

# Lesson 7

Chemistry 0

Fall 2021, L. Tracey Gao



## Summary from last lesson

- There are two main classes of elements:
  - Elements that tend to lose valence electrons- **Metal**
  - Elements that tend to gain electrons- **Nonmetal**
- **Metal** atoms donate all of their valence electrons to **nonmetal** atoms and all the atoms get their outer shells filled. After the electron transfer, the oppositely charged ions attract, and forming an ionic bond.
- **Nonmetals** bond with other **nonmetals** covalently by sharing electrons so that both atoms have a sense of having a filled outer shell.



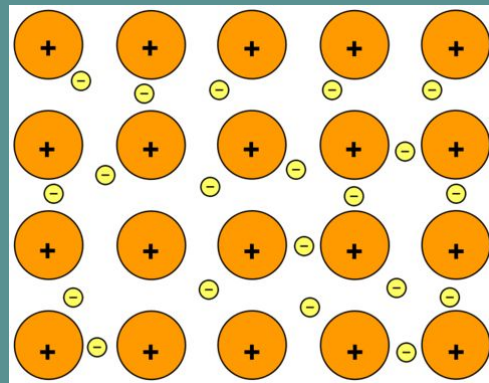
## Week 6 Homework

<https://docs.google.com/forms/d/1EqYyWjZZv8OX6aipwV-vIrBF0N94rJFSrBrgjRd5mUc/edit>

## Previous question

Metal- Non Metal: Ionic Bonding  
Non Metal- Non Metal: Covalent Bonding

What about Metal- Metal?



<https://chem.libretexts.org>



## Lewis dot structures

- One popular method of representing atoms is through Lewis dot diagrams. In a dot diagram, only the symbol for the element and the electrons in its outermost energy level (valence electrons) are shown.













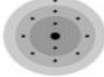
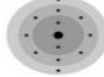
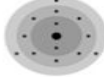
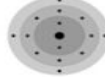
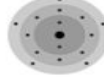
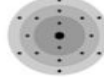

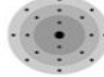


## Lewis dot structures

- A Lewis dot structure is like a simplified electron energy level model.
- The Lewis structure contains the element symbol with dots representing electrons.
- The only electrons shown are those on the outer energy level or valence electrons.
- The electrons are placed around the element symbol, one at a time, clockwise or counterclockwise, and then grouped in pairs as more electrons are added.

# Lewis dot structures

| PERIODIC TABLE<br>ELEMENTS 1-20 |                                |                                 |                                |                                  |                              |                                 |                                 |
|---------------------------------|--------------------------------|---------------------------------|--------------------------------|----------------------------------|------------------------------|---------------------------------|---------------------------------|
| HYDROGEN<br>1<br><b>H</b> ·     |                                |                                 |                                |                                  |                              |                                 | HELIUM<br>2<br>·<br><b>He</b> · |
| LITHIUM<br>3<br><b>Li</b> ·     | BERYLLIUM<br>4<br><b>Be</b> ·  | BORON<br>5<br>· <b>B</b> ·      | CARBON<br>6<br>· <b>C</b> ·    | NITROGEN<br>7<br>· <b>N</b> :    | OXYGEN<br>8<br>· <b>O</b> :  | FLUORINE<br>9<br>: <b>F</b> :   | NEON<br>10<br>: <b>Ne</b> :     |
| SODIUM<br>11<br><b>Na</b> ·     | MAGNESIUM<br>12<br><b>Mg</b> · | ALUMINUM<br>13<br>· <b>Al</b> · | SILICON<br>14<br>· <b>Si</b> · | PHOSPHORUS<br>15<br>· <b>P</b> : | SULFUR<br>16<br>· <b>S</b> : | CHLORINE<br>17<br>: <b>Cl</b> : | ARGON<br>18<br>: <b>Ar</b> :    |
| POTASSIUM<br>19<br><b>K</b> ·   | CALCIUM<br>20<br><b>Ca</b> ·   |                                 |                                |                                  |                              |                                 |                                 |

