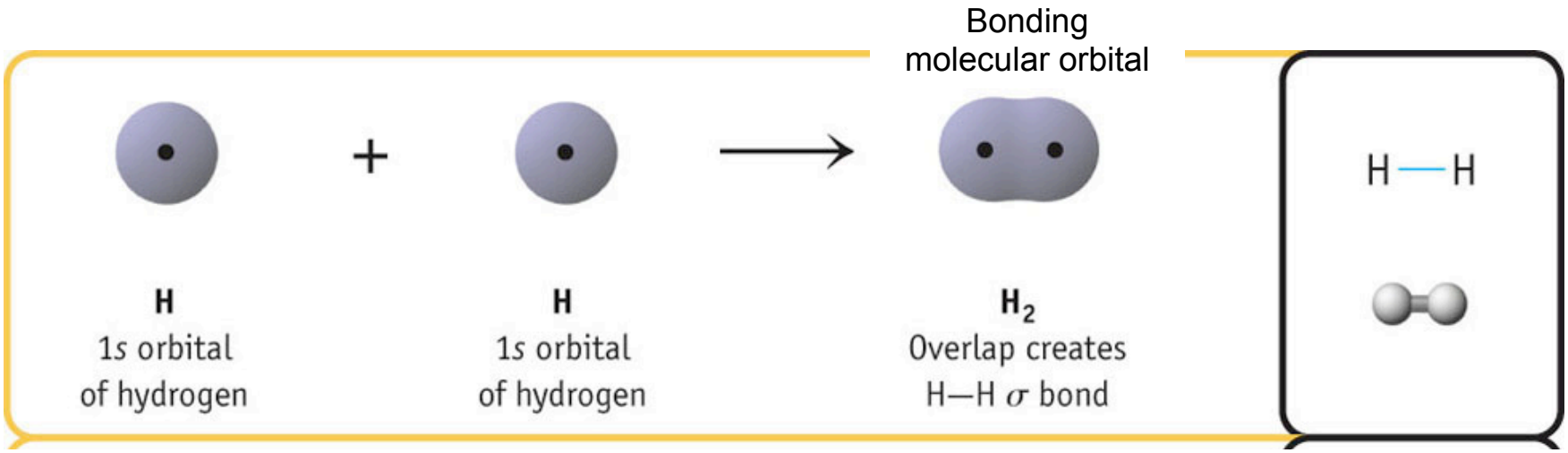


We can combine two atomic orbitals to create a new molecular orbital



We can combine two atomic orbitals to create a new molecular orbital

In reality, when we combine **two** atomic orbitals, we get back **two** molecular orbitals



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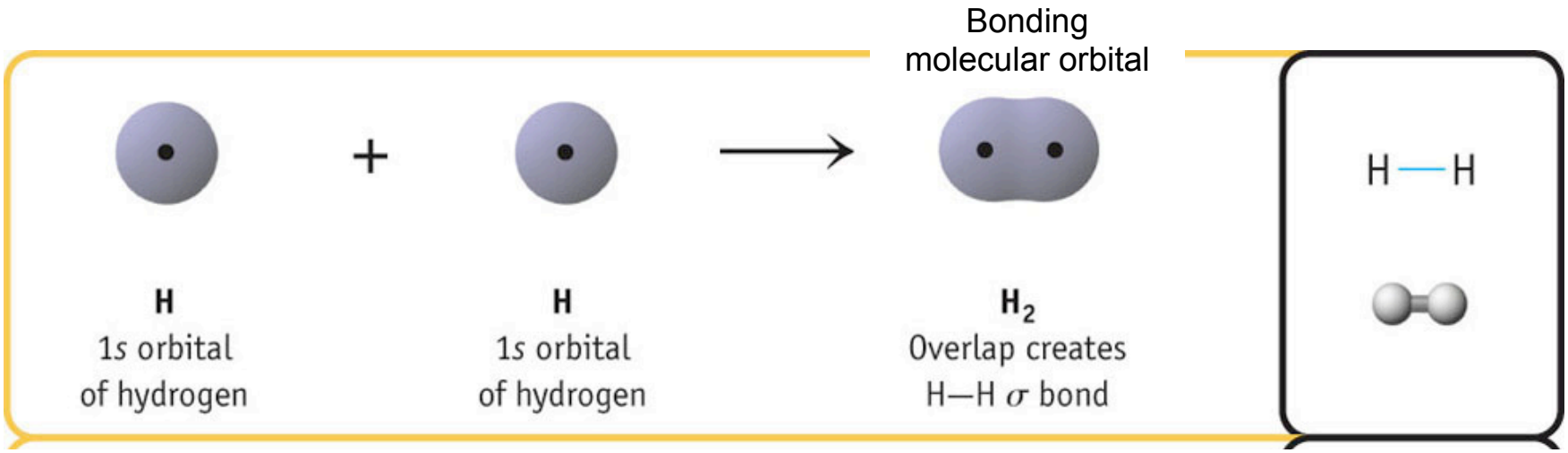
In reality, when we combine **two** atomic orbitals, we get back **two** molecular orbitals

Mixing of the **two** atomic orbitals creates
one **bonding** molecular orbital (lower in energy)
one **anti-bonding** molecular orbital (higher in energy)



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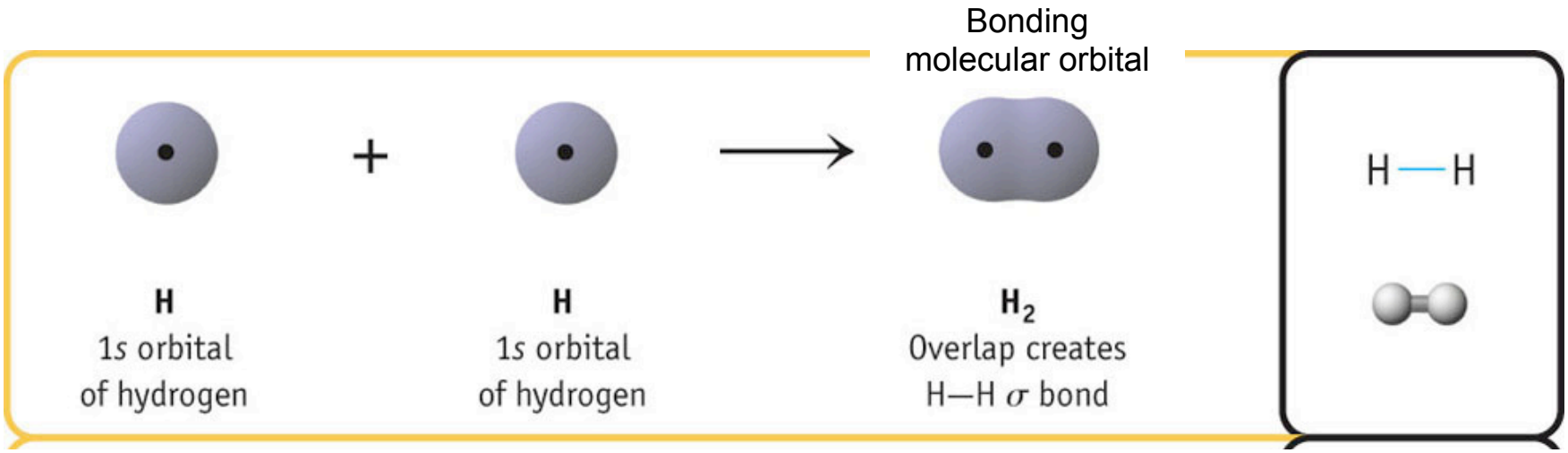
both electrons go here



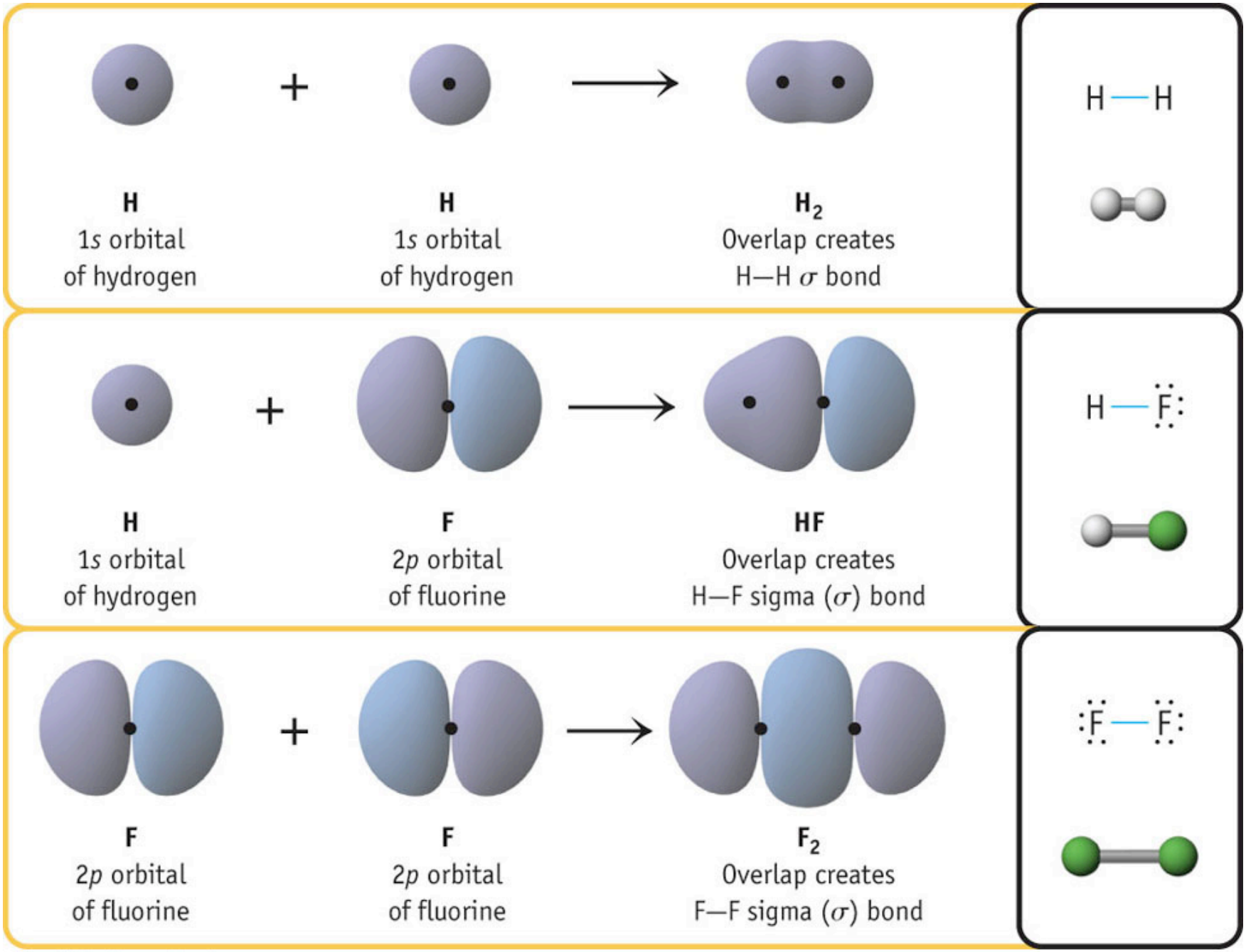
We can combine two atomic orbitals to create a new molecular orbital

