

Elements

- An _____ is a substance that cannot be broken down to other substances by chemical reactions
 - Example: _____
- A _____ is a substance consisting of two or more different elements combined
 - Example: _____
- A _____ is made up of two or more of the same element
 - Example: _____
- Four elements make up the majority of living organisms
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- These make up approx. _____ of body weight
- All living organisms are _____ (carbon-based)
- These are _____ – along with Ca, P, K, and S
- _____ are required by an organism in minute quantities and may not be required by all organisms
 - Example: Iron (Fe) is needed by all organisms, iodine (I) is required by vertebrates

Atoms

- _____ are the smallest units of matter
- Subatomic particles include
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- If an element has a neutral charge, number of protons = number of electrons
- An _____ is an element with a + or – charge
- The number of neutrons can vary – called an _____

- Some isotopes are _____, meaning the nucleus decays spontaneously transforming the atom into a different element
 - Example – carbon-14 decays into nitrogen

Radioactive Isotopes

- Uses in Biology:
 - Measurement of radioactivity in fossils to determine age
 - Tracers to follow atoms through metabolism
 - Diagnostic tools in medicine
- Radiation from decaying isotopes can also be harmful
 - Example – radioactive fallout from nuclear accidents

Energy and Chemical Bonding

- _____ is defined as the capacity to cause change
- _____ is the energy that matter possesses because of its location/structure
- When atoms are bound together, their bonds hold _____
- As these bonds break, energy is _____
- Stronger bonds
 - _____: negative e⁻ is attracted to its own nucleus and the nucleus of the other atom
 - _____: electrons are equally shared, ex. _____
 - _____: electrons are unequally shared, ex. _____
 - _____: electron is not shared, but transferred
 - _____ – atom that assumes a + charge
 - _____ – atom that assumes a – charge
 - Example, $\text{Na}^+ + \text{Cl}^- \rightarrow \text{NaCl}$
- Weaker bonds
 - _____: H is bound to a highly electronegative atom (such as N, O, or F); not actually a “bond”, more of an “attraction”

Chemical Reactions

- _____ make and break chemical bonds
- All reactions are reversible, with the products becoming the reactants

- When the reactions offset one another, _____ has been reached
- _____ refers to the idea that reactions still take place, but the total amount of reactants/products do not change
- _____ – reactions that consume energy (thermal energy)
- _____ – reactions that release energy (thermal energy)

Properties of Water

- Water has _____ bonds
- _____ occurs between a “positive” hydrogen of one H₂O and a “negative” oxygen of another H₂O
- This attraction makes water “sticky” or _____
- Water is also _____ – clings to other substances, like cell walls
- Water has high _____ – the measurement of how difficult it is to break the surface of a liquid
- _____ refers to the process plants use to transport water
- Moderation of temperature
 - High _____ – the amount of heat that must be absorbed or lost for 1g of substance to change temperature by 1°C
 - Large bodies of water can store a lot of heat – leading to mild temperatures along most coasts
- High _____
 - Quantity of heat a liquid must absorb for 1g to be converted to gas
 - As liquid evaporates, the liquid left behind is cooler because the warmer liquid is turning into a gas – _____
- _____ because it is less dense than water
 - Allows for cycling of nutrients in aquatic areas
- _____ – liquid that is completely homogenous mixture of 2 or more substances
 - _____ – dissolving agent (universal solvent is _____)
 - _____ – substance that is dissolved
- _____ – “water-loving”, will dissolve in water
- _____ – “water-fearing”, will not dissolve in water

Acids and Bases

- _____ – when dissolved in water, it donates a H^+ to the solution increasing the hydrogen ion concentration
- _____ – when dissolved in water, it accepts a H^+ or dissociates to form OH^- , both reducing the hydrogen ion concentration
- _____ – a solution in which H^+ and OH^- concentrations are equal

The pH Scale

- The pH scale ranges from _____
 - Lower number = more acidic (high H^+)
 - Higher number = more basic/alkaline (low H^+)
 - 7 = neutral

- To solve for pH, use the equation

$$pH = \underline{\hspace{2cm}}$$

- Practice Problems:
 - If the H^+ concentration is 0.0001 M/l, what is the pH?
 - If the H^+ concentration is 1.0×10^{-8} , what is the pH?
 - If a solution has a pH of 12, what is its H^+ concentration?

Buffers and Blood pH

- _____ – substance that minimizes changes in the concentrations of H^+ and OH^- in a solution
- The internal pH of most living cells is close to 7
- Our blood has a pH of _____ (slightly alkaline)...a pH of 7 or 7.8 could be deadly
- One buffer that contributes to pH stability is _____ (H_2CO_3)
- Carbonic acid is formed when CO_2 reacts with water in blood plasma
- When pH rises, carbonic acid dissociates into _____ (HCO_3^-) and a H^+ ion