Science Gateway Content Review Topics

Chemistry Topics

*Solutions and Concentrations
- solute, solvent
- unsaturated, saturated, supersaturated
- effect of temperature increase on solid solutes
- effect of temperature increase on gas solutes
- molarity (moles solute/liter of solution)
- percent concentration (grams solute/grams solute + grams solvent) x 100%

*Periodic Table and Trends
- metals, nonmetals, metalloids: location on periodic table and properties of each
- trend of atomic radii (size) across a period and down a group
- trend of reactivity across a period and down a group
- location of radioactive elements
- the 7 diatomic elements

*Acids and Bases
- acids—have hydrogen capable of releasing as hydrogen ion (H⁺)
- bases—have hydroxide ion and capable of releasing hydroxide ion (OH⁻)
- properties of acids and bases
- tests for an unknown substance and deciding if it is an acid, base, or neutral (litmus and phenolphthalein)
- pH scale for measuring acidity and alkalinity
- range of pH scale for acids, bases, and neutral substances
- within acidic range, which is most acidic; within basic range which is most basic
- acid rain—cause (how it forms) and effects

*Chemical and Physical Properties of Matter
- examples of physical properties as observable or measurable properties
- examples of chemical properties as reactivity or non-reactivity
- identify substances using physical and chemical properties
- comparison of physical and chemical changes
- classify substances as elements, compounds, or mixtures
*Energy
  • law of conservation of energy/mass
  • exothermic and endothermic changes
  • energy changes in photosynthesis and respiration
  • identify energy transformations (ex: From gasoline in a car to car’s wheels moving)
  • calculate heats of combustion

*Atomic Structure
  • location of protons, neutrons, electrons in an atom
  • charge and mass of these subatomic particles
  • atomic number and atomic mass and mass number
  • isotopes
  • radioactive elements: location on periodic table
  • 3 types of radioactive particles released; use in bombs and power plants
  • energy of the future: fusion

*Bonding
  • bonding occurs via gaining, losing, or sharing e⁻
  • covalent bonding: sharing electrons that occurs between two non-metals
  • ionic bonding: gaining or losing electrons; occurs between a metal and a non-metal
  • how ions form from neutral atoms (cations form from an atom losing electrons; anions form from an atom gaining electrons)
  • group 1 ions form 1:1 compounds with group 17 and 2:1 compounds with group 16.
  • single, double, triple bonds = # of electron pairs being shared
  • writing and naming formulas
  • electron dot formulas

**Intermolecular forces on boiling and melting points**
**Graphing Reminders**

- identify independent and dependent variables and which goes on x and y axis
- appropriately label x and y axes with measurement AND unit
- choose appropriate scales for x and y axes
- plot points and connect, using best fit
- title graph so that it reflects overall purpose, yet is fairly specific
- use key for graph if needed
Biology Topics

*Energy/Matter Transformations

- Law of Conservation of Matter and Energy—occurs in food chain (includes decomposers)

*Basic Life Functions and Organization

- Homeostasis—balance of life functions, environment, and activities of organism
- Characteristics of living things—made of cells highly organized, need energy, grow and develop, life span, reproduce, respond to stimuli adapt to environmental changes
- levels of organization: Cells→tissue→organ→organ system→organism

*Ecology

- relationships of living things to their environment
- population, community, ecosystem, biomes, biosphere
- factors—abiotic (nonliving components; ex: light) and biotic (living components; ex: predator)
- food chain—producer (plants), consumer (herbivores and carnivores), decomposers
- biological diversity—the number of species in community, greatest at equator
- niche—position or role of a species in community.

*Cell Theory

- the cell is the basic unit of life—all organisms are made of one or more cells
- cells are produced from other cells
- differences between animal and plant cells—plant cells contain a cell wall and chloroplasts; undergo photosynthesis
- compare a cell’s organelles to the operation of a factory
- function—absorb nutrients, release wastes, convert energy, communicate with other cells
- 2 types of cells: PROKARYOTES (small, simple, no nucleus, single chromosome) and EUKARYOTES (nucleus, typical cell)
• **Cell Organelles**
  
  - cell & nuclear membrane—controls in & out, semipermeable
  - nucleus—control center (the brain)
  - cytoplasm—gel-like, throughout cell
  - mitochondria—makes & releases energy for cell, called ATP; place of respiration (power supply)
  - Golgi body—package & deliver proteins (packing and shipping)
  - endoplasmic reticulum—transports materials throughout cell (highways)
  - ribosomes—site of protein synthesis (protein factories)
  - cell wall—in plants only; support/give structure
  - chloroplasts—in plants only; carries out photosynthesis

*Photosynthesis & Cellular Respiration*

• reverse reactions (recycling matter)—one needs and stores energy, the other releases energy (as ATP)

• animals only go through cellular respiration, but plants photosynthesis AND respire

• **Photosynthesis**
  
  - endothermic, stores energy, requires light, occurs in chloroplasts of cells
  - makes a high energy molecule called glucose (food) and oxygen from carbon dioxide and water and energy (sunlight)
  - equation:
    \[ 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy} \rightarrow \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \]

• **Respiration**
  
  - Exothermic, releases energy (ATP—adenosine triphosphate), occurs in mitochondria
  - makes energy, carbon dioxide, and water from glucose and oxygen
  - equation:
    \[ \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy} \]
* Genetics/DNA/Heredity

- DNA (deoxyribonucleic acid)—the “code” for making proteins; DNA controls everything; found in the nucleus of cells on chromosomes
- building blocks of DNA are called nucleotides
- DNA = double strand (double helix) in a spiral with nitrogen bases paired up (A with T and C with G)
- bases = adenine (A), thymine (T), cytosine (C), guanine (G)
- DNA is like a recipe containing directions of how to make something (hair color, height, eye color, etc)
- sequence of bases (A, T, C, G) determines traits (genes)
- only identical twins have the same sequence of bases; everyone else has different sequences
- traits—1 gene from each parent (dominant and recessive traits)
- genotype and phenotype
- proteins for the cell are made from portions of DNA

Mitosis

- a cell divides giving resulting cells the full number of chromosomes
- one cell produces 2 cells in one division
- occurs in growth
- animal cells pinch in half while plant cells grow a cell wall

Meiosis

- a cell divides giving resulting cell ½ the number of chromosomes
- one cell produces 4 cells in two divisions
- occurs in (reproductive) sex cells so that offspring get half of the needed chromosomes from each parent.