In reality, when we combine **two** atomic orbitals, we get back **two** molecular orbitals

Mixing of the **two** atomic orbitals creates
one **bonding** molecular orbital (lower in energy)
one **anti-bonding** molecular orbital (higher in energy)

both electrons go here

Absolute rule: if you "mix" **n** atomic orbitals, you get back **n** molecular orbitals



(we're only showing bonding orbitals)

Fig. 9-2, p. 407

Switch our Thinking

Move away from thinking of p and s orbitals

Switch our Thinking

Move away from thinking of p and s orbitals

We can combine **n** atomic orbitals, to get back **n** hybrid atomic orbitals

Switch our Thinking

Move away from thinking of p and s orbitals

We can combine **n** atomic orbitals, to get back **n** hybrid atomic orbitals

Combine one 2s and one 2p atomic orbital

Switch our Thinking

Move away from thinking of p and s orbitals

We can combine **n** atomic orbitals, to get back **n** hybrid atomic orbitals

Combine one 2s and one 2p atomic orbital

Get back two sp hybrid atomic orbitals

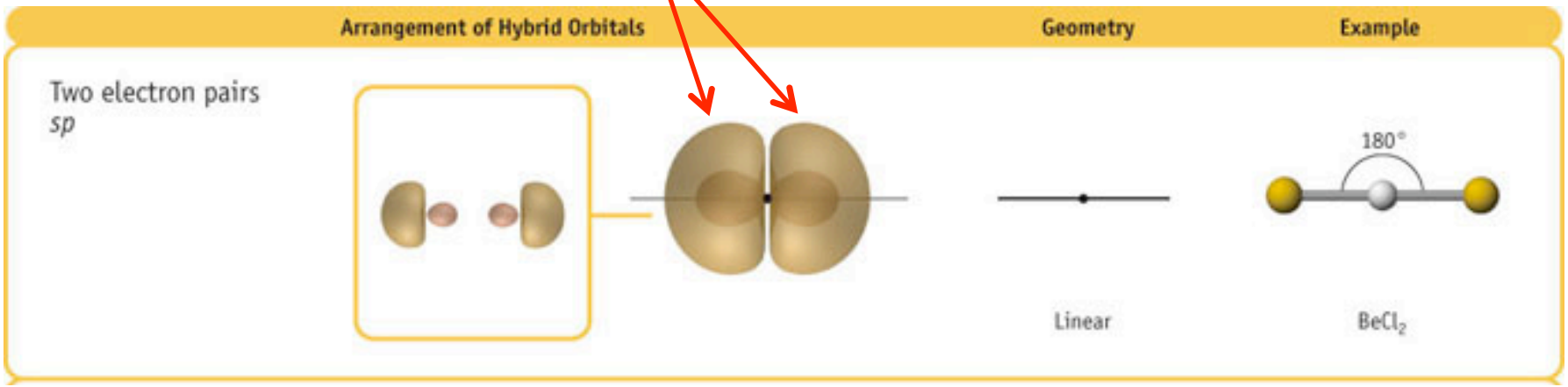
Switch our Thinking

Move away from thinking of p and s orbitals

We can combine **n** atomic orbitals, to get back **n** hybrid atomic orbitals

Combine one 2s and one 2p atomic orbital

Get back two sp hybrid atomic orbitals



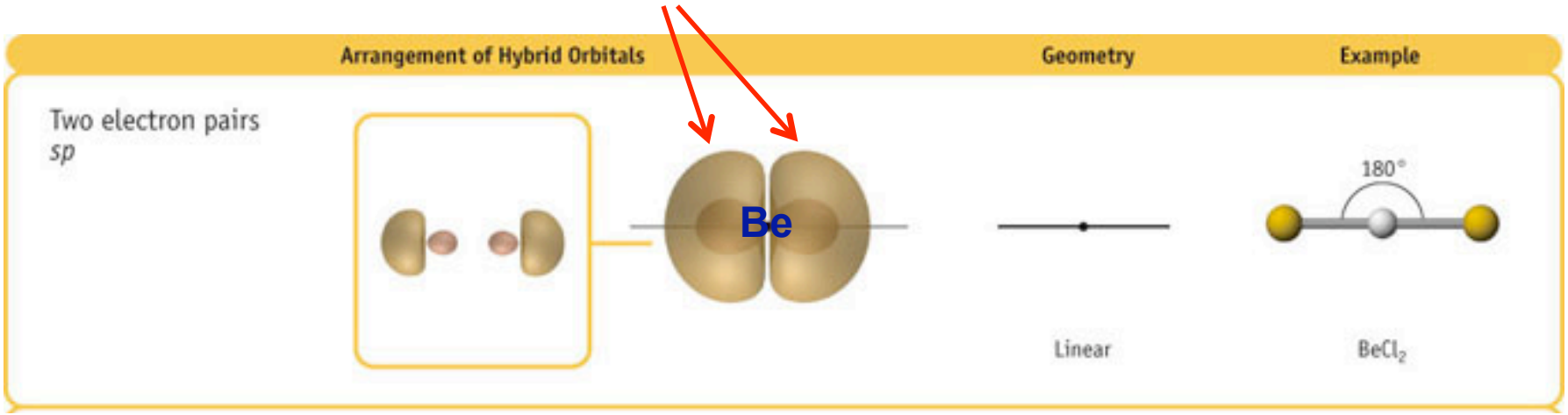
Switch our Thinking

Move away from thinking of p and s orbitals

We can combine **n** atomic orbitals, to get back **n** hybrid atomic orbitals

Combine one 2s and one 2p atomic orbital

Get back two sp hybrid atomic orbitals



Switch our Thinking

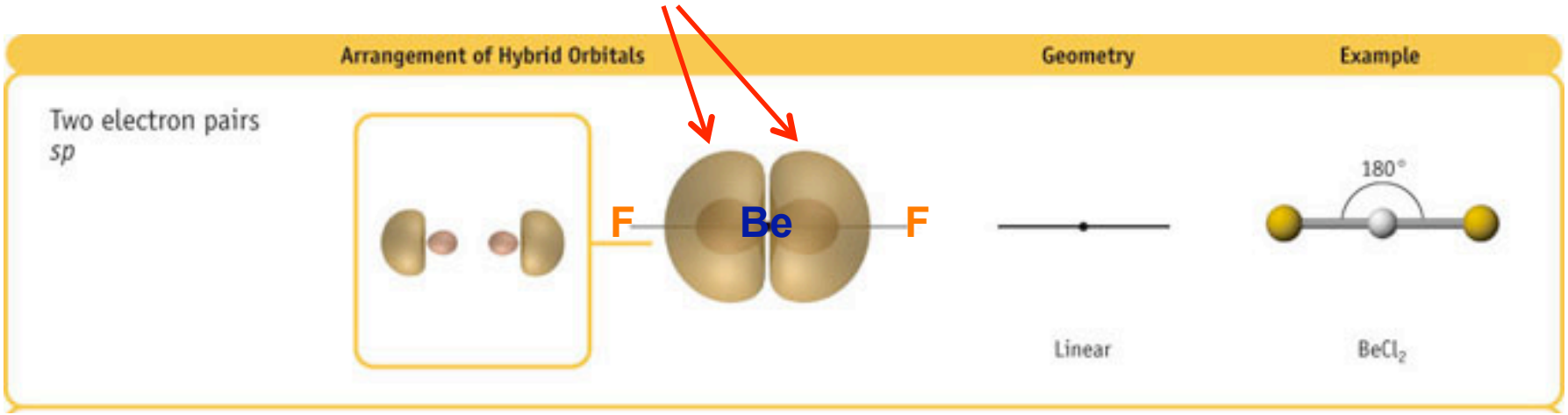
Hybrid Atomic Orbitals

Move away from thinking of p and s orbitals

We can combine **n** atomic orbitals, to get back **n** hybrid atomic orbitals

Combine one 2s and one 2p atomic orbital

Get back two sp hybrid atomic orbitals



Switch our Thinking

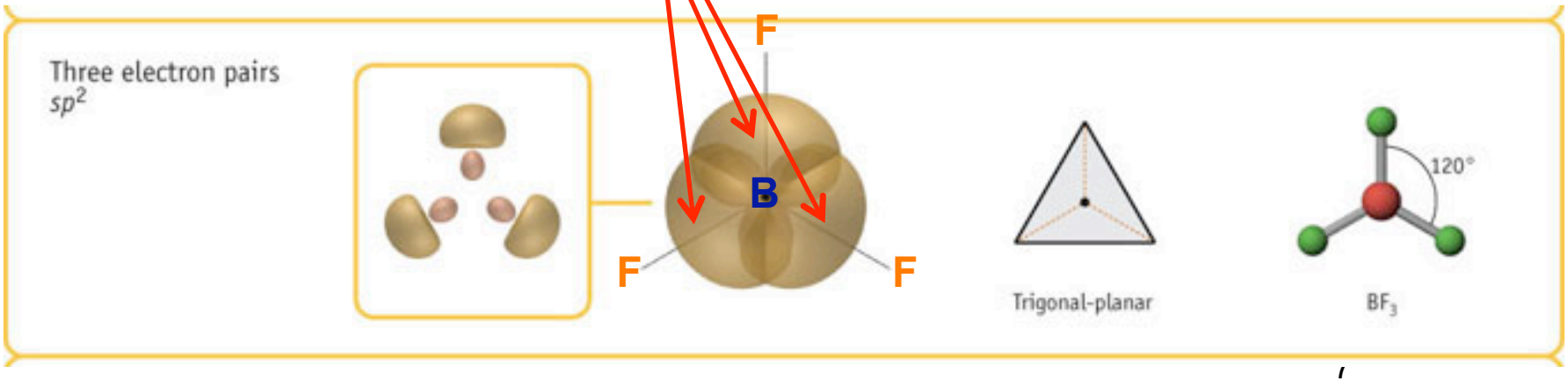
Hybrid Atomic Orbitals

Move away from thinking of p and s orbitals

We can combine **n** atomic orbitals, to get back **n** hybrid atomic orbitals

Combine one 2s and two 2p atomic orbitals

Get back three sp^2 hybrid atomic orbitals



Switch our Thinking

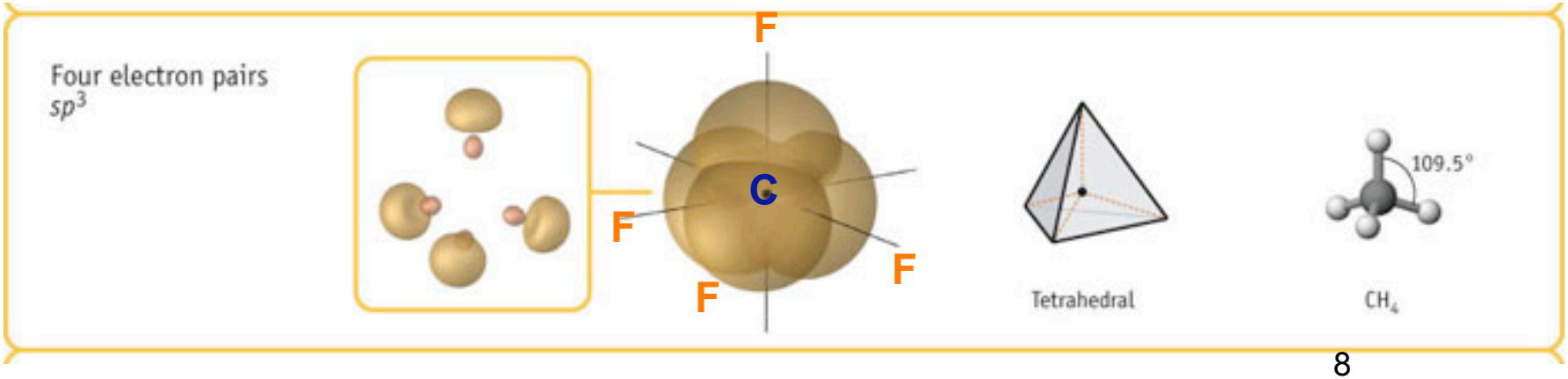
Hybrid Atomic Orbitals

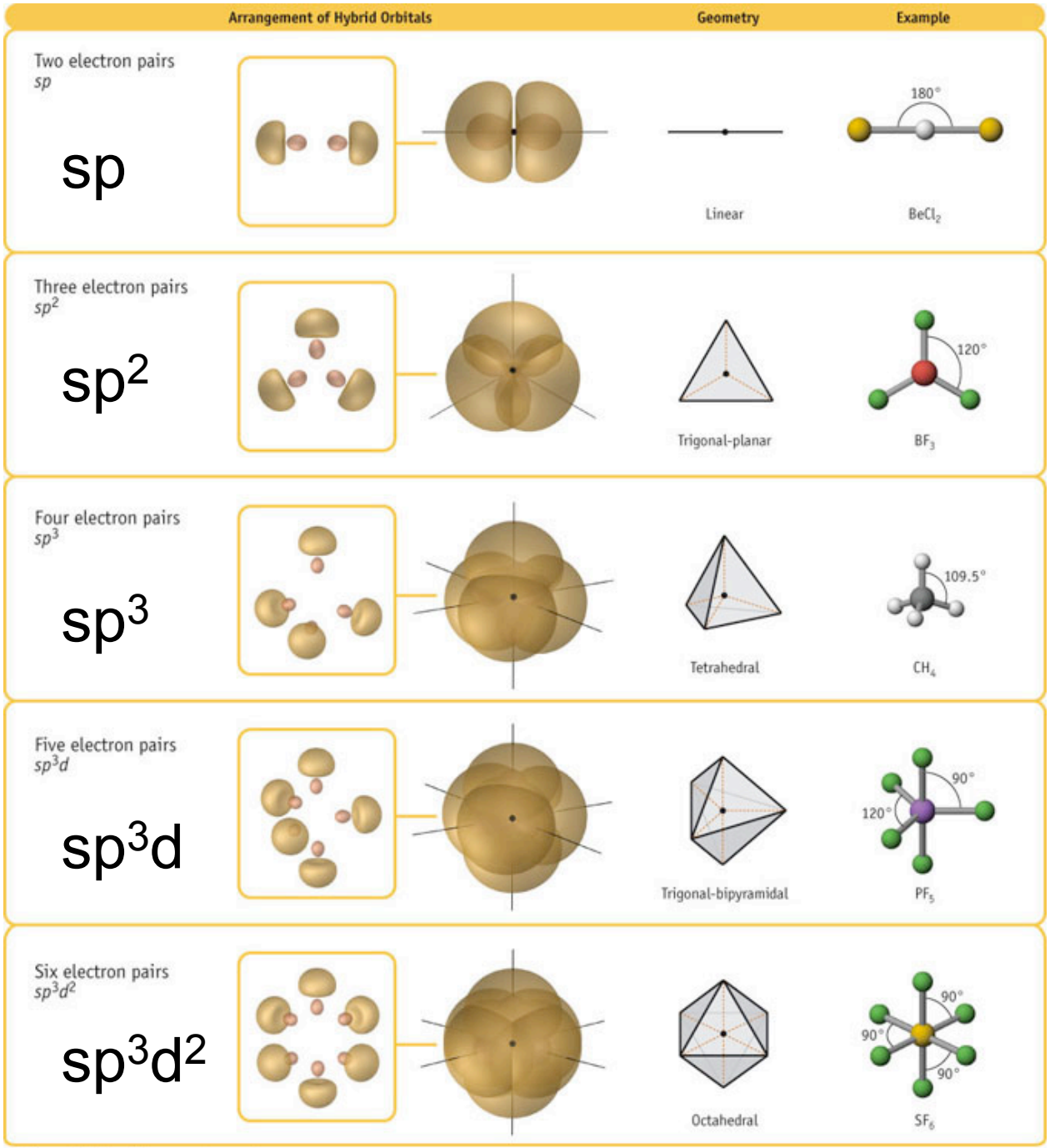
Move away from thinking of p and s orbitals

