Chemical Bonds


BONDING

IONIC BONDING

Formation of Ions from

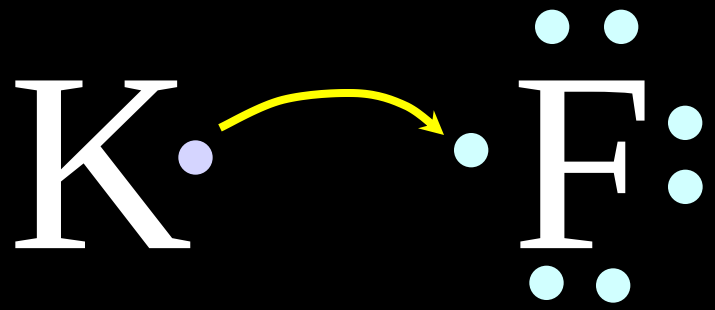
- **Ionic compounds result when metals react with nonmetals**
- **Metals *lose* electrons to match the *number of valence electrons* of their nearest noble gas**
- ***Positive ions* form *when* the number of electrons are less than the number of protons**

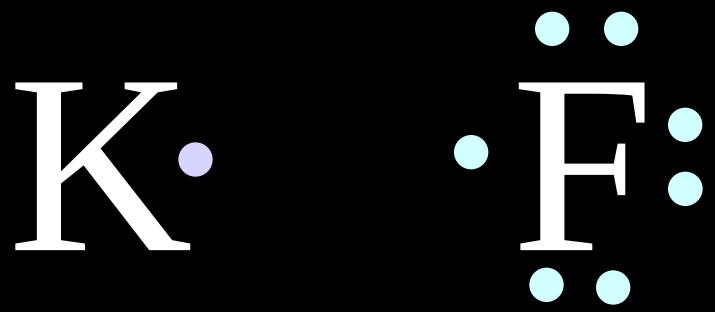
Group 1 metals ⟶ ion $^{1+}$

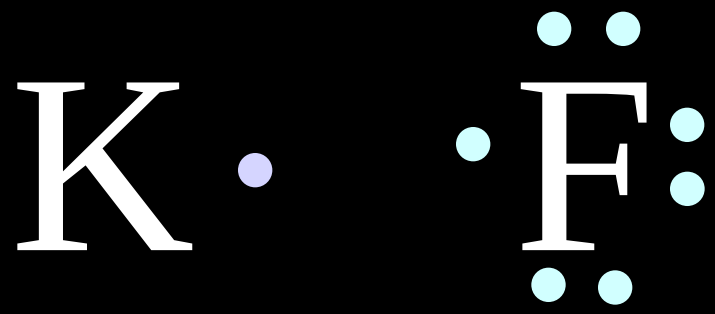
Group 2 metals ⟶ ion $^{2+}$

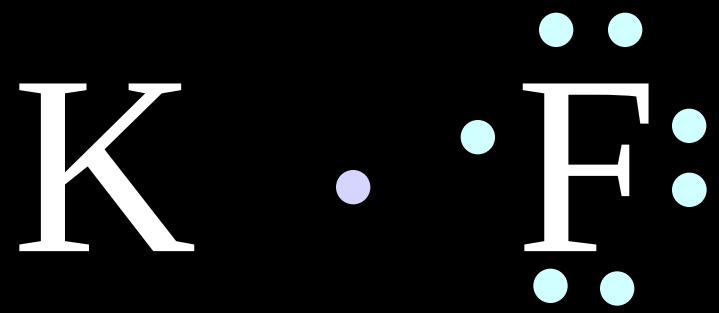
- **Group 13 metals ⟶ ion $^{3+}$**

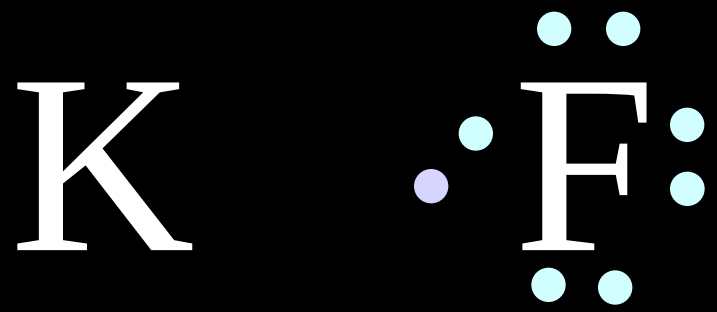
In an **IONIC** bond,
electrons are lost or gained,
resulting in the formation of **IONS**
in ionic compounds. Ionic bonds take place between metals and non-metals.

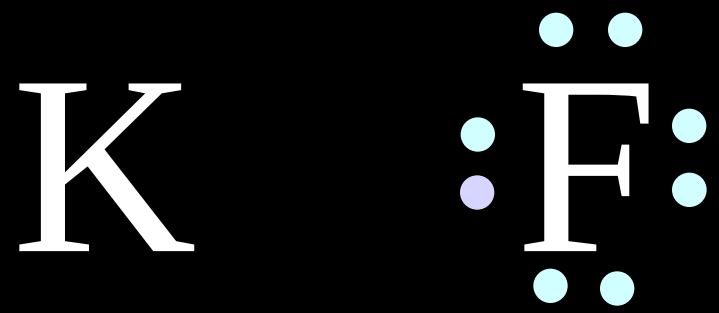


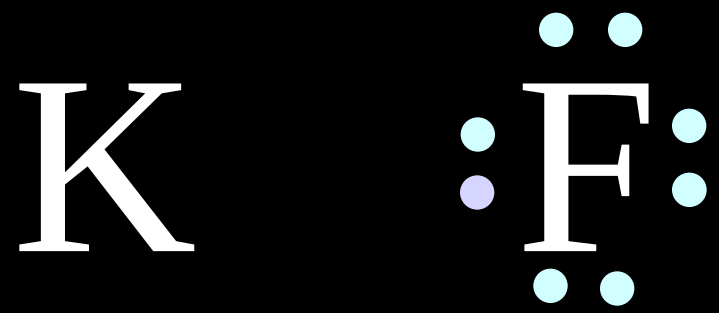

K
F

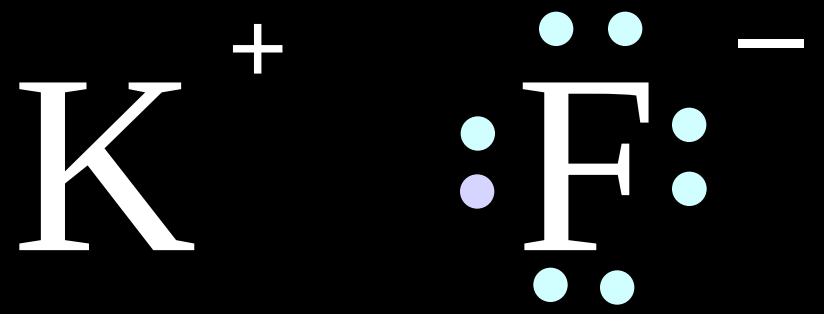

K
F

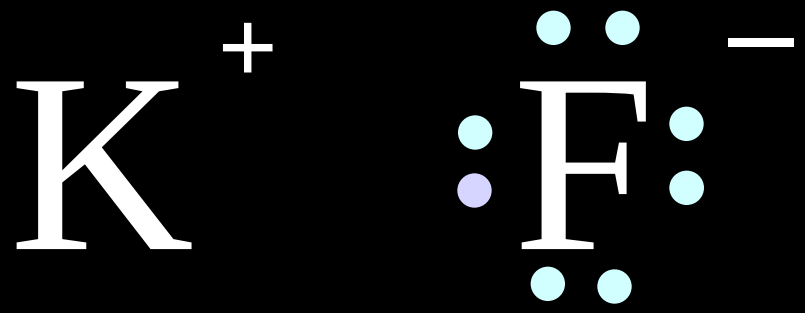

K
F


K
F

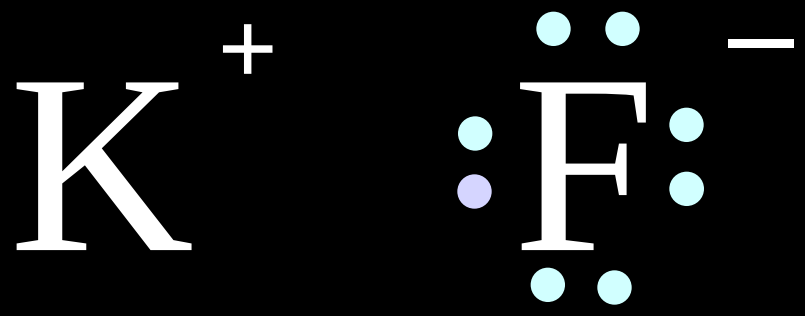

K
F


K
F


K
+
F
–



The compound potassium fluoride consists of potassium (K^+) ions and fluoride (F^-) ions



The ionic **bond** is the attraction between the positive K^+ ion and the negative F^- ion

Covalent Bonds

So what are covalent bonds?

