Science (8)

Science

Grade(s) 8th, Duration 1 Year, 1 Credit
Required Course

Course Overview

This course covers the concepts of what science is and how it works. The main emphasis is on basic chemistry.

8th grade physical science is a yearlong course designed to cover four main topics in physical science. The first quarter we will cover the nature of science and how it is related to technology. The second quarter is designed to introduce the students to the types of matter, the elements, and the phases of matter. The third and fourth quarter will continue basic chemistry with atomic structure, bonding, and types of chemical reactions - including some acid-base chemistry.

Scope And Sequence

Timeframe	Unit	Instructional Topics
3 Week(s)	What is Science?	1. Thinking like a Scientist 2. Scientific Inquiry (Scientific Method) 3. Why Study Science? 4. Careers in Science
3 Week(s)	The Work of Scientists	1. Measurements 2. Mathematics in Science 3. Use of Graphs
3 Week(s)	Technology and Engineering	1. Understanding Technology 2. Technology Design 3. Technology and Society
3 Week(s)	Introduction to Matter	1. Describing Matter 2. Measuring Matter 3. Changes in Matter 4. Energy and Matter
3 Week(s)	Solids, Liquids, and Gases	1. States of Matter 2. Changes of State 3. Gas Behavior
4 Week(s)	Elements and the Periodic Table	1. Introduction to Atoms 2. Organizing the Elements 3. Metals 4. Nonmetals and Metalloids
3 Week(s)	Exploring Materials	1. Polymers and Composites 2. Metals and Alloys 3. Ceramics and Glass 4. Radioactive Elements and Radiolactive Decay
5 Week(s)	Atoms and Bonding	1. Elements and Atoms 2. Atoms, Bonding, and the Periodic Table 3. Ionic Bonding 4. Covalent Bonding 5. Bonding in Metals
3 Week(s)	Chemical Reactions	1. Observing Chemical Change 2. Describing Chemical Reactions 3. Controlling Chemical Reactions
4 Week(s)	Acids, Bases, and Solutions	1. Understanding Solutions 2. Concentration and Solubility 3. Describing Acids and Bases 4. Acids and Bases in Solutions

Materials and Resources

Textbooks; The Nature of Science and Technology, Chemical Building Blocks, and Chemical Interactions.

Prerequisites

Enrollment in 8th Grade.

Course Details

Unit: What is Science? **Duration:** 3 Week(s)

Unit Overview

How scientists investigate the natural world, their methods and their traits.

Materials and Resources

Textbook: The Nature of Science and Technology - Chapter One (pages 5 through 41)

Lab Safety Guidelines and Lab Safety Contract

Lab: Identification of laboratory equipment (sketching and labeling key pieces)

Academic Vocabulary

observing
quantitative observation
qualitative observation
inferring
predicting
classifying
models
science
skepticism
scientific inquiry
scientific method
hypothesis
variable
manipulated variable
responding variable
controlled experiment
operational definition
data
communicating
scientific theory
scientific law
independent variable
dependent variable
scientific literacy

Summative Assessment

1.1 Quiz
1.2 Quiz
1.3/1.4 Quiz
Chapter One Examination
Lab Safety Quiz

Topic: Thinking like a Scientist **Duration:** 5 Day(s)

Topic Overview

The students will be able to describe some of the skills that are used by scientists in their work. These include:
1) observing
2) inferring
3) predicting
4) classifying
5) making models

Learning Targets

Skills and attitudes of scientists.

The students will be able to describe some of the skills and traits that are common among scientists.

Thinking Like a Scientist

SC.2007.8-12.1.1 The student will demonstrate the abilities necessary to do scientific inquiry.
- actively engages in asking and evaluating research questions.
- actively engages in investigations, including developing questions, gathering and analyzing data, and designing and conducting research
- actively engages in using technological tools and mathematics in their own scientific investigations.
- Well-formed research questions drive scientific inquiry.
- The scientific investigations includes, when appropriate,
- formulating a testable hypothesis.
- identify and test variables (independent, dependent, and variables to be kept constant).
- using methods for gathering data that is observable, measurable, and replicable.
- analyzing and evaluating the results in order to clarify the questions and hypotheses, and to refine methods for further research.
- using a variety of technologies, such as hand tools, measuring instruments, calculators, and computers as an integral component of scientific investigations.
- using common mathematical functions to analyze and describe data.
- uses statistical and graphing data analysis techniques.
- recognizes that the accuracy and precision of the data, and therefore the quality of the investigation, depends on the instruments used.
- using equipment properly and safely.
- actively engages in conducting an inquiry, formulating and revising his or her scientific explanations and models (physical, conceptual, or mathematical) using logic and evidence, and recognizing that potential alternative explanations and models should be considered.
- actively engages in communicating and defending the design, results, and conclusion of his/her investigation.
- engages in discussions that result in the revision of his/her explanation.
- analyzes their explanation by reviewing current scientific understanding, weighing the evidence, and examining the logic so as to decide which explanations and models have the greatest explanatory power.
- evaluates personal preconceptions and biases with respect to his/her conclusions.
- based on their results, students consider modifications to their investigations.
- writes procedures, expresses concepts, reviews information, summarizes data, and uses language appropriately.
- develops diagrams and charts to summarize and analyze data.
- presents information clearly and logically, both orally and in writing.
- constructs reasoned arguments.
- responds appropriately to critical comments.

Topic: Scientific Inquiry (Scientific Method) — **Duration:** 5 Day(s)

Topic Overview

Student will learn and be able to demonstrate using the steps involved in scientific inquiry (method).
These steps are:
1) Posing a question
2) Develop a hypothesis
3) Design an experiment
4) Collect and interpret data
5) Reach a conclusion
6) Communicate your results

They will also be able to distinguish between a scientific theory and a scientific law.

Lab: Lab stressing the use of scientific method - The sprouting of potato plants

Learning Targets

Steps of the Scientific Method

Students will be able to describe the steps and then use the steps in the laboratory.

Scientific Method

SC.2007.8-12.7.2 The student will develop an understanding of the nature of scientific knowledge.
- understands scientific knowledge describes and explains the physical world in terms of matter, energy, and forces. Scientific knowledge is provisional and is subject to change as new evidence becomes available.
- understands scientific knowledge begins with empirical observations, which are the data (also called facts or evidence) upon which further scientific knowledge is built.
- Additional evidence can lead to further confirmation, revision and refinement, or rejection of previously accepted explanations.
- The core theories of science have a high degree of reliability within the limits to which they have been tested and their scope of applicability.
- The open-endedness of science is its greatest strength and allows for constant refining and improvement of our explanations.
- The breadth and depth of sensory observations are enhanced by technological instruments such as microscopes, telescopes, and oscilloscopes.
- Observations often include measurements, to varying degrees of accuracy and precision, so they can be described and analyzed with mathematics.
- Observational data is gathered in a number of ways, including controlled experiments, field studies, and the systematic observation of natural phenomena.
- understands scientific knowledge consists of hypotheses, inferences, laws, and theories.
- understands a testable hypothesis or inference must be subject to confirmation by empirical evidence
- A hypothesis is a testable statement that is subject to further investigation and potential confirmation
- An inference is a testable conclusion, based on previously established knowledge, observed evidence, and logic.
- A law is a thoroughly tested descriptive generalization of a highly regular phenomenon, usually expressed in mathematical form.
- A theory is a broad explanation that integrates a wide range of observations and tested hypotheses, inferences, and laws (when applicable) into a meaningful and coherent whole.
- Well established and widely accepted explanations have explanatory and predictive power and are fruitful as guides for further research.
- A valid hypothesis or inference must be potentially falsifiable.
- A hypothesis or inference is tested by making logical predictions about what observational data one would expect to exist, given the hypothesis, and then comparing actual observed data to the predicted data, which will either support or not support the hypothesis.

Topic: Why Study Science? — **Duration:** 4 Day(s)

Topic Overview

Students will understand the benefits of being able to use and understand science.

Learning Targets

The student will be able to recognize many of the benefits of using science in the everyday world.

Students will explore topics such as:
1) How things work
2) Staying healthy
3) Use of Earth's resouces
4) Scientific literacy

Why Study Science?

SC.2007.8-12.7.1 The student will develop an understanding that science is a human endeavor that uses models to describe and explain the physical universe.
- demonstrates an understanding of science as both vocation and avocation.
- explains how science uses peer review, replication of methods, and norms of honesty.
- recognizes the universality of basic science concepts and the influence of personal and cultural beliefs that embed science in society.
- recognizes that society helps create the ways of thinking (mindsets) required for scientific advances, both toward training scientists and educating a populace to utilize benefits of science (e.g., standards of hygiene, attitudes toward forces of nature, etc.).
- understands there are many issues which involve morals, ethics, values or spiritual beliefs that go beyond what science can explain, but for which solid scientific literacy is useful.
- recognizes society’s role in supporting topics of research and determining institutions where research is conducted.
- Scientific knowledge is made public through presentations at professional meetings and publications in scientific journals.
- Common examples involve bioethics, environmental issues, and military applications.