We can combine **n** atomic orbitals, to get back **n** hybrid atomic orbitals

Combine one 2s and three 2p atomic orbitals

Get back four sp^3 hybrid atomic orbitals





s + p

s + p + p

s + p + p + p

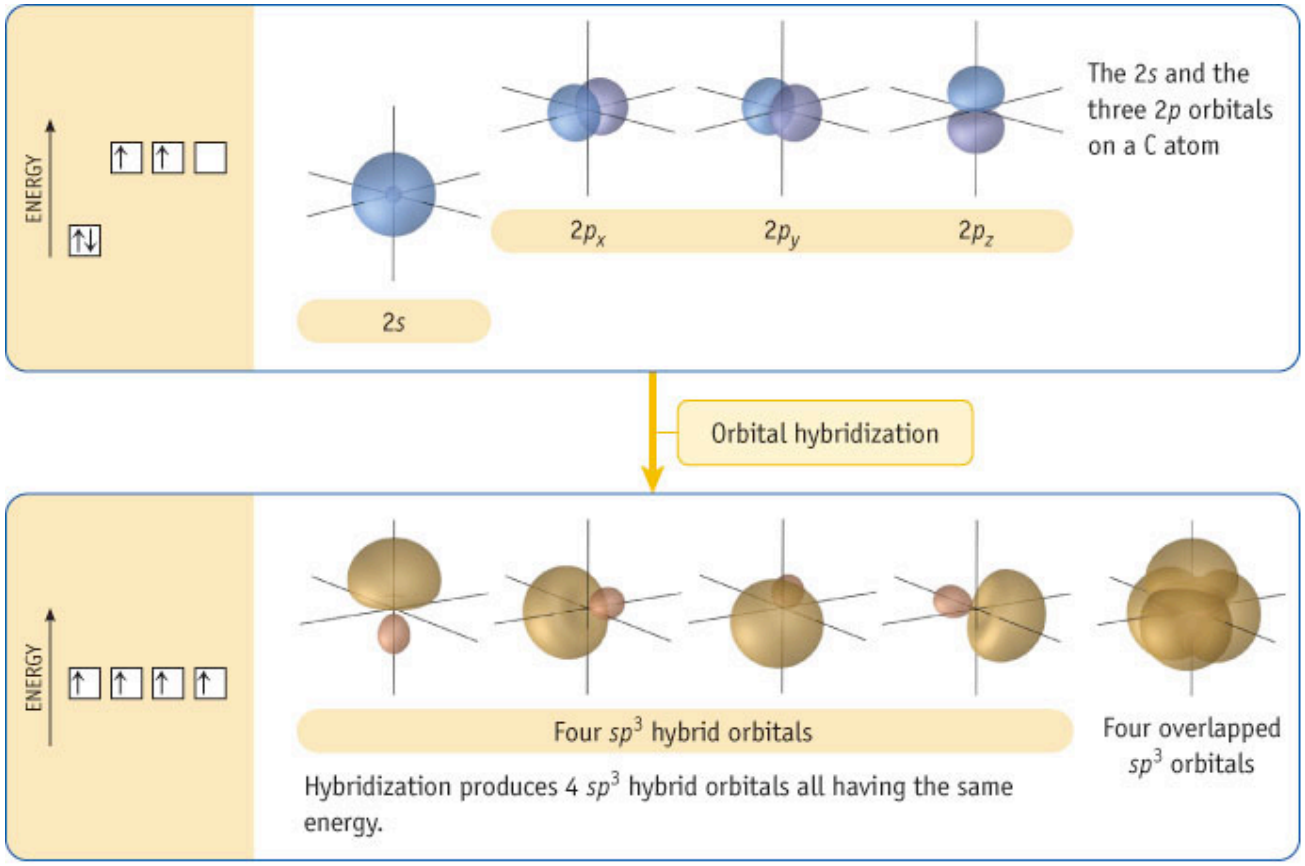
s+p+p+p+d

s+p+p+p+d+d

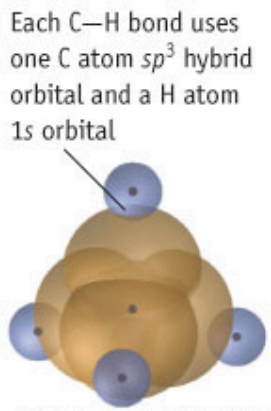
Fig. 9-5, p. 410

Conservation of energy

The sum of the energies of the starting orbitals must equal the sum of the energies of the resulting orbitals



Molecular model, CH_4

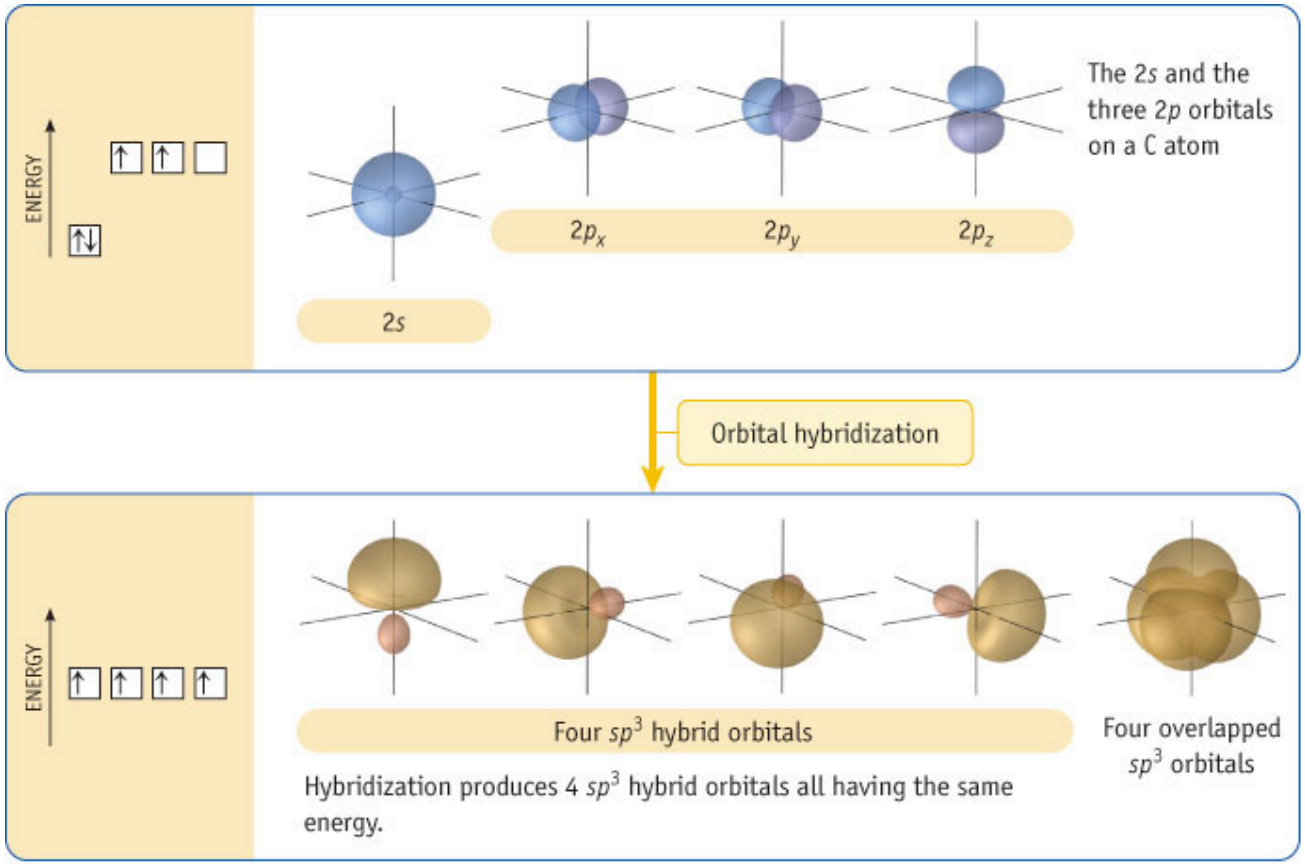


Orbital representation

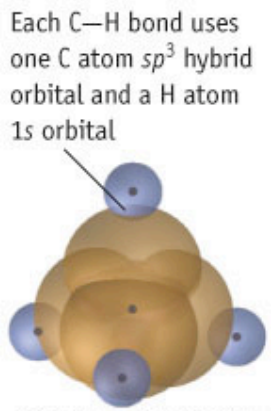
Fig. 9-6, p. 411

Conservation of energy

The sum of the energies of the starting orbitals must equal the sum of the energies of the resulting orbitals



