



## **Physical Science**

### **Semester A Summary:**

This full-year course focuses on traditional concepts in chemistry and physics, and encourages exploration of new discoveries in this field of science. The course includes an overview of scientific principles and procedures, and leads students toward a clearer understanding of matter, energy, and the physical universe. As students refine and expand their understanding of physical science, they will apply their knowledge in experiments that require them to ask questions and create hypotheses. Throughout the course, students solve problems, reason abstractly, and learn to think critically.

### **Semester A Outline**

#### **1. Matter**

1. Introduction to Matter
  - Explain what makes up matter
  - Describe how to measure mass and volume
  - Differentiate between mass and weight
2. Physical Properties
  - Describe and give examples of physical properties of matter
  - Explain what happens during a physical change
  - Identify examples of physical changes
  - Explain how and why matter is conserved during a physical change
3. Density
  - Explain density and state the SI units used to measure it
  - Calculate the mass, volume, or density of an object given the other two measurements
  - Determine whether an object will sink or float relative to the density of the surrounding liquid
4. Lab: Density of Solids
  - Measure the mass and volume of various solid objects
  - Calculate the density of several solid objects
  - Use density to identify an unknown substance
5. States of Matter
  - Describe the arrangement and motion of atoms in the different states of matter
  - Discriminate the characteristics of solids, liquids, and gases
6. Changes of State
  - Describe what happens during the different changes of state
  - Explain how energy is related to changes of state
7. Chemical Properties
  - Describe and give examples of chemical properties of matter
  - Explain what happens during a chemical change
  - Identify examples of chemical changes

- Differentiate between physical and chemical changes
8. Matter Unit Review
  9. Matter Unit Test
- 2. Atoms, Elements, and the Periodic Table**
1. Atomic Theory
    - Describe the development of the modern model of the atom
    - Compare the models of the atom put forth by Dalton, Thomson, Rutherford, and Bohr
  2. Atoms
    - Describe the parts of an atom
    - Identify the masses, locations, and charges of protons, neutrons, and electrons
  3. Elements
    - Examine the properties of an element
    - Describe what an isotope is and explain how isotopes of the same element are different
    - Explain how ions form
  4. Periodic Table: Part 1
    - Examine the history of the periodic table
    - Describe the organization of the periodic table
    - Determine an element's symbol, atomic number, and mass number from the periodic table
  5. Periodic Table: Part 2
    - Examine the history of the periodic table
    - Describe the organization of the periodic table
    - Determine an element's symbol, atomic number, and mass number from the periodic table
  6. Metals
    - Describe the characteristic properties of metals
    - Identify the location of metals in the periodic table
    - Explain how and why the reactivity of metals changes in the periodic table
  7. Nonmetals
    - Describe the characteristic properties of nonmetals
    - Identify the location of nonmetals in the periodic table
    - Explain how and why the reactivity of nonmetals changes in the periodic table
  8. Metalloids
    - Describe the characteristic properties of metalloids
    - Identify the location of metalloids in the periodic table
    - Explain why most metalloids are used as semiconductors
  9. Atoms, Elements, & Periodic Table Unit Review
  10. Atoms, Elements, & Periodic Table Unit Test
- 3. Bonding**
1. Compounds
    - Describe the defining characteristics of a compound
    - Explain how chemical formulas represent compounds
    - Determine the number of atoms of each element in a chemical formula
    - Use models to visualize the chemical structure of a compound
  2. Chemical Bonding
    - Explain why atoms bond
    - Identify the three types of bonds
    - Complete electron dot diagrams

3. Ionic Bonds
  - Describe characteristics of ionic bonds
  - Explain how ionic bonds form
  - Identify the properties of ionic compounds
  - Give examples of ionic compounds
4. Covalent Bonds
  - Describe characteristics of covalent bonds
  - Explain how covalent bonds form
  - Identify the properties of covalent compounds
  - Give examples of covalent compounds
5. Polymers
  - Explain the formation of polymers
  - Describe the uses of natural and synthetic polymers
  - Examine the benefits and limitations of using synthetic polymers
6. Bonding Unit Review
7. Bonding Unit Test