# Energy Levels Model

| <b>ENERGY LEVELS<br/>ELEMENTS 1-20</b>   |  |   |  |   |   |   |  |
|--|--|---|--|---|---|---|--|
| <b>HYDROGEN</b><br>1<br><br>1.01    |  |   |  |   |   |   | <b>HELIUM</b><br>2<br><br>4.00  |
| <b>LITHIUM</b><br>3<br><br>6.94     | <b>BERYLLIUM</b><br>4<br><br>9.01   | <b>BORON</b><br>5<br><br>10.81     | <b>CARBON</b><br>6<br><br>12.01   | <b>NITROGEN</b><br>7<br><br>14.01    | <b>OXYGEN</b><br>8<br><br>16.00  | <b>FLUORINE</b><br>9<br><br>19.00  | <b>NEON</b><br>10<br><br>20.18  |
| <b>SODIUM</b><br>11<br><br>22.99    | <b>MAGNESIUM</b><br>12<br><br>24.31 | <b>ALUMINUM</b><br>13<br><br>26.98 | <b>SILICON</b><br>14<br><br>28.09 | <b>PHOSPHORUS</b><br>15<br><br>30.97 | <b>SULFUR</b><br>16<br><br>32.07 | <b>CHLORINE</b><br>17<br><br>35.45 | <b>ARGON</b><br>18<br><br>39.95 |
| <b>POTASSIUM</b><br>19<br><br>39.10 | <b>CALCIUM</b><br>20<br><br>40.08   |   |  |   |   |   |  |





## Questions

- Compare the dots around each symbol with the energy levels in your chart. What relationship do you notice between the dots in these two charts?
- The number of dots near hydrogen and helium are the same as in the energy level chart. Why?

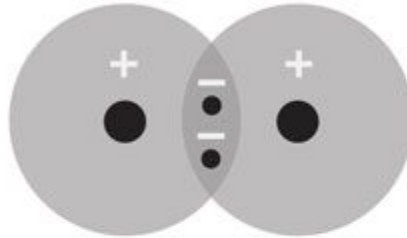
# Covalent bonding in Hydrogen



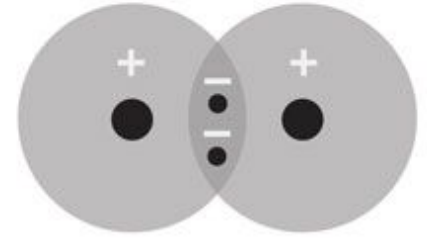
Hydrogen



Hydrogen



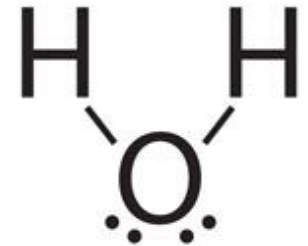
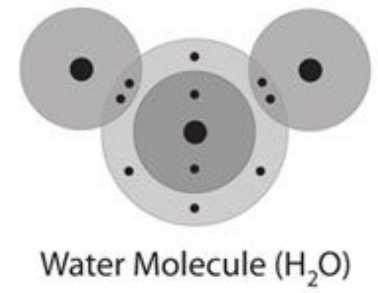
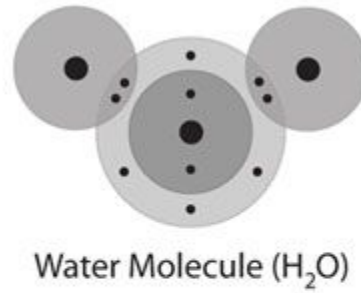
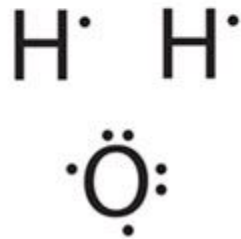
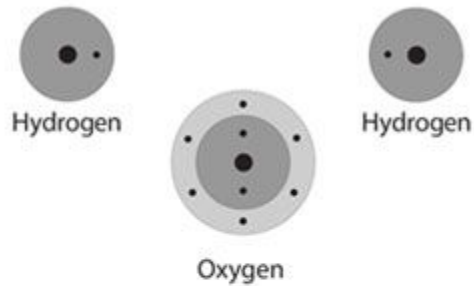
Hydrogen Molecule ( $\text{H}_2$ )