Topic: Careers in Science — **Duration:** 4 Day(s)

Topic Overview

The main branches of scientific investigation will be covered as well as careers that depend on those areas of study.

Learning Targets

The student will know the three main branches of science and various careers within each field.

We will cover:
1) Earth/Space Science
2) Physical Science
3) Life Science

and example careers that utilize those fields of study.

Careers in Science

SC.2007.8-12.7.1 The student will develop an understanding that science is a human endeavor that uses models to describe and explain the physical universe.
- demonstrates an understanding of science as both vocation and avocation.
- explains how science uses peer review, replication of methods, and norms of honesty.
- recognizes the universality of basic science concepts and the influence of personal and cultural beliefs that embed science in society.
- recognizes that society helps create the ways of thinking (mindsets) required for scientific advances, both toward training scientists and educating a populace to utilize benefits of science (e.g., standards of hygiene, attitudes toward forces of nature, etc.).
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- Scientific knowledge is made public through presentations at professional meetings and publications in scientific journals.
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Unit: The Work of Scientists

Duration: 3 Week(s)

Unit Overview

The use of measurements, data collection, and data analysis in science.

Materials and Resources

Their textbook: The Nature of Science and Technology - Chapter 2 - The Work of Scientists - pages 42 through 85

Academic Vocabulary

metric system
SI
mass
weight
volume
meniscus
density
kilo
hecto
deka
deci
centi
milli
gram
Liter
meter
estimate
accuracy
precision
significant figures
percent error
mean
median
mode
range
graph
horizontal axis
vertical axis
origin
coordinate
data point
line of best fit
linear graph
slope
nonlinear graph

Summative Assessment

2.1 Quiz
2.2 Quiz
2.3 Quiz
Chapter Two Examination

Topic: Measurements **Duration:** 1 Week(s)

Topic Overview

We will cover how and why the metric system developed, the use of the SI (metric) system in getting measurements, and how to convert units as needed in problems. The ability to convert within the metric (SI) system will be stressed - not the ability to convert from the English system of measurements to the metric system. The students will also learn how to take measurements using standard scientific tools.

Lab: Use of electronic scales and pan balances, correct technique for getting readings

Learning Targets

How to take meaurements using the SI (metric) system.

The students will learn the common units of measurements in the metric system and how to make conversions as needed. This will include the use of labs designed to have the students collect data.

Measurements

SC.2007.8-12.1.1 The student will demonstrate the abilities necessary to do scientific inquiry.
- actively engages in asking and evaluating research questions.
- actively engages in investigations, including developing questions, gathering and analyzing data, and designing and conducting research
- actively engages in using technological tools and mathematics in their own scientific investigations.
- Well-formed research questions drive scientific inquiry.
- The scientific investigations includes, when appropriate,
- formulating a testable hypothesis.
- identify and test variables (independent, dependent, and variables to be kept constant).
- using methods for gathering data that is observable, measurable, and replicable.
- analyzing and evaluating the results in order to clarify the questions and hypotheses, and to refine methods for further research.
- using a variety of technologies, such as hand tools, measuring instruments, calculators, and computers as an integral component of scientific investigations.
- using common mathematical functions to analyze and describe data.
- uses statistical and graphing data analysis techniques.
- recognizes that the accuracy and precision of the data, and therefore the quality of the investigation, depends on the instruments used.
- using equipment properly and safely.
- actively engages in conducting an inquiry, formulating and revising his or her scientific explanations and models (physical, conceptual, or mathematical) using logic and evidence, and recognizing that potential alternative explanations and models should be considered.
- actively engages in communicating and defending the design, results, and conclusion of his/her investigation.
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- analyzes their explanation by reviewing current scientific understanding, weighing the evidence, and examining the logic so as to decide which explanations and models have the greatest explanatory power.
- evaluates personal preconceptions and biases with respect to his/her conclusions.
- based on their results, students consider modifications to their investigations.
- writes procedures, expresses concepts, reviews information, summarizes data, and uses language appropriately.
- develops diagrams and charts to summarize and analyze data.
- presents information clearly and logically, both orally and in writing.
- constructs reasoned arguments.
- responds appropriately to critical comments.

Topic: Mathematics in Science **Duration:** 1 Week(s)

Topic Overview

We will cover some of the basic mathematical tools that are used by most scientists in their work. In addition to covering significant figures they will also cover the use of scientific notation (exponential notation) in order to express very large or very small numbers. Calculations of measures of central tendancy will also be addressed.

Lab: Finding the hardness of the local tap water; how to calculate water hardness

Lab: Finding and calculating the density of both wood and clay

Learning Targets

The students will be able to keep track of accuracy and precision in calculations by the use of significant figures and percent error calculations.

The students will understand the need for estimation, the differences between accuracy and precision, and keep track of significant figures when doing calculations involving measurements. They will also be able to use basic statistical calculations including mean, median, and mode.

Mathematics in Science

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- presents information clearly and logically, both orally and in writing.
- constructs reasoned arguments.
- responds appropriately to critical comments.

Topic: Use of Graphs

Duration: 1 Week(s)

Topic Overview

The students will learn how to organize data and to select an approriate graph to display the results.

Learning Targets

The students will be able to construct an appropriate graph when given data and also be able to interpret a graph as required.

We will cover the construction of graphs (line, bar, "pie", and scatter) and how to determine which is most appropriate for a given set of data. We will also cover how to make a "line of best-fit" for a graph. In addition students will be able to interpret information from a graph.

Graphs in Science

SC.2007.8-12.1.1 The student will demonstrate the abilities necessary to do scientific inquiry.
- actively engages in asking and evaluating research questions.
- actively engages in investigations, including developing questions, gathering and analyzing data, and designing and conducting research
- actively engages in using technological tools and mathematics in their own scientific investigations.
- Well-formed research questions drive scientific inquiry.
- The scientific investigations includes, when appropriate,
- formulating a testable hypothesis.
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- develops diagrams and charts to summarize and analyze data.
- presents information clearly and logically, both orally and in writing.
- constructs reasoned arguments.
- responds appropriately to critical comments.

Unit: Technology and Engineering

Duration: 3 Week(s)

Unit Overview

How technology and engineering are related

Materials and Resources

The Nature of Science and Technology, Chapter 3 (Technology and Engineering) - pages 86 through 121

Academic Vocabulary

technology
obsolete
system
goal
input
process
output
feedback
engineer
brainstorming
constraint
trade-off
prototype
troubleshooting
patent
risk-benefit analysis

Summative Assessment

3.1 Quiz
3.2 Quiz
3.3 Quiz
Chapter 3 Examination

Topic: Understanding Technology

Duration: 4 Day(s)

Topic Overview

The students will learn the goal of technology and how it relates to science. This will include comparing different general types of technology including:
a) obsolete
b) current
c) emerging
d) and coexisting

Learning Targets

Understanding Technology

SC.2007.8-12.5.1 The student will develop an understanding that technology is applied science.
- understands technology is the application of scientific knowledge for functional purposes.
- understands creativity, imagination, and a broad scientific knowledge base are required to produce useful results.
- understands science advances new technologies. New technologies open new areas for scientific inquiry.
- Technology is driven by the need to meet human needs and solve human problems.
- Engineering is the practical application of science to commerce or industry.
- Medicine is a practical application of science to human health.
- All technological advances contain a potential for both gains and risks for society.
- Technological knowledge may be kept confidential because of the commercial or military potential of the idea or invention.
- Invention which produces a new device, method or process is developed from study and experimentation often utilizing technology.

Topic: Technology Design — Duration: 1 Week(s)

Topic Overview

The students will learn about the steps of technological design and apply it to a project. These include the following steps:
a) identifying a need
b) researching the problem
c) designing a solution
d) building a prototype
e) troubleshooting
f) redesigning
g) communication
h) patents

Lab: Designing a container to protect a raw egg from a 15 foot drop.

Learning Targets

Technology Design

SC.2007.8-12.5.1 The student will develop an understanding that technology is applied science.
- understands technology is the application of scientific knowledge for functional purposes.
- understands creativity, imagination, and a broad scientific knowledge base are required to produce useful results.
- understands science advances new technologies. New technologies open new areas for scientific inquiry.
- Technology is driven by the need to meet human needs and solve human problems.
- Engineering is the practical application of science to commerce or industry.
- Medicine is a practical application of science to human health.
- All technological advances contain a potential for both gains and risks for society.
- Technological knowledge may be kept confidential because of the commercial or military potential of the idea or invention.
- Invention which produces a new device, method or process is developed from study and experimentation often utilizing technology.