#### 4. **Chemical Reactions**

1. Introduction to Chemical Reactions
  - Recognize that a chemical reaction is a chemical change
  - Describe the evidence that shows that a chemical reaction has occurred
  - Explain the difference between an endothermic and an exothermic reaction
2. Describing Chemical Reactions
  - Identify the parts of a chemical equation
  - Describe the law of conservation of mass
  - Explain how mass is conserved in chemical equations
3. Balancing Chemical Equations
  - Explain what it means for a chemical equation to be balanced
  - Demonstrate how to balance a chemical equation
  - Relate balanced chemical equations to the law of conservation of mass
4. Types of Chemical Reactions: Part 1
  - Distinguish among the types of chemical reactions
  - Predict the product of each type of chemical reaction
5. Types of Chemical Reactions: Part 2
  - Distinguish among the types of chemical reactions
  - Predict the product of each type of chemical reaction
6. Lab: Rate of Chemical Reactions
  - Describe the signs of a chemical reaction
  - Identify how temperature and surface area affect the rate of a chemical reaction
  - Conduct several controlled tests of multiple variables using repeated trials during an investigation about chemical reaction rate
7. Chemical Reactions Unit Review
8. Chemical Reactions Unit Test

#### 5. **Solutions and Other Mixtures**

1. Mixtures
  - Distinguish between substances and mixtures
  - Identify the properties of a mixture
  - Compare and contrast types of mixtures
2. Solubility
  - Define solubility and recognize that substances have different solubilities
  - Describe types of solutions
  - Identify factors that affect the solubility of a substance

- Describe factors that affect the rate of dissolving
3. Properties of Acids and Bases
    - Compare the properties of acids and bases
    - Describe common uses of acids and bases
  4. Acids & Bases in Solution
    - Describe what happens when acids and bases are put in water
    - Classify acids and bases based on strength
    - Explain how pH can be used to identify an acid or base
    - Summarize what happens during a neutralization reaction
  5. Lab: Acids & Bases
    - Show how pH is based on the concentration of  $H^+$  and  $OH^-$  in solution
    - Determine the pH of various solutions using a multi-use indicator
  6. Solutions & Other Mixtures Unit Review
  7. Solutions & Other Mixtures Unit Test
- 6. Motion and Forces**
1. Introduction to Motion
    - Describe the position of an object
    - Explain how an object's motion is relative to a reference point or frame
    - Distinguish between distance and displacement
  2. Speed & Velocity
    - Differentiate between speed and velocity
    - Solve problems involving distance, time, speed, and/or velocity
    - Interpret graphs of distance versus time
  3. Acceleration
    - Describe the concept of acceleration
    - Solve problems involving velocity, time, and acceleration
    - Interpret graphs of velocity versus time
  4. Lab: Motion
    - Measure distance and time to determine speed
    - Graph changes in motion
    - Interpret data to determine acceleration
  5. Introduction to Forces
    - Describe the concept of force
    - Explain how to determine the net force on an object
    - Distinguish between balanced and unbalanced forces and their effect on motion
  6. Friction
    - Describe friction and explain what causes it to occur
    - Identify and describe the different types of friction
    - Explain how friction can be reduced or increased depending on the application
  7. Gravity
    - Describe Newton's law of universal gravitation
    - Identify and describe the factors that affect the gravitational force between two objects
    - Explain the concept of free fall
    - Describe how gravity affects projectile motion
  8. Newton's Laws of Motion
    - Describe Newton's first law of motion and how it relates to inertia
    - Use Newton's second law of motion to calculate force, mass, and acceleration
    - Explain Newton's third law of motion and how it relates to action and reaction forces

