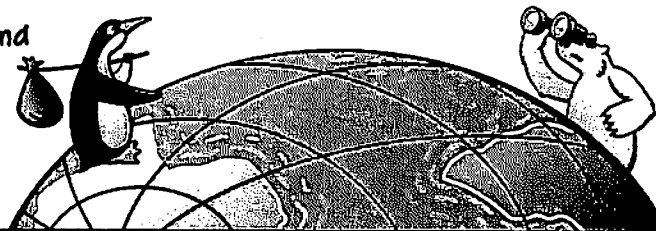
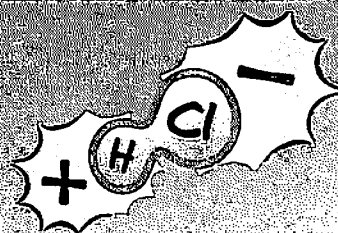


The BARE ESSENTIALS of POLARITY

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.

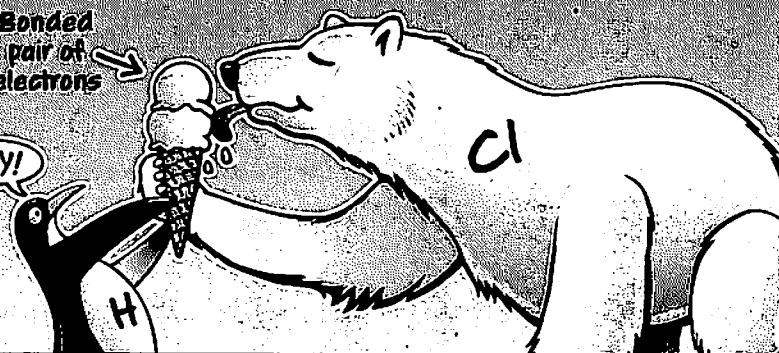


Polarity in molecules is caused by differences in electronegativity between atoms. Electronegativity describes the ability of an atom to attract bonding electrons toward itself.



