

Integrated Physics & Chemistry

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Course Objective

Integrated Physics and Chemistry students conduct field and laboratory investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. This course integrates the principles of physics and chemistry in the following topics: motion, waves, energy transformations, properties of matter, and changes in matter and solution chemistry.

Course Prerequisites or Corequisites

- 8th Grade Science (required)
- Algebra I (required)

Unit 1: Science and the Scientific Method

- Define science.
- Identify two important aspects of science.
- Describe the language of science, which is mathematics.
- Describe the source of mathematics in science.
- Explain the limitations of science.
- Describe events in the history of science.
- Explain two important ideas concerning scientific work.
- Explain the steps of the scientific method.
- Describe laboratory equipment.
- Identify laboratory glassware and other laboratory items.
- Understand the importance and techniques of laboratory safety.
- Identify and recognize the meaning of lab safety signs.
- Understand the care of equipment.
- Practice safe storage, disposal, and recycling of laboratory materials.
- Describe the metric system.
- Make measurements using the metric system.
- Convert British measurements to metric terms.
- Convert metric measurements to British terms.
- Convert metric units by multiplication or division by 10.
- Choose the right metric units for distance, area, volume, and weight and mass.
- Describe derived units.

Unit 2: Science and the World

- Understand the impact of science on society; describe the effect of two inventions on the society of their time.
- Explain the meaning of the Industrial Revolution and the Information Age.
- Explain that science is not a source of absolute truth.
- Describe the use of science as a means of detecting falsehood.
- Define the study of physics.
- Explain that physics is the foundation of every other branch of science.
- Describe the objectives of physics.
- Define the study of chemistry; list several aspects of chemistry.
- Describe the orders of operation.

- Describe careers in science and technology; explain the relationship between science and technology.
- Define engineering and describe its branches.
- Describe the negative effects of technology on the environment; describe ways technology can be used to reverse these negative effects.

Unit 3: Speed Versus Mass

- Describe the meaning of mass; distinguish between mass and weight.
- Explain the concept of density.
- Describe force and motion; explain relative motion.
- Explain the difference between scalar and vector quantities.
- Describe the result of an unbalanced force.
- Explain the idea of displacement.
- Define the scalar quantity of speed.
- Describe instantaneous speed, uniform speed, and average speed.
- Define the vector quantity of velocity.
- Describe changes to vectors.
- Define the vector quantity of acceleration; describe and compute changes in acceleration.
- Describe Newton's three laws of motion; describe the newton (N).
- Define the idea of inertia.
- Describe and use the formula that relates force, mass, and acceleration.
- Explain the principle of the action force and corresponding reaction force, including vectors.
- Explain the role of friction in mechanical experiments.

Unit 4: Momentum

- Describe gravity.
- Understand the concept of universal gravitation.
- Describe the inverse-square law.
- Recount the history leading up to Newton's Principia.
- Repeat the formula for computing the force of gravity.
- Describe the value of the gravitational constant.
- Describe the value of acceleration force of gravity (g) on the earth.
- Use the formula for acceleration due to gravity.
- Compute momentum; describe the conservation of momentum.
- Understand the meaning of a "closed system;" describe collisions between objects in a closed system.
- Explain the difference between elastic and inelastic collisions.
- Describe the process of computing projectile motion.
- Explain why objects achieve orbit.
- Describe the concept of energy.
- Describe kinetic energy.
- Describe potential energy.
- Describe the conservation of energy.
- Explain the difference between work and power.
- Explain and use Mechanical Advantage.
- Describe six types of simple machines.

Unit 5: Electrical Properties

- Describe an electrical charge and its polarity.
- Explain the idea that the universe's net charge is 0.
- Describe a static electricity generator.
- Explain the difference between insulators and conductors.
- Write the formula for electrical force, known as Coulomb's law.
- Compare and contrast electrical force with gravity.
- Describe the contributions of several physicists to the study of electricity.
- Describe lines of force and the electric field.
- Understand electric potential energy, or voltage.
- Explain why current moves through a circuit.
- Describe a conductor.
- Define sources of high electric potential energy.
- Describe electrical resistance.
- Explain the difference between AC and DC.
- Describe the measurement of electric power.
- Name the components of an electric circuit.
- Know the difference between series and parallel circuits.
- Describe the protective devices used in an electric circuit.
- Describe a typical household AC circuit.
- Explain the importance of handling electricity safely.
- Explain the use of transformers and meters.
- Describe magnetism and electromagnets.
- Understand induction.
- Discuss the generation of electricity and its impact on the environment.