In covalent bonding,
atoms still want to achieve
a noble gas configuration, meaning the outer shell is filled with 8 electrons.
(the octet (8) rule).

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But rather than losing or gaining electrons,
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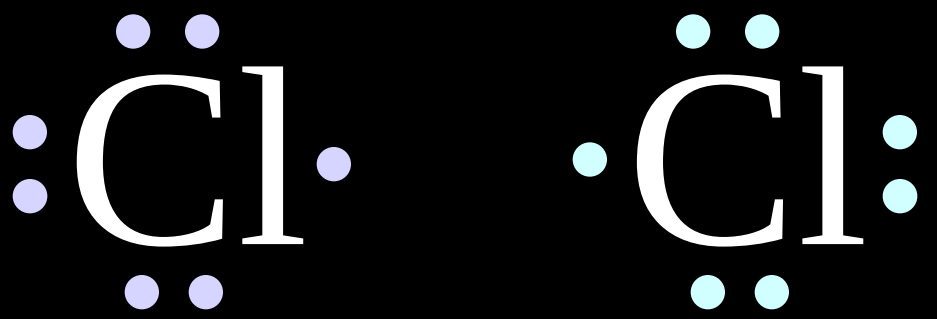
electrons,
atoms now **share** an electron pair.

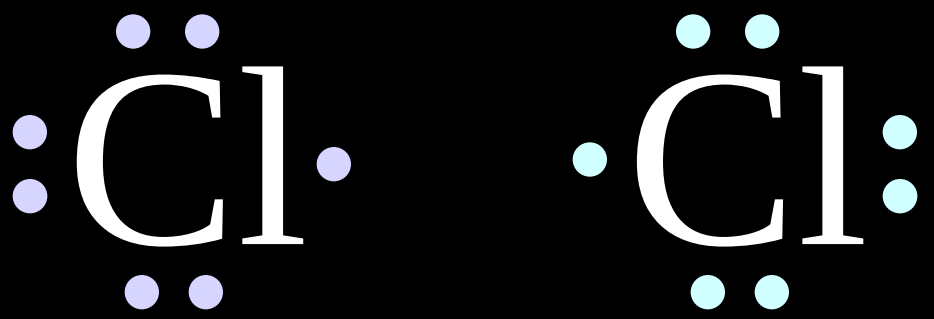
The shared electron pair
is called a *bonding pair*

Chlorine forms a covalent bond with itself

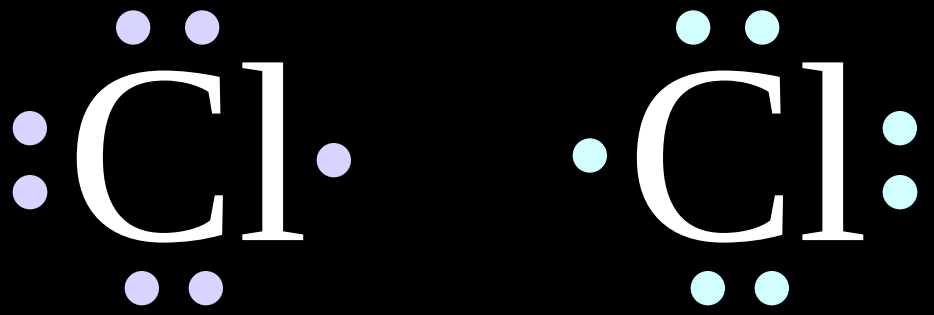
Cl_2



How will two chlorine atoms react?

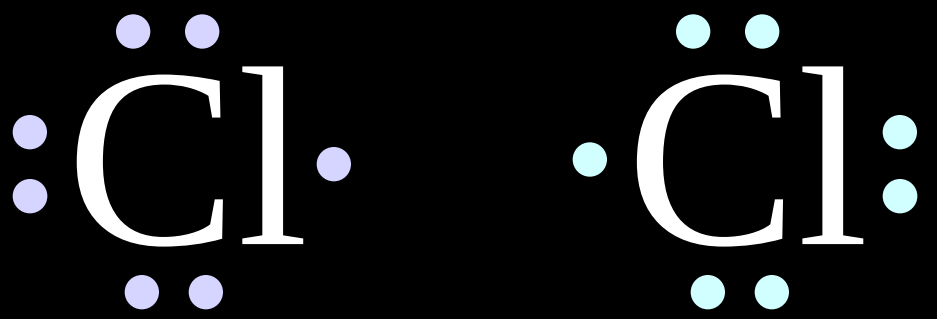


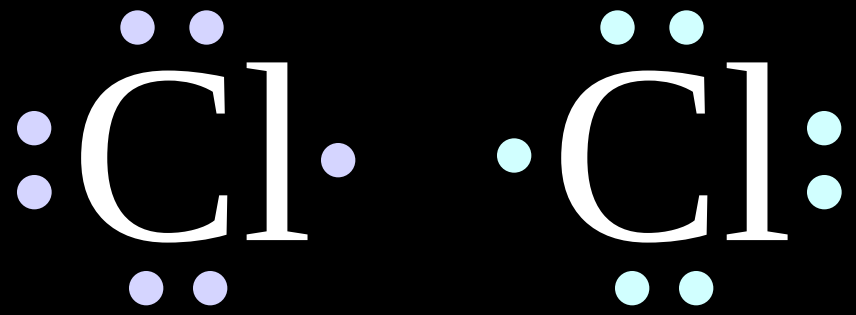
Each chlorine atom wants to
gain one electron to achieve an octet

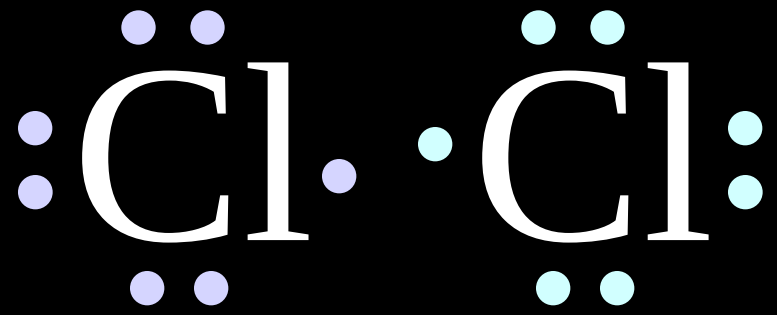


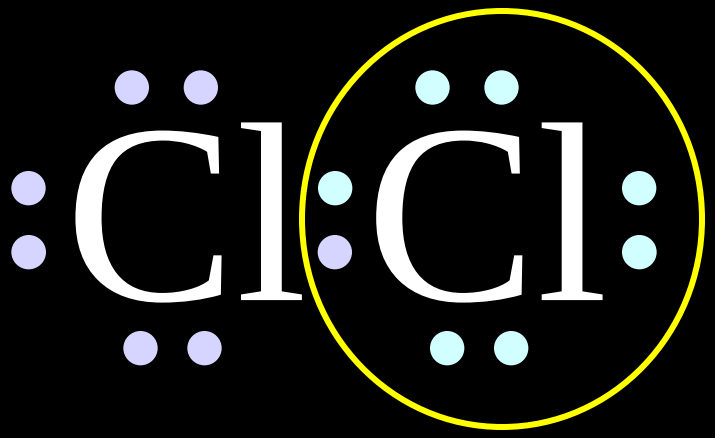
Neither atom will give up an electron – chlorine is highly electronegative.