Topic: Technology and Society — Duration: 1 Week(s)

Topic Overview

How science, technology, and engineering affect society. The students will be able to analyse both the risks and the benefits of a technology. They will also look at how technology has affected society in the past.

Group Activity: construction of Technology Timeline Poster outlining the development of a particular technology through history.

Learning Targets

Technology and Society

SC.2007.8-12.6.5 The student will develop an understanding of the relationship between science, technology, and society.
- understands progress in science and technology can be affected by social issues and challenges. Science and technology indicate what can happen, not what should happen.
- Increased use of antibiotics may also increase human resistance to antibiotics.

Technology and Societal Changes

SC.2007.8-12.5.1 The student will develop an understanding that technology is applied science.
- understands technology is the application of scientific knowledge for functional purposes.
- understands creativity, imagination, and a broad scientific knowledge base are required to produce useful results.
- understands science advances new technologies. New technologies open new areas for scientific inquiry.
- Technology is driven by the need to meet human needs and solve human problems.
- Engineering is the practical application of science to commerce or industry.
- Medicine is a practical application of science to human health.
- All technological advances contain a potential for both gains and risks for society.
- Technological knowledge may be kept confidential because of the commercial or military potential of the idea or invention.
- Invention which produces a new device, method or process is developed from study and experimentation often utilizing technology.

SC.2007.8-12.6.4 The student will understand the effect of natural and human-influenced hazards.
- understands natural processes of earth may be hazardous for humans.
- understands there is a need to assess potential risk and danger from natural and human-induced hazards.
- Humans live at the interface between two dynamically changing systems, the atmosphere and earth's crust. Human beings need to make informed choices about potential disruption by natural processes (such as volcanic activity, earthquake zones, severe weather, flood plains, …)
- Human-initiated changes in the environment bring benefits as well as risks to society. Various changes have costs and benefits. For example, vaccinations are a benefit for our society but can have risks for individuals.

Unit: Introduction to Matter

Duration: 3 Week(s)

Unit Overview

Students will describe matter, measure matter, discover changes in matter, and explore energy and matter.

Materials and Resources

Textbook: Chemical Building Blocks - Chapter One (pages 5 through 35)

Academic Vocabulary

matter
chemistry
substance
physical property
chemical property
element
atom
chemical bond
molecule
compound
chemical formula
mixture
heterogeneous mixture
homogeneous mixture
solution
weight
mass
International System of Units
volume
density
physical change
chemical change
law of conservation of mass
energy
temperature
thermal energy
endothermic energy
exothermic energy
kinetic energy
potential energy
chemical energy
electromagenetic energy
electrical energy
electrode

Summative Assessment

1.1 Quiz
1.2 Quiz
1.3/1.4 Quiz
Chapter One Examination

Topic: Describing Matter **Duration:** 1 Week(s)

Topic Overview

Students will explore and understand:
-the properties are used to describe matter
-what elements are, and how they relate to compounds
-what the properties of a mixture are

Lab: Analyzing the composition of a mixture of three substances (sand, ammonium chloride, and sodium chloride)

Learning Targets

Properties Used to Describe Matter

Students will develop an understanding of the physical and chemical properties of matter.

Elements

Students will develop an understanding of elements (pure substances that cannot be broken down) and particles of elements (atoms).

Mixtures

Students will develop an understanding of mixtures - including the differences between heterogeneous mixtures and homogeneous mixtures.

Describing Matter

SC.2007.8-12.2A.2 The students will understand the states and properties of matter.
- understands chemists use kinetic and potential energy to explain the physical and chemical properties of matter on earth that may exist in any of these three states: solids, liquids, and gases.
- understands the periodic table lists elements according to increasing atomic number. This table organizes physical and chemical trends by groups, periods, and sub-categories.
- Elements and molecules may exist as gases, liquids or solids. Ionic compounds most commonly exist as solids.
- Intermolecular attraction (attraction between molecules) determines the state of the molecule. Examples of intermolecular attraction include hydrogen bonding, permanent dipole interaction, and induced dipole interaction. Gases have the weakest and solids have the greatest intermolecular attraction. The hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules.
- Elements in the same group have the same number of valence electrons and can be used to predict similar physical and chemical properties. Elements are grouped by similar ground state valence electron configurations.
- As periods increase, the principle energy levels of the outermost (valence) electrons increase Electrons changing from one energy level to another may result in the emission or absorption of various forms of electromagnetic radiation, including the range of colors that form visible light. When there is color, there are electrons changing energy levels.
- Sub-categories are regions such as metals, non-metals, and transition elements Nonmetals have different physical and chemical properties than metals. For example, nonmetals have lower melting points, lower density, and are poorer conductors of electricity and heat. Chemical properties depend on the subshell of the valence electrons which are different for metals and non-metals.
- understands chemical bonds result when valence electrons are transferred or shared between atoms. Breaking a chemical bond requires energy. Formation of a chemical bond releases energy. Ionic compounds result from atoms transferring electrons. Molecular compounds result from atoms sharing electrons.
- Valence electron configurations determine whether an atom gains, loses, or shares electrons to achieve a more stable electron configuration similar to the noble gases.
- Positively charged ions are called cations, and negatively charged ions are called anions. Cations are attracted to anions (opposite charges attract). Most cations are metals; most anions are nonmetals. In stable ionic compounds, the sum of the charges is zero.
- Covalent bonds form when two or more atoms share one or more pairs of electrons to achieve a more stable electron configuration. The two classifications of covalent bonds are nonpolar and polar. The greater the electronegativity difference between atoms involved in the bond, the more polar the bond.
- The energy required to break ionic bonds is greater than the energy required to break covalent bonds. Heat exchange during a chemical reaction is often easily noticed: a reaction that absorbs heat will feel colder; a reaction that releases heat will feel warmer.
- Carbon atoms can bond to each other in chains, rings, and branching networks to form a variety of molecular structures including relatively large molecules essential to life. Diamonds, a 3-dimensional branching of carbon atoms and quartz, a repeated 3-dimensional branching of silicon dioxide molecules, are further examples of network solids. Unique properties of network solids include hardness, high melting points, poor conductors - indicative of covalent bonding and stable geometry.
- Metallic bonding is defined as free roaming electrons forming a negative sea of electrons surrounding the positive metal ions.

Topic: Measuring Matter **Duration:** 2 Day(s)

Topic Overview

Students will explore and understand:
-the difference between weight and mass
-what the units are that are used to express the amount of space occupied by matter
-how the density of a material determined

Learning Targets

Weight and Mass

Students will develop an understanding of the differences between weight and mass. Additionally, they will explore units of mass, volume, and density.

Difference between Mass and Weight

SC.2007.8-12.2B.3 The student will understand the nature of the fundamental interactions of matter and energy.
- There are four fundamental forces in nature: strong nuclear force, weak nuclear force, electromagnetic force, and gravitational force.
- understands waves have energy and can transfer energy when they interact with matter.
- The student understand interference – how waves interact with other waves
- The student will understand the principles of reflection and refraction.
- understands electromagnetic waves result when a charged particle is accelerated or decelerated.
- The student understands basic electrostatics and circuits.
- The strong nuclear force keeps particles together in atomic nuclei.
- The weak nuclear force plays a role in the radioactive disintegration of certain nuclei.
- The strong and weak nuclear forces act on quarks and leptons, subatomic particles.
- The electromagnetic force is the force that charged particles exert on one another. The electric force between any two charged particles is given by Coulomb's law, which state that the force is inversely proportional to the square of the distance between the charges. The magnetic force occurs between any two charged particles moving relative to each other.
- The gravitational force is the attractive force that objects exert on one another due to their mass. The gravitational force between any two masses is given by Newton's law of universal gravitation, which states that the force is inversely proportional to the square of the distance between the masses. This explains the motion of planets. Near the surface of the Earth, the acceleration of an object due to gravity is independent of the mass of the object and therefore constant.
- Waves are traveling disturbances which transport energy without the bulk motion of matter. In transverse waves, the disturbance is perpendicular to the direction of travel. In longitudinal waves, the disturbance is parallel to the direction of travel.
- There are many different types of waves. Examples are water waves, sound waves, and electromagnetic waves. Visible light, radio waves, and X-rays are all examples of electromagnetic waves. Periodic waves can also be described in terms of their wavelength, frequency, period, and amplitude.
- All waves can be described in terms of their velocities. The velocity of most types of waves depends on the medium in which they are traveling. There is a relationship between the speed, wavelength, and frequency of a periodic wave. The frequency of sound waves is related to the pitch we perceive. Difference wavelengths of visible light correspond to different colors.
- Most common types of waves obey the principle of linear superposition. When two waves meet, they superimpose. At points where the crests (or troughs) of two waves meet there is constructive interference. At points where the crest of one wave meets the through of another, there is destructive interference. Beats are heard when two sound waves with slightly different frequencies interfere. Two waves traveling in opposite directions can combine to produce a standing wave.
- Diffraction is the bending of a wave around an obstacle or an edge. When this happens, different intensities of the wave are observed downstream due to the wave interfering with itself.
- When light reflects from a surface, the angle of incidence is equal to the angle of reflection. When light propagates from one transparent medium to another, it bends (refracts) at the interface in a manner given by Snell's law. One can trace rays to predict the properties of images produced by mirrors. One can trace rays to predict the properties of images produced by lenses.
- Electromagnetic waves include radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays. The energy of electromagnetic waves is carried in packets and has a magnitude that is inversely proportional to the wavelength.**
- Some particles, such as protons and electrons, have a physical property known as charge. There are two types of charge, known as positive and negative.
- Charged particles experience a force given by Coulomb's law. Coulomb's law indicates that the electric force between two charges is attractive if the charges have opposite sign, and repulsive if they have the same sign. The force between charges is inversely proportional to the square of the distance between them.
- The magnitude of the magnetic force on a particle in a magnetic field is proportional to the particle's

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Topic: Changes in Matter **Duration:** 3 Day(s)

Topic Overview

Students will explore and understand:
-physical change
-chemical change
-how changes in matter are related to changes in energy

Lab: Investigating the combustion of wax

Lab: Reaction of Iron with a Copper Sulfate solution (single relacement reaction) to demonstrate a chemical change.