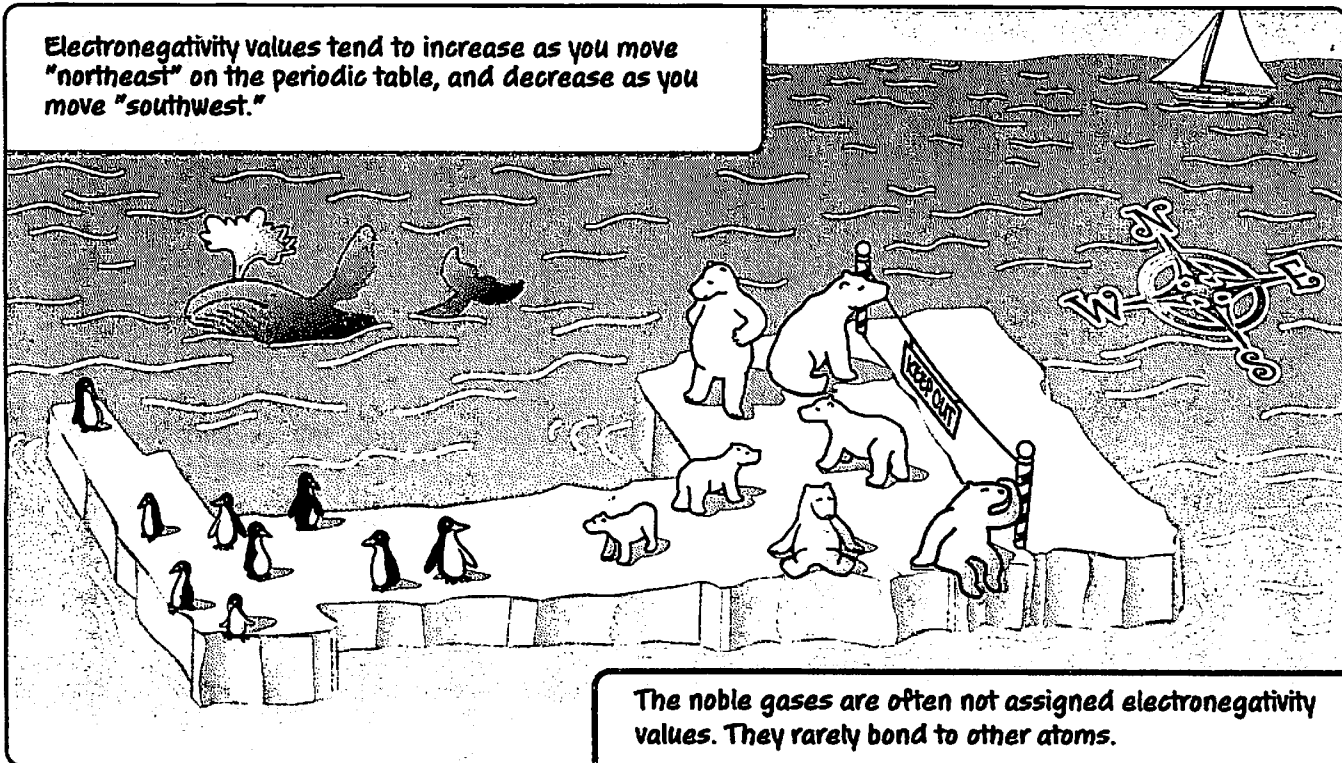
Bonded pair of electrons

HEY!



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.

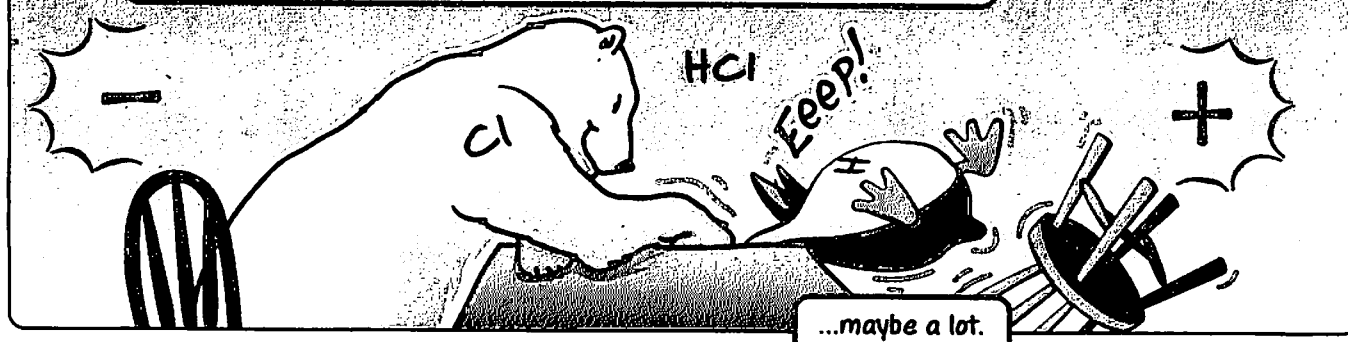
When two atoms with different electronegativity values bond, the bonding electrons spend more time around the more electronegative atom, creating a PARTIAL NEGATIVE CHARGE on that atom. The other atom then has a PARTIAL POSITIVE CHARGE, and the bond is polar.



When atoms with equal electronegativity values bond, they form nonpolar bonds. The electron-attracting strength of each atom is the same.

