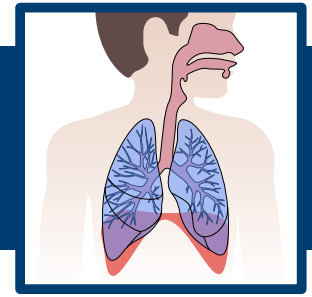


Student Background

PULMO PARK

LESSON 3: RESPIRATORY EXPLORATORY – DIVING DEEPER

Activity 3C: Exchange It!

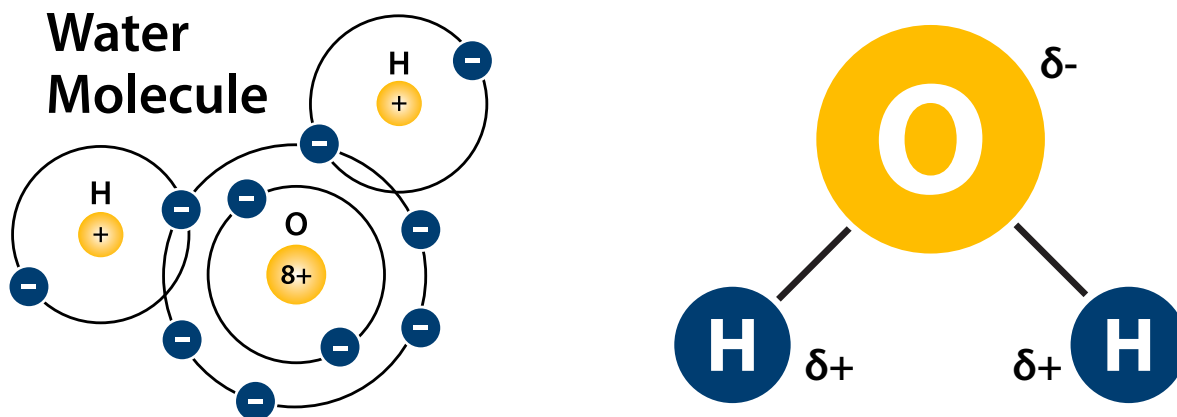


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Exchange It!

The circulatory system is a transport system, carrying O_2 and nutrients to body organs and cells while transporting metabolic waste products, like CO_2 , to the lungs. Blood is a complex solution. In addition to O_2 , CO_2 , and nutrients, blood also contains red blood cells, white blood cells (part of the immune system), and plasma. Plasma is the liquid component of blood. Plasma is 90% water. The other 10% contains electrolytes to maintain pH levels, hormones, vitamins, enzymes, and coagulates (platelets) for blood clotting.

Looking at all components of blood, it is about 80% water, which is important for processes like osmosis and diffusion. But water has unique properties. The water molecule consists of 2 hydrogen atoms bonded to 1 oxygen atom (H_2O). Hydrogen, the smallest atom, has only 1 outer electron, but needs 2 electrons to be stable. Oxygen atoms contain 6 outer electrons, but need 8 outer electrons to be stable. As a result, oxygen and hydrogen atoms seek out other atoms to share electrons to reach stability. But oxygen has a greater *affinity* (attraction) for electrons, meaning it unequally shares electrons with the hydrogen atoms. This imbalance of outer electrons results in the oxygen atom having a slight negative charge (O^{-2}) while the hydrogen atoms each have a slight positive charge (H^{+1}). Because of the unequal sharing of electrons, water molecules have partial charges. These partial charges attract other partially charged molecules.



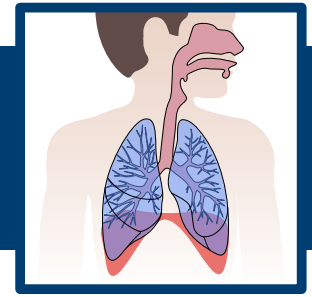
The oxygen and hydrogen atoms share electrons, creating a *covalent bond*. However, the electrons are not shared equally due to the oxygen nucleus having more positive protons than hydrogen (8 to 1). The difference in the number of protons creates this unequal sharing of electrons. Oxygen's 8 positive protons have a stronger attraction for electrons than hydrogen's one proton. As a result hydrogen's electron spends more time with oxygen, making water molecules polar. A polar molecule has an unequal distribution of charge. The oxygen atom pulls the electrons away from the hydrogen atoms resulting in the oxygen atom having a partial negative charge ($-\delta$) and each hydrogen atom has a partial positive charge ($+\delta$).

Student Background

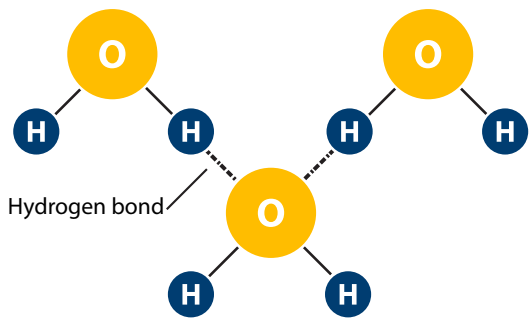
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When water molecules are together, they attract other water molecules. The partial positive charge on each hydrogen atom is weakly attracted to the negative oxygen atom of neighboring water molecules. This weak bond is called “hydrogen bonding”. Think about when drinking a soda through a straw. Soda is mostly water. When drinking through a straw, the pressure inside your mouth is lower than the atmospheric pressure.

It is hydrogen bonding that helps the liquid move up the straw. Each hydrogen bond pulls adjacent water molecules up the straw, moving from the higher atmospheric pressure area to the lower pressure area inside your mouth.



Another example is the form of a water droplet. When a drop of water falls, it forms a rounded structure. This is caused by hydrogen bonds pulling water molecules together, creating surface tension. The surface tension created by the hydrogen bonds holds the droplet in shape as it falls.