Learning Targets

Physical Changes

Students will develop an understanding of physical changes of matter, and how to recognize physical change.

Chemical Changes

Students will develop an understanding of chemical changes in matter (including combustion, electrolysis, oxidation, and tarnishing) and how to recognize them.

Matter and Thermal Energy

Students will develop an understanding of the relationship between changes in matter and changes in energy. Additionally, they will look at temperature, thermal energy, and endothermic and exothermic change.

Changes in Matter

SC.2007.8-12.2A.2 The students will understand the states and properties of matter.
- understands chemists use kinetic and potential energy to explain the physical and chemical properties of matter on earth that may exist in any of these three states: solids, liquids, and gases.
- understands the periodic table lists elements according to increasing atomic number. This table organizes physical and chemical trends by groups, periods, and sub-categories.
- Elements and molecules may exist as gases, liquids or solids. Ionic compounds most commonly exist as solids.
- Intermolecular attraction (attraction between molecules) determines the state of the molecule. Examples of intermolecular attraction include hydrogen bonding, permanent dipole interaction, and induced dipole interaction. Gases have the weakest and solids have the greatest intermolecular attraction. The hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules.
- Elements in the same group have the same number of valence electrons and can be used to predict similar physical and chemical properties. Elements are grouped by similar ground state valence electron configurations.
- As periods increase, the principle energy levels of the outermost (valence) electrons increase Electrons changing from one energy level to another may result in the emission or absorption of various forms of electromagnetic radiation, including the range of colors that form visible light. When there is color, there are electrons changing energy levels.
- Sub-categories are regions such as metals, non-metals, and transition elements Nonmetals have different physical and chemical properties than metals. For example, nonmetals have lower melting points, lower density, and are poorer conductors of electricity and heat. Chemical properties depend on the subshell of the valence electrons which are different for metals and non-metals.
- understands chemical bonds result when valence electrons are transferred or shared between atoms. Breaking a chemical bond requires energy. Formation of a chemical bond releases energy. Ionic compounds result from atoms transferring electrons. Molecular compounds result from atoms sharing electrons.
- Valence electron configurations determine whether an atom gains, loses, or shares electrons to achieve a more stable electron configuration similar to the noble gases.
- Positively charged ions are called cations, and negatively charged ions are called anions. Cations are attracted to anions (opposite charges attract). Most cations are metals; most anions are nonmetals. In stable ionic compounds, the sum of the charges is zero.
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- The energy required to break ionic bonds is greater than the energy required to break covalent bonds. Heat exchange during a chemical reaction is often easily noticed: a reaction that absorbs heat will feel colder; a reaction that releases heat will feel warmer.
- Carbon atoms can bond to each other in chains, rings, and branching networks to form a variety of molecular structures including relatively large molecules essential to life. Diamonds, a 3-dimensional branching of carbon atoms and quartz, a repeated 3-dimensional branching of silicon dioxide molecules, are further examples of network solids. Unique properties of network solids include hardness, high melting points, poor conductors - indicative of covalent bonding and stable geometry.
- Metallic bonding is defined as free roaming electrons forming a negative sea of electrons surrounding the positive metal ions.

Topic: Energy and Matter **Duration:** 1 Week(s)

Topic Overview

Students will explore and understand:
-forms of energy that are related to changes in matter
-chemical energy related to chemical change

Lab: Determining the number of calories in a marshmallow and comparing that to the advertized amount

Learning Targets

Forms of Energy

Students will develop an understanding of kinetic, potential, chemical, electromagnetic, and electrical energy and how they effect changes in matter.

Energy and Matter

SC.2007.8-12.2A.3 The student will gain a basic concept of chemical reactions.
- understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.
- understands how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e., through stoichiometric relationships.
- understands the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.
- Chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved.
- Examples of chemical reactions are synthesis, decomposition, combustion, single and double replacement, acid/base, and oxidation/reduction.
- Two or more of the following may often identify chemical reactions: physical property change, effervescence, mass change, precipitation, light emission, and heat exchange.
- The rate (speed) of a chemical reaction depends on such parameters as temperature, concentration, catalysts, inhibitors, surface area, and reaction type.
- Reaction stoichiometry involves understanding the use of coefficients (moles) to balance equations and solve for a variety of relationships using the molar mass of the substances. Examples of these types of relationships include mole/mole, mole/mass, mole/volume, mass/volume, mass/mass, etc.
- Acids react with bases to produce water and salt.
- pH is a logarithmic function of hydronium ion concentration. pH decreases as the hydronium ion concentration increases. pOH and hydroxide concentrations are found in a similar way.
- Determination of an unknown base may be determined by experimental titration and use of Ma X Va = Mb X Vb.
- Dilution formulas (M1 X V1 = M2 X V2) can be used to determine the concentration of a solution after diluting it with water.

Unit: Solids, Liquids, and Gases

Duration: 3 Week(s)

Unit Overview

Students will explore the states of matter, changes in states of matter, and gas behavior.

Materials and Resources

Textbook: Chemical Building Blocks - Chapter Two (pages 40 through 62)

Academic Vocabulary

solid
crystalline solid
amorphous solid
liquid
fluid
surface tension
viscosity
gas
melting
freezing
melting point
vaporization
evaporation
boiling
boiling point
condensation
sublimation
pressure
Boyle's law
Charles's law

Summative Assessment

2.1 Quiz
2.2 Quiz
2.3/2.4 Quiz
Chapter Two Examination

Topic: States of Matter

Duration: 1 Week(s)

Topic Overview

Students will explore and understand:
-the characteristics of a solid
-the characteristics of a liquid
-the characteristics of a gas

Learning Targets

Solids

Students will develop an understanding of the properties of a solid state of matter. They will understand the particles in a solid, and explore different types of solids.

Liquids

Students will develop an understanding of the properties of a liquid state of matter. They will understand the particles in a liquid, and explore different properties of liquids.

Gases

Students will develop an understanding of the properties of a gas state of matter. They will understand the particles in a gas, and explore different properties of gases.

Phases of Matter

SC.2007.8-12.2A.2 The students will understand the states and properties of matter.
- understands chemists use kinetic and potential energy to explain the physical and chemical properties of matter on earth that may exist in any of these three states: solids, liquids, and gases.
- understands the periodic table lists elements according to increasing atomic number. This table organizes physical and chemical trends by groups, periods, and sub-categories.
- Elements and molecules may exist as gases, liquids or solids. Ionic compounds most commonly exist as solids.
- Intermolecular attraction (attraction between molecules) determines the state of the molecule. Examples of intermolecular attraction include hydrogen bonding, permanent dipole interaction, and induced dipole interaction. Gases have the weakest and solids have the greatest intermolecular attraction. The hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules.
- Elements in the same group have the same number of valence electrons and can be used to predict similar physical and chemical properties. Elements are grouped by similar ground state valence electron configurations.
- As periods increase, the principle energy levels of the outermost (valence) electrons increase Electrons changing from one energy level to another may result in the emission or absorption of various forms of electromagnetic radiation, including the range of colors that form visible light. When there is color, there are electrons changing energy levels.
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- Carbon atoms can bond to each other in chains, rings, and branching networks to form a variety of molecular structures including relatively large molecules essential to life. Diamonds, a 3-dimensional branching of carbon atoms and quartz, a repeated 3-dimensional branching of silicon dioxide molecules, are further examples of network solids. Unique properties of network solids include hardness, high melting points, poor conductors - indicative of covalent bonding and stable geometry.
- Metallic bonding is defined as free roaming electrons forming a negative sea of electrons surrounding the positive metal ions.