What's the solution – what can they do to achieve an octet?

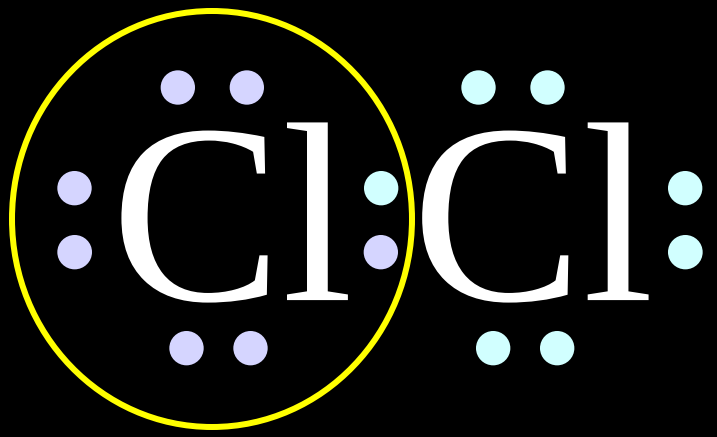

Cl
Cl



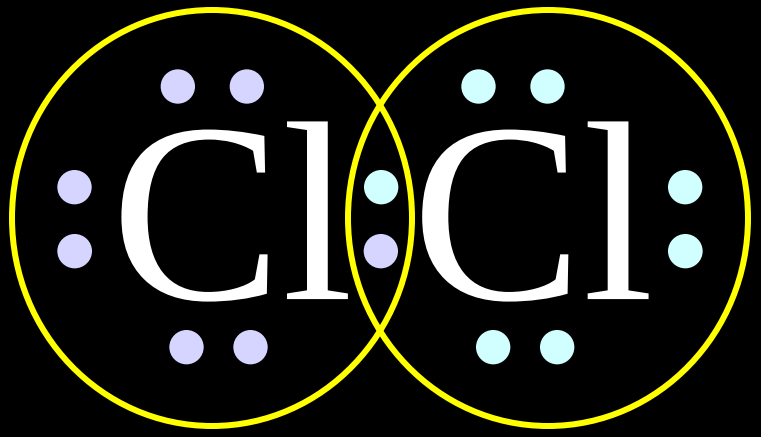




octet



octet



The octet is achieved by each atom sharing the electron pair in the middle

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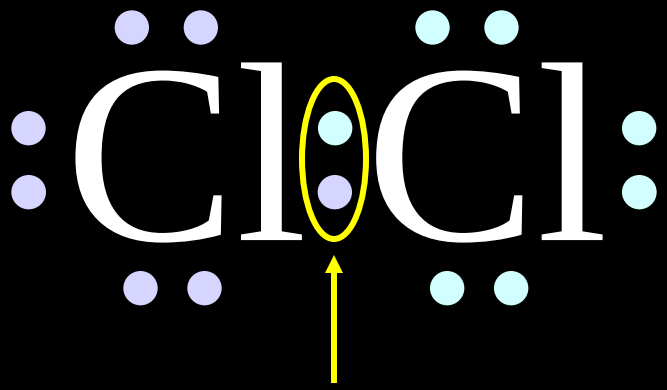
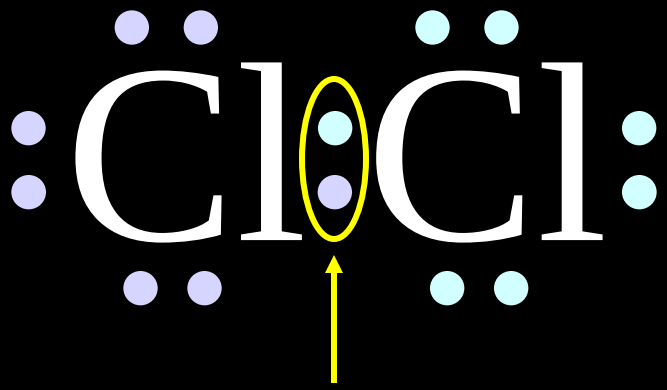
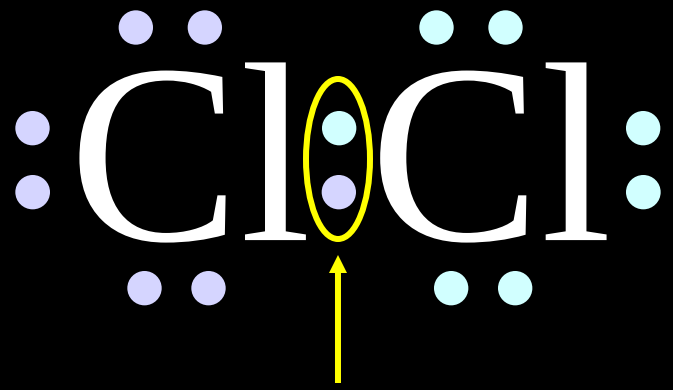


