Physical Science
411-Level 1

Framework Standard: Mathematical skills

- ✓ Construct and use tables and graphs to interpret data sets.
- ✓ Solve simple algebraic expressions.
- ✓ Perform basic statistical procedures to analyze the center and spread of data.
- ✓ Measure with accuracy and precision (e.g., length, volume, mass, temperature, time)
- ✓ Convert within a unit (e.g., centimeters to meters).
- ✓ Use common prefixes such as *milli-*, *centi-*, and *kilo-*.
- ✓ Use scientific notation, where appropriate.
- ✓ Use ratio and proportion to solve problems.
- ✓ Determine the correct number of significant figures.
- ✓ Use appropriate metric/standard international (SI) units of measurement for mass (g); length (cm); and time (s).
- ✓ Use the Celsius and Kelvin scales.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Perform calculations involving scientific notation and conversion factors. Identify metric and SI units used in science and convert between common metric prefixes Compare and contrast between accuracy and precision. Determine the correct number of significant figures. Organize and analyze data using charts and graphs.	Using a calculator with scientific notation Measuring with a device that has lines Algebraic manipulation	Prentice hall : Physical Science Concepts in Action pp.2-25 Instructional Fair: Physical Science Chemistry Handouts	Lab: measurement Quiz: scientific notation Quiz: metric prefixes Test: Measurement

Physics

1. Motion and Forces
Central Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.

Framework Standard:

1.1 Compare and contrast vector quantities (e.g., displacement, velocity, acceleration force, linear momentum) and scalar quantities (e.g., distance, speed, energy, mass, work).

1.2 Distinguish between displacement, distance, velocity, speed, and acceleration. Solve problems involving displacement, distance, velocity, speed, and constant acceleration.

1.3 Create and interpret graphs of 1-dimensional motion, such as position vs. time, distance vs. time, speed vs. time, velocity vs. t time, and acceleration vs. time where acceleration is constant.

1.4 Interpret and apply Newton's three laws of motion

1.5 Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Identify frames of reference Distinguish between distance and displacement Calculate displacement using vector addition Compare and contrast instantaneous speed vs. average speed Interpret and make time vs. distance graphs Combine velocities using vector addition Identify acceleration	calculation graphing using a stop watch understand the concepts of linear motion	Text Prentice Hall : Physical Science- Concepts in Action Physical Science Instructional Fair :	Lab: Indy 500 Lab: Marble acceleration Quiz: Velocity and acceleration calculation Test : Chapter 11

Interpret and create acceleration vs. time graphs Describe examples of force and identify appropriate SI units Explain how motion is affected by balanced and unbalanced forces Compare and contrast the four types of friction Describe Newton's first law of motion Describe Newton's second law of motion and use it to calculate acceleration, mass, and force Relate mass to weight Describe Newton's third law of motion Calculate momentum and describe collisions	Distinguish between mass and weight Recognize and describe Newton's three laws of motion	Physical Science	Lab: Weight vs. Mass Quiz : Newton's laws Test: Chapter 12

2. Conservation of Energy and Momentum

Central Concept: The laws of conservation of energy and momentum provide alternate approaches to predict and describe the movement of objects.

Framework Standard:

2.1 Interpret and provide examples that illustrate the law of conservation of energy.
2.2 Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa.
2.3 Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy.
2.4 Describe both qualitatively and quantitatively the concept of power as work done per unit time.
2.5 Provide and interpret examples showing that linear momentum is the product of mass and velocity, and is always conserved (law of conservation of momentum). Calculate the momentum of an object.

