

Biology – Chapter 2a The Chemistry of Life

Honors Biology – Chapter 2 The Chemical Basis of Life

Ridgefield Memorial High School

TABLE 2.1 ELEMENTS IN THE HUMAN BODY

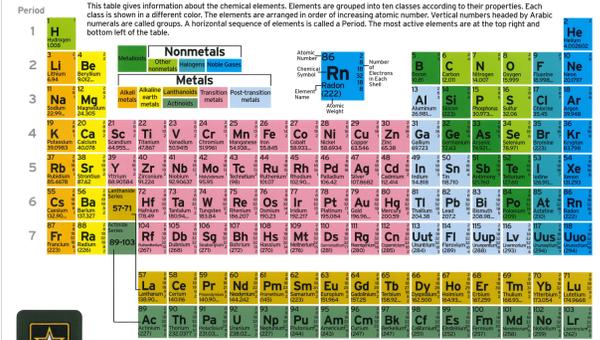
Element	Symbol	Percentage of Human Body Weight
Oxygen	O	65.0
Carbon	C	18.5
Hydrogen	H	9.56
Nitrogen	N	3.3
Calcium	Ca	1.5
Phosphorus	P	1.0
Potassium	K	0.4
Sulfur	S	0.3
Sodium	Na	0.2
Chlorine	Cl	0.2
Magnesium	Mg	0.1

Trace elements (less than 0.01%): boron (B), chromium (Cr), cobalt (Co), copper (Cu), fluorine (F), iodine (I), iron (Fe), manganese (Mn), molybdenum (Mo), selenium (Se), silicon (Si), tin (Sn), vanadium (V), and zinc (Zn).

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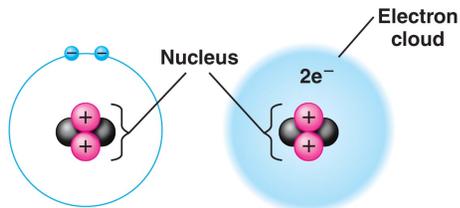
The four most common elements in biology spell CHON.

Periodic Table of the Elements



MONEY FOR COLLEGE MONEY TO PAY BACK STUDENT LOANS ENLISTMENT BONUS

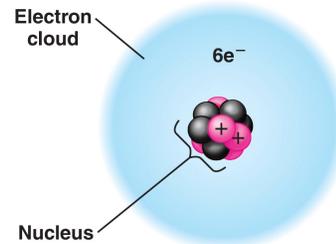
JOIN THE TEAM THAT MAKES A DIFFERENCE.



2 \oplus Protons } Mass number = 4
 2 \bullet Neutrons }
 2 \ominus Electrons

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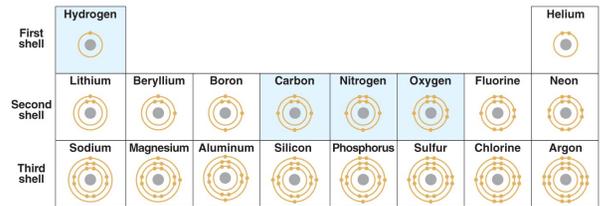
Helium has 2 protons, 2 neutrons, and 2 electrons.



6 \oplus Protons } Mass number = 12
 6 \bullet Neutrons }
 6 \ominus Electrons

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Carbon has 6 protons, 6 neutrons, and 6 electrons.



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The 1st orbital holds 2 electrons and each additional holds up to 8.

TABLE 2.4 ISOTOPES OF CARBON

	Carbon-12	Carbon-13	Carbon-14
Protons	6	6	6
Neutrons	6	7	8
Electrons	6	6	6

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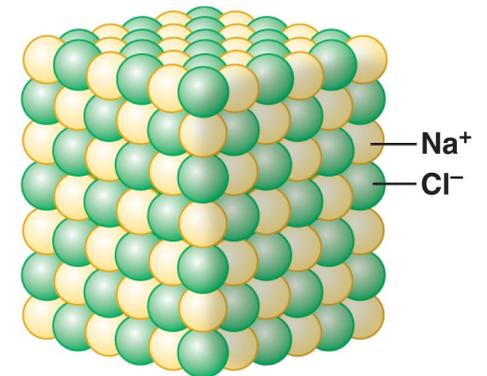
Isotopes are elements that are the same except for the number of neutrons.



