LESSON 16 ACTIVITY

Polar Bears and Penguins

Electronegativity and Polarity

Name _____

Date _____ Period _____

Purpose

To understand polarity and bonding between atoms.

Instructions

Read the comic strip "The Bare Essentials of Polarity," and use it to answer these questions.

1. How does the comic strip define a polar molecule?

2. Define electronegativity as you understand it, after reading the first two pages of the comic strip.

3. What is the artist trying to represent by two polar bears arm wrestling or two penguins arm wrestling?

4. What three types of bonds are represented on the third page of the comic strip? What happens to the bonding electrons in each type of bond?

5. Explain why there are four scoops of ice cream in the illustration of O_2 on the third page.

6. What do the six scoops of ice cream represent in the illustration of N_2 on the fourth page?

7. Describe what you think is happening to the penguin in the CO_2 molecule in the picture on the fourth page.

8. Name three things that the picture of CO_2 on the fourth page illustrates about the molecule.

9. Describe what you think is happening to the penguins in the illustration of H_2O on the fourth page.

10. What does the crossed arrow represent in the comic strip? 

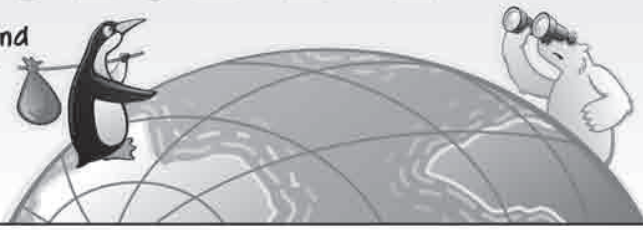
11. What are two of the definitions of dipole given in the comic strip?

12. Making Sense What does electronegativity have to do with polarity?

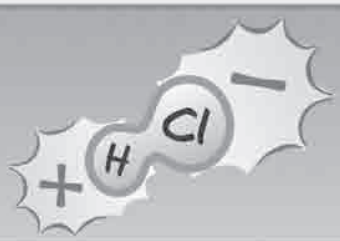
13. If You Finish Early Using polar bears and penguins, create an illustration showing a hydrogen sulfide molecule, H_2S. (*Hint:* You might want to start with a Lewis dot structure.)

The BARE ESSENTIALS of POLARITY

You don't have to go to the ends of the earth to find polar molecules. They're all over the place. A polar molecule is just a molecule with a difference in electrical charge between two ends.