Learning Objectives/ Content Outcomes	Skills	Resources	Assessments

(The learner should be able to…)			
Describe conversion of energy from one form to another. State and apply the law of conservation of energy. Analyze how energy is conserved in conversions between conservation of energy. Solve equations that equate initial energy to final energy. Describe the relationship between work and energy. Relate kinetic energy to mass and speed and calculate these quantities. Analyze how potential energy is related to position and give examples of both gravitational and elastic potential energy. Solve equations that relate an objects gravitational potential energy to its mass and height.	Describe the law of conservation of energy and understand how it is conserved Understand the relationship between energy types calculation	Text: pp.446-459 Instructional fair handouts Demo: pendulum swing Demo: energy conversions during the lighting of a match	 Lab: work the body Quiz: work and energy calculations Lab: falling motion Test:Energy Report: Alternative energy

3. Heat and Heat Transfer

Central Concept: Heat is energy that is transferred by the processes of convection, conduction, and radiation between objects or regions that are at different temperatures.

Framework Standard:

3.1 Explain how heat energy is transferred by convection, conduction, and radiation.

3.2 Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.

3.3 Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a solid to a liquid to a gas, and that energy is released when a substance changes from a gas to a liquid to a solid. Explain the relationships among evaporation, condensation, cooling, and warming.

3.4 Explain the relationships among temperature changes in a substance, the amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Describe convection, conduction, radiation and identify which of these is occurring in a given situation. Apply the second law of thermodynamics in situations where heat moves from cooler to warmer objects. Classify materials as thermal conductors or thermal insulators. Apply the law of conservation of energy to conversions between thermal energy and other forms of energy. State the third law of thermodynamics. Explain how work and heat transfer energy. Relate thermal energy to the amount of particles that make up matter. Calculate thermal energy, temperature change, or mass using specific heat. Describe how a calorimeter works and calculate thermal energy changes or specific heat using calorimetry measurements.	Using a thermometer Using a calorimeter Temperature unit conversions Using a balance Differentiate between the types of heat energy Recognize Newton's second and third laws	Text pp. 474-478 Instructional fair handouts Demo: suface temperature vs. heat Demo: radiometer Demo: thermal contraction	Lab: specific heat of aluminum Test: Heat

4. Waves
Central Concept: Waves carry energy from place to place without the transfer of matter.

Framework Standard:
- 4.1 Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period) and explain the relationships among them. Recognize examples of simple harmonic motion.
- 4.2 Distinguish between mechanical and electromagnetic waves.
- 4.3 Distinguish between the two types of mechanical waves, transverse and longitudinal.
- 4.4 Describe qualitatively the basic principles of reflection and refraction of waves.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Define mechanical waves and relate waves to energy. Describe longitudinal, surface and transverse waves	Graphing waves	Text;pp.500-512 Prentice Hall diagrams	

and discuss how they are produced. Identify examples of each wave type. Analyze the motion of a medium as a wave passes through it. Define frequency, period, and wavelength. Solve equations relating wave speed to frequency or pe4riod. Describe how to measure the amplitude, and relate it to energy of the wave. Describe how reflection, refraction, diffraction, and interference affect waves. Distinguish between constructive and destructive interference.	Describe and recognize the types of waves Understand how waves are affected Show how waves transfer energy	Demo: big slinky, long spring Demo: video of wave types and medium movement	Lab: making waves Quiz: wave types Test: waves

Chemistry

1. Properties of Matter
Central Concept: Physical and chemical properties reflect the nature of the interactions between molecules or atoms, and can be used to classify and describe matter.

1.1 Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g., the ability to form new substances). Distinguish between chemical and physical changes.
1.2 Explain the difference between pure substances (elements and compounds) and mixtures.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Classify pure substance as elements or compounds. Describe the characteristics of an element and the symbols that identify them. Describe the characteristics of a compound Distinguish pure substances from mixtures. Classify mixtures as homogeneous or heterogeneous. Describe physical properties of matter Identify substances based on their physical properties. Describe methods used to separate mixtures. Describe chemical properties of matter Describe the three signs of chemical change.	Lab skills: Recognizing equipment Learning basic lab techniques following directions and analyzing data Describe physical and chemical properties and changes Classify matter into	Text: pp. 36-65 Instructional Fair: Physical Science Lab: Chromotography	Quiz: elements and symbols Lab questions Quiz mixtures vs. substances

Distinguish physical changes from chemical changes	mixtures and substances		Test: Properties of Matter

6. States of Matter, Kinetic Molecular Theory, and Thermochemistry

Central Concepts: Gas particles move independently of each other and are far apart. The behavior of gas particles can be modeled by the kinetic molecular theory. In liquids and solids, unlike gases, particles are close to each other. The driving forces of chemical reactions are energy and entropy. The reorganization of atoms in chemical reactions results in the release or absorption of heat energy

1.3 Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.