Molecular model, CH_4



Orbital representation

Take home: don't mix more atomic orbitals than you need to

Fig. 9-6, p. 411

sp^3 hybridization

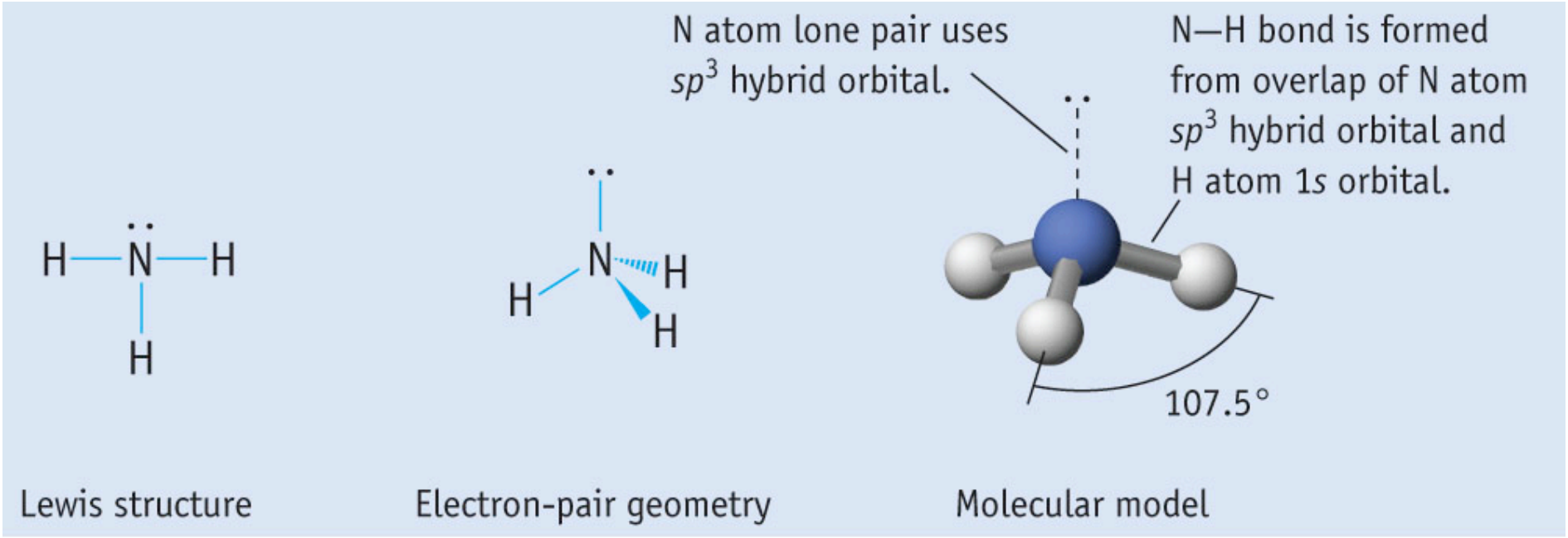


Fig. 9-7, p. 412

sp^3 hybridization

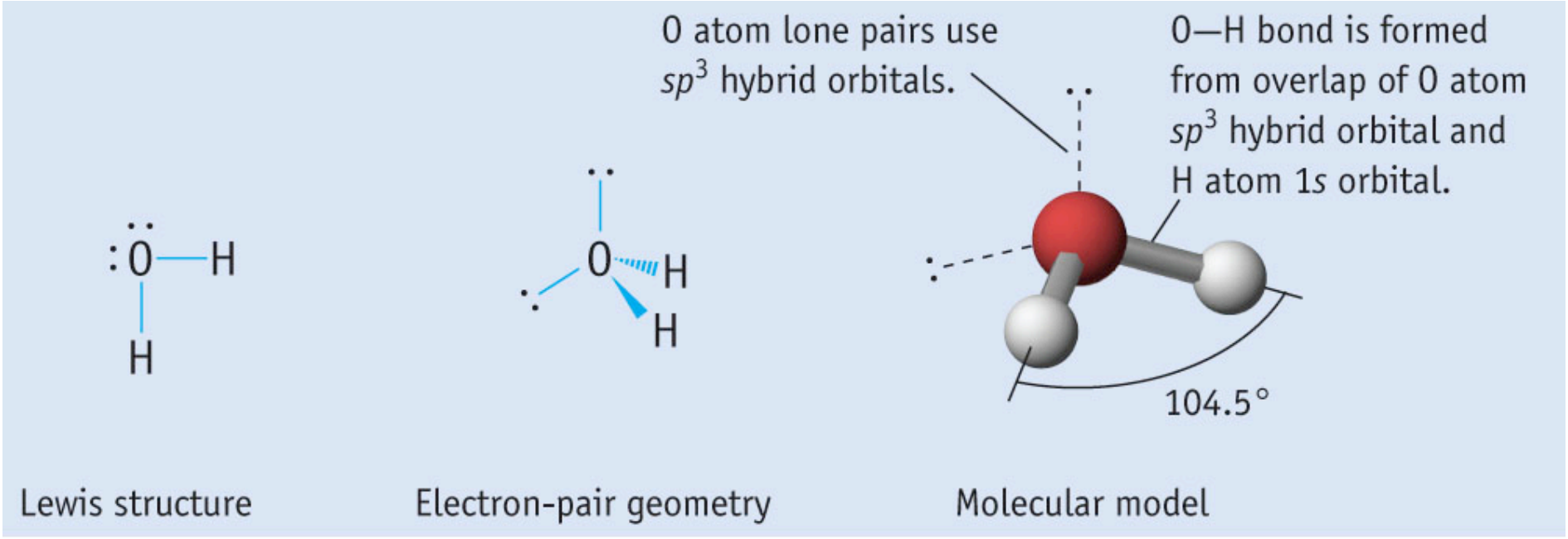
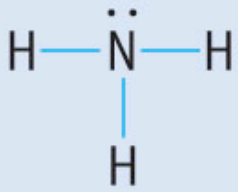
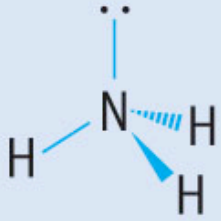