Sodium + Chlorine → Sodium Chloride

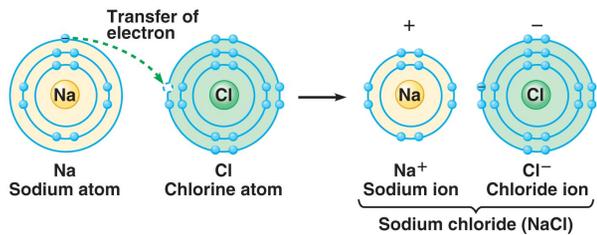
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Sodium (a highly reactive metal) and chlorine (a toxic gas) create ordinary table salt (NaCl). When atoms combine to form molecules, their physical and chemical properties change.



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Salt is composed of equal numbers of sodium and chlorine atoms.



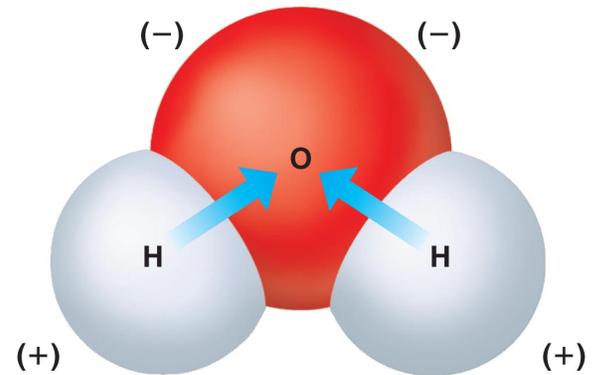
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Salt is formed by an ionic (give and take) bond.

TABLE 2.8 ALTERNATIVE WAYS TO REPRESENT FOUR COMMON MOLECULES			
Molecular Formula	Electron-Distribution Diagram	Structural Formula	Space-Filling Model
H ₂		H—H Single bond	
O ₂		O=O Double bond	
CH ₄ Methane			
H ₂ O Water			

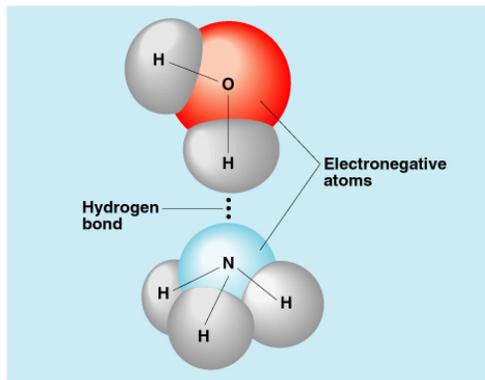
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These are different ways to draw molecules.

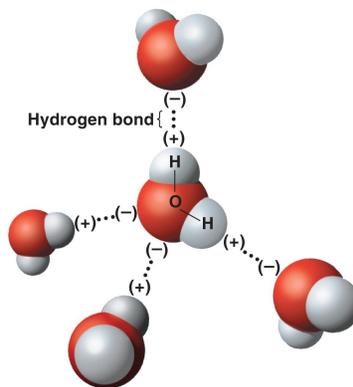


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Oxygen is electronegative. That means it is a bully. It steals electrons from hydrogens. This makes the water molecule POLAR.



The partial + charge on the H attracts the partial - charge on nitrogen (or oxygen).



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Water's 4 H-bonds are responsible for cohesion and adhesion. Every H₂O molecule has 2 partial negative charges and 2 partial positive charges.



Cohesion is when small water droplets stick together due to hydrogen bonds, forming larger droplets.



Adhesion is when water forms droplets on other surfaces.



Adhesion is when water forms droplets on other surfaces.



A meniscus is observed because water molecules "stick" to the sides of the graduated cylinder (adhesion).



Capillary action is the ability of water molecules to rise vertically through narrow areas (against gravity).



This celery stalk turned red because the red-colored water traveled up the stalk and into the leaves due to capillary action.



NOTE: Drinking through a straw is NOT an example of capillary action!



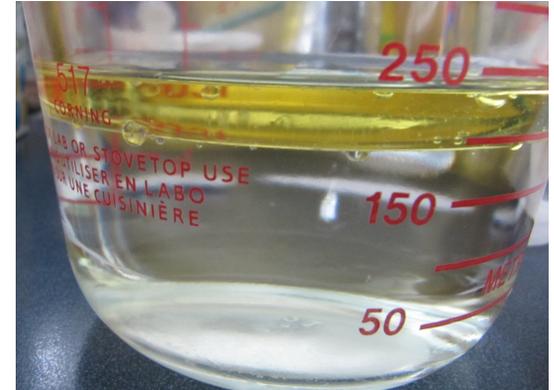
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This water strider is experiencing surface tension, an upward force on the surface of the water.