6.1 Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), pressure and temperature (Gay-Lussac's law), and the number of particles in a gas sample (Avogadro's hypothesis). Use the combined gas law to determine changes in pressure, volume, and temperature.

6.3 Using the kinetic molecular theory describe and contrast the properties of gases, liquids, and solids. Explain, at the molecular level, the behavior of matter as it undergoes phase transitions.

6.4 Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Describe the five states of matter. Classify materials as solids, liquids, or gases.		Text: pp.66-95	

Explain the behavior of gases using kinetic theory. Define pressure and gas pressure. Identify factors that affect gas pressure. Predict changes in gas pressure due to changes in temperature or volume. Explain Charles's law and Boyle's law. Describe phase changes. Explain how temperature can be used to recognize a phase change. Explain what happens to the motion, arrangement o, and average KE of water molecules during phase changes. Identify phase changes as endothermic or exothermic.	Lab skills of liquid measurement and following directions Lab skills of predicting and inquiry Recognize states of matter Recognize and quantify Boyle's and Charles's Law	Lab: Rainbow lab Lab: Investigating space between particles	Lab questions Lab questions Quiz: States of matter and gas laws Test chapter three: States of Matter

2. Atomic Structure

Central Concepts: Atomic models are used to explain atoms and help us understand the interaction of elements and compounds observed on a macroscopic scale.

Framework Standard:

2.1 Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.

2.2 Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

2.3 Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.

2.4 Write the electron configurations for the first twenty elements of the periodic table.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Describe the ancient Greek models of the atom List the main points of Dalton's atomic theory Explain how Thomson and Rutherford used experiments to produce their atomic models Describe the Bohr atomic model and recognize evidence for it Describe modern atomic models in terms of	Understand the major parts of the development of atomic models Know the major parts of the atom	Text pp.99-121 Demo: Cathode Ray Tube Demo: Atomic Spectrum Tubes, Bright line spectrums, Diffraction glasses	

probability and the electron cloud Differentiate between all atomic models Identify three subatomic particles and their properties Distinguish atomic number from mass number and use these to describe atomic structure Recognize ions atomic charge and the particles to achieve them	Calculation	Instructional Fair: (Chemistry) p.27	Quiz: atomic structure Poster: Atomic structure Element report Element presentation Test: Chapter 4

3. Periodicity

Central Concepts: Repeating (periodic) patterns of physical and chemical properties occur among elements that define families with similar properties. The periodic table displays the repeating patterns, which are related to the atoms' outermost electrons.

Framework Standard:

3.1 Explain the relationship of an element's position on the periodic table to its atomic number. Identify families (groups) and periods on the periodic table.
3.2 Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.
3.3 Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
3.4 Identify trends on the periodic table (ionization energy, electronegativity, and relative sizes of atoms and ions).

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Describe how Mendeleev organized his periodic table Describe the modern organization of he periodic table Identify properties of metals, nonmetals, and metalloids and show their position on the periodic table Describe how properties of elements change across the periodic table and identify periods Identify groups and their properties Relate properties to valence electrons Describe activity in terms of electronegativity and	Understand the organization of the periodic table Relate the organization of the periodic table to the structure and reactivity of the elements	Text: pp.124-153 Instructional Fair: (physical science) p.46 IF (Chemistry) p.31	Quiz on group names

ionization energy Describe how atomic radius changes		IF: (PS)p.47 IF: p.49	3-D periodic table Test Chapter 5

4. Chemical Bonding

Central Concept: Atoms bond with each other by transferring or sharing valence electrons to form compounds.

