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|  | Water is important to living organisms.  What property of water makes humans such great runners? |
| The Molecule That Supports All of Life  Life on Earth began in water and evolved there for \_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ years before colonizing land.  Even terrestrial organisms are tied to water.   * 1. Most cells are surrounded by \_\_\_\_\_\_\_\_\_\_\_\_\_.   2. Cells are \_\_\_\_\_\_\_\_ water.   3. Water is a \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_ in many of the chemical reactions of life. |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent bonds in water molecules result in \_\_\_\_\_\_\_\_\_\_\_\_ bonding  Because oxygen is more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than hydrogen, a water molecule is a polar molecule in which opposite ends of the molecule have opposite charges.  Water has a variety of unusual properties because of the attraction between polar water molecules.  Four emergent properties of water contribute to Earth’s suitability for life |
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|  | Organisms depend on the cohesion of water molecules.  Collectively, hydrogen bonds hold water together, a phenomenon called \_\_\_\_\_\_\_\_\_\_\_\_.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_, the clinging of one substance to another, also contributes, as water adheres to the walls of the vessels.  \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_, a measure of the force necessary to stretch or break the surface of  a liquid, is related to cohesion. |
| Water moderates temperatures on Earth.  Water moderates air temperatures by \_\_\_\_\_\_\_\_\_\_\_\_\_ heat from warmer air and \_\_\_\_\_\_\_\_\_ the stored heat to cooler air.   * Atoms and molecules have \_\_\_\_\_\_\_\_\_\_\_\_ energy, the energy of motion, because they are always moving.   What is the difference between heat and temperature?  How would you describe what happens when you feel something cold?  In most biological settings, temperature is measured on the \_\_\_\_\_\_\_\_\_\_\_ scale (°C).   * + At sea level, water freezes at \_\_\_°C and boils at \_\_\_\_\_°C.   + Human body temperature is typically \_\_\_\_°C.   + To measure heat, one calorie =   In many biological processes, the **kilocalorie (kcal)** is a more convenient unit. |
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|  | **Water has a high specific heat.**  The \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ of a substance is the amount of heat that must be absorbed or lost for 1 g of that substance to change its temperature by 1°C.  Examples:  Water  Ethanol  Iron  Water’s high specific heat is due to \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_.   * + Heat must be absorbed to \_\_\_\_\_\_\_\_\_\_\_\_\_ hydrogen bonds, and heat is released when hydrogen bonds \_\_\_\_\_\_\_\_\_\_\_\_.   The investment of 1 calorie of heat causes relatively little change in the temperature of water because:  Water’s high heat of \_\_\_\_\_\_\_\_\_\_\_ has many effects. The transformation of a molecule from a  liquid to a gas is called vaporization, or evaporation.  Vaporization occurs when a molecule:  Heat of vaporization is the quantity of heat that a liquid must \_\_\_\_\_\_\_\_\_\_\_\_\_ for 1 g of it to be converted from liquid to gas.   * Water has a relatively high heat of vaporization, with about \_\_\_\_\_\_\_\_\_ cal of heat required to evaporate \_\_\_ g of water at room temperature. * The heat of vaporization is high because \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ must be broken before a water molecule can evaporate from the liquid.   As a liquid evaporates, the surface of the liquid that remains behind cools, a phenomenon called \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_. |
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|  | Oceans and lakes don’t freeze solid because:  Water is unusual because it is \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ as a solid than as a cold liquid.  Water begins to freeze when its molecules are no longer moving vigorously enough to break their hydrogen bonds. |
| Water is the solvent of life.  A liquid that is a completely \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ of two or more substances is called a solution.  Solvent:  Solute:  What is an aqueous solution?  Why is water an effective solvent?  Hydrophilic vs Hydrophobic:  Hydrophilic substances are dominated by \_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_ bonds.  Hydrophobic substances are \_\_\_\_\_\_\_\_\_\_\_\_ and have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent bonds. |
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|  | Acidic and basic conditions affect living organisms  Occasionally, a hydrogen atom participating in a hydrogen bond between two water molecules shifts from one molecule to the other.  The hydrogen atom leaves its electron behind and is transferred as a:  The water molecule that lost the proton is now:  The water molecule with the extra proton is now:  Adding certain solutes, called \_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_, disrupts the equilibrium and modifies the concentrations of hydrogen and hydroxide ions.  The \_\_\_\_\_\_\_ scale is used to describe how acidic or basic a solution is.  An ***acid*** is a substance that \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the hydrogen ion concentration in a solution.  Ex. HCl  Any substance that \_\_\_\_\_\_\_\_\_\_\_\_ the hydrogen ion concentration in a solution is a ***base***.  Ex. NH3  NaOH |
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|  | **The pH scale measures the H+ concentration of a solution.**  In any aqueous solution at 25°C, the product of the H+ and OH- concentrations is constant at: \_\_\_\_\_\_  Adding an acid to a solution shifts the balance between H+ and OH− toward H+ and leads to a \_\_\_\_\_\_\_\_ in the OH− concentration.  If [H+] = 10−5 M, then [OH−] = \_\_\_\_\_\_\_\_.  To express this variation more conveniently, the H+ and OH− concentrations are typically expressed with the pH scale. The pH of a solution is defined as the negative logarithm (base 10) of the hydrogen ion concentration:    In a neutral solution, [H+] = \_\_\_\_\_\_\_ M and pH = \_\_\_\_\_\_\_\_.  The pH decreases as the H+ concentration \_\_\_\_\_\_\_\_\_\_\_\_\_\_.   1. What is the hydrogen [H+] concentration of a solution at pH 12? 2. What is the hydroxide [-OH] concentration of a solution at pH 12? 3. What is the pH when the [-OH] concentration of a solution is 10-8 M?   Buffers \_\_\_\_\_\_\_\_\_\_\_ changes in the pH of a solution when H+ or OH− is added to the solution. Buffers \_\_\_\_\_\_\_\_\_\_\_\_\_\_ hydrogen ions from the solution when they are in excess and \_\_\_\_\_\_\_\_\_\_\_\_\_ hydrogen ions when they have been depleted.  Buffers typically consist of a weak acid and its corresponding base.  One important buffer in human blood and other biological solutions is carbonic acid (H2CO3), formed when CO2 reacts with water in blood plasma.  Carbonic acid dissociates to yield: |
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