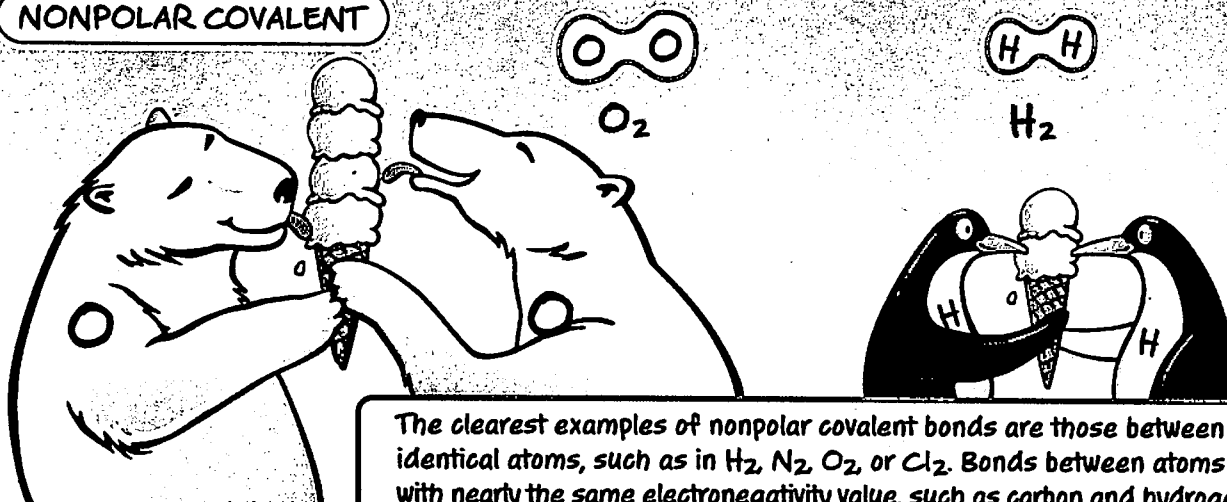


However, if the electronegativities of two bonded atoms are different, then their bond will be polarized—maybe a little...



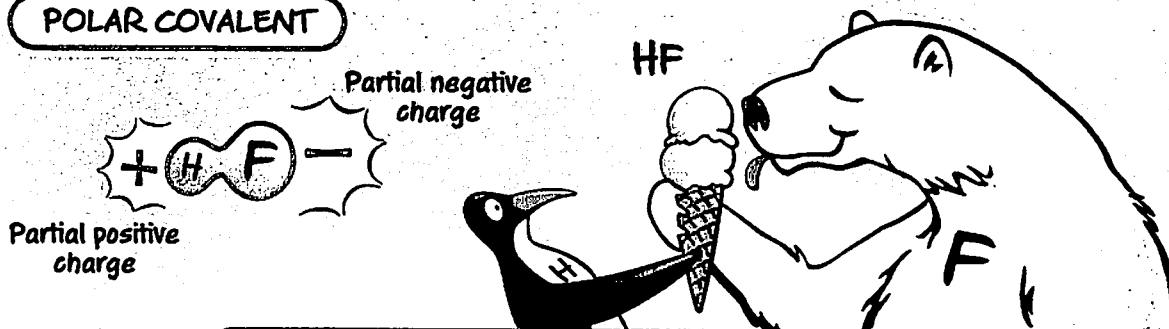
Because the elements have such varying electronegativities and can bond in many different combinations, there is really a continuum of polarity in bonding. We can break the continuum down into three categories.

NONPOLAR COVALENT



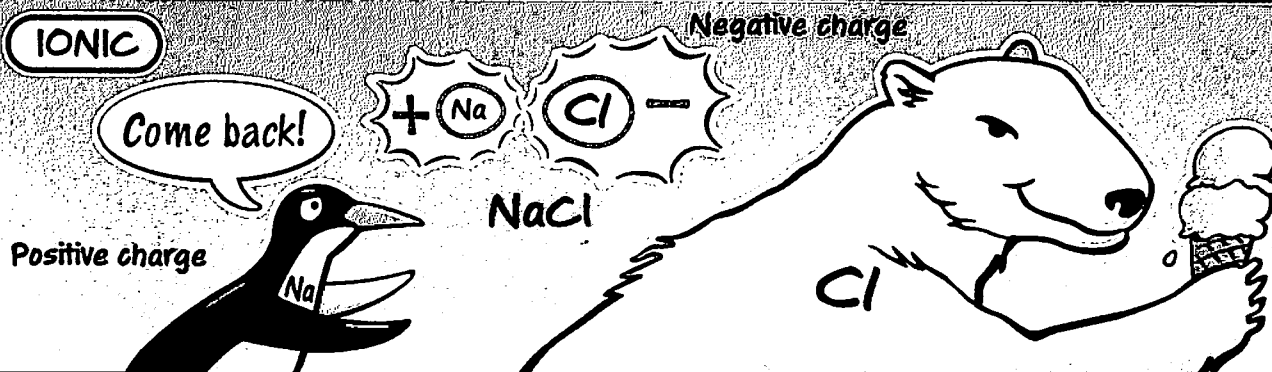
The clearest examples of nonpolar covalent bonds are those between identical atoms, such as in H_2 , N_2 , O_2 , or Cl_2 . Bonds between atoms with nearly the same electronegativity value, such as carbon and hydrogen, can also be considered nonpolar.