- Identify applications of Newton's three laws of motion
9. Momentum
    - Define and calculate momentum
    - Explain how momentum is conserved
    - Apply Newton's third law of motion to understand what happens to momentum when two objects collide
    - Use mathematical representations to show that the total momentum of a system of objects is conserved when there is no net force on the system
  10. Lab: Newton's Laws of Motion
    - Demonstrate Newton's first law
    - Verify Newton's second law by changing the variables  $F$ ,  $m$ , or  $a$
  11. Motion & Forces Unit Review
  12. Motion & Forces Unit Test
7. **Cumulative Exam**
    1. Final Exam Review
    2. Final Exam

## **Semester B Summary:**

This full-year course focuses on traditional concepts in chemistry and physics, and encourages exploration of new discoveries in this field of science. The course includes an overview of scientific principles and procedures, and leads students toward a clearer understanding of matter, energy, and the physical universe. As students refine and expand their understanding of physical science, they will apply their knowledge in experiments that require them to ask questions and create hypotheses. Throughout the course, students solve problems, reason abstractly, and learn to think critically.

## **Semester B Outline**

1. **Work and Energy**
  1. Work and Power
    - Identify when work is done
    - Calculate the work done on an object
    - Explain how force, work, and power are related
    - Calculate power
  2. Introduction to Machines
    - Define a machine and explain its purpose
    - Calculate the mechanical advantage of a machine
    - Calculate the efficiency of a machine
  3. Simple Machines
    - Describe the six different types of simple machines
    - Calculate the mechanical advantage of each type of simple machine
    - Identify simple machines found in the human body
    - Distinguish compound machines from simple machines
  4. Introduction to Energy
    - Define energy
    - Explain how energy and work are related
    - Identify and describe the different forms of energy
  5. Potential & Kinetic Energy
    - Distinguish between potential and kinetic energy
    - Calculate the potential energy in a system
    - Calculate the kinetic energy in a system

- Explain how energy is transferred in a moving system
- 6. Energy Transformation
  - Explain how energy changes form
  - Identify examples of energy transformations
  - Summarize the law of conservation of energy
- 7. Lab: Kinetic Energy
  - Calculate the kinetic energy of objects of different mass
  - Determine the kinetic energy of objects at different speeds
  - Graph data to illustrate changes in kinetic energy
- 8. Work & Energy Unit Review
- 9. Work & Energy Unit Test

## 2. **Temperature and Heat**

1. Temperature & Thermal Energy
  - Explain how temperature relates to kinetic energy
  - Describe how temperature is measured
  - Convert temperature readings between different temperature scales
  - Describe how thermal energy relates to temperature
2. Heat
  - Distinguish between heat and thermal energy
  - Predict how thermal energy flows between objects at different temperatures
  - Explain why some substances change temperature more easily than others
3. Conduction
  - Explain how molecular movement transfers thermal energy by conduction
  - Distinguish between insulators and conductors
  - Identify situations in which conduction occurs
4. Convection
  - Explain how fluid movement transfers thermal energy by convection
  - Describe the motion of liquids and gases due to convection
  - Identify situations in which convection occurs
5. Radiation: Part 1
  - Explain how electromagnetic waves transfer energy by radiation
  - Describe the role of color and texture in absorbers and reflectors
  - Identify situations in which radiation occurs
6. Radiation: Part 2
  - Explain how electromagnetic waves transfer energy by radiation
  - Describe the role of color and texture in absorbers and reflectors
  - Identify situations in which radiation occurs
7. Lab: Thermal Energy Transfer
  - Investigate how different materials transfer thermal energy
  - Determine how mass affects the amount of thermal energy transferred
  - Observe and compare the specific heat of water with the specific heat of other substances
8. Temperature & Heat Unit Review
9. Temperature & Heat Unit Test

## 3. **Waves and Sound**

1. Introduction to Waves
  - Define waves and explain how they carry energy
  - Distinguish between mechanical waves and electromagnetic waves
  - Compare and contrast transverse waves and longitudinal waves
2. Properties of Waves
  - Describe how a wave's amplitude is related to the energy the wave carries
  - Describe the relationship between the frequency and wavelength of a wave