Topic: Changes of State **Duration:** 1 Week(s)

Topic Overview

Students will explore and understand:
-what happens to a substance during changes between solid and liquid
-what happens to a substance during changes between liquid and gas
-what happens to a substance during changes between solid and gas

Lab: Melting/Freezing Point determination of Napthalene

Lab: Melting/Freezing Point determination of para-dichlorbenzene

Lab: Fusion of ice lab (determining the heat of fusion)

Learning Targets

Changes Between Solid and Liquid

Students will develop an understanding of the changes that occur when a solid turns into a liquid. More specifically, they will explore the changes during melting and freezing.

Changes Between Liquid and Gas

Students will develop an understanding of the changes that occur when a liquid turns into a gas. More specifically, they will explore the changes during vaporization and evaporation.

Changes Between Solid and Gas

Students will develop an understanding of the changes that occur when a solid turns into a gas. More specifically, they will explore the changes during sublimination.

Topic: Gas Behavior **Duration:** 1 Week(s)

Topic Overview

Students will explore and understand:
-the types of measurements that are useful when working with gases
-how the volume, temperature, and pressure of a gas are related

Lab: Boyle's Law Lab, determing the effect of pressure on the volume of a gas

Lab: Virtual Charles's Law Lab, computer simulation

Lab: Balloon Lab, construction of hot air balloon and testing the lift

Learning Targets

Measuring Gases

Students will develop an understanding of measuring gases through volume, temperature, and pressure.

Pressure and Volume

Students will develop an understanding of how pressure and volume interact. More specifically, students will explore Boyle's Law.

Pressure and Temperature

Students will develop an understanding of how pressure and temperature interact.

Volume and Temperature

Students will develop an understanding of how volume and temperature interact. More specifically, students will explore Charles's Law.

Behavior of Gases

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Unit: Elements and the Periodic Table

Duration: 4 Week(s)

Science (8)

Science

Grade(s) 8th, Duration 1 Year, 1 Credit
Required Course

Unit Overview

Students will explore and understand atoms, and the organization of the elements in the periodic table including metals,nonmetals, and metalloids.

Materials and Resources

Textbook: Chemical Building Blocks - Chapter Three (pages 72 through 108)

Academic Vocabulary

nucleus
proton
neutron
electron
atomic number
isotope
mass number
model
atomic mass
periodic table
chemical symbol
period
group
metal
malleable
ductile
conductivity
reactivity
corrosion
alkali metal
alkaline earth metal
transition metal
alloy
particle accelerator
nonmetal
diatomic molecule
halogen
noble gas
metalloid
semiconductor

Summative Assessment

3.1 Quiz
3.2 Quiz
3.3/3.4 Quiz
Chapter Three Examination

Topic: Introduction to Atoms **Duration:** 1 Week(s)

Topic Overview

Students will explore and understand:
-the structure of an atom and how it's subparticles function.
-how the elements are described in terms of their atoms
-various different models of the atom and why models are useful for understanding atoms

Learning Targets

Structure of an Atom

Students will develop an understanding of the structure of an atom, including an atom's specific particles (protons, neutrons, and electrons).

Atoms and Elements

Students will develop an understanding of the relationship between atoms and elements. More specifically, students will explore atomic numbers and isotopes.

Atomic Structure

SC.2007.8-12.2A.1 The student will understand the structure of the atom.
- understands atoms, the fundamental organizational unit of matter, are composed of subatomic particles. Chemists are primarily interested in the protons, electrons, and neutrons found in the atom.
- understands isotopes are atoms with the same atomic number (same number of protons) but different numbers of neutrons. The nuclei of some atoms are radioactive isotopes that spontaneously decay, releasing radioactive energy.
- All atoms are identified by the number of protons in the nucleus, i.e. the atomic number. The protons have a positive charge and a mass of 1 amu. Protons and neutrons are found in the small, dense, nucleus.
- Neutrons have a neutral charge and a mass of 1 amu.
- The electrons have a negative charge and are found outside the nucleus in an electron cloud. The mass of an electron is approximately 2,000 times smaller than a proton. The electrons determine the size and chemical properties of the atom.
- The number of electrons is equal to the number of protons in a neutral atom. Ions have a different number of electrons than protons.
- The periodic table reflects the average mass of the isotopes.
- Examples of released radioactivity are alpha, beta, and gamma radiation.
- Some isotopes spontaneously decay at a first order rate. There is a negative linear relationship between the log of the sample isotope concentration vs. time,
- To balance a nuclear equation, the sum of the atomic numbers and the sum of the mass numbers must be equal on both sides of the equation.

Topic: Organizing the Elements — Duration: 1 Week(s)

Topic Overview

Students will explore and understand:
-how Mendeleev discovered the pattern that led to the periodic table
-what data about elements are found in the periodic table
-how the organization of the periodic table is useful for predicting the properties of elements

Element Bingo activity, help students learn the symbols of the elements

Element "Beach Ball" Activity; reinforces the names and symbols of the elements of the periodic table

Learning Targets

Patterns in the Elements

Students will develop an understanding of patterns among the elements. They will explore Mendaleev's work and how elements are organized according to increasing atomic mass.

Finding Data on Elements

Students will develop an understanding of the information on a periodic table; including atomic numbers, chemical symbols and names, and average atomic mass.

The Organization of the Periodic Table

Students will develop an understanding of the organization of the periodic table - including information about the rows and groups of elements.

The Periodic Table

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- Intermolecular attraction (attraction between molecules) determines the state of the molecule. Examples of intermolecular attraction include hydrogen bonding, permanent dipole interaction, and induced dipole interaction. Gases have the weakest and solids have the greatest intermolecular attraction. The hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules.
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- The energy required to break ionic bonds is greater than the energy required to break covalent bonds. Heat exchange during a chemical reaction is often easily noticed: a reaction that absorbs heat will feel colder; a reaction that releases heat will feel warmer.
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- Metallic bonding is defined as free roaming electrons forming a negative sea of electrons surrounding the positive metal ions.

Topic: Metals **Duration:** 2 Day(s)

Topic Overview

Students will explore and understand:
-what the physical properties of metals are
-how the reactivity of metals changes across the periodic table
-how the elements that follow uranium are produced

Learning Targets

Properties of Metals

Students will develop an understanding of the physical and chemical properties of metals. Additionally they will look at the conductivity of metals and the destruction of metals (through corrosion).

Metals in the Periodic Table

Students will develop an understanding of alkali metals and alkaline earth metals.

Properties of Metals

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Topic: Nonmetals and Metalloids **Duration:** 1 Week(s)

Topic Overview

Students will explore and understand:
-the properties of nonmetals
-how metalloids are useful

Lab: Properties of Sulfur Lab (allotrophic forms)

Lab: Production of Hydrogen gas and testing its properties

Lab: Production of Oxygen gas and testing its properties

Learning Targets

Properties of Nonmetals
Students will develop an understanding of the physical and chemical properties of nonmetals.

Families of Nonmetals
Students will develop an understanding of the properties of the Carbon family, the Nitrogen family, the Oxygen family, and the Halogen family of nonmetals.

Metalloids
Students will develop an understanding of the properties of metalloids.

properties of Non-metals and Metalloids

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Unit: Exploring Materials

Duration: 3 Week(s)

Unit Overview

Students will explore and understand polymers and composites, metals and alloys, ceramics and glass, and radioactive elements.

Materials and Resources

Textbook: Chemical Building Blocks - Chapter Four (pages 117 through 147)

Academic Vocabulary

polymer
monomer
plastic
composite
alloy
ceramic
glass
optical fiber
nuclear reaction
radioactive decay
radioactivity
alpha particle
beta particle
gamma radiation
half-life
radioactive dating
tracer

Summative Assessment

4.1 Quiz
4.2 Quiz
4.3/4.4 Quiz
Chapter Four Examination

Topic: Polymers and Composites	**Duration:** 1 Week(s)

Topic Overview

Students will explore and understand:
-how polymers form
-what composites are made of
-what benefits and problems relate to the use of synthetic polymers

Lab: Casein Glue Lab: production of a polymer

Learning Targets

Forming Polymers

Students will develop an understanding of how polymers form and their chemical bonds.

Polymers and Composites

Students will develop an understanding of natural polymers and synthetic polymers. Additionally, they will look at the properties of composites.

Topic: Metals and Alloys	**Duration:** 2 Day(s)

Topic Overview

Students will explore and understand:
-how the properties of metals and alloys compare
-how steels and other alloys are made and used

Learning Targets

Comparing Metals and Alloys

Students will develop an understanding of the properties of metals and alloys and how they compare.

