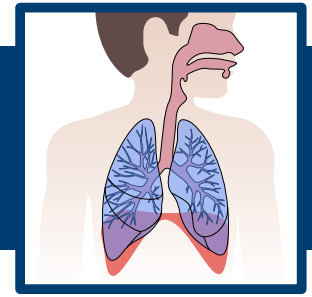


Student Background

PULMO PARK

LESSON 2: RESPIRATORY EXPLORATORY

Activity 2C: Tension – It's a Surface Thing

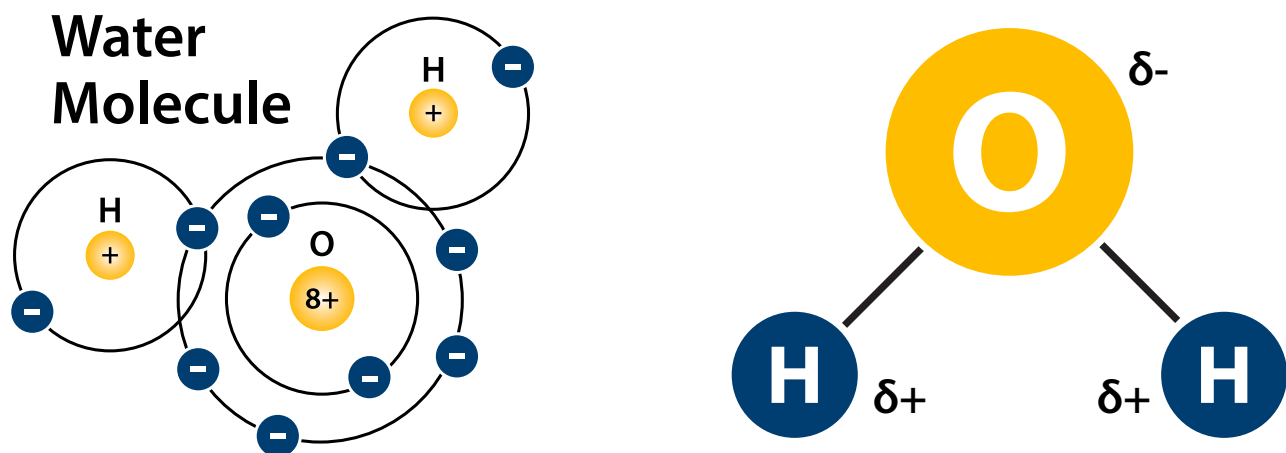


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Surface Tension

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 the blood which allows it to flow through the body. Plasma is 90% water with the other 10% being made of electrolytes to maintain pH levels, hormones, vitamins, enzymes, and coagulates (platelets) for blood clotting,

In other words, our blood is about 90% water, which is important for processes like diffusion. But water has unique properties. The water molecule consists of 2 hydrogen atoms bonded to 1 oxygen atom (H_2O). The oxygen atom contains 6 outer electrons, but atoms are only stable when there are 8 outer electrons. As a result, oxygen atoms seek out other atoms that can share electrons. This imbalance of outer electrons means an oxygen atom has a slight negative charge (-2) because of the missing 2 electrons. Hydrogen, the smallest of atoms has 1 outer electron, making it have a slightly positive charge (+1). The slightly negative charge of an oxygen atom attracts the slightly positively charged hydrogen atoms. Since oxygen needs 2 electrons, it can attract 2 hydrogen atoms.



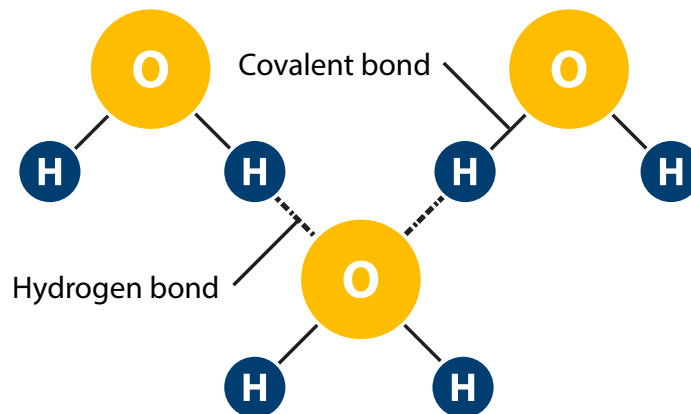
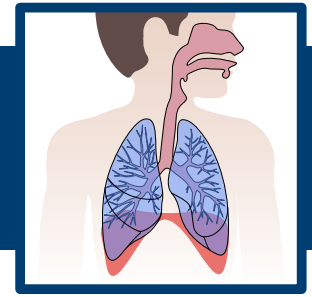
The oxygen and hydrogen share electrons, called a covalent bond. But it is not an equal sharing. Oxygen atoms are bigger than hydrogen atoms. Very simply, think of oxygen as a “bully” who keeps hydrogen’s single electron. As a result, the water molecule is “polar”, meaning the molecule has an unequal 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

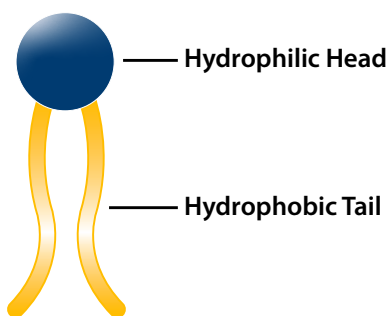
PULMO PARK

LESSON 2: RESPIRATORY EXPLORATORY

Activity 2C: Tension – It's a Surface Thing



As already discussed, opposites attract. When multiple water molecules are together, individual molecules attract other water molecules. The partial positive charge on each hydrogen is weakly attracted to the positive oxygen 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. The liquid travels up the straw. It is hydrogen bonding that helps the liquid move up the straw. Each hydrogen bond pulls the adjacent water molecules up, too. Another example is creating 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.



Surface tension is great for drinking from a straw, but can cause issues inside the body. The hydrogen bonds could cause the alveoli to collapse in on themselves, like a deflated balloon. When alveoli collapse, gas exchange does not happen. The body cells keep producing the waste product CO_2 but do not receive the necessary O_2 . In other words, the cells “suffocate”. To prevent alveolar collapse, the lungs have specialized cells which produce a “surfactant”. The surfactant is a specialized phospholipid which has a hydrophilic end (loves water) and a hydrophobic end (repels water). The hydrophobic end disrupts hydrogen bonds which reduces the surface tension and keeps the alveoli inflated.