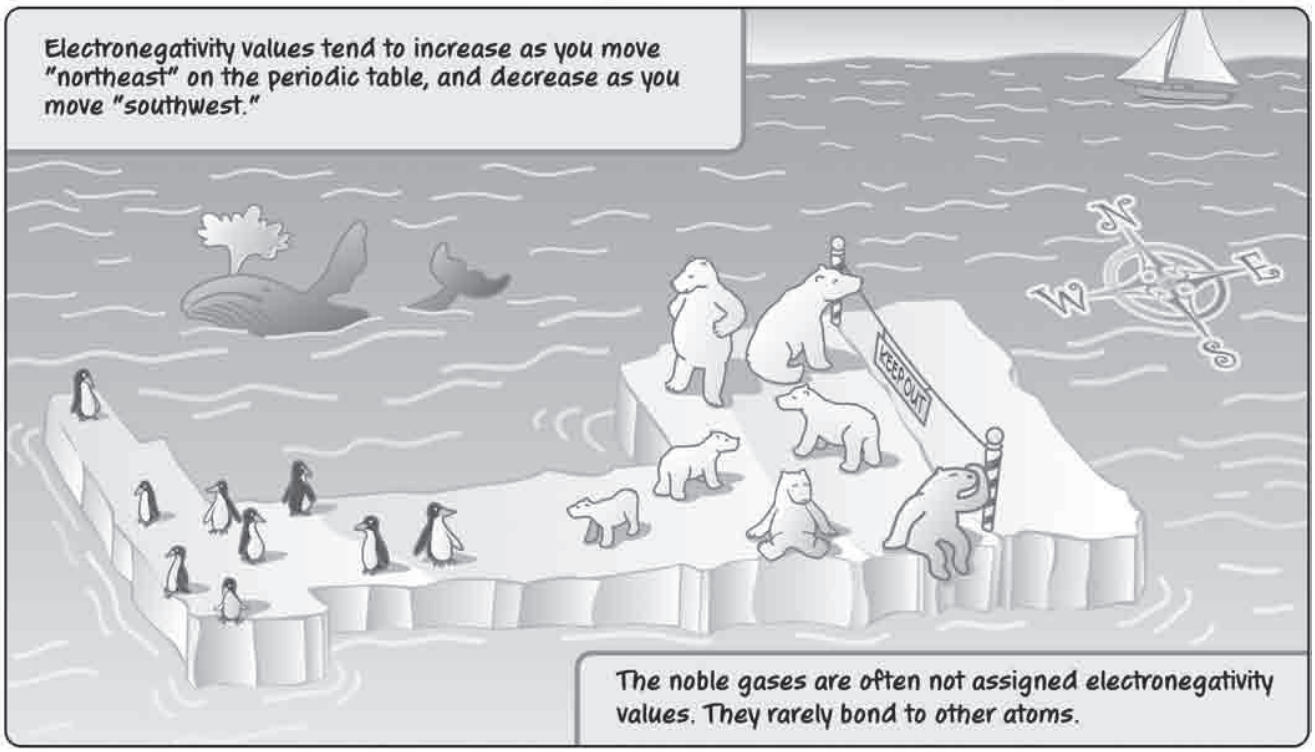


Polarity in molecules is caused by differences in electronegativity between atoms. Electronegativity describes the ability of an atom to attract bonding electrons toward itself.



Chlorine is more electronegative than hydrogen. So the bonded pair of electrons in HCl spends more time near chlorine.

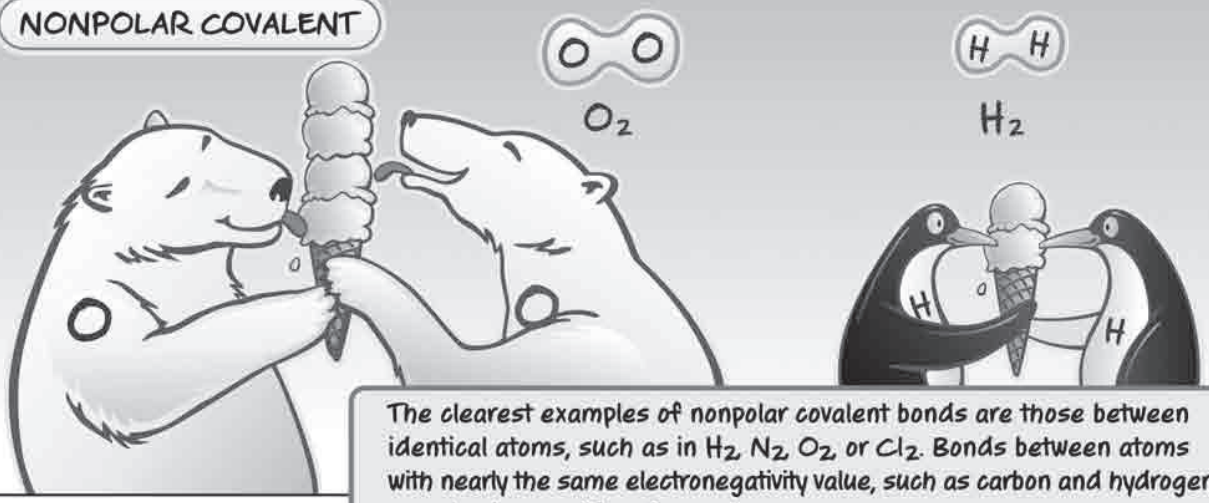
Electronegativity values tend to increase as you move "northeast" on the periodic table, and decrease as you move "southwest."



The noble gases are often not assigned electronegativity values. They rarely bond to other atoms.

