

Name: _____

The Structure of Water

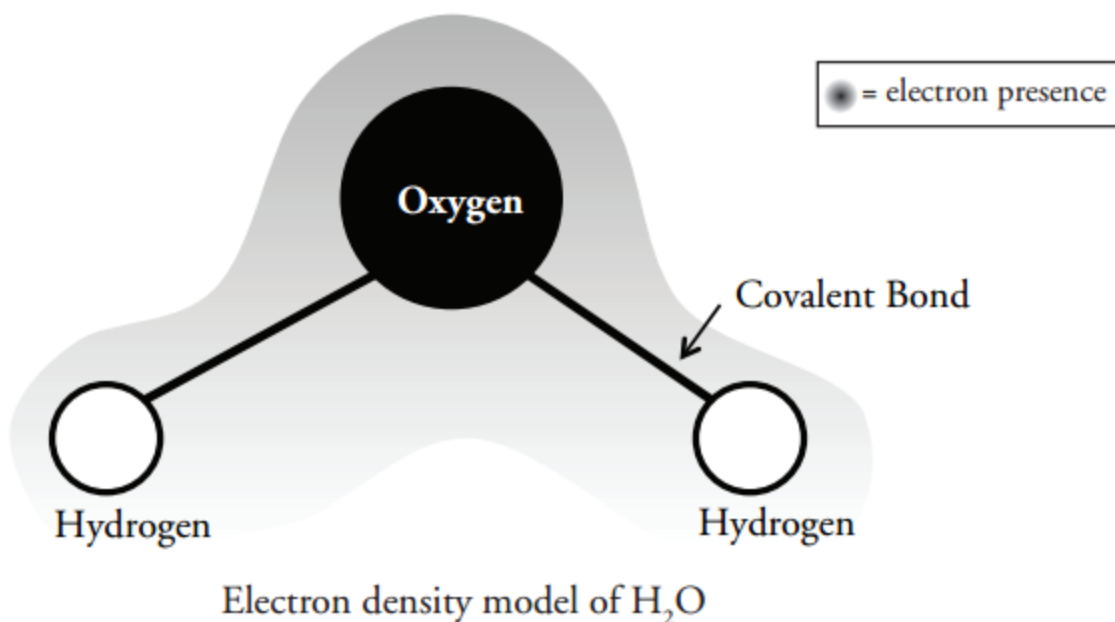
Guided Inquiry

Learning Target

Describe how the structure of water leads to its unique properties.

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, everything living would die. Water covers about 70% of Earth's surface and it makes up 65-75% of our bodies (for instance, our blood is over 82% 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? _____

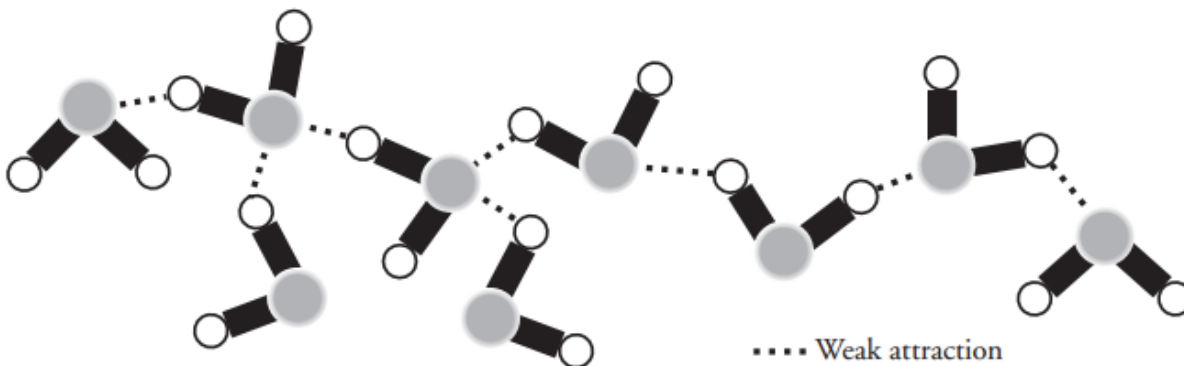
2. How many oxygen atoms are in a molecule of water? _____

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

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?

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

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:

- a. The small, unshaded circles in Model 2 _____
- b. The larger gray shaded circles in Model 2 _____

7. What do the solid lines between the small and large circles represent?

8. According to Model 2, what is represented by the dotted lines?

9. Remember that electrons in a water molecule are more dense around the oxygen atom and less dense around the hydrogen atoms.

a. What kind of charge would the oxygen atom have compared to the hydrogens?

b. What kind of charge would the hydrogen atoms have compared to the oxygen?

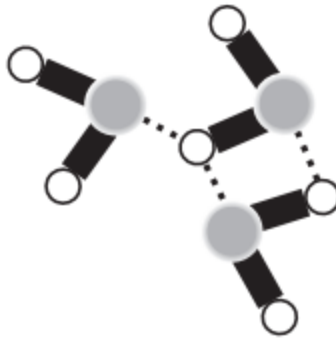
10. Describe the arrangement of water molecules in Model 2 with one another.

11. Describe the cause of attractions between molecules of water.

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 reasoning.

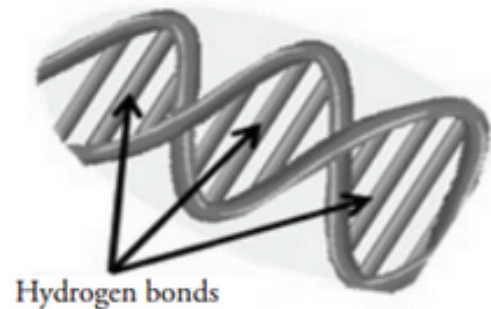
The bonding electrons in some molecules are not equally shared between the atoms. These neutral molecules with a difference of charge across the molecule are called polar molecules. Because of the arrangement of the atoms and electrons in a water molecule, there are two differently charged areas of the 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.



Extension Questions

14. Other polar molecules include nucleic acids and some proteins. Look at the DNA sketch provided and predict how the two strands are attracted to one another.



15. Some molecules that are covalently bonded do not have a difference in charge across the molecule. These molecules are referred to as nonpolar. What arrangement of electrons would result in a nonpolar molecule?

16. Some examples of nonpolar molecules include fats, oils, and waxes. How do these substances interact with water?

17. What prediction would you make about why oil and water interact in the way described above?