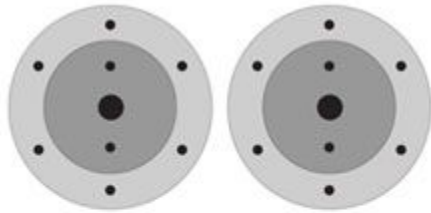
Hydrogen Molecule ( $\text{H}_2$ )



# Covalent bonding in Water

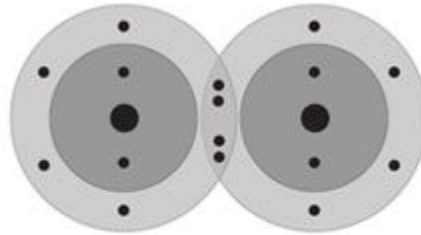


# Covalent bonding in Oxygen



Oxygen

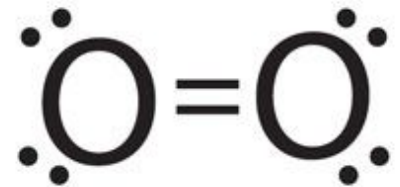
Oxygen



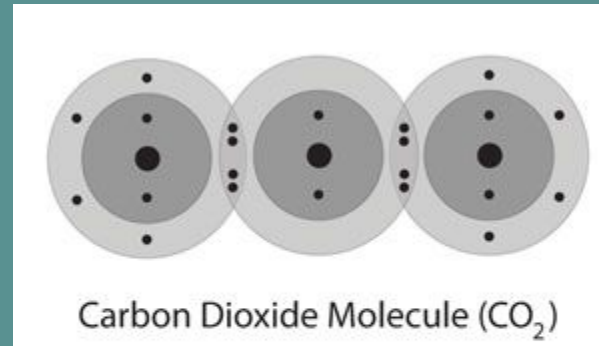
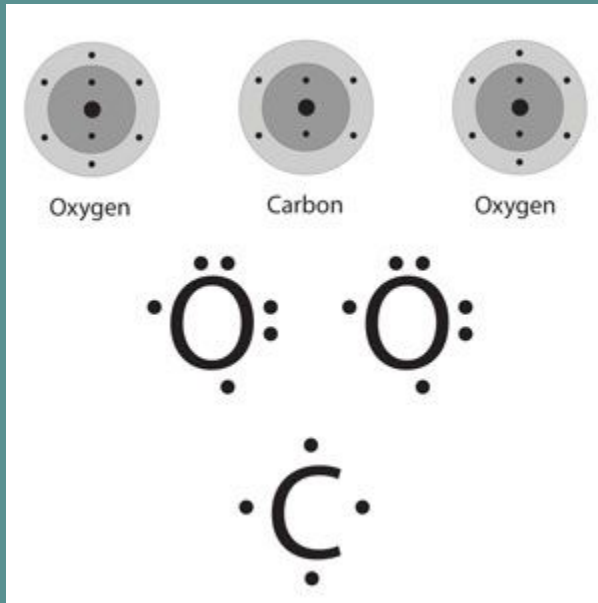
Oxygen Molecule (O<sub>2</sub>)