Fig. 9-7, p. 412

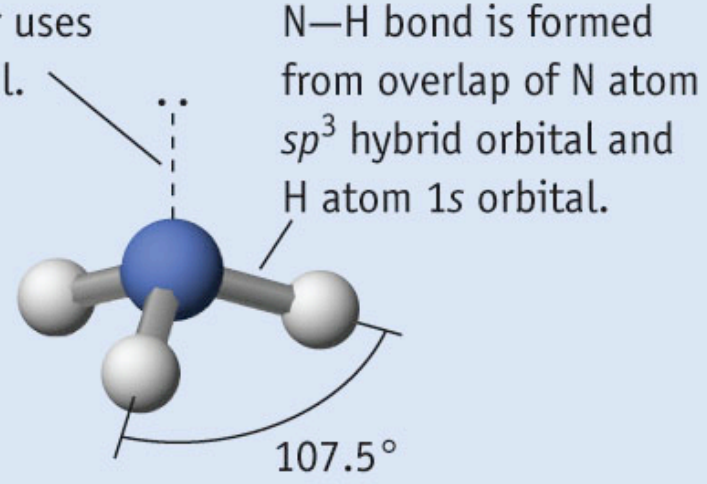
sp^3 hybridization



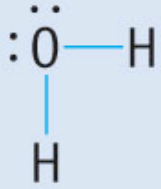
Lewis structure



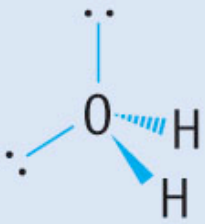
Electron-pair geometry



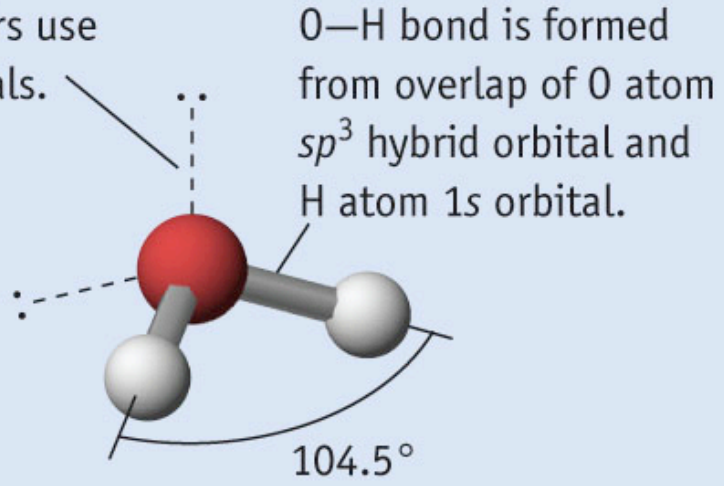
Molecular model



Lewis structure

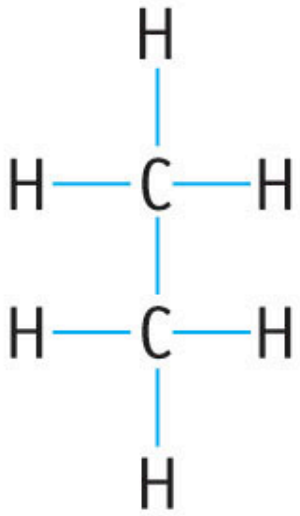


Electron-pair geometry

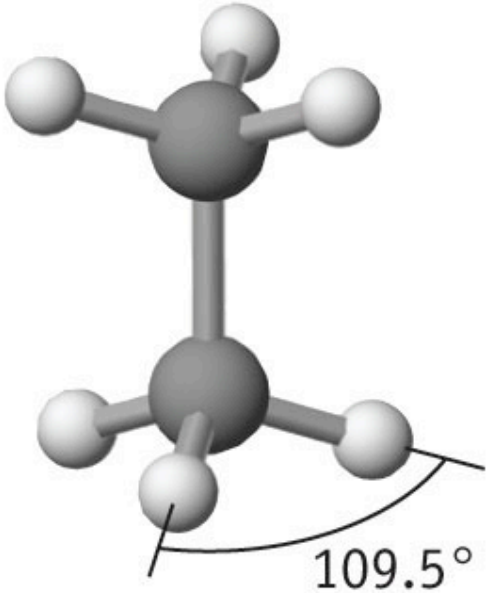


Molecular model

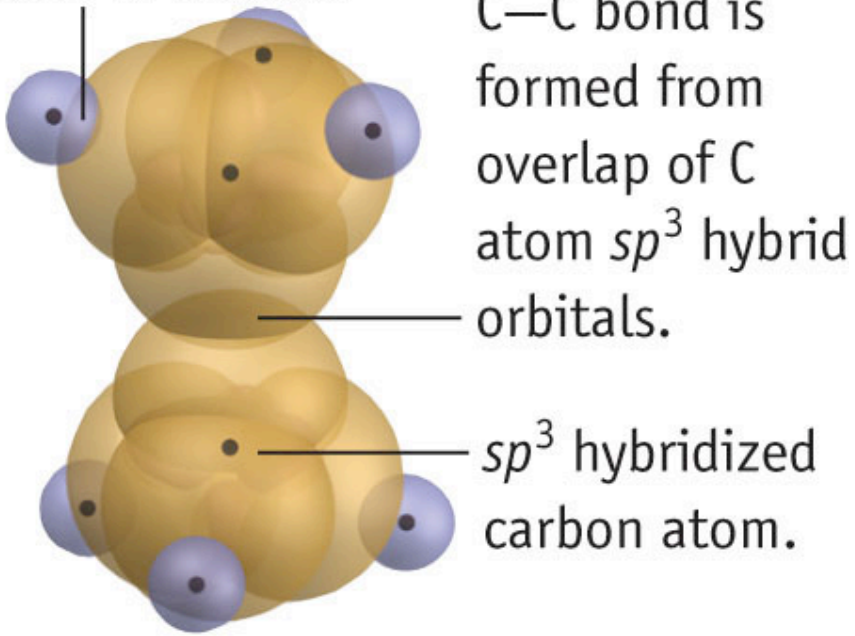
Fig. 9-7, p. 412



