**Measurement and Scientific Method**

-SI Units

-Significant figures

-Metric staircase **K**ing **H**enry **D**ied **B**y **D**rinking **C**hocolate **M**ilk (kilo, hecto, deca, base unit, deci, centi, milli)

-Line graph= data that changes over a time period

-Bar graph=compares several items or events

-Circle graph=parts of a whole

-Independent variable= x-axis, manipulated variable

-Dependent variable= y-axis, changes in response to independent variable

-Scientific method

**Forces and Motion**

**-**Frame of reference

-Distance= total length traveled

-Displacement= starting point to ending point

-Vector

-Scalar

-Speed= distance/time

-Average speed= total distance/total time

-Instantaneous speed= speed at a given moment (ex. Speedometer gives instantaneous speed in a car)

-Velocity= vector quantity; speed and direction

-Acceleration= changes in speed, direction, or both. (vf-vi)/total time

-Free fall= movement of object to Earth solely because of gravity

-Distance-time graph

Slope of graph is speed because distance/time=speed

-Speed-time graph

Slope of graph is acceleration because change in speed/time is acceleration

-Force

-Balanced vs Unbalanced Forces

-Static friction= acts on objects that are **not moving**

-Sliding friction= force that opposes the direction of motion as an object slides across a surface

-Rolling friction= acts on rolling objects

-Fluid friction= opposes motion of object through a fluid (liquid or gas)

-Projectile motion= motion of a falling object with an initial forward velocity (parabola)

-Newton’s Laws

1. An object in motion stays in motion unless an outside force acts upon it (inertia).
2. The acceleration of an object is equal to the net force acting on it divided by the object’s mass (doubling mass cuts acceleration in half). F=am
3. Equal and opposite force

-Weight= mass x acceleration due to gravity (9.8 m/s/s)

-Mass

-Momentum= mass x velocity

-Law of conservation of momentum

-Universal forces

1. Electromagnetic
2. Nuclear; Strong and Weak
3. Gravitational

**Work, Energy Transfer and Conservation**

-Work= force x distance

For a force to do work on an object, some of the force must act in the same direction as the objects moves.

-Power= rate of doing work; work/time

-Work input and output

-Input force

-Input distance

-Because of friction, the work done by a machine is always less than the work done on the machine.

-Actual mechanical advantage= output force/ input force

-Ideal mechanical advantage= mechanical advantage in the absence of friction; input distance/ output distance

-Efficiency= work output/ work input x 100= %

-Simple Machines

1. Lever (3 categories based on fulcrum placement)
2. Wheel and axle
3. Inclined plane
4. Wedge
5. Screw
6. Pulley

-Compound machine

-Kinetic energy= energy of motion; 1/2 mv2

-Potential energy= stored energy as a result of position; mgh or Wh

-Elastic potential energy

-Forms of energy

1. Mechanical
2. Thermal
3. Chemical
4. Electrical
5. Electromagnetic
6. Nuclear

-Energy conservation= energy can change forms

-Law of conservation of energy= energy cannot be created nor destroyed

-(KE + PE)beginning=(KE + PE)end

-Nonrenewable resources

-Renewable resources

-Specific heat= amount of heat needed to raise the temperature of 1 g of a material by 1 degree Celsius; Q= mass x specific heat x change in temperature

-Conduction= transfer of thermal energy through **touch**

-Convection= transfer of thermal energy when **particles of a fluid move from one place to another**

-Radiation= transfer of thermal energy by **waves**

-Laws of Thermodynamics

1. 1st Law, energy is conserved.
2. 2nd Law, thermal energy can only go from hot to cold objects unless work is done on the system.
3. 3rd Law, absolute zero cannot be reached.

**Waves**

-Mechanical wave

1. Transverse
2. Longitudinal
3. Surface

-Medium= material through which a wave travels

-Crest, trough, resting position, amplitude, wavelength

-Compression, rarefaction

-Period= time required for 1 cycle (crest to crest).

-Frequency= number of complete cycles in a given time, measured in hertz (Hz).

-Wave speed= wavelength x frequency

-Amplitude= can be measured from resting position to crest or resting position to trough

The more energy a wave has the greater the amplitude

-Reflection= wave bounces off a surface it cannot pass through.

Incident ray

Angle of reflection

Regular reflection

Diffuse reflection

-Refraction= bending of a wave as it enters a new medium

-Diffraction= bending of a wave as it moves around an obstacle or passes through a narrow opening

-Interference

Constructive= two or more waves combine to produce a wave with a larger displacement

Destructive= two or more waves combine to produce a wave with a reduced amplitude

-Ultrasound

-Sonar

-Doppler Effect

-Electromagnetic Spectrum

**Electricity**

-Electric charge

-Electric forces

-Electric fields

-Static electricity and charging

1. Friction= movement
2. Contact= touch
3. Induction= no touch

-Electric current (ampere, amps, A)

1. Alternating current (AC)= current reverses direction
2. Direct current (DC)= current flows in one direction

-Conductor

-Insulator

-Resistance= (Ohm) opposition to flow

-Voltage= (volts) power supply such as batteries

-Potential difference= difference in potential energy between two places in an electric field