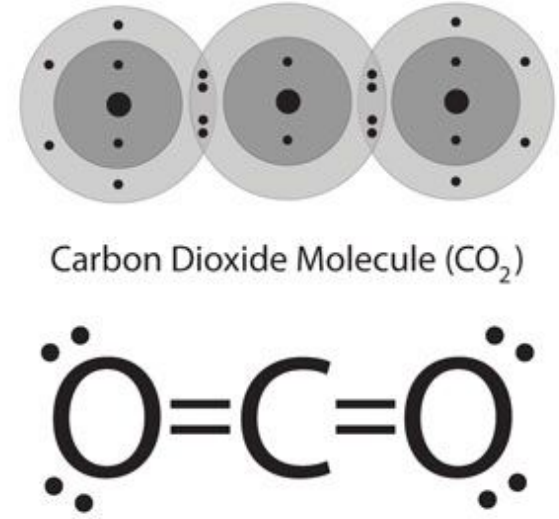
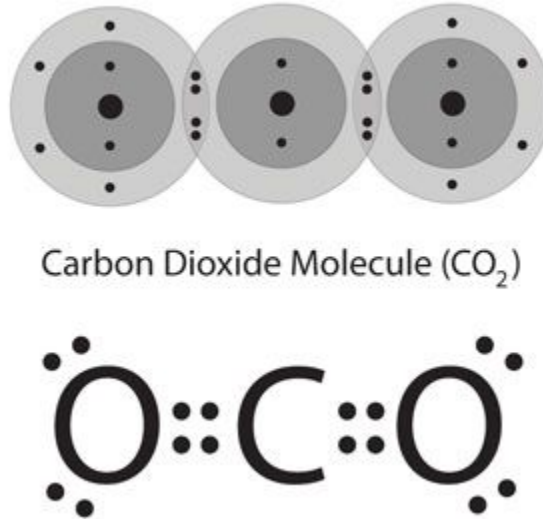
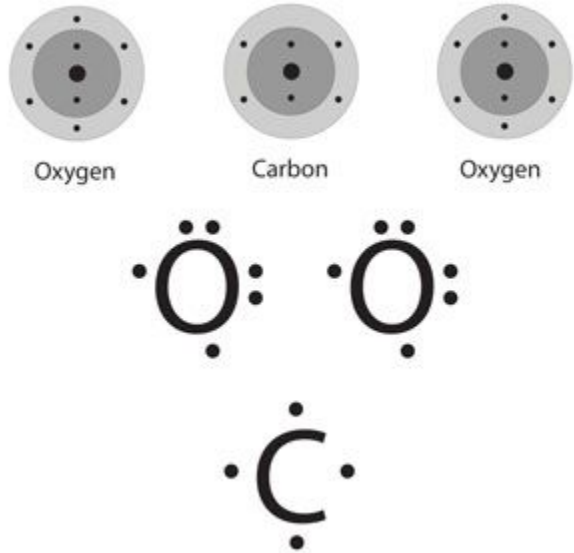
Oxygen Molecule (O<sub>2</sub>)



# Exercise: Covalent bonding in CO<sub>2</sub>



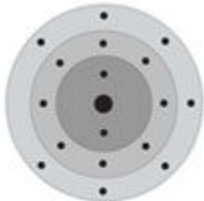
# Exercise: Covalent bonding in CO<sub>2</sub>



# Ionic Bond in Sodium Chloride



Sodium



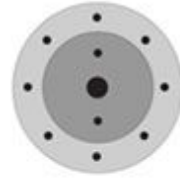
Chlorine



+  
Sodium ion



-  
Chloride ion



+  
Sodium ion



-  
Chloride ion



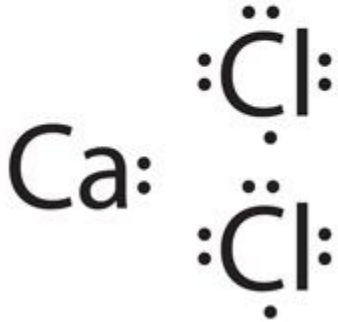
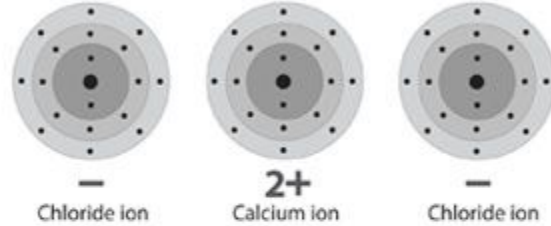
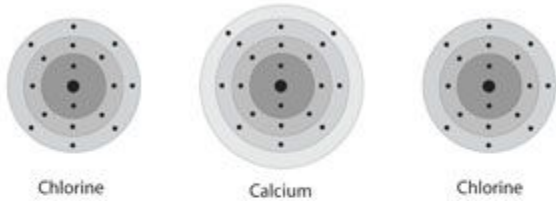


## Questions

- In the second dot diagram, why are there no electrons surrounding sodium?
- In the final dot diagram of NaCl, the dots between the sodium and chlorine are between the atoms. Are these atoms sharing the electrons?



# Exercise: Ionic Bond in Calcium Chloride



# Exercise: Ionic Bond in Calcium Chloride