Framework Standard:

4.1 Explain how atoms combine to form compounds through both ionic and covalent bonding. Predict chemical formulas based on the number of valence electrons.
4.2 Draw Lewis dot structures for simple molecules and ionic compounds.
4.3 Use electronegativity to explain the difference between polar and nonpolar covalent bonds.
4.6 Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Recognize stable electron configurations. Predict an element's chemical properties using number of valence electrons and electron dot diagrams. Describe how and ionic bond forms and how ionization energy affects this process. Predict the composition of ionic formulas and name them. Relate ionic properties to their crystal lattice structure. Describe how covalent bonds form. Compare polar and nonpolar molecules, and demonstrate how polar bonds affect the polarity of a	Recognize how stability determines bonding Differentiate between types of bonding Write basic names and formulas	Text:158-181 IF handouts Demo: models and examples of bonding Demo: the polarity of water	Quiz : ionic bonding Quiz: covalent bonding

molecule. Name and write covalent molecular formulas. Describe bonding in metallic formulas.			Test: bonding

5. Chemical Reactions and Stoichiometry

Central Concepts: In a chemical reaction, one or more reactants are transformed into one or more new products. Chemical equations represent the reaction and must be balanced. The conservation of atoms in a chemical reaction leads to the ability to calculate the amount of products formed and reactants used (stoichiometry).

Framework Standard:

5.1 Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions).
5.2 Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
5.3 Use the mole concept to determine number of particles and molar mass for elements and compounds.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Interpret chemical equations in terms of reactants, products, and conservation of mass. Balance chemical equations by manipulating coefficients Convert between moles and mass using molar mass. Classify reactions as synthesis, decomposition, single-replacement, double replacement or combustion	Recognize five types of reactions Apply the conservation of mass to chemical equations by balancing	Text: 192-205 IF handouts Demos: chemical reactions RSW 7.1 RSW 7.2	Quiz: balancing and reaction id Test: Chemical reactions

7. Solutions, Rates of Reaction, and Equilibrium
Central Concepts: Solids, liquids, and gases dissolve to form solutions. Rates of reaction and chemical equilibrium are dynamic processes that are significant in many systems (e.g., biological, ecological, geological).

Framework Standard:

6.4 Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.
7.5 Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, catalyst).

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Describe the energy changes that take place during a chemical reaction Classify chemical reactions as exothermic or endothermic Explain how energy is conserved during a chemical reaction Explain what a reaction rate is & factors that affect it	Recognize exothermic vs. endothermic reactions Realize that energy is conserved in a reaction	Text: 206-215 RSW 7.3 RSW 7.4	Test: chemical reactions

8. Acids and Bases and Oxidation-Reduction Reactions

Central Concepts: Acids and bases are important in numerous chemical processes that occur around us, from industrial procedures to biological ones, from the laboratory to the environment.

Framework Standard:

8.1 Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronsted-Lowry theory of acids and bases in terms of proton donors and acceptors.

8.2 Relate hydrogen ion concentrations to the pH scale and to acidic, basic, and neutral solutions. Compare and contrast the strengths of various common acids and bases (e.g., vinegar, baking soda, soap, citrus juice).

8.3 Explain how a buffer works.

Learning Objectives/ Content Outcomes (The learner should be able to…)	**Skills**	**Resources**	**Assessments**
Define acid and describe some of the general properties of an acid Define base and describe some of the general properties of a base. Explain how acids and bases can be described as proton donors and proton acceptors. Identify neutralization and describe how the reactants and products of a neutralization reaction. Define pH and relate pH to hydronium ion concentration in a solution Distinguish between strong and weak acids and bases Define buffer and describe how a buffer can be made	Using pH paper Understand the development of the theory of acids Describe acids and bases	Text;pp.240-249 RSW 8.3 and 8.4 Demo: neutralization	Lab: preparing a salt by neutralization Test: acids and bases

Curriculum guide

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Level one