Making and Using Alloys

Students will develop an understanding of how alloys are made and used (including through the uses of brass, bronze, stainless steel, sterling silver, and more)

Topic: Ceramics and Glass	**Duration:** 3 Day(s)

Topic Overview

Students will explore and understand:
-the properties of ceramics
-the properties of glass

Learning Targets

Ceramics

Students will develop an understanding of the properties of ceramics, how to make ceramics, and how to use ceramics.

Glass

Students will develop an understanding of the properties of glass, how to make glass, and how to use glass.

Topic: Radioactive Elements and Radiolactive Decay

Duration: 1 Week(s)

Topic Overview

Students will explore and understand:
-how radioactivity was discovered
-the types of particles and energy radioactive decay can produce
-how radioactive isotopes are useful

Learning Targets

Radioactivity

Students will develop an understanding of nuclear reactions, radioactive decay, and how radioactivity was discovered. Additionally, they will explore polonium and radium.

Types of Radioactive Decay

Students will develop an understanding of alpha decay, beta decay, and gamma radiation, as well as the effects of nuclear radiation.

Uses of Radioactive Isotopes

Students will develop an understanding of the uses of radioactive isotopes including radioactive dating, uses in science, uses in medicine, and nuclear power. Additionally, students will explore how to use radioactive materials safely.

Radioactive Elements

SC.2007.8-12.2A.1 The student will understand the structure of the atom.
- understands atoms, the fundamental organizational unit of matter, are composed of subatomic particles. Chemists are primarily interested in the protons, electrons, and neutrons found in the atom.
- understands isotopes are atoms with the same atomic number (same number of protons) but different numbers of neutrons. The nuclei of some atoms are radioactive isotopes that spontaneously decay, releasing radioactive energy.
- All atoms are identified by the number of protons in the nucleus, i.e. the atomic number. The protons have a positive charge and a mass of 1 amu. Protons and neutrons are found in the small, dense, nucleus.
- Neutrons have a neutral charge and a mass of 1 amu.
- The electrons have a negative charge and are found outside the nucleus in an electron cloud. The mass of an electron is approximately 2,000 times smaller than a proton. The electrons determine the size and chemical properties of the atom.
- The number of electrons is equal to the number of protons in a neutral atom. Ions have a different number of electrons than protons.
- The periodic table reflects the average mass of the isotopes.
- Examples of released radioactivity are alpha, beta, and gamma radiation.
- Some isotopes spontaneously decay at a first order rate. There is a negative linear relationship between the log of the sample isotope concentration vs. time,
- To balance a nuclear equation, the sum of the atomic numbers and the sum of the mass numbers must be equal on both sides of the equation.

Unit: Atoms and Bonding

Duration: 5 Week(s)

Science (8)

Science

Grade(s) 8th, Duration 1 Year, 1 Credit
Required Course

Unit Overview

In this unit we will be covering how atoms bond, both ionically, covalently, and in metallic substances. We will stress how the movement of electrons is involved and how this can be predicted by using the periodic table.

Materials and Resources

The textbook; Chemical Interactions, published by Prentice Hall, Chapter 1 (Atoms and Bonding) - pages 4 through 43

Academic Vocabulary

matter
element
compound
mixture
atom
scientific theory
model
electron
nucleus
proton
neutron
energy level
orbital
valence electrons
electron dot diagram (notation)
Lewis Dot Notation
chemical bonds
symbol
atomic number
period
series
group
family
noble gas
inert gas
halogen
alkali metal
alkaline earth metal
transition metal
mixed group metal
Lanthanides
Actinides
metalloid
ion
anion
cation
polyatomic ion
monatomic ion
ionic bond
ionic compound
chemical formula
subscript
crystal
covalent bond
molecule
double bond
triple bond
molecular compound
polar bond
nonpolar bond
metallic bond
alloy
ductile
malleable

Summative Assessment

1.1 Quiz
1.2 Quiz
1.3 Quiz
1.4 Quiz
1.5 Quiz
Chapter 1 Examination

Topic: Elements and Atoms — Duration: 1 Week(s)

Topic Overview

In this topic we will be covering basic atomic theory on the structure of the atom. A brief history of the development of the "modern" atomic model will also be covered. This will include how the different subparticles (protons, neutrons, and electrons) are related, their properties, location, and interactions.

Lab: Emmission spectrum Lab, observing the emmission spectrum of various elements when "excited" to see the wavelengths of visible light emitted that reflects the movement of electrons from one level to another.

Learning Targets

We will cover various atomic models; Dalton's, Thomson's, Rutherford's, Bohr's, and updated variations.

Structure of the Atom

SC.2007.8-12.2A.1 The student will understand the structure of the atom.
- understands atoms, the fundamental organizational unit of matter, are composed of subatomic particles. Chemists are primarily interested in the protons, electrons, and neutrons found in the atom.
- understands isotopes are atoms with the same atomic number (same number of protons) but different numbers of neutrons. The nuclei of some atoms are radioactive isotopes that spontaneously decay, releasing radioactive energy.
- All atoms are identified by the number of protons in the nucleus, i.e. the atomic number. The protons have a positive charge and a mass of 1 amu. Protons and neutrons are found in the small, dense, nucleus.
- Neutrons have a neutral charge and a mass of 1 amu.
- The electrons have a negative charge and are found outside the nucleus in an electron cloud. The mass of an electron is approximately 2,000 times smaller than a proton. The electrons determine the size and chemical properties of the atom.
- The number of electrons is equal to the number of protons in a neutral atom. Ions have a different number of electrons than protons.
- The periodic table reflects the average mass of the isotopes.
- Examples of released radioactivity are alpha, beta, and gamma radiation.
- Some isotopes spontaneously decay at a first order rate. There is a negative linear relationship between the log of the sample isotope concentration vs. time,
- To balance a nuclear equation, the sum of the atomic numbers and the sum of the mass numbers must be equal on both sides of the equation.

Topic: Atoms, Bonding, and the Periodic Table — Duration: 1 Week(s)

Topic Overview

In this topic we will be covering valence electrons and how they are in involved in bonding. We will cover how to predict the valence of an element using the periodic table.

Learning Targets

Students will be able to determine the number of valence electrons in an element's atoms and how it can be used to determine the number of bonds it can form. They will also learn how to do a Lewis Dot Notation (electron dot diagram) for an element. They will also be able to predict general reactivity of an element based on it's location on the periodic table.

see the description in the attached standard

Atoms, Bonding, and the Periodic Table

SC.2007.8-12.2A.2 The students will understand the states and properties of matter.
- understands chemists use kinetic and potential energy to explain the physical and chemical properties of matter on earth that may exist in any of these three states: solids, liquids, and gases.
- understands the periodic table lists elements according to increasing atomic number. This table organizes physical and chemical trends by groups, periods, and sub-categories.
- Elements and molecules may exist as gases, liquids or solids. Ionic compounds most commonly exist as solids.
- Intermolecular attraction (attraction between molecules) determines the state of the molecule. Examples of intermolecular attraction include hydrogen bonding, permanent dipole interaction, and induced dipole interaction. Gases have the weakest and solids have the greatest intermolecular attraction. The hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules.
- Elements in the same group have the same number of valence electrons and can be used to predict similar physical and chemical properties. Elements are grouped by similar ground state valence electron configurations.
- As periods increase, the principle energy levels of the outermost (valence) electrons increase Electrons changing from one energy level to another may result in the emission or absorption of various forms of electromagnetic radiation, including the range of colors that form visible light. When there is color, there are electrons changing energy levels.
- Sub-categories are regions such as metals, non-metals, and transition elements Nonmetals have different physical and chemical properties than metals. For example, nonmetals have lower melting points, lower density, and are poorer conductors of electricity and heat. Chemical properties depend on the subshell of the valence electrons which are different for metals and non-metals.
- understands chemical bonds result when valence electrons are transferred or shared between atoms. Breaking a chemical bond requires energy. Formation of a chemical bond releases energy. Ionic compounds result from atoms transferring electrons. Molecular compounds result from atoms sharing electrons.
- Valence electron configurations determine whether an atom gains, loses, or shares electrons to achieve a more stable electron configuration similar to the noble gases.
- Positively charged ions are called cations, and negatively charged ions are called anions. Cations are attracted to anions (opposite charges attract). Most cations are metals; most anions are nonmetals. In stable ionic compounds, the sum of the charges is zero.
- Covalent bonds form when two or more atoms share one or more pairs of electrons to achieve a more stable electron configuration. The two classifications of covalent bonds are nonpolar and polar. The greater the electronegativity difference between atoms involved in the bond, the more polar the bond.
- The energy required to break ionic bonds is greater than the energy required to break covalent bonds. Heat exchange during a chemical reaction is often easily noticed: a reaction that absorbs heat will feel colder; a reaction that releases heat will feel warmer.
- Carbon atoms can bond to each other in chains, rings, and branching networks to form a variety of molecular structures including relatively large molecules essential to life. Diamonds, a 3-dimensional branching of carbon atoms and quartz, a repeated 3-dimensional branching of silicon dioxide molecules, are further examples of network solids. Unique properties of network solids include hardness, high melting points, poor conductors - indicative of covalent bonding and stable geometry.
- Metallic bonding is defined as free roaming electrons forming a negative sea of electrons surrounding the positive metal ions.