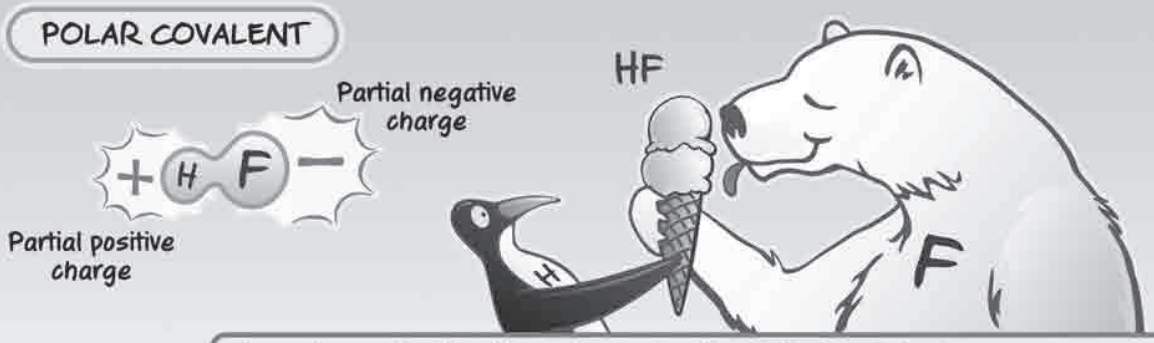
Because the elements have such varying electronegativities and can bond in many different combinations, there is really a continuum of polarity in bonding. We can break the continuum down into three categories.

NONPOLAR COVALENT



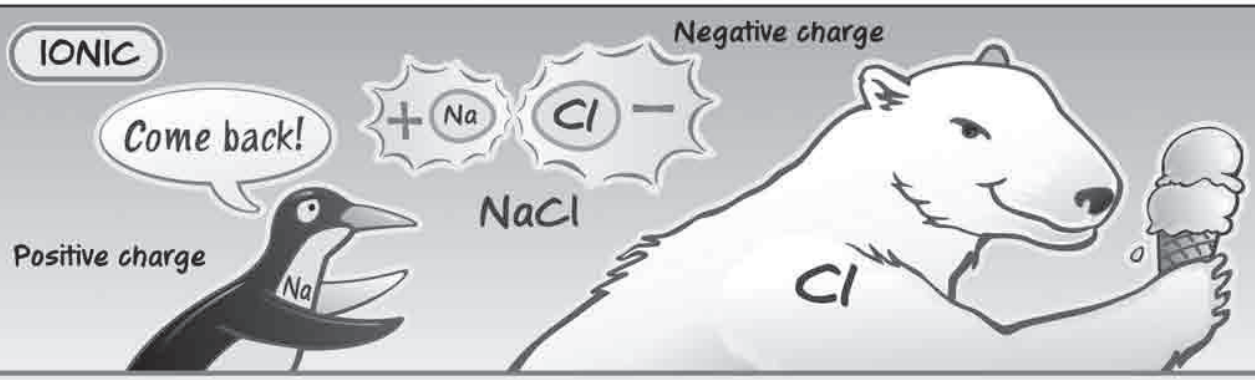
The clearest examples of nonpolar covalent bonds are those between identical atoms, such as in H_2, N_2, O_2, or Cl_2. Bonds between atoms with nearly the same electronegativity value, such as carbon and hydrogen, can also be considered nonpolar.

POLAR COVALENT



In a polar covalent bond, two atoms share bonded pairs of electrons somewhat unequally. The electrons are more attracted to one atom than the other. Examples include bonds between carbon and oxygen atoms, or between hydrogen and fluorine atoms.

IONIC

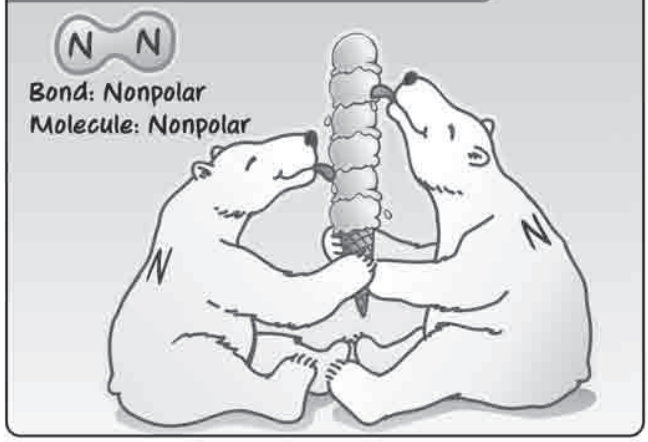


A large difference in electronegativity results in the winner-take-all situation of ionic bonding. The more electronegative atom takes the bonding electrons and becomes a negative ion, while the other atom becomes a positive ion. The opposite charges on the ions attract each other.