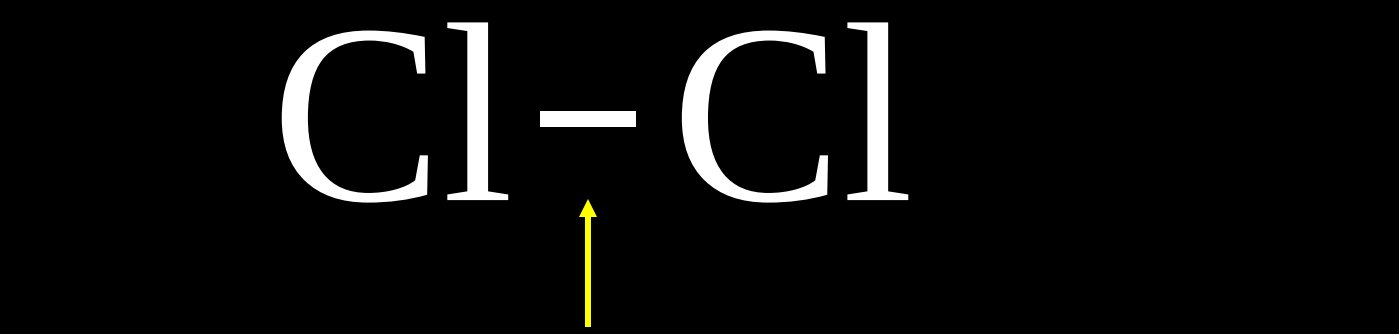
This is the bonding pair



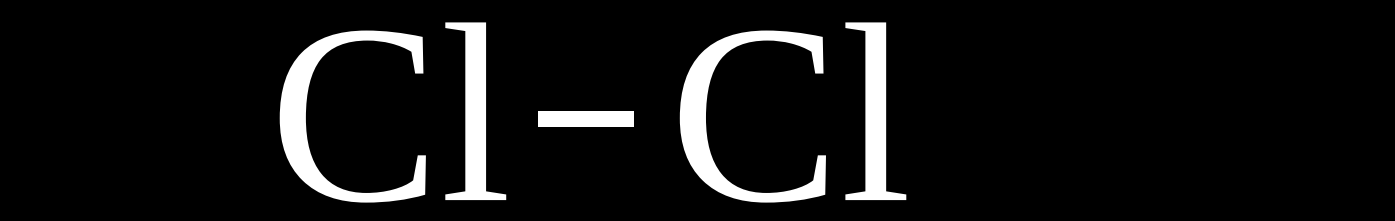
It is a *single* bonding pair



It is called a **SINGLE BOND**



Single bonds are abbreviated with a dash

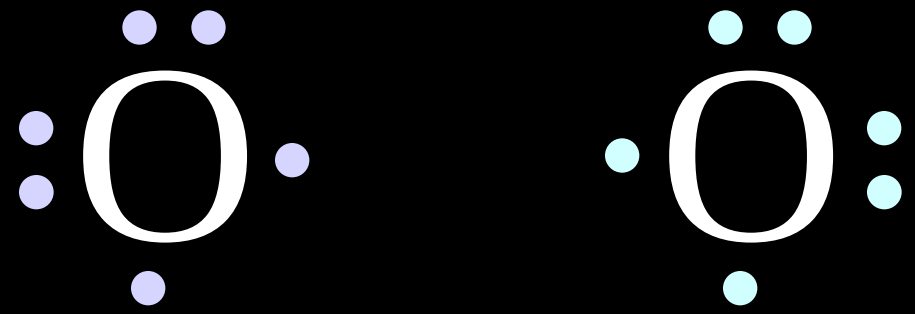


This is the chlorine molecule,

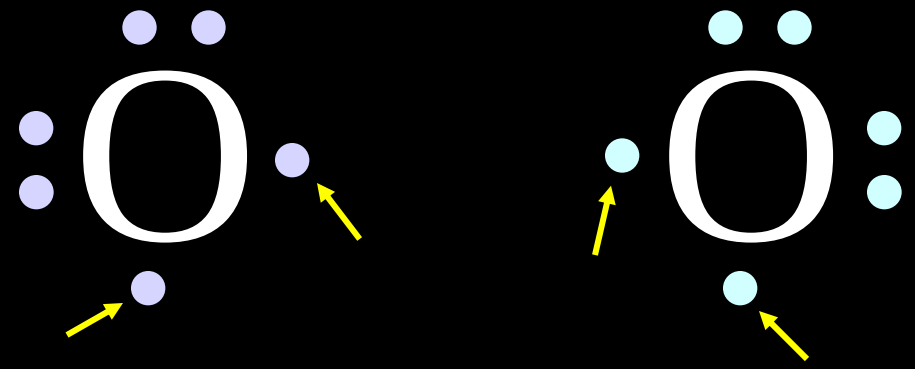
Cl_2

O_2

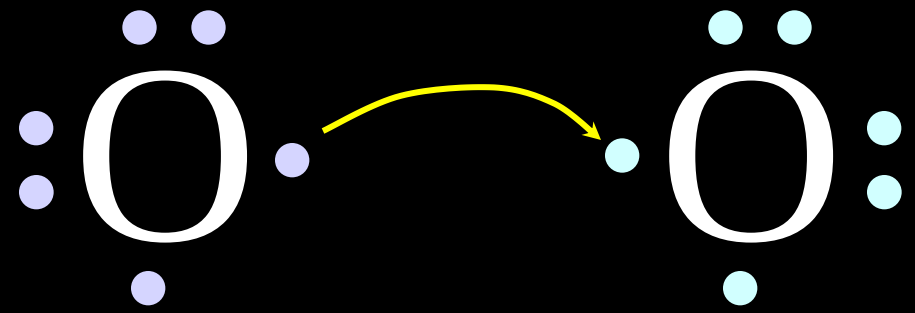
Oxygen is also one of the diatomic molecules

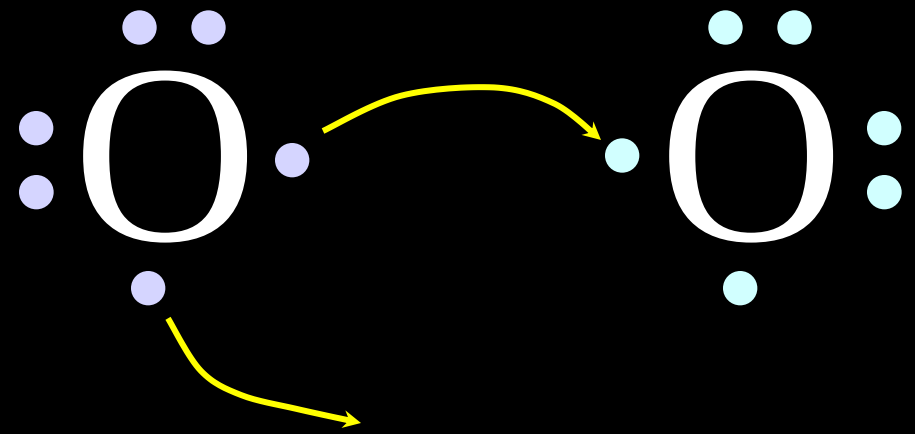


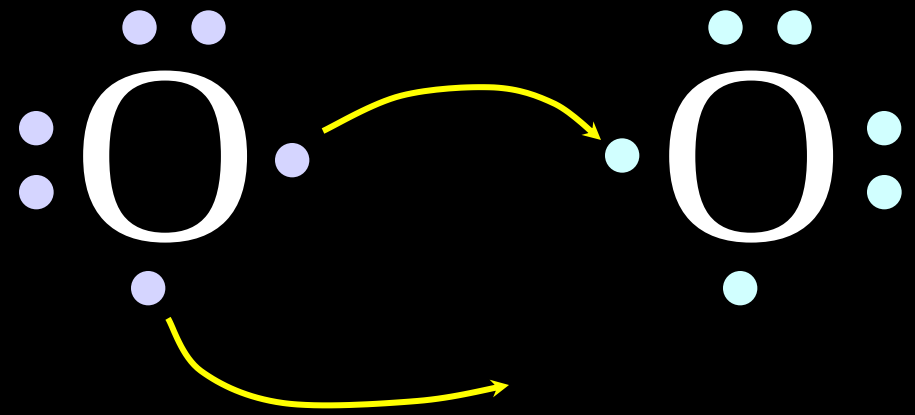
How will two oxygen atoms bond?