Lewis structure

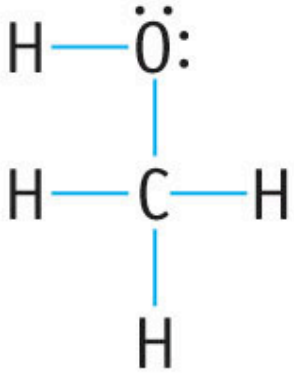


Molecular model

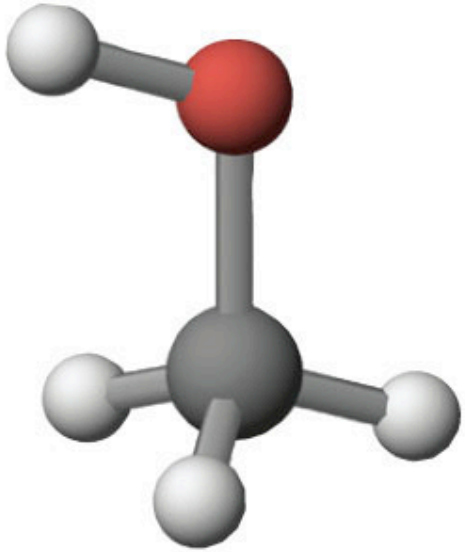


Orbital representation

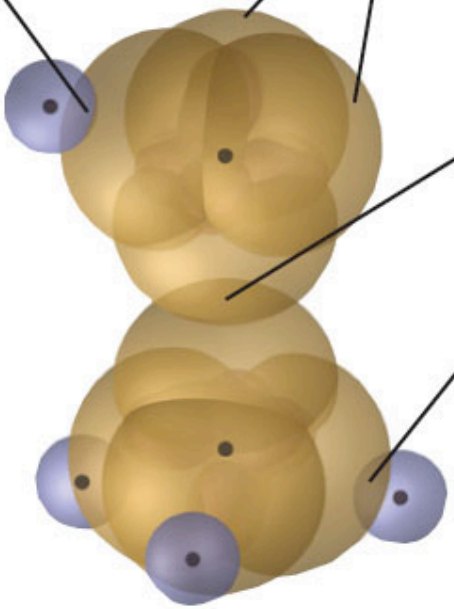
Example 9-1, p. 412



Lewis structure



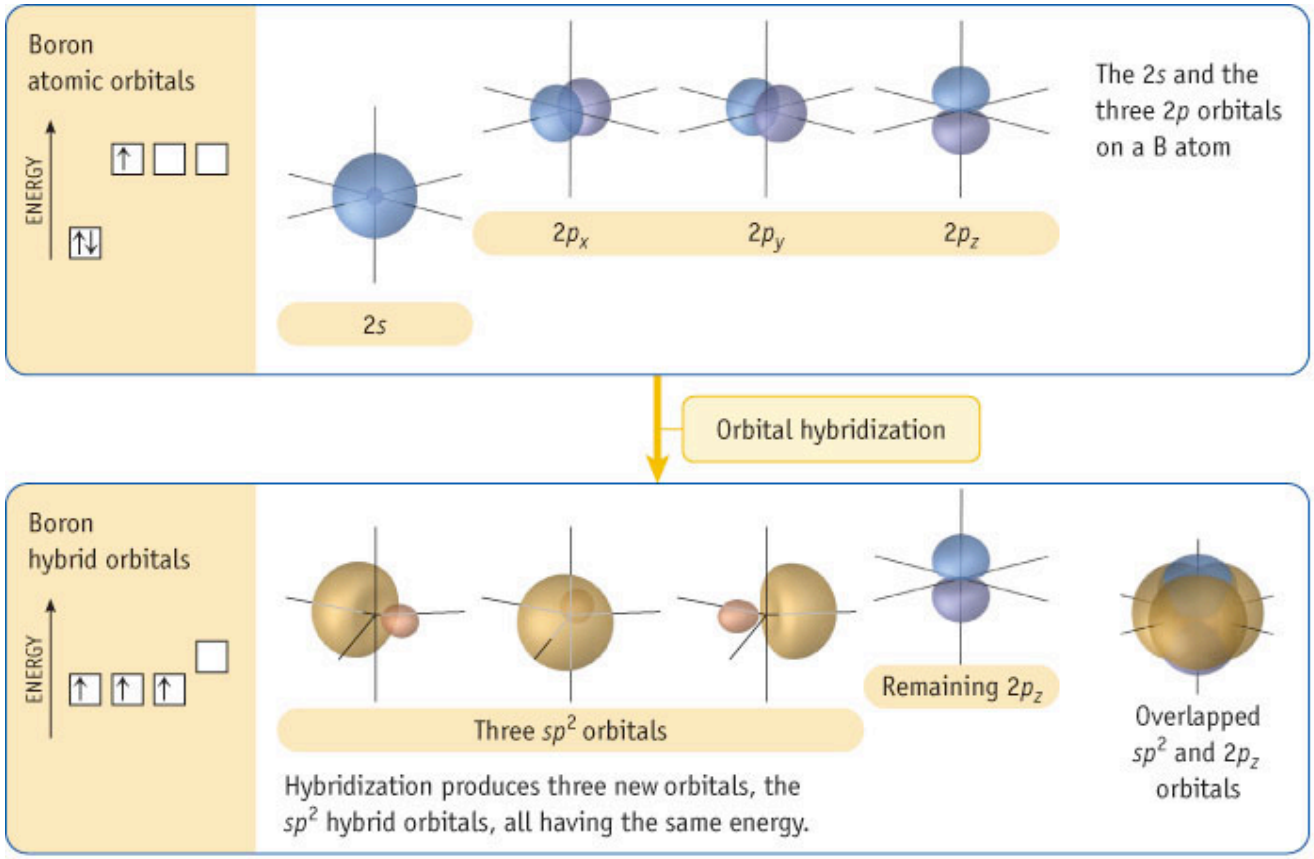
Molecular model

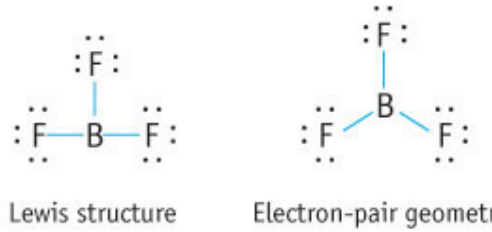


Orbital representation

Example 9-2, p. 413

sp^2 hybridization





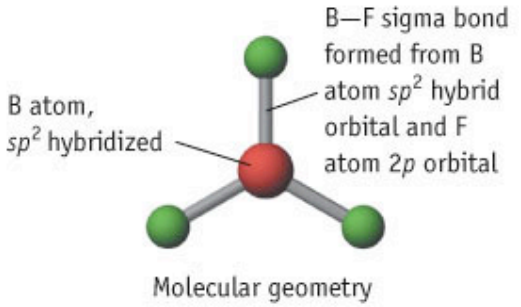
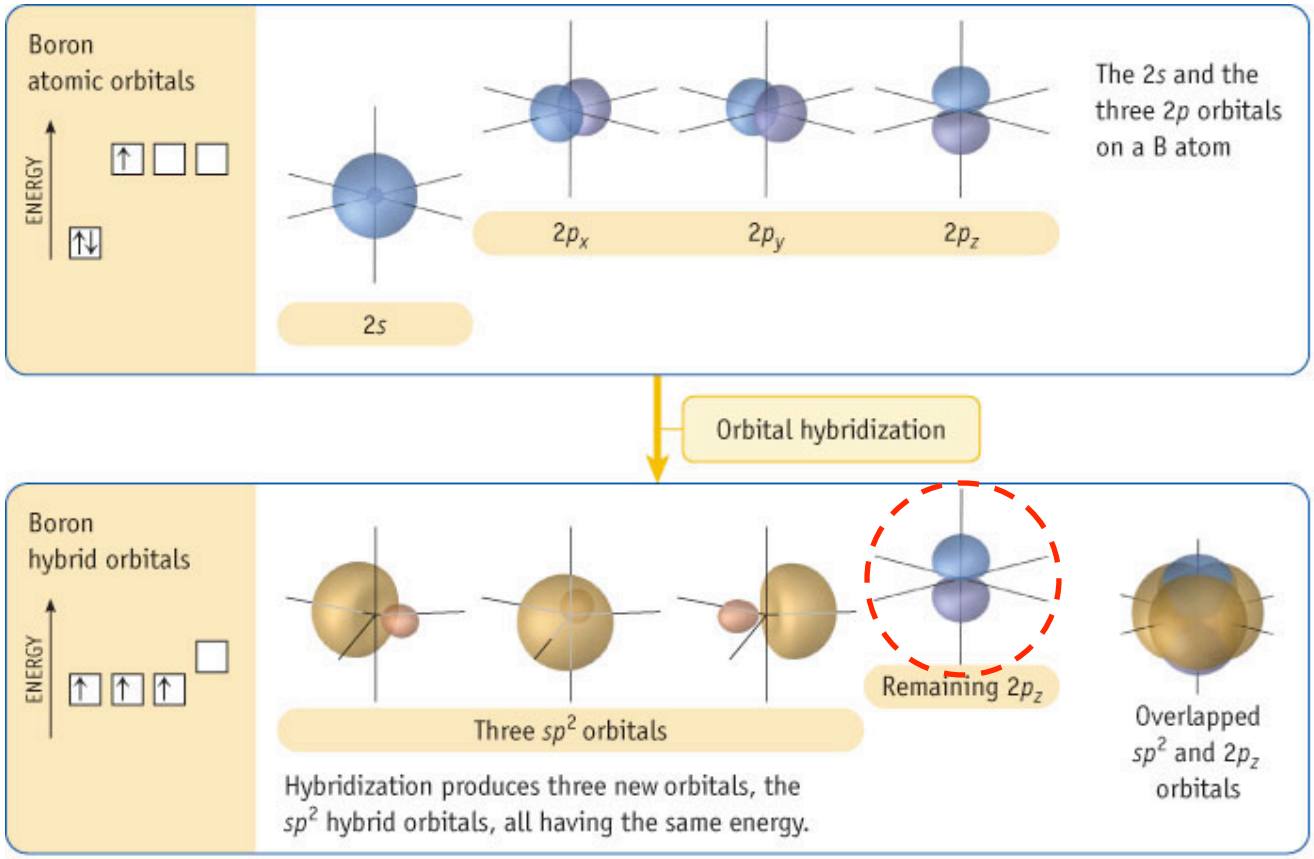