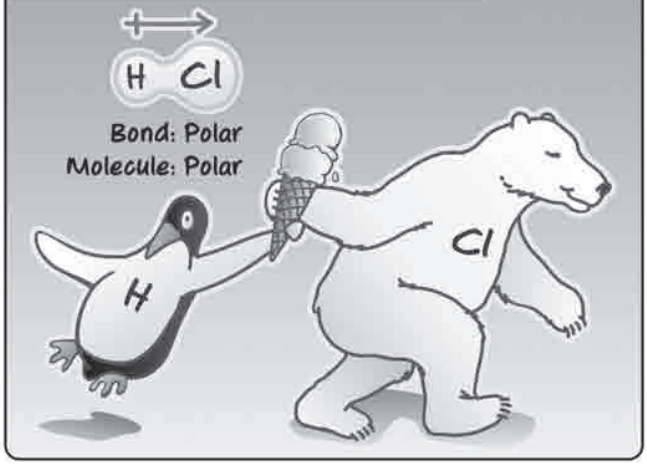
Polar bonds between atoms create dipoles. The word dipole can refer to (1) the polarity of an individual polar bond between atoms, (2) the net polarity of an individual polar molecule that may have several polar covalent bonds within it, and (3) the polar molecule itself.

Confusing? Here are some examples:

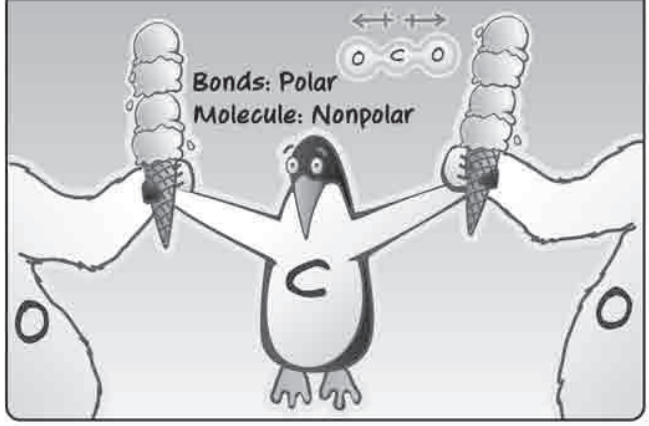
An N_2 molecule isn't a dipole and it doesn't have any dipoles.



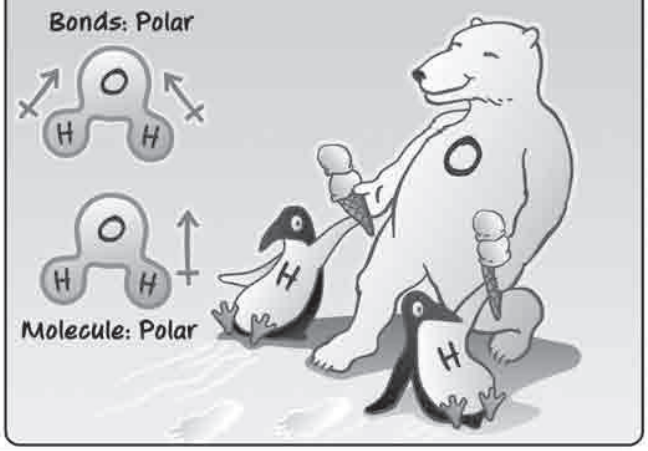
HCl has a dipole and it is a dipole.



CO_2 has two dipoles but the CO_2 molecule itself is not a dipole. Its polar bonds balance each other out and make the molecule nonpolar overall.



H_2O has two dipoles. Because of its bent shape, it also has a dipole in the sense of an overall polarity.



The polarity of molecules can affect many of their other properties, such as their solubility, their boiling and melting points, and their odor.