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.

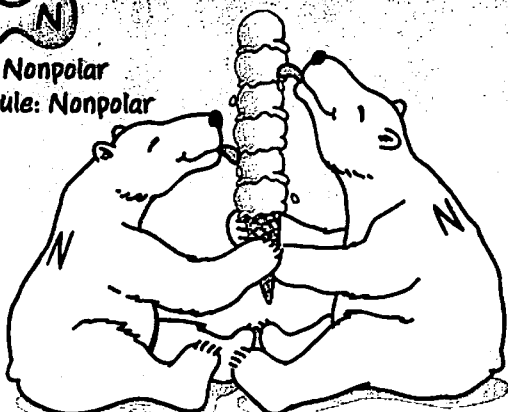


Confusing? Here are some examples:

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



Bond: Nonpolar
Molecule: Nonpolar



HCl has a dipole and it is a dipole.

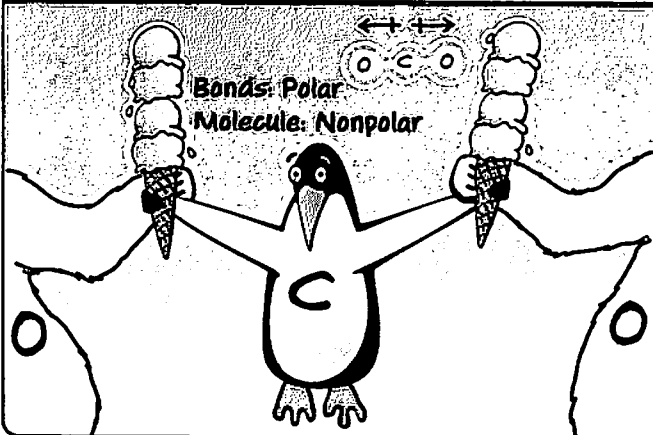


Bond: Polar
Molecule: Polar



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.

Bonds: Polar
Molecule: Nonpolar

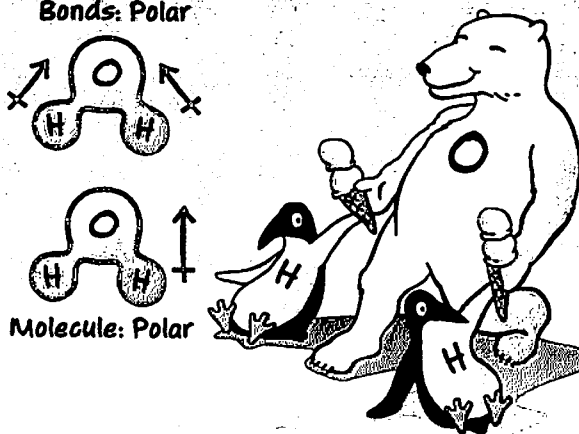


H_2O has two dipoles. Because of its bent shape, it also has a dipole in the sense of an overall polarity.