-Ohm’s Law

V=IR

-Circuit diagram

-Series circuit= 1 path, if one part of the circuit stops working all parts stop working

-Parallel circuit= 2 or more paths, if one part stops working the rest of the parts can still operate (ex. house)

-Electric power

Power (watts) = I (amps) x V (volts)

-Safety

Fuse

Circuit breaker

Grounding= excess charge to Earth

Insulated wire

**Magnetism**

-Magnetic force

-Magnetic poles= north and south

-**Likes repel, opposite attract**

-Magnetic field

Field lines move from north to south

-Magnetosphere

-Magnetic domain

-Ferromagnetic material

-Solenoid= coil of current carrying wire

-Electromagnet= solenoid with a ferromagnetic core

Increasing loops, increasing current makes electromagnet stronger

-Generator= mechanical energy to electrical energy

-Motor= electrical energy to mechanical energy

-Transformers= Step-up and Step-down

**Properties and States of Matter**

-Pure substance= element or compound

Elements

Compounds= 2 or more elements in fixed proportions

-Mixtures

Heterogenous= parts are noticeable (ex. Trail mix)

Suspension= layers

Homogeneous= substances evenly distributed (ex. Cake batter)

Solution= dissolved substance

Colloid= heterogeneous mixture that doesn’t separate over time (ex. Fog, mayo)

-Separation techniques: filtration (particle size) and distillation (boiling point).

-Physical properties

-Chemical properties

Flammability, reactivity

Production of a gas, precipitate, color change

-Solids

-Liquids

-Gases

-Know differences in kinetic energy of particles

-Gas Laws

Boyles law= P1V1=P2V2

Charles law= V1/T1=V2/T2

Combined gas law= P1V1/T1= P2V2/T2

-Phase change diagrams

-Heating curves

-Melting, freezing

-Boiling

-Evaporation

-Condensation

-Sublimation

-Deposition

**Atomic Structure and History**

-Democritus and Leucippus

-John Dalton= sphere

-JJ Thomson= cathode ray tube, plum pudding model

-Ernest Rutherford= gold foil, positively charged nucleus

-Niels Bohr= Bohr model, electrons in orbitals

-Erwin Schrodinger= quantum theory, electron cloud model

-Protons= positive, have mass, in nucleus

-Neutrons= no charge, have mass, in nucleus

-Electrons= negative charge, no mass, orbit nucleus

-Atomic number= number of protons (and electrons)

-Mass number= protons + neutrons

-Isotopes= same atomic number, different atomic mass

-Bohr Models

1st orbital=2 electrons

2nd orbital= 8 electrons

3rd orbital= 18 electrons

4rd orbital= 32 electrons

-Lewis Dot Diagram= only valence electrons

**Periodic Table and History**

-Mendeleev= father of the periodic table

-Period= rows

-Group= column

-Location of metals, nonmetals, and metalloids

-Families

1. Alkali metals
2. Alkaline Earth metals
3. Boron
4. Carbon
5. Nitrogen
6. Oxygen
7. Halogens
8. Noble Gases

-Know how to determine valence electrons

-Oxidation numbers

-Cations

-Anions

**Types of Bonds**

-Ionization energy and electronegativity = increases from left to right and decreases down the the group

-Ionic Bonds

Metal + nonmetal

Cation + anion

Transfer of electrons

Crystal lattice structure

Conduct electricity when dissolved in solvent

-Covalent Bonds

Nonmetal + nonmetal

Sharing of electrons

Polar= electrons not shared equally, electrons spend more time around most electronegative element

-Metallic bonds

Metal + metal

Sea of electrons

All atoms share valence electrons

**Chemical Nomenclature**

-Ionic

Cation (metal) 1st= elements name

Anion (nonmetal) 2nd= elements name + -ide

Transition metals have oxidation numbers in parenthesis as roman numerals (ex. Copper (II))

Polyatomic Ions

Ex. LiCl= lithium chloride

PbSO4= lead (II) sulfate

-Molecular/ Covalent

Prefixes (mono, di, tri, tetra, penta, hexa, hepta, octa, nona, deca)

Omit mono from first element if there is just one

Name of element with prefix + name of element with prefix and -ide

Ex. P2O5= diphosphorus pentoxide

CO= carbon monoxide

**Balancing Equations and Types of Reactions**

-Reactants -> Products

-Law of Conservation of Mass

Ex.Unbalanced equation: Cu + O2 -> CuO

-Types of reactions

1. Synthesis: A+B-> C
2. Decomposition: AB-> A+B
3. Single-Replacement: A + BC -> AC + B
4. Double-Replacement: AB + CD -> AD +CB
5. Combustion: CH4+ 2**O2** -> **CO2** + 2**H2O**
6. Oxidation Reduction: OIL RIG, LEO goes GER

-Endothermic= requires heat (heat on reactants side)

-Exothermic= releases heat (heat on products side)

-Fission vs Fusion

-Alpha decay

Release of He atom

-Beta decay

Release of electron

-Gamma radiation

-pH scale 0-14

-Acids

H +

pH less than 7

Sour

Red when reacts with litmus paper

-Bases

OH -

pH greater than 7

Bitter, slippery

Blue when reacts with litmus paper

-Acids and bases form salts when combined