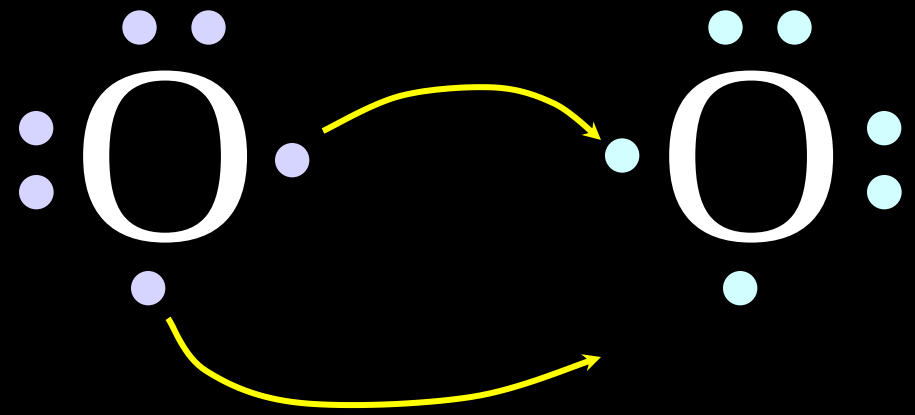


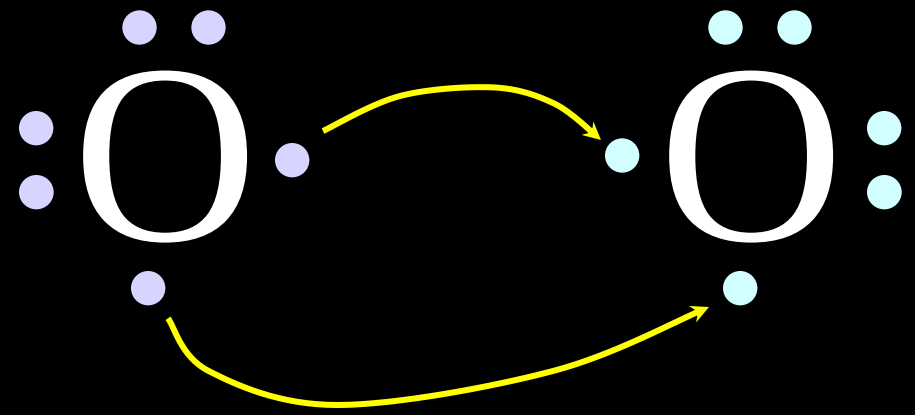
Each atom has two unpaired electrons

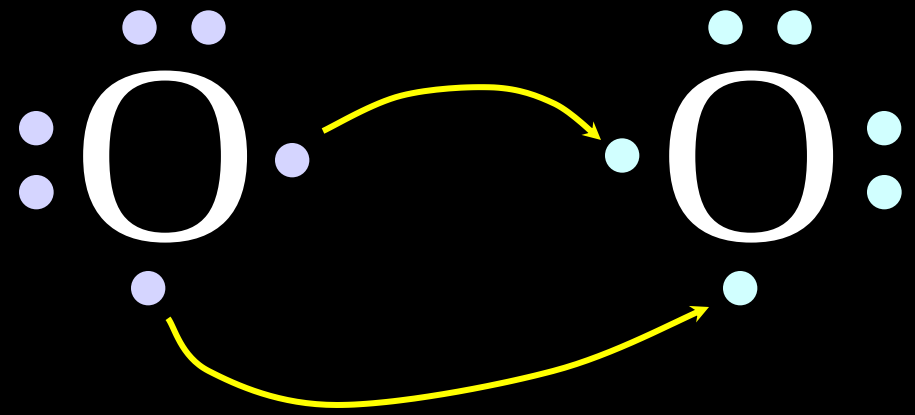

O
O

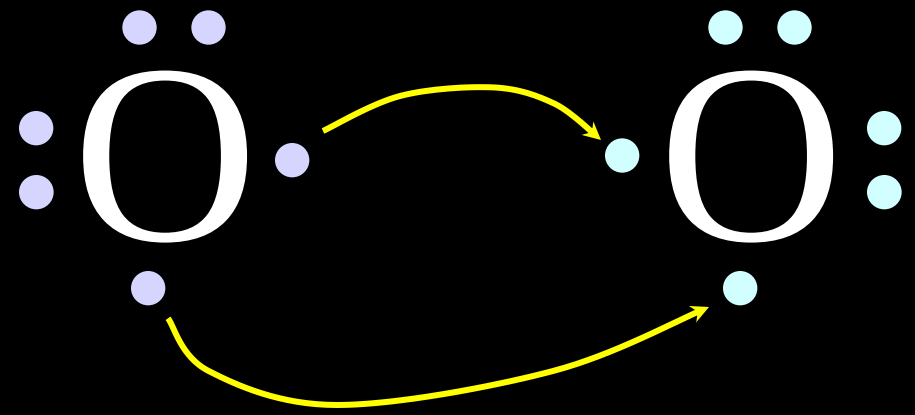

O
O


O
O


O
O

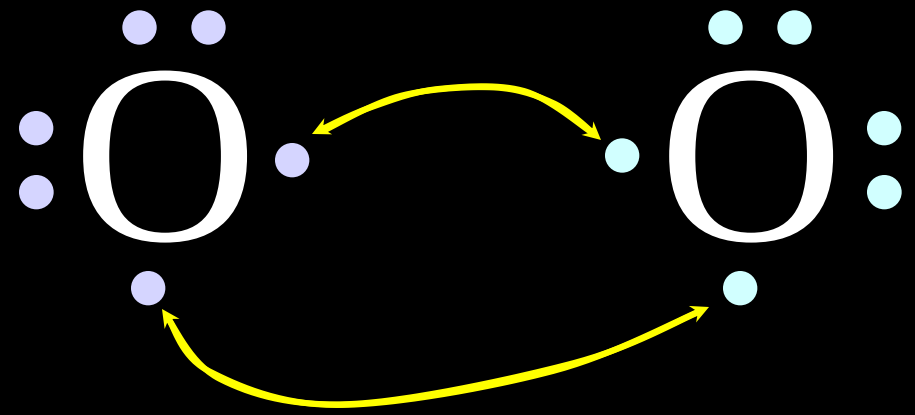

O
O


O
O



Oxygen atoms are highly electronegative.

So both atoms want to gain two electrons.



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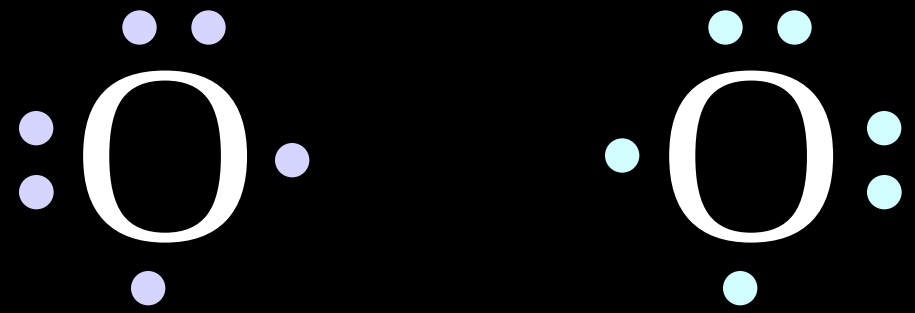
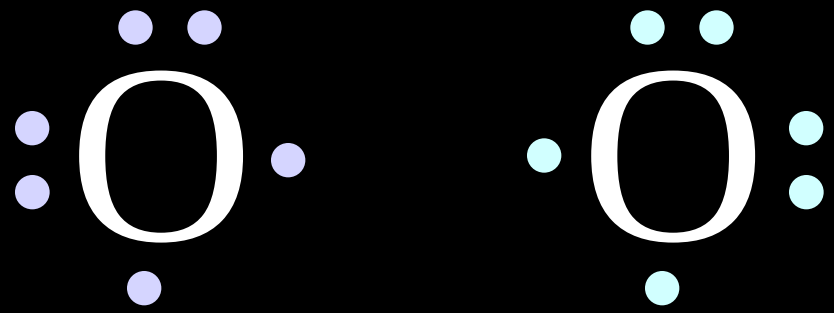
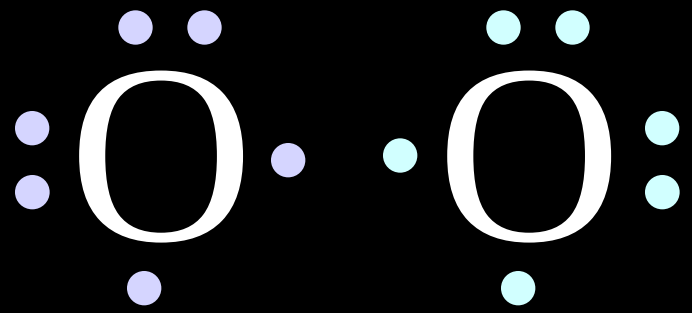
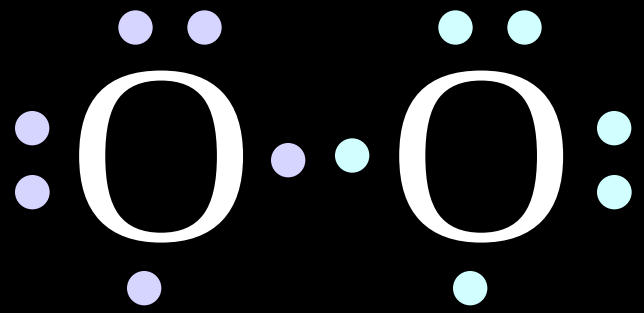
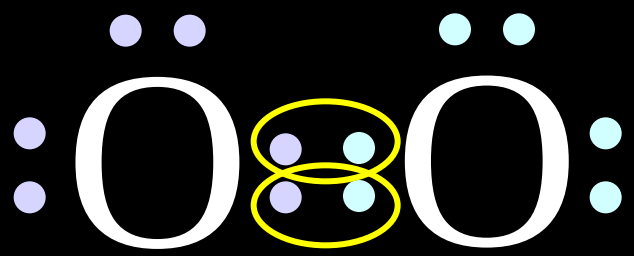