Bonds: Polar



Molecule: Polar

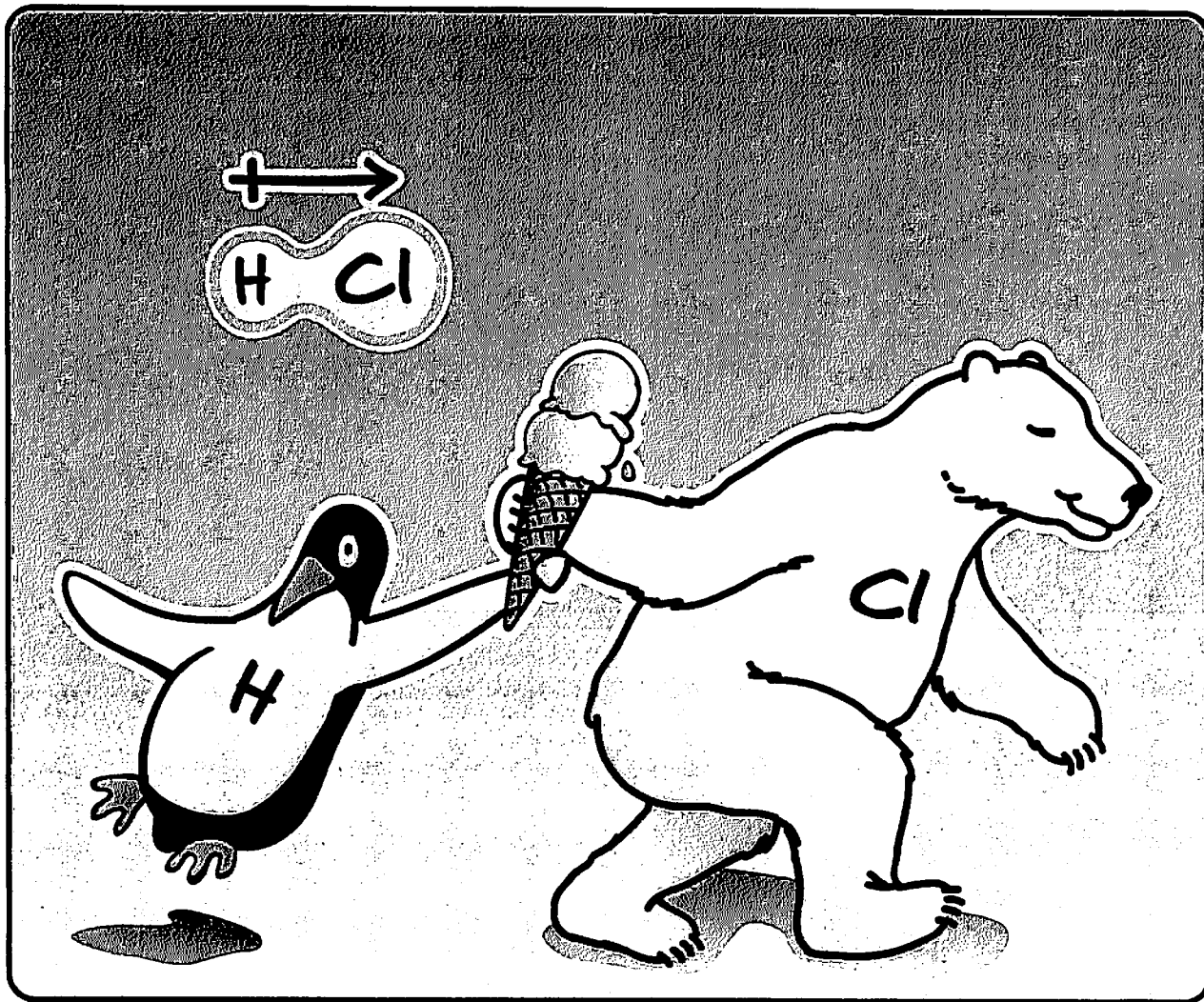


The polarity of molecules can affect many of their other properties, such as their solubility, their boiling and melting points, and their odor.