Topic: Ionic Bonding **Duration:** 1 Week(s)

Topic Overview

The students will be able to explain how an ionic bond forms, and learn some of the common polyatomic ions. They will also learn how to write formulas for ionic compounds using ionic charges and how to name ionic compounds based on their formula.

Learning Targets

The students will be able to write the name for ionic compounds (some containing polyatomic ions) when given the formula, write the formula of an ionic compound when given the name of that compound, and be able to describe some of the general properties of ionic compounds including; crystalline structure, high melting point, and conductivity when dissolved in aqueous solutions.

see description in the attached standard

Ionic Bonding

SC.2007.8-12.2A.2 The students will understand the states and properties of matter.
- understands chemists use kinetic and potential energy to explain the physical and chemical properties of matter on earth that may exist in any of these three states: solids, liquids, and gases.
- understands the periodic table lists elements according to increasing atomic number. This table organizes physical and chemical trends by groups, periods, and sub-categories.
- Elements and molecules may exist as gases, liquids or solids. Ionic compounds most commonly exist as solids.
- Intermolecular attraction (attraction between molecules) determines the state of the molecule. Examples of intermolecular attraction include hydrogen bonding, permanent dipole interaction, and induced dipole interaction. Gases have the weakest and solids have the greatest intermolecular attraction. The hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules.
- Elements in the same group have the same number of valence electrons and can be used to predict similar physical and chemical properties. Elements are grouped by similar ground state valence electron configurations.
- As periods increase, the principle energy levels of the outermost (valence) electrons increase Electrons changing from one energy level to another may result in the emission or absorption of various forms of electromagnetic radiation, including the range of colors that form visible light. When there is color, there are electrons changing energy levels.
- Sub-categories are regions such as metals, non-metals, and transition elements Nonmetals have different physical and chemical properties than metals. For example, nonmetals have lower melting points, lower density, and are poorer conductors of electricity and heat. Chemical properties depend on the subshell of the valence electrons which are different for metals and non-metals.
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- Positively charged ions are called cations, and negatively charged ions are called anions. Cations are attracted to anions (opposite charges attract). Most cations are metals; most anions are nonmetals. In stable ionic compounds, the sum of the charges is zero.
- Covalent bonds form when two or more atoms share one or more pairs of electrons to achieve a more stable electron configuration. The two classifications of covalent bonds are nonpolar and polar. The greater the electronegativity difference between atoms involved in the bond, the more polar the bond.
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- Metallic bonding is defined as free roaming electrons forming a negative sea of electrons surrounding the positive metal ions.

Topic: Covalent Bonding **Duration:** 1 Week(s)

Topic Overview

The students will learn how some elements form covalent bonds by sharing their valence electrons. They will also be able to explain how double and triple bonds can form by using Lewis Dot Notation. They will be able to describe some of the general characteristics of molecular compounds; low melting and boiling points, and poor electrical conductivity in aqueous solutions. The effect of polar vs. nonpolar bonds on the behavior of a covalent compound will also be covered.

Learning Targets

The students will be able to contrast covalent bonding to ionic bonding, but also recognize that both involve valence electrons. We will touch on how electronegativity contributes to polarity in covalent bonds.

see description in the attached standard

Covalent Bonding

SC.2007.8-12.2A.2 The students will understand the states and properties of matter.
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- Elements in the same group have the same number of valence electrons and can be used to predict similar physical and chemical properties. Elements are grouped by similar ground state valence electron configurations.
- As periods increase, the principle energy levels of the outermost (valence) electrons increase Electrons changing from one energy level to another may result in the emission or absorption of various forms of electromagnetic radiation, including the range of colors that form visible light. When there is color, there are electrons changing energy levels.
- Sub-categories are regions such as metals, non-metals, and transition elements Nonmetals have different physical and chemical properties than metals. For example, nonmetals have lower melting points, lower density, and are poorer conductors of electricity and heat. Chemical properties depend on the subshell of the valence electrons which are different for metals and non-metals.
- understands chemical bonds result when valence electrons are transferred or shared between atoms. Breaking a chemical bond requires energy. Formation of a chemical bond releases energy. Ionic compounds result from atoms transferring electrons. Molecular compounds result from atoms sharing electrons.
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- Carbon atoms can bond to each other in chains, rings, and branching networks to form a variety of molecular structures including relatively large molecules essential to life. Diamonds, a 3-dimensional branching of carbon atoms and quartz, a repeated 3-dimensional branching of silicon dioxide molecules, are further examples of network solids. Unique properties of network solids include hardness, high melting points, poor conductors - indicative of covalent bonding and stable geometry.
- Metallic bonding is defined as free roaming electrons forming a negative sea of electrons surrounding the positive metal ions.

Topic: Bonding in Metals

Duration: 1 Week(s)

Topic Overview

In this topic we will be covering how atoms bond in metals, using the "sea of electrons" model. It will be stressed that valence electrons are still involved in the bonding. The students will also be able to explain how some of the properties of metals are due to this type of bonding.

Learning Targets

The students will be able to explain metallic bonding and how it explains many of the properties of metals (electrical conductivity, malleability, luster, ductility, and heat conductivity).

see description in the attached standard

Bonding in Metals

SC.2007.8-12.2A.2 The students will understand the states and properties of matter.
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- understands the periodic table lists elements according to increasing atomic number. This table organizes physical and chemical trends by groups, periods, and sub-categories.
- Elements and molecules may exist as gases, liquids or solids. Ionic compounds most commonly exist as solids.
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- Elements in the same group have the same number of valence electrons and can be used to predict similar physical and chemical properties. Elements are grouped by similar ground state valence electron configurations.
- As periods increase, the principle energy levels of the outermost (valence) electrons increase Electrons changing from one energy level to another may result in the emission or absorption of various forms of electromagnetic radiation, including the range of colors that form visible light. When there is color, there are electrons changing energy levels.
- Sub-categories are regions such as metals, non-metals, and transition elements Nonmetals have different physical and chemical properties than metals. For example, nonmetals have lower melting points, lower density, and are poorer conductors of electricity and heat. Chemical properties depend on the subshell of the valence electrons which are different for metals and non-metals.
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- Metallic bonding is defined as free roaming electrons forming a negative sea of electrons surrounding the positive metal ions.

Unit: Chemical Reactions **Duration:** 3 Week(s)

Science (8)

Science

Grade(s) 8th, Duration 1 Year, 1 Credit
Required Course

Unit Overview

In this unit we will be covering what happens in a chemical reaction and how to describe a reaction using an equation. We will also cover how to balance a chemical equation. Finally we will cover how to alter the rate of a chemical reaction.

Materials and Resources

Chemical Reactions, published by Prentice Hall, Chapter 2 (Chemical Change) - pages 46 through 81

Academic Vocabulary

matter
physical property
chemistry
chemical property
physical change
chemical reaction
precipitate
endothermic reaction
exothermic reaction
chemical equation
reactant
product
conservation of mass
closed system
open system
coefficient
synthesis
decomposition
single replacement
double replacement
activation energy
concentration
catalyst
enzyme
inhibitor
combustion
fuel

Summative Assessment

2.1 Quiz
2.2 Quiz
2.3 Quiz
2.4 Quiz
Chapter 2 Examination

Topic: Observing Chemical Change **Duration:** 1 Week(s)

Topic Overview

In this topic we will cover physical vs. chemical changes and how the formation and breaking of bonds is fundemental to chemical reactions. We will also cover what changes can indicate a chemical change has occured.

Learning Targets

The students will learn how to distinguish between chemical and physical changes and give examples of common types for each. They will also be able to describe how bonding is essential to the explanation for chemical change. The concept of energy change as indicated by a change in temperature (endothermic vs. exothermic) will be tied into chemical reactions.

see description in the attached standard

Observing Chemical Change

SC.2007.8-12.2A.3 The student will gain a basic concept of chemical reactions.
- understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.
- understands how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e., through stoichiometric relationships.
- understands the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.
- Chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved.
- Examples of chemical reactions are synthesis, decomposition, combustion, single and double replacement, acid/base, and oxidation/reduction.
- Two or more of the following may often identify chemical reactions: physical property change, effervescence, mass change, precipitation, light emission, and heat exchange.
- The rate (speed) of a chemical reaction depends on such parameters as temperature, concentration, catalysts, inhibitors, surface area, and reaction type.
- Reaction stoichiometry involves understanding the use of coefficients (moles) to balance equations and solve for a variety of relationships using the molar mass of the substances. Examples of these types of relationships include mole/mole, mole/mass, mole/volume, mass/volume, mass/mass, etc.
- Acids react with bases to produce water and salt.
- pH is a logarithmic function of hydronium ion concentration. pH decreases as the hydronium ion concentration increases. pOH and hydroxide concentrations are found in a similar way.
- Determination of an unknown base may be determined by experimental titration and use of Ma X Va = Mb X Vb.
- Dilution formulas (M1 X V1 = M2 X V2) can be used to determine the concentration of a solution after diluting it with water.