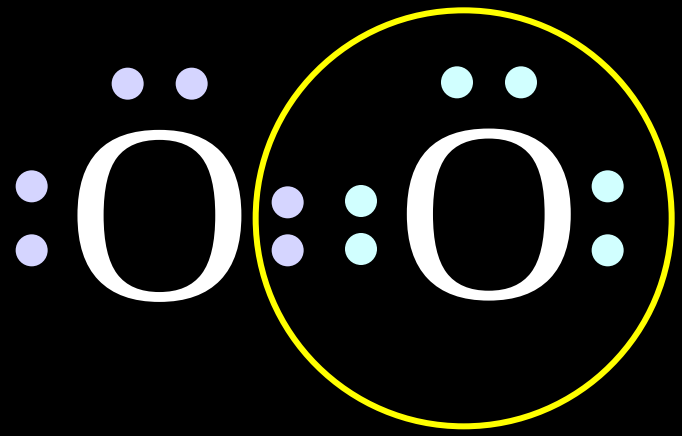




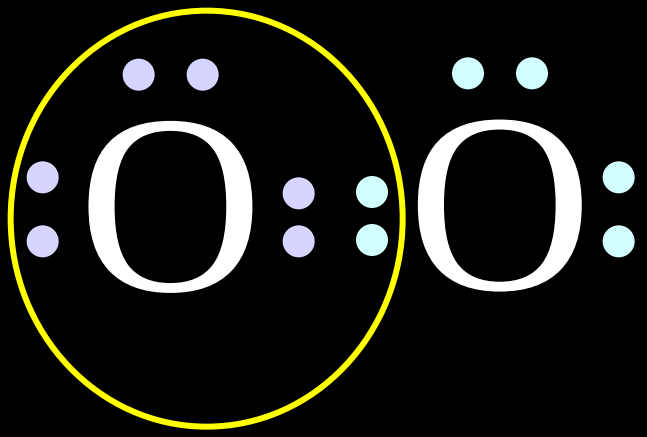




Both electron pairs are shared.



6 valence electrons
plus 2 shared electrons
= full octet



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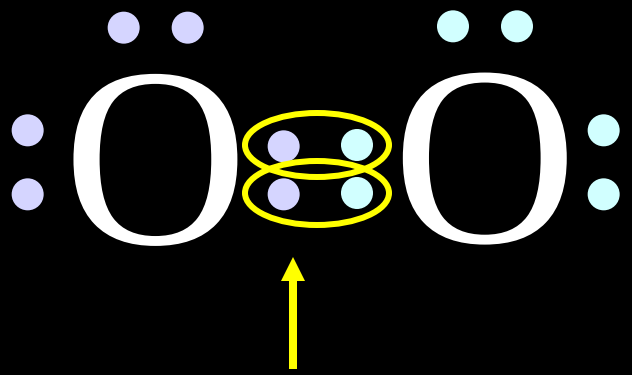
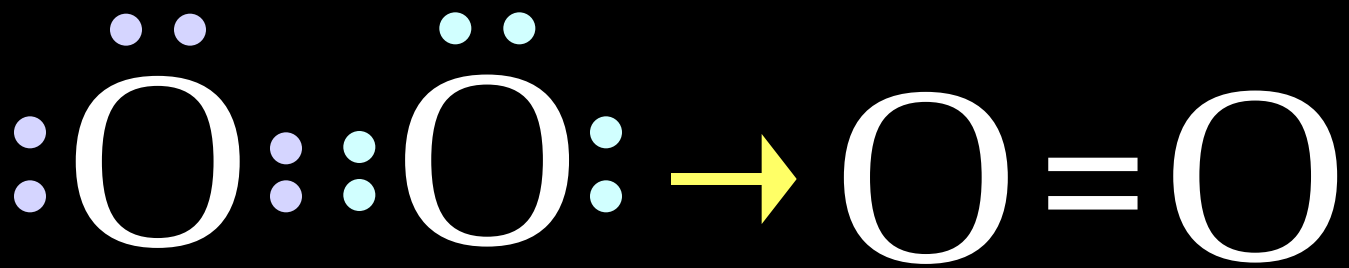


two bonding pairs,

making a ***double bond***



For convenience, the double bond can be shown as two dashes.