Fig. 9-8, p. 414

sp^2 hybridization



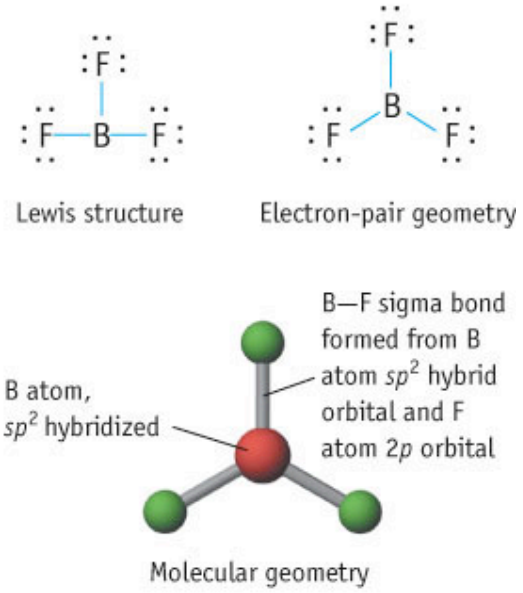
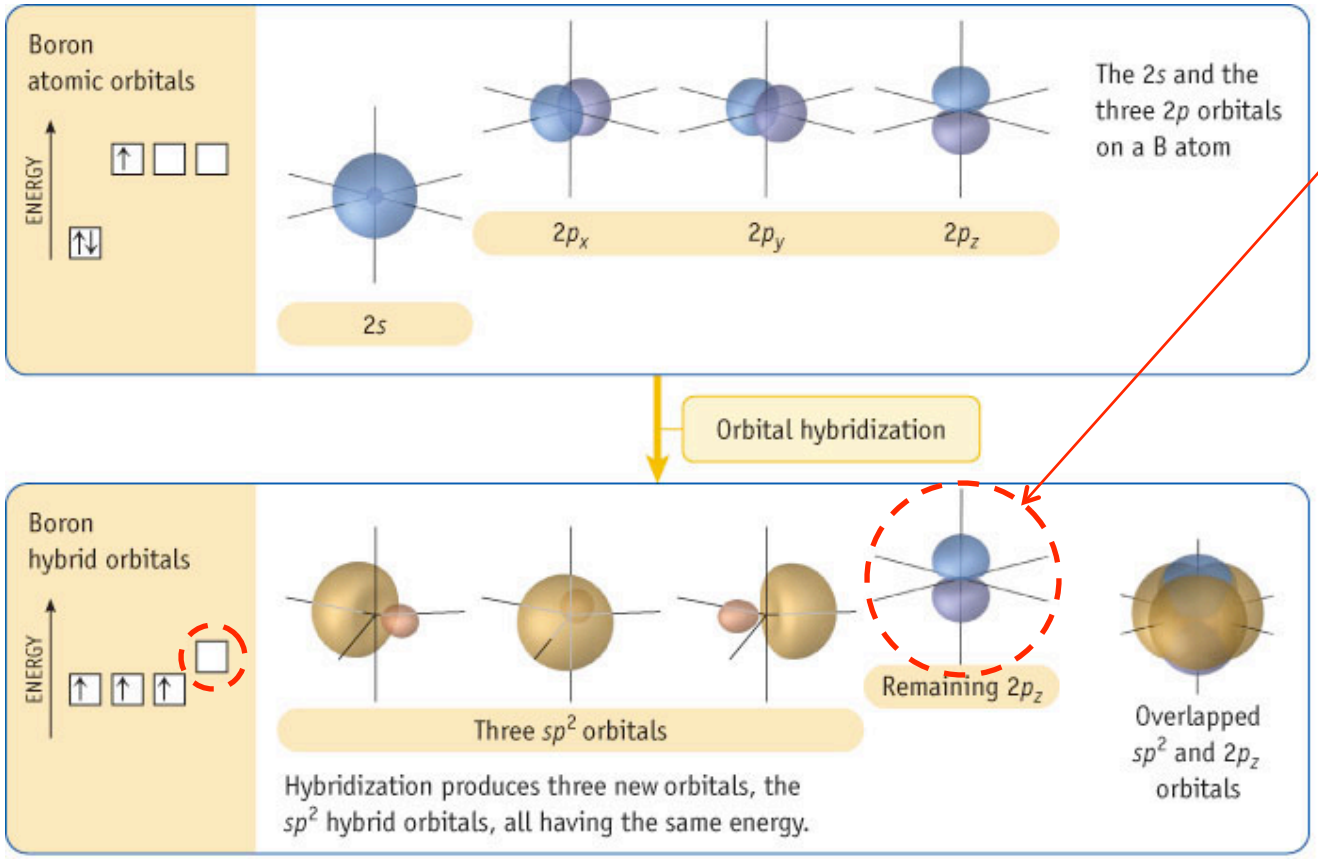
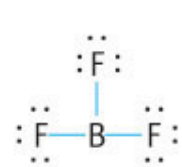