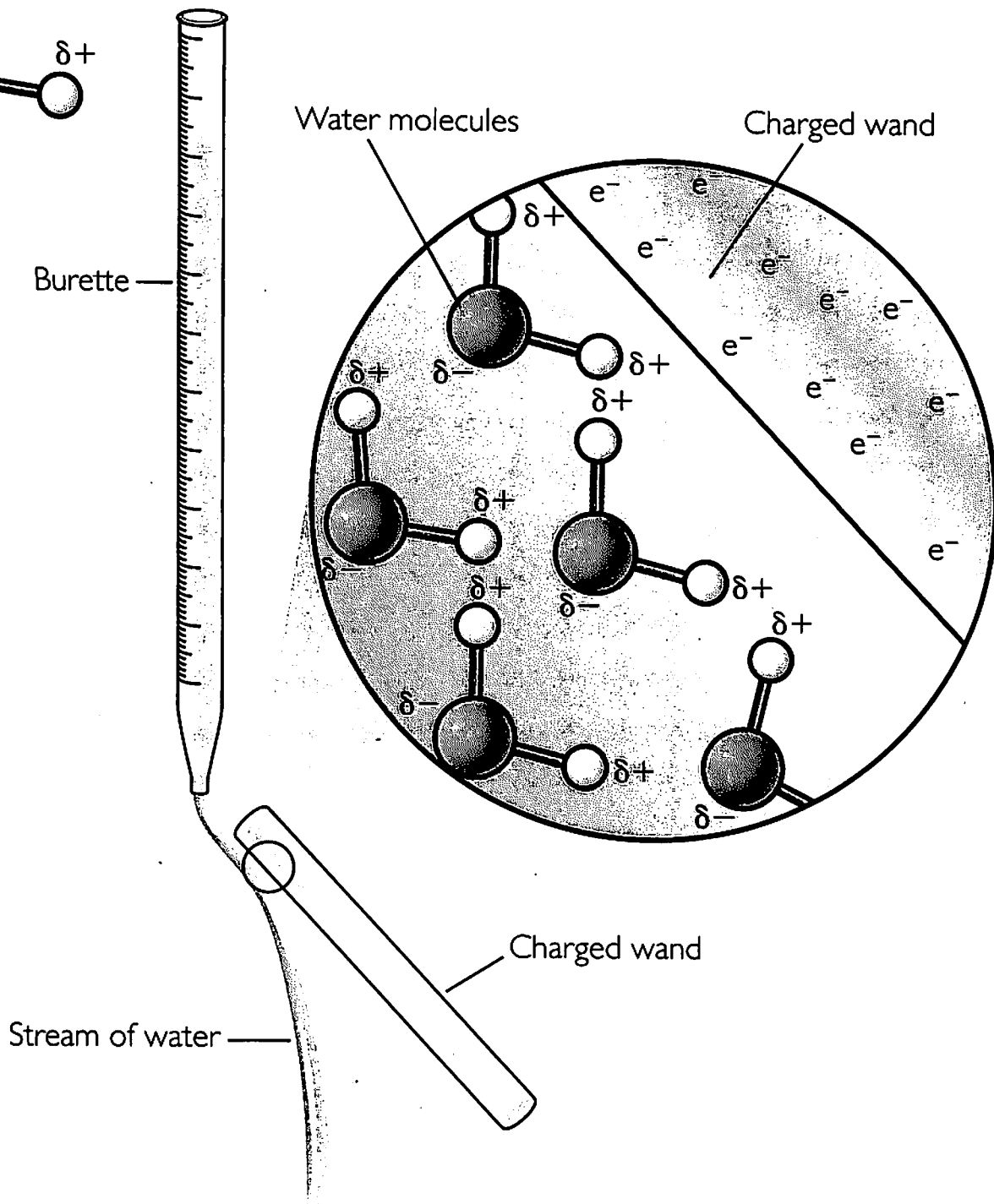
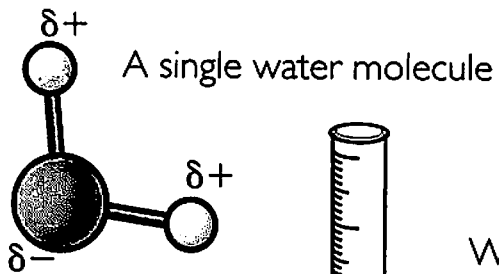
ChemCatalyst

Consider this illustration:



1. If the penguin represents a hydrogen atom and the polar bear represents a chlorine atom, what does the ice cream represent in the drawing? What do you think the picture is trying to illustrate?
2. Would HCl be attracted to a charged wand? Explain your thinking.

Charged Wand



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?