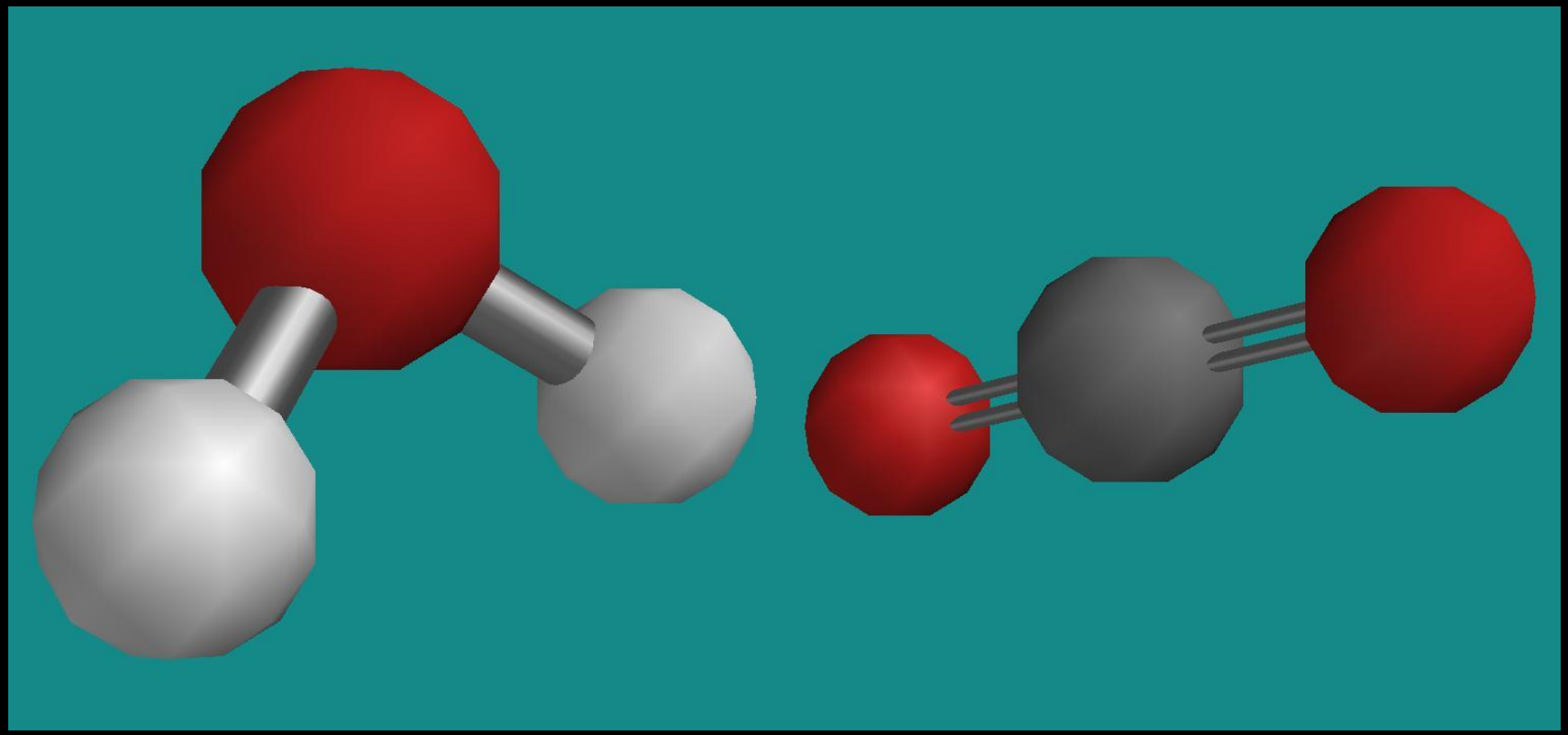
$O=O$

This is the oxygen molecule,

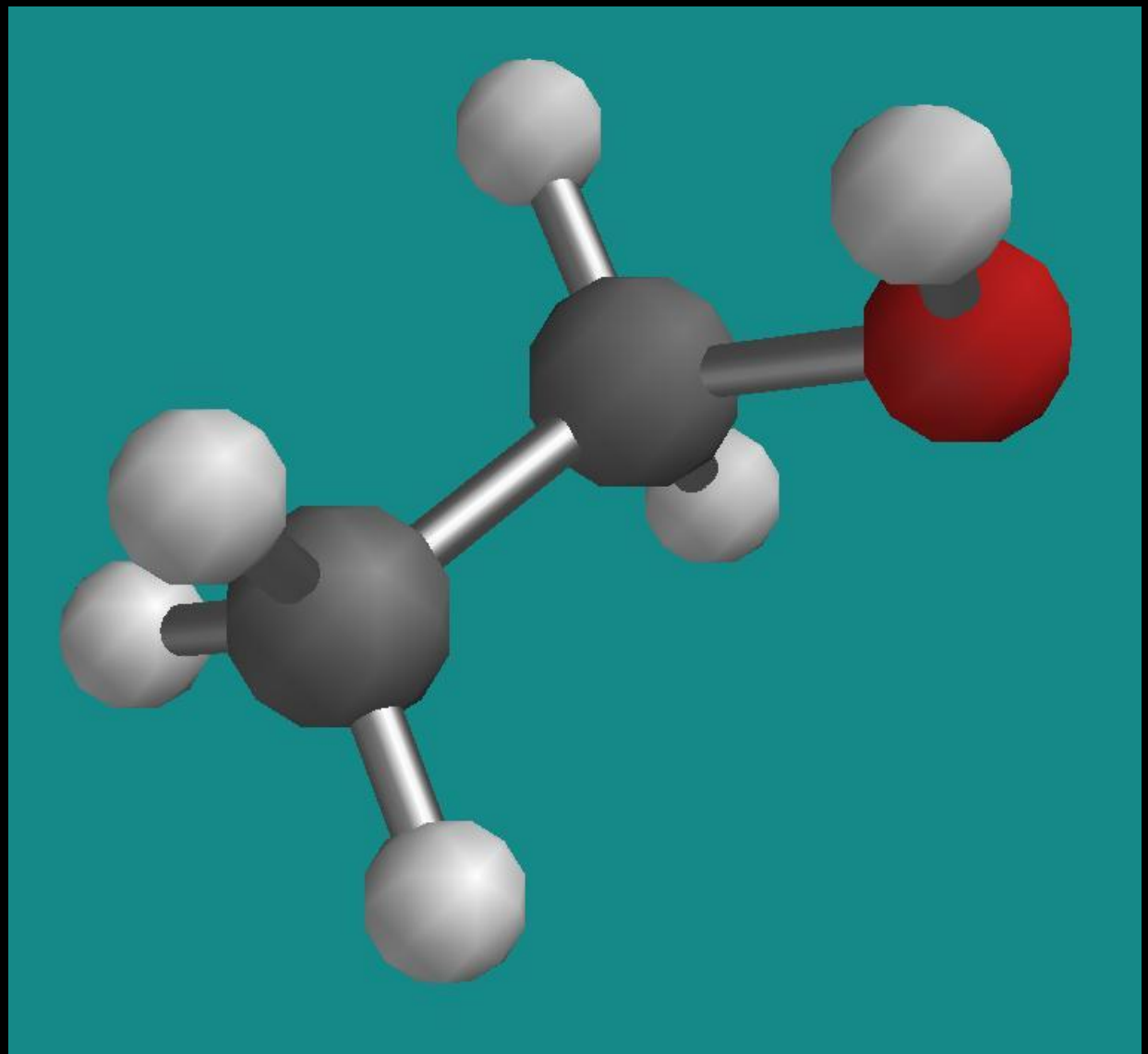
O_2

Covalent bonding allows for an amazingly large variety of compounds such as

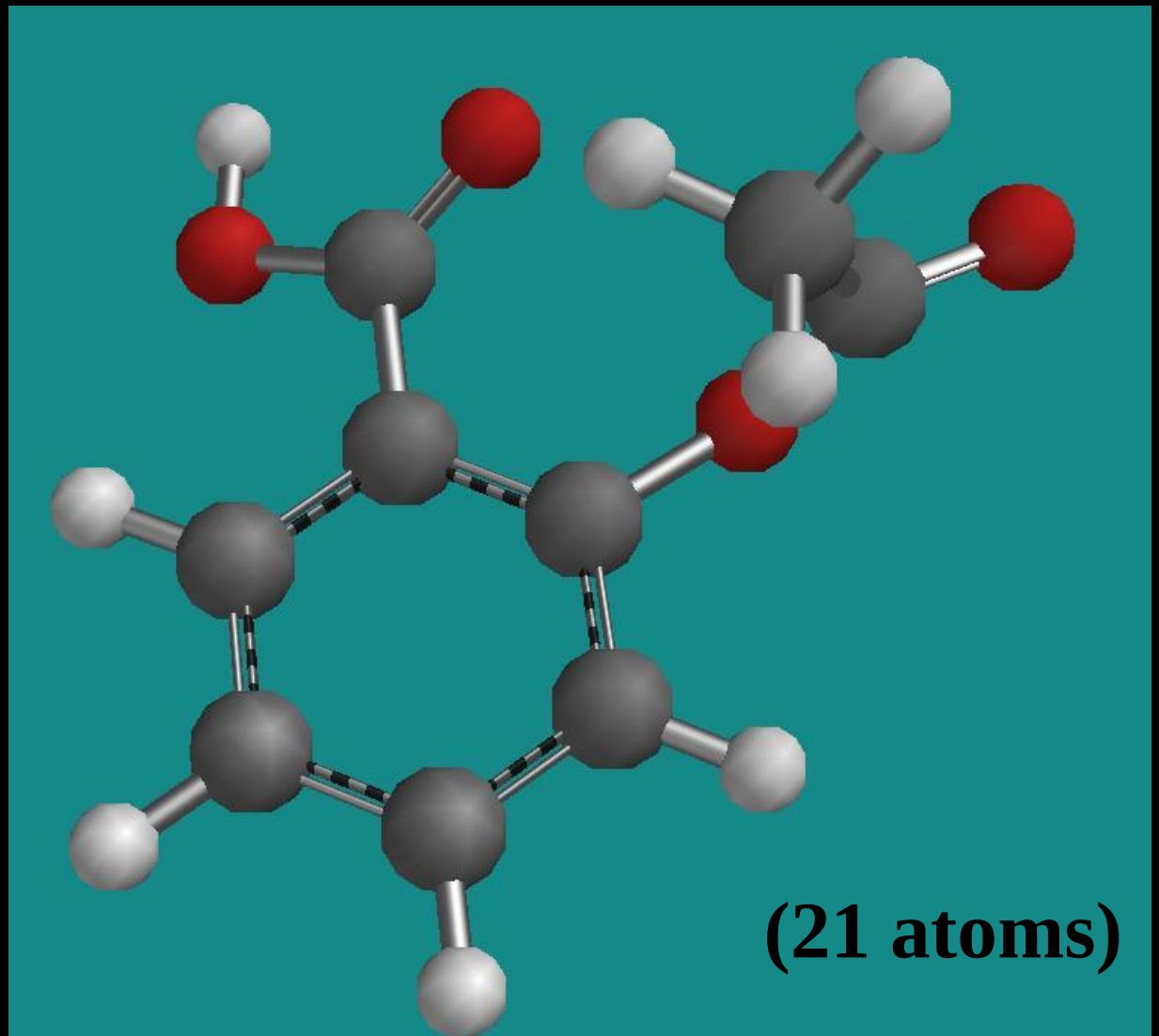
small compounds like water and carbon dioxide,