- Calculate the speed of a transverse wave
  - Explain why waves travel at different speeds
  - Use mathematical representations to show relationships among the frequency, wavelength, and speed of waves traveling in various media
3. Wave Interactions
    - Explain what happens when waves interact
    - Describe how a wave's direction is changed by reflection, refraction, and diffraction
    - Differentiate between constructive and destructive interference
  4. Sound Waves
    - Describe how sound waves are produced and how they travel
    - Identify the features of a sound wave
    - Explain how different materials and different temperatures affect the speed of sound waves
  5. Using Sound
    - Explain how and why animals use echolocation
    - Describe the uses of ultrasound technology
    - Summarize the ways in which sound waves are used for communication
  6. Waves & Sound Unit Review
  7. Waves & Sound Unit Test

#### 4. **Light**

1. The Electromagnetic Spectrum
  - Describe the different parts of the electromagnetic spectrum
  - Distinguish how electromagnetic waves differ from one another
  - Identify how different types of electromagnetic waves are used
2. Properties of Light
  - Describe the wave and particle models of light
  - Explain what happens when light interacts with objects
  - Recognize what determines the color of an object
3. Reflection & Mirrors
  - Explain how light is reflected from a surface
  - Describe the law of reflection
  - Describe how a mirror forms an image
  - Identify the types of images formed by different kinds of mirrors
4. Refraction & Lenses
  - Explain how light is refracted when it passes from one medium to another
  - Describe how a lens forms an image
  - Analyze ray diagrams for a lens
  - Identify the types of images formed by different kinds of lenses
5. Using Light
  - Describe how magnifying glasses, microscopes, telescopes, and cameras work
  - Differentiate laser light from regular light and identify uses of lasers
  - Identify uses of fiber optics
6. Light Unit Review
7. Light Unit Test

#### 5. **Electricity and Magnetism**

1. Electric Charge
  - Determine how electric charges interact
  - Explain how electrons cause objects to become electrically charged
  - Analyze the factors that affect the strength of an electric force
  - Describe the electric field due to a charge

2. Electric Current
  - Explain how an electric current is produced
  - Explain the relationship between voltage and an electric current
  - Describe resistance and how it affects current
  - Distinguish between conductors, superconductors, semiconductors, and insulators
3. Ohm's Law
  - Explain the relationship between current, voltage, and resistance (Ohm's law)
  - Calculate the voltage, current, or resistance given the other two quantities
4. Electric Circuits
  - Explain how a circuit functions
  - Interpret the electric symbols for the parts of a circuit
  - Identify open and closed circuits
  - Contrast series and parallel circuits
5. Magnets & Magnetism
  - Describe the properties of magnets
  - Determine how magnetic poles interact with each other
  - Illustrate the magnetic field around a magnet
  - Describe Earth's magnetic field
6. Electromagnetism
  - Indicate how magnetism is produced by electric currents
  - Explain how an electric current is produced by a magnet
  - Describe the characteristics of solenoids and electromagnets
7. Applications of Electromagnetism: Day 1
  - Identify uses of electromagnets
  - Explain how an electric motor uses a magnetic force to cause motion
  - Describe how a generator works
  - Contrast direct current with alternating current
8. Applications of Electromagnetism: Day 2
  - Identify uses of electromagnets
  - Explain how an electric motor uses a magnetic force to cause motion
  - Describe how a generator works
  - Contrast direct current with alternating current
9. Lab: Magnetic & Electric Fields
  - Demonstrate and describe magnetic fields
  - Demonstrate and describe electric fields
  - Show how magnetic and electric fields are related
10. Electricity & Magnetism Unit Review
11. Electricity & Magnetism Unit Test

## 6. **Cumulative Exam**

1. Final Exam Review
2. Final Exam