Fig. 9-8, p. 414

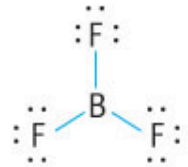
sp^2 hybridization



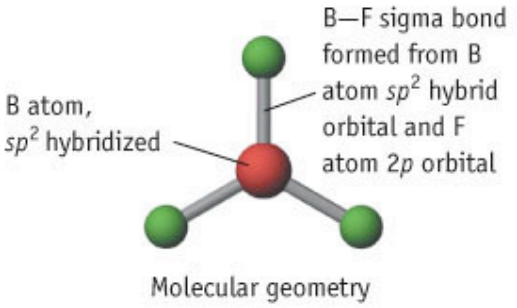
Left over (unused) atomic orbital



Lewis structure



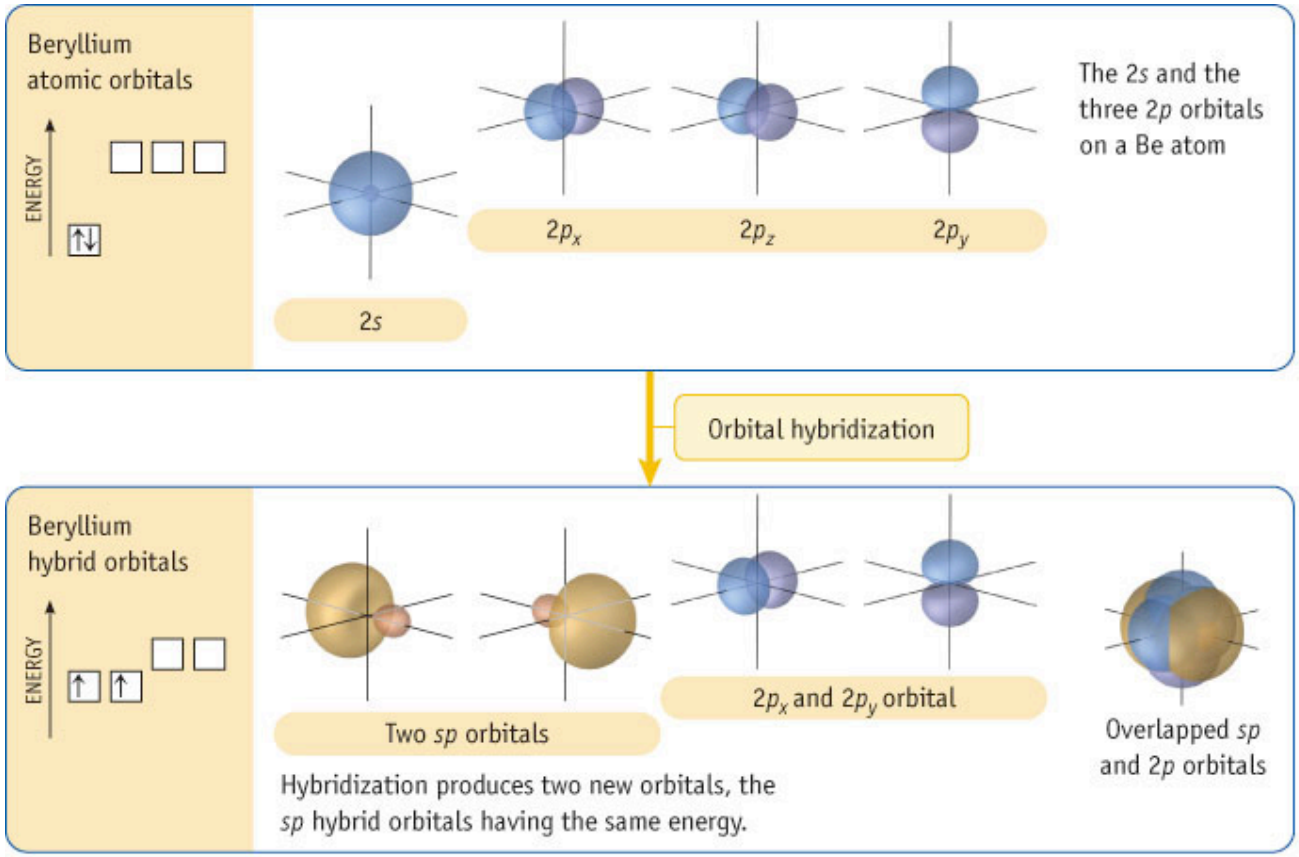
Electron-pair geometry



Molecular geometry

Fig. 9-8, p. 414

sp hybridization



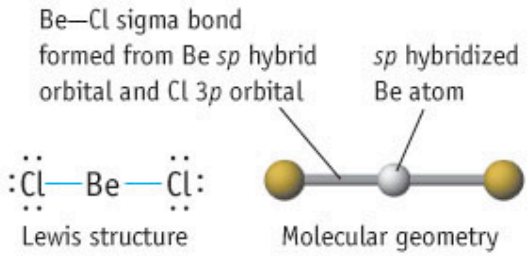
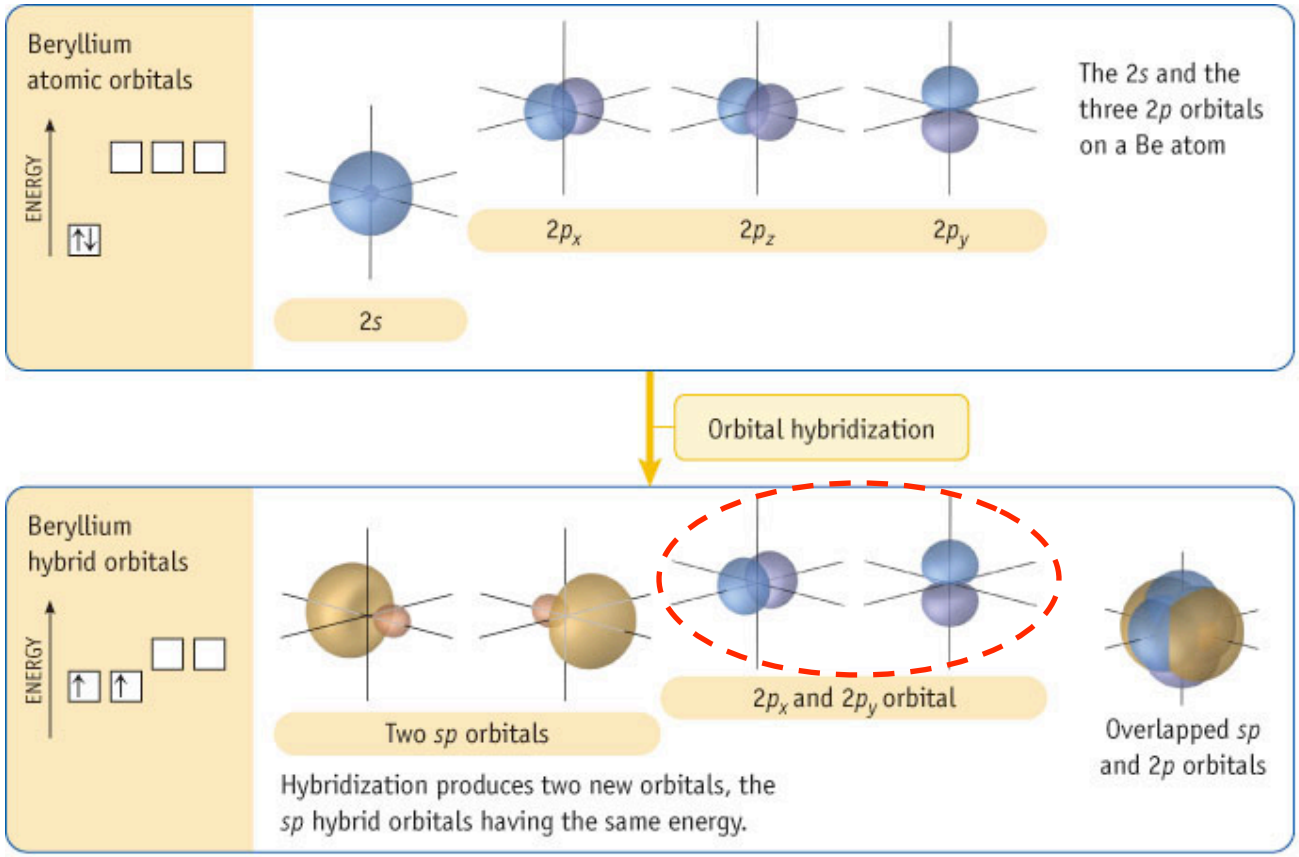


Fig. 9-9, p. 415

sp hybridization



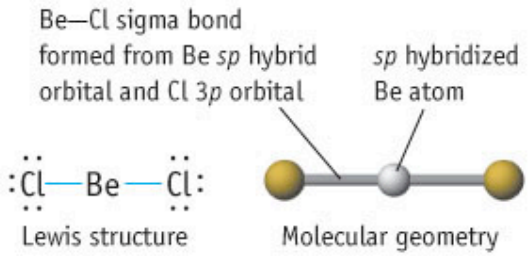
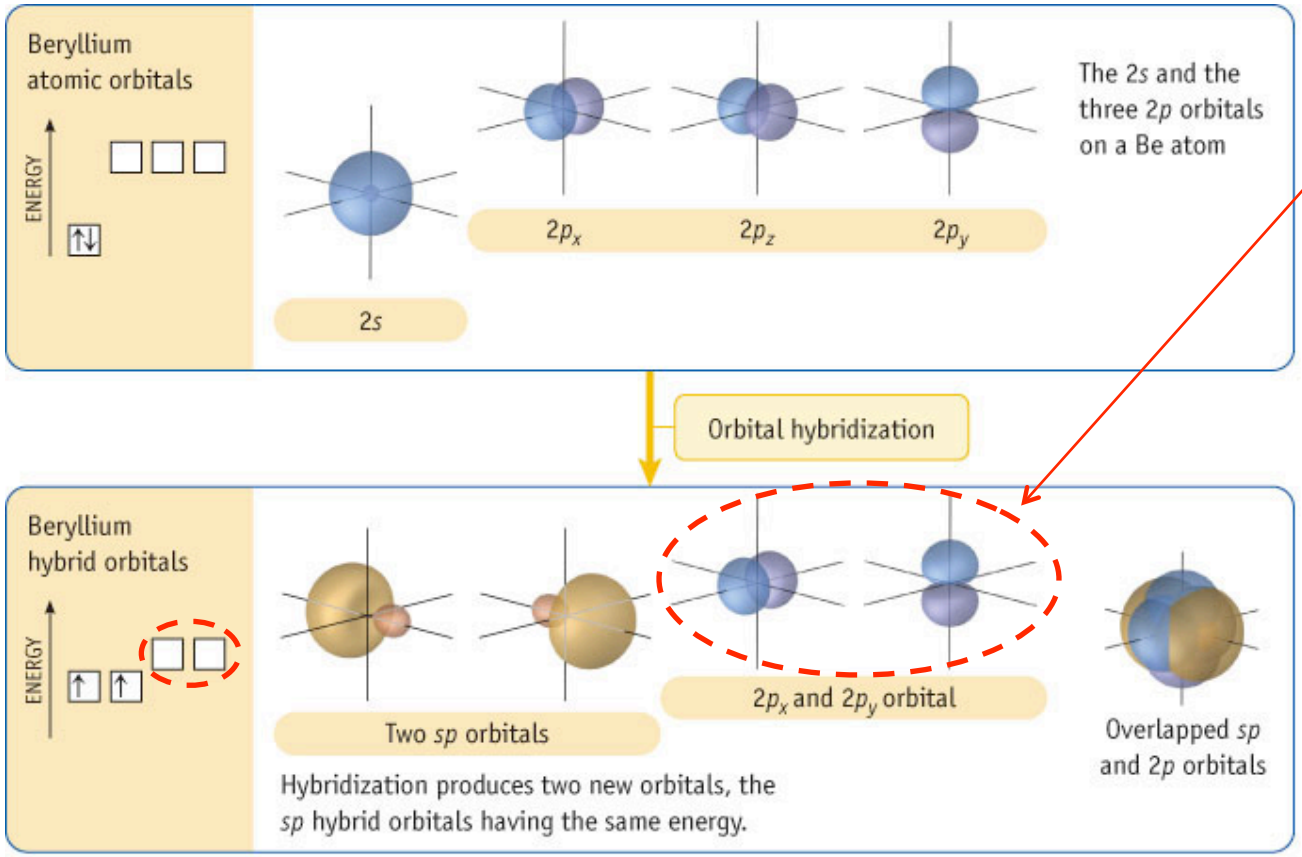


Fig. 9-9, p. 415

sp hybridization

Left over (unused) atomic orbitals



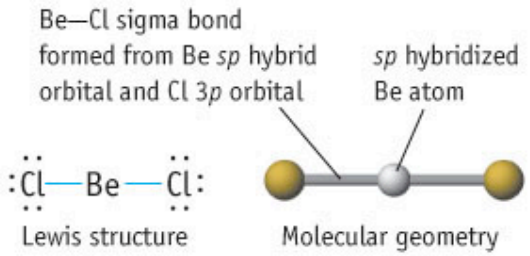


Fig. 9-9, p. 415