and ethanol (alcohol),

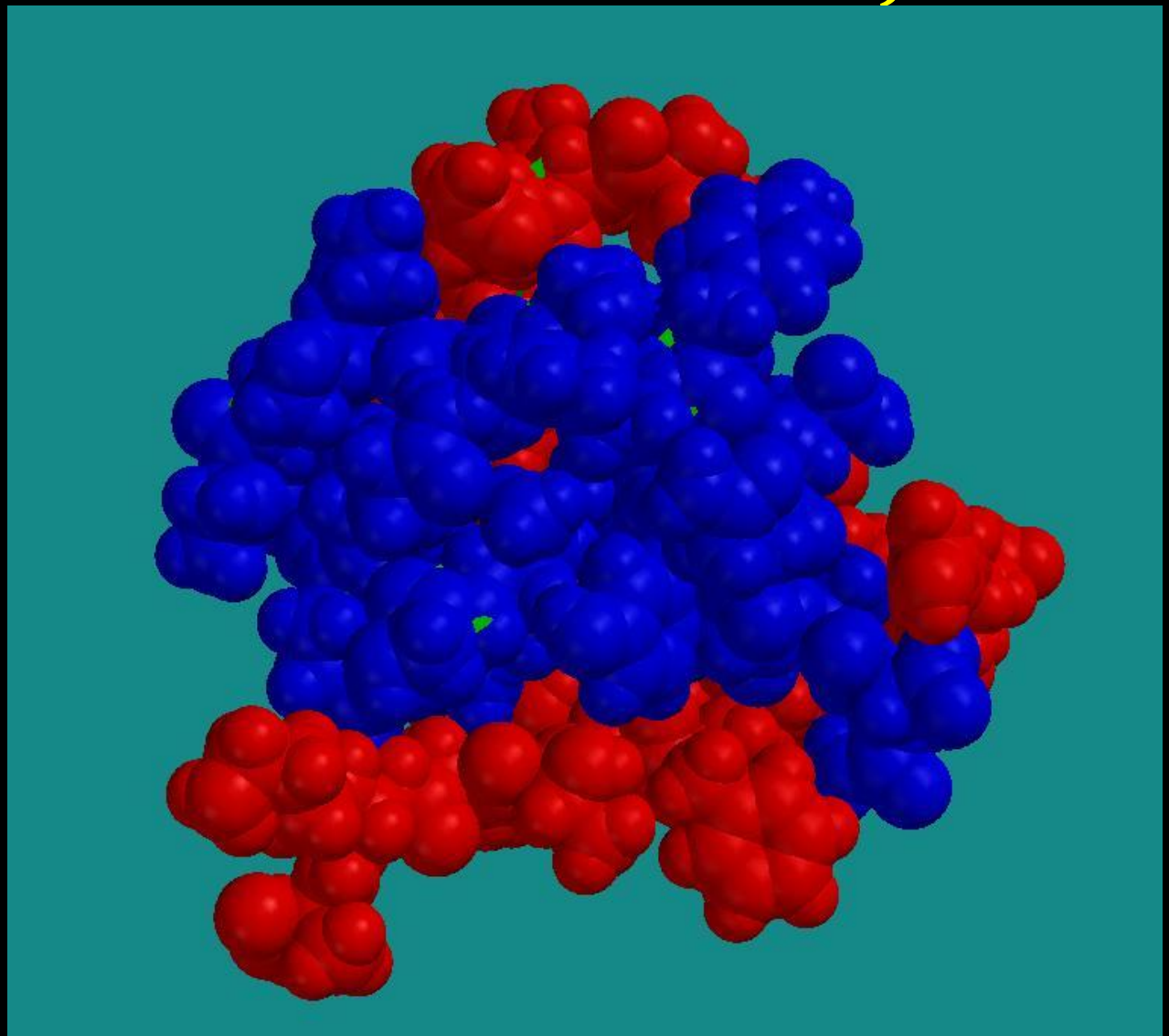


to larger compounds such as aspirin,

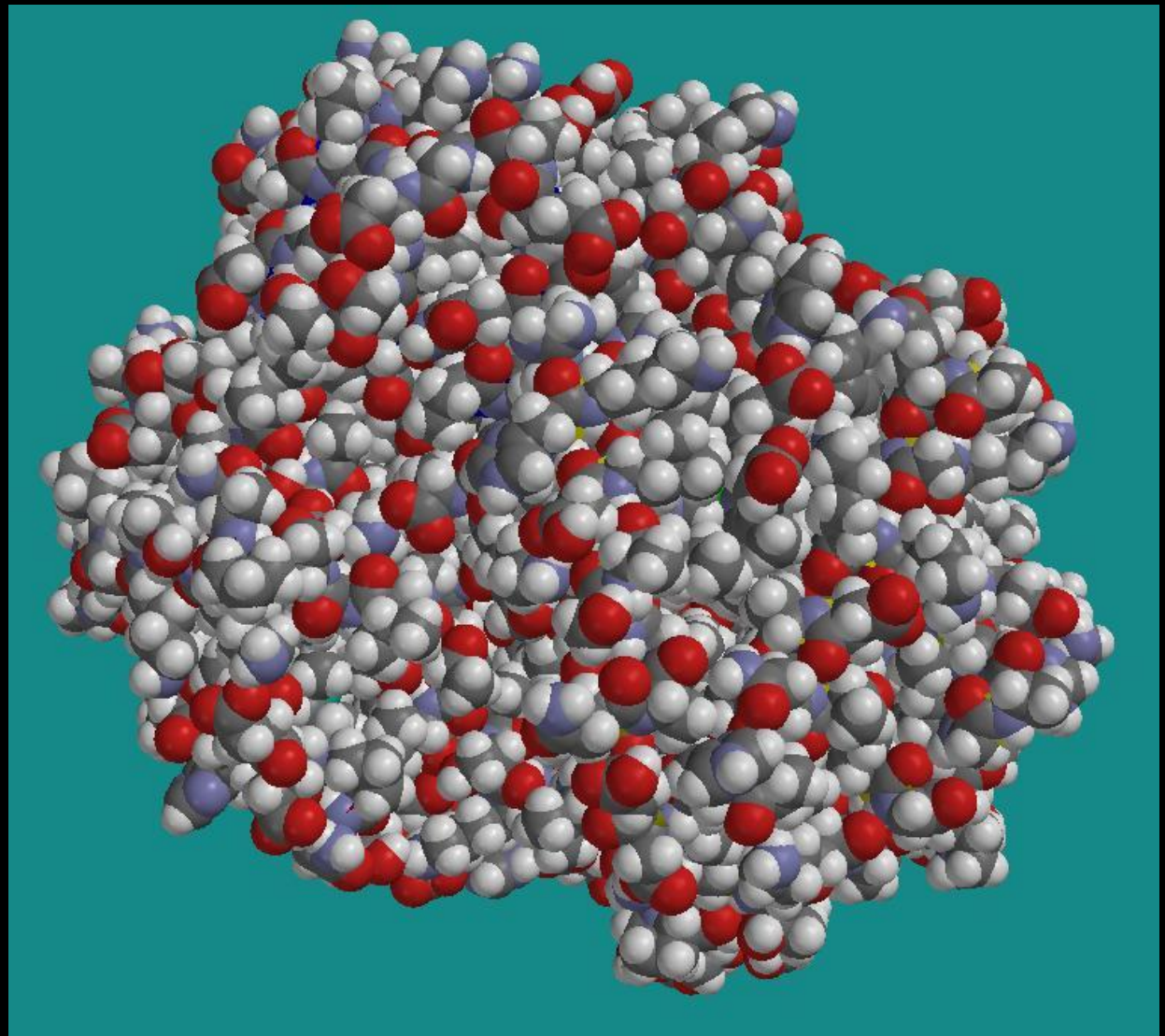


to all of the 40,000 proteins you have in your body, including

insulin,
with 779 atoms,



and hemoglobin, with about 11,000 atoms!



There are an estimated 10^{40} possible compounds containing up to 50 atoms

The known chemical world, including natural and synthetic compounds, is far far far below 1% of that.

NATURE volume 442 p. 502 3 August 2006

As of 2007, there are about 31,000,000 known compounds;

About 12.5 million of those are commercially available.

***Thousands* of new compounds are discovered or synthesized *every week*!**

CAS registry: http://www.cas.org/cgi-bin/regreport.pl