

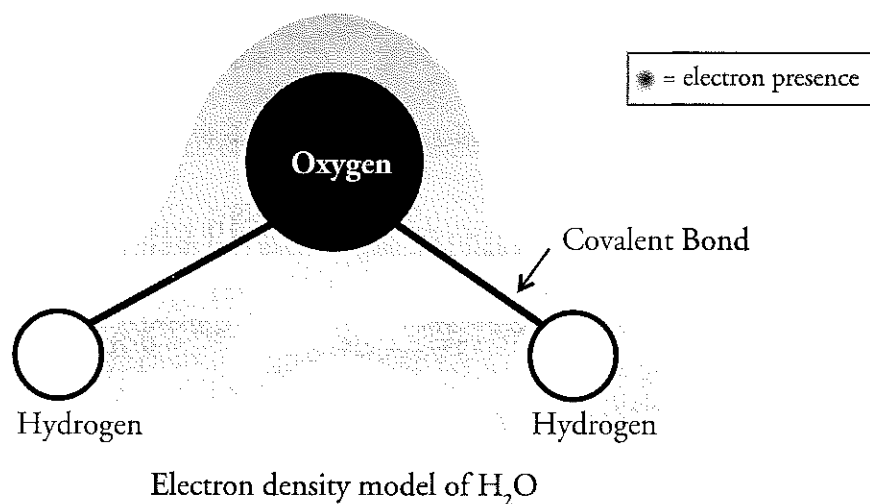
Properties of Water

What makes water so special?

Why?

When you hear that NASA's space probes are looking for "evidence of life" on other planets, do you know what that means? They are looking for evidence of liquid water. Water is fundamental for all life; without it every living thing would die. Water covers about 70% of Earth's surface and it makes up 65–75% of our bodies (82% of our blood is water). Even if water might seem boring to you—no color, taste, or smell—it has amazing properties that make it necessary for supporting life.

Model 1 – The Molecular Structure of Water



1. How many hydrogen atoms are in a molecule of water?

Two.

2. How many oxygen atoms are in a molecule of water?

One.

3. What holds the hydrogen atoms to the oxygen atom?

Covalent bonds.

4. The shading around the molecule represents the relative density of electrons shared by the atoms. What does this indicate about the density of electrons around the oxygen atom as compared to the density of electrons around the hydrogen atoms?

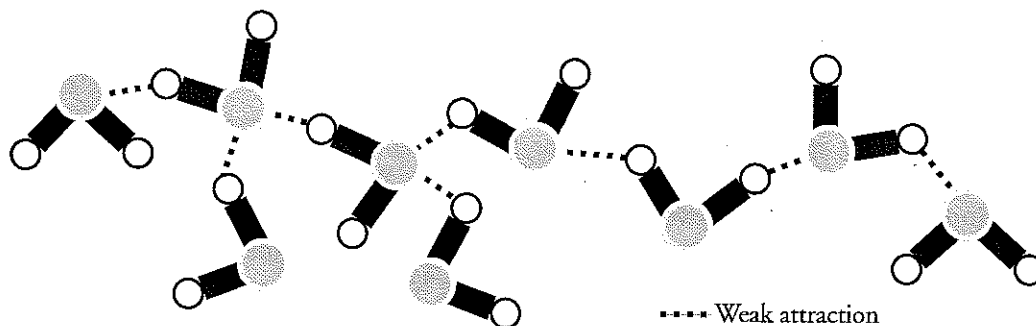
Electrons are more dense around the oxygen atom than around the hydrogen atoms.

5. Where is the majority of negative charge on the water molecule?

A greater negative charge is around the oxygen atom than around the hydrogen atoms (because the shared electrons are more closely held by the oxygen nucleus).



Model 2 – Attraction of Water Molecules



6. Looking at your answers to Questions 1 and 2 from Model 1, tell what atoms are represented by:
- The small, unshaded circles in Model 2.
Hydrogen atoms.
 - The larger gray shaded circles in Model 2.
Oxygen atoms.
7. What do the solid lines between the small and large circles represent?
Covalent bonds.
8. According to Model 2, what is represented by the dotted lines?
Weak attraction.
9. Remember that electrons in a water molecule are more dense around the oxygen atom and less dense around the hydrogen atoms.
- What kind of charge would the oxygen atom have compared to the hydrogen atoms?
Negative.
 - What kind of charge would the hydrogen atoms have compared to the oxygen?
Positive.
10. Describe the arrangement of the water molecules in Model 2 with one another.
A hydrogen atom of one water molecule is attracted to the oxygen atom of another water molecule.
11. Describe the cause of the attractions between molecules of water.
When the electrons in a covalent bond are not equally shared between the atoms, the negative end of one molecules is attracted to the positive end of another molecule. This orients water molecules only in a hydrogen-to-oxygen arrangement.
12. If another water molecule was added to the group in Model 2 at the upper right side, which of its atoms would be connected to the existing molecule with a dotted line? Describe your group's reasoning.
The hydrogen atom in the added molecule would be attracted to the existing molecule's oxygen because the oxygen atom in a water molecule is slightly negative and the hydrogen atoms are slightly positive.



Read This!

The bonding electrons in some molecules are not equally shared between the atoms. These neutral molecules with a difference of charge across the molecule are called **polar molecules**. Because of the arrangement of the atoms and electrons in a water molecule, there are two differently charged areas of the molecule even though the molecule is neutral overall. The hydrogen molecules are slightly positive, while the oxygen is slightly negative. The positive area charge (hydrogen) of one water molecule is attracted to the negative area (oxygen) of a different water molecule. This weak attraction is often referred to as **hydrogen bonding**.

13. In the space below, draw 10 water molecules to create a cluster. Be sure to indicate the hydrogen bonds that link the water molecules.

Look for students' drawings in which the oxygen atom on one water molecule is linked by dotted lines to a hydrogen atom on a different water molecule. The arrangements do not matter as long as the links are as described above.