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This boxer is experiencing evaporative cooling (sweating). When water evaporates, H-bonds are broken and heat is released.



"LIKE DISSOLVES LIKE":

Oil and water do not mix because oil is non-polar and water is polar.

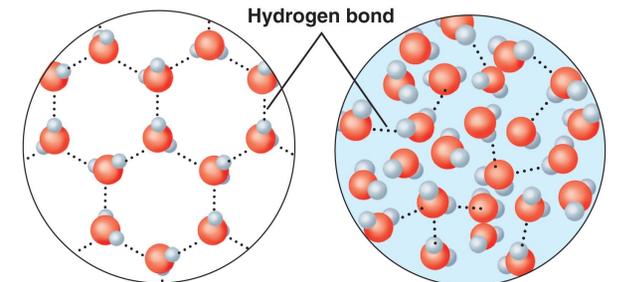


Soap is amphipathic, meaning that it can mix with both water and oil.



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The ice floats because...



Ice
Hydrogen bonds are stable

Liquid water
Hydrogen bonds constantly break and re-form

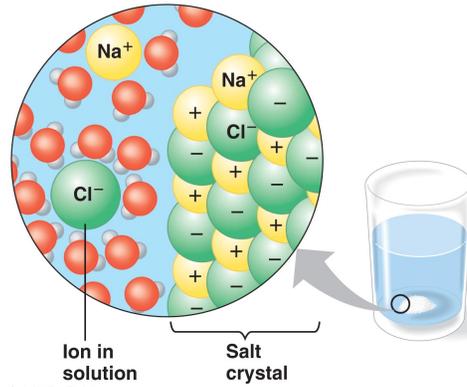
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...the hydrogen bonds expand when water freezes.

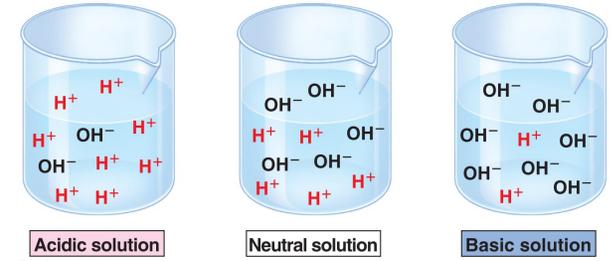


Benjamin Cummings

H₂O is shown in three forms: ice (left), water (center), and water vapor (right).



Water is a universal solvent. It dissolves many different things.



Acids have more H⁺s. Bases have more OH⁻s. Water has an equal number of both.

The HOH molecules "dissociate" into H⁺ and OH⁻. Acids have more H⁺s. Bases have more OH⁻s. Water has an equal number of both.

Sometimes the water molecule is split here.

	Acids	Bases	HOH
	more H ⁺ than OH ⁻	more OH ⁻ than H ⁺	equal amounts of H ⁺ and OH ⁻
	pH between 0 and 6	pH between 8 and 14	pH=7 (neutral)
	chemical formula usually starts with "H" EX: HCl H ₂ SO ₄	chemical formula usually ends with "OH" EX: NaOH Ca(OH) ₂	chemical formula starts with "H" and ends with "OH" EX: H-OH

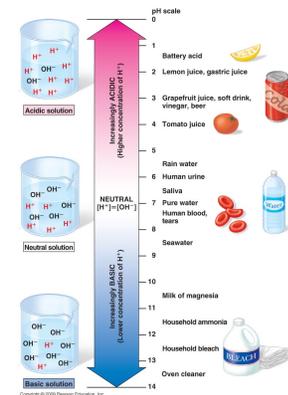
H⁺ acids and OH⁻ bases

The difference between an acid and a base is due to the relative amounts of H⁺ and OH⁻ in a solution.

pH 9 is ___ times more basic than 8.
 pH 9 is ___ times more basic than 7.
 pH 14 is ___ times more basic than 7.
 pH 1 is ___ times more acidic than 7.

0-1-2-3-4-5-6-7-8-9-10-11-12-13-14
 ↑ strongest acid ↑ neutral ↑ strongest base

Each step on the pH scale is 10 times stronger than the previous one.



Each step on the pH scale is 10 times stronger than the previous one.



A pH indicator can be used to visually determine the approximate pH of a solution. Indicators change color depending on the pH level.



A pH buffer can be used to maintain a constant pH even when an acid or a base is added to a solution.



Ocean acidification (due to pollution) dissolves away the calcium in the coral reefs.