Topic: Describing Chemical Reactions **Duration:** 1 Week(s)

Topic Overview

In this topic we will cover how to describe chemical reactions by using chemical equations, how to balance a chemical equation and how that reflects the Law of Conservation of Mass. We will also cover some of the general types of chemical reactions.

lab: Reaction of magnesium sulfate and ammonium hydroxide; example of double replacement reaction

Lab: Reaction of iron with oxygen; Conservation of Mass Lab

Lab: Electrolysis of Copper Chloride lab

Lab: Reaction of potassium dichromate with lead nitrate lab, example of double replacement reaction

Learning Targets

The students will learn how to write a chemical reaction using chemical formulas and standard symbols. They will learn how to balance chemical equations by manipulating coefficients in order to reflect the Law of Conservation of Mass and to ensure that the total number of atoms for each element in the reactants and products are equal. We will also cover five of most common general types of chemical reactions; synthesis, decomposition, single replacement, double replacement, and combustion.

see description in the attached standard

Describing Chemical reactions

SC.2007.8-12.2A.3 The student will gain a basic concept of chemical reactions.
- understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.
- understands how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e., through stoichiometric relationships.
- understands the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.
- Chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved.
- Examples of chemical reactions are synthesis, decomposition, combustion, single and double replacement, acid/base, and oxidation/reduction.
- Two or more of the following may often identify chemical reactions: physical property change, effervescence, mass change, precipitation, light emission, and heat exchange.
- The rate (speed) of a chemical reaction depends on such parameters as temperature, concentration, catalysts, inhibitors, surface area, and reaction type.
- Reaction stoichiometry involves understanding the use of coefficients (moles) to balance equations and solve for a variety of relationships using the molar mass of the substances. Examples of these types of relationships include mole/mole, mole/mass, mole/volume, mass/volume, mass/mass, etc.
- Acids react with bases to produce water and salt.
- pH is a logarithmic function of hydronium ion concentration. pH decreases as the hydronium ion concentration increases. pOH and hydroxide concentrations are found in a similar way.
- Determination of an unknown base may be determined by experimental titration and use of Ma X Va = Mb X Vb.
- Dilution formulas (M1 X V1 = M2 X V2) can be used to determine the concentration of a solution after diluting it with water.

Topic: Controlling Chemical Reactions — **Duration:** 1 Week(s)

Topic Overview

In this unit we will be covering the importance of activation energy in order start a chemical reaction and how the rate of a reaction can be altered by various means (surface area, temperature, concentration, catalysts, and inhibitors).

Learning Targets

The students will be able to explain how activation energy is linked to the breaking of chemical bonds in order to start a reaction. They will also be able to interpret a energy graph of either an endothermic or an exothermic reaction and identify the activation energy required for the reaction.In addition, they will be able to describe how temperature, concentration, and catalysts or inhibitors can effect the rate at which the reaction proceeds.

see description in the attached standard

Controlling Chemical Reactions

SC.2007.8-12.2A.3 The student will gain a basic concept of chemical reactions.
- understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.
- understands how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e., through stoichiometric relationships.
- understands the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.
- Chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved.
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- Determination of an unknown base may be determined by experimental titration and use of Ma X Va = Mb X Vb.
- Dilution formulas (M1 X V1 = M2 X V2) can be used to determine the concentration of a solution after diluting it with water.

Unit: Acids, Bases, and Solutions

Duration: 4 Week(s)

Unit Overview

Students will understand what a solution is and how to make one. they will also learn how to express concentration and solubility of a solute in a solvent. They will also be able to describe the properties of acids and bases and how the pH scale is used to describe concentration.

Materials and Resources

Textbook: Chemical Interactions - Chapter Three (Acids, Bases, and Solutions) - pages 82 through 119

Academic Vocabulary

solution
solvent
solute
colloid
suspension
concentration
dilute solution
concentrated solution
solubility
saturated solution
unsaturated solution
supersaturated solution
acid
base
corrosive
indicator
hydrogen ion (H+)
hydronium ion (H3O+)
hydroxide ion (OH-)
pH scale
neutralization
salt
digestion
mechanical digestion
chemical digestion

Summative Assessment

3.1 Quiz
3.2 Quiz
3.3 Quiz
3.4 Quiz
Chapter 3 Examination

Topic: Understanding Solutions

Duration: 1 Week(s)

Topic Overview

The students will learn the characteristics of solutions, colloids, and suspensions. They will also be able to explain how a solute affects the freezing and melting point of a solvent.

Learning Targets

Understanding Solutions

SC.2007.8-12.2A.3 The student will gain a basic concept of chemical reactions.
- understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.
- understands how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e., through stoichiometric relationships.
- understands the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.
- Chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved.
- Examples of chemical reactions are synthesis, decomposition, combustion, single and double replacement, acid/base, and oxidation/reduction.
- Two or more of the following may often identify chemical reactions: physical property change, effervescence, mass change, precipitation, light emission, and heat exchange.
- The rate (speed) of a chemical reaction depends on such parameters as temperature, concentration, catalysts, inhibitors, surface area, and reaction type.
- Reaction stoichiometry involves understanding the use of coefficients (moles) to balance equations and solve for a variety of relationships using the molar mass of the substances. Examples of these types of relationships include mole/mole, mole/mass, mole/volume, mass/volume, mass/mass, etc.
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- Determination of an unknown base may be determined by experimental titration and use of Ma X Va = Mb X Vb.
- Dilution formulas (M1 X V1 = M2 X V2) can be used to determine the concentration of a solution after diluting it with water.

Topic: Concentration and Solubility — **Duration:** 1 Week(s)

Topic Overview

The students will leaarn how concentration is measured and what factors affect the solubility of a substance.

Learning Targets

Concentration and Solubility

SC.2007.8-12.2A.3 The student will gain a basic concept of chemical reactions.
- understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.
- understands how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e., through stoichiometric relationships.
- understands the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.
- Chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved.
- Examples of chemical reactions are synthesis, decomposition, combustion, single and double replacement, acid/base, and oxidation/reduction.
- Two or more of the following may often identify chemical reactions: physical property change, effervescence, mass change, precipitation, light emission, and heat exchange.
- The rate (speed) of a chemical reaction depends on such parameters as temperature, concentration, catalysts, inhibitors, surface area, and reaction type.
- Reaction stoichiometry involves understanding the use of coefficients (moles) to balance equations and solve for a variety of relationships using the molar mass of the substances. Examples of these types of relationships include mole/mole, mole/mass, mole/volume, mass/volume, mass/mass, etc.
- Acids react with bases to produce water and salt.
- pH is a logarithmic function of hydronium ion concentration. pH decreases as the hydronium ion concentration increases. pOH and hydroxide concentrations are found in a similar way.
- Determination of an unknown base may be determined by experimental titration and use of Ma X Va = Mb X Vb.
- Dilution formulas (M1 X V1 = M2 X V2) can be used to determine the concentration of a solution after diluting it with water.

Topic: Describing Acids and Bases — **Duration:** 1 Week(s)

Topic Overview

The students will learn the properties of both acids and bases and be able to identify common uses of both.

Learning Targets

Describing Acids and Bases

SC.2007.8-12.2A.3 The student will gain a basic concept of chemical reactions.
- understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.
- understands how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e., through stoichiometric relationships.
- understands the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.
- Chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved.
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- Determination of an unknown base may be determined by experimental titration and use of Ma X Va = Mb X Vb.
- Dilution formulas (M1 X V1 = M2 X V2) can be used to determine the concentration of a solution after diluting it with water.

Topic: Acids and Bases in Solutions — Duration: 1 Week(s)

Topic Overview

The students will learn what kind of ions acids and bases form, how the pH scale measures the concentration of an acid, and how an acid can be neutralized by a base.

Learning Targets

Acids and Bases in Solutions

SC.2007.8-12.2A.3 The student will gain a basic concept of chemical reactions.
- understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.
- understands how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e., through stoichiometric relationships.
- understands the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.
- Chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved.
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- Acids react with bases to produce water and salt.
- pH is a logarithmic function of hydronium ion concentration. pH decreases as the hydronium ion concentration increases. pOH and hydroxide concentrations are found in a similar way.
- Determination of an unknown base may be determined by experimental titration and use of Ma X Va = Mb X Vb.
- Dilution formulas (M1 X V1 = M2 X V2) can be used to determine the concentration of a solution after diluting it with water.