Unit 6: Energy

- Describe thermal energy.
- Explain the concept of temperature as average kinetic heat.
- Define that temperature is relative and given on a scale.
- Describe the three temperature scales.
- Define absolute zero.
- Describe the concept of heat.
- Explain the concepts of specific heat content, expansion due to heating, and heat transfer.
- Name the three ways in which heat may be transferred.
- List and explain the two laws of thermodynamics.
- Describe vibrations.
- Describe and label the parts of a sine wave.
- Explain that energy, not matter, travels in waves.
- Describe the two types of energy waves.
- Compute wave speed from frequency and wavelength.
- Describe the behavior of sound waves.
- Define terms concerning sound.
- Describe the Doppler Effect.
- Describe the various forms of energy waves in the electromagnetic spectrum.
- Explain colors and their relationship to white light.
- Communicate various behaviors of energy waves.

Unit 7: It Really Matters

- Define matter.
- Describe the physical and chemical properties of matter.
- Explain how to use a substance's physical properties for identification.
- Describe the MOH Hardness Scale.
- Define the four phases of matter.
- Explain how a substance may change phase.
- Describe the structure of an atom.
- Define isotopes and ions.
- Define an element.
- List and describe the groupings of elements.
- Navigate the Periodic Table of the Elements.
- Describe the items on an entry from the Periodic Table.
- Explain how atoms combine to form new substances.
- Describe ionic and covalent bonds.
- Describe a molecule.
- Explain the concepts of compounds, mixtures, and solutions.
- Discuss water as a solvent.
- Understand solubility and other aspects of solutions.

Unit 8: Chemical Formulas and Reactions

- Explain how chemical names are formed.
- Read and understand simple chemical formulas.
- Explain the use of subscripts in chemical formulas.
- Understand the difference between empirical and molecular formulas.
- Define a chemical reaction.
- Describe the law of the conservation of mass (or matter).
- Describe the law of definite proportions.
- Describe Avogadro's Hypothesis.
- Give the value of a mole and describe its purpose.
- Describe the difference between exothermic and endothermic reactions.
- Define the idea of activation energy.
- List the basic types of chemical reactions.
- Explain how valence numbers affect chemical reactions.
- Write a simple chemical formula.
- Balance a simple chemical equation.
- Explain the effects of catalysts on chemical reactions.

Unit 9: Acids and Bases, Water and Soap

- Explain a redox reaction.
- List several types of redox reactions.
- Describe acids and bases.
- Define the concept of pH and identify compounds as acidic or basic by use of their pH numbers.
- Describe neutralization reactions.
- Use the terms strength and weakness properly when discussing acids and bases.
- Discuss the problem of acid rain.
- Discuss the postulates of the Kinetic Theory of Gases.
- Find the gaseous elements on the Periodic Table.
- Understand the physical properties of gases.
- Use several gas laws.
- Explain the use of a barometer.
- Describe the abilities of surfactants.
- Describe the surface tension of water and how it is broken by soap.
- Define the ingredients of soap and describe the method for making it.
- Describe the molecular structure of a soap molecule.
- Describe the characteristics of a detergent.
- Explain the use of water softeners.
- Describe the uses of household chemicals.

Unit 10: Nuclear Power

- Describe the decay of radioactive elements.
- Describe the discovery of radiation.
- Describe the various types of emissions that accompany radioactive decay.
- Describe the change in state caused by elemental decay.
- Explain the terms “parent” and “daughter” nuclides.
- Explain that transmutation involves changing one element into another.
- Describe methods of detecting radiation.
- Explain how the half-life concept is used in radioactive dating.
- Define artificial nuclear decay.
- Describe five different types of collision reactions.
- Describe nuclear fission chain reactions.
- Describe the concept of critical mass.
- Name two nuclear fuels.
- Describe the purposes of three types of nuclear reactors.
- Explain how a nuclear power plant produces electricity.
- Describe the development of nuclear weapons.
- Describe the process and uses of nuclear fusion.
- Describe the fusion process within a hydrogen bomb.
- Discuss attempts to control fusion.
- Explain other uses of radioactivity in medicine and industry.
- Discuss the environmental concerns about radioactivity.

Chemistry

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Course Objective

Chemistry students conduct field and laboratory investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include: characteristics of matter; energy transformations during physical and chemical changes; atomic structure; periodic table of elements; behavior of gases; bonding; nuclear fusion and nuclear fission; oxidation-reduction reactions; chemical equations; solutes; properties of solutions; acids and bases; and chemical reactions. Students will investigate how chemistry is an integral part of our daily lives.

Course Prerequisites or Corequisites

- Biology (required)
- Algebra I (required)

Unit 1: Introduction to the World of Chemistry

- Recognize the benefits of taking Chemistry.
- Understand the reasons for standards in measurement.
- Understand base units and derived units.
- Know the common measurements and their base units in both the English system and in the SI.
- Know the common derived measurements and their units in the SI.
- Know the difference between accuracy and precision.
- Understand the importance of correct measurement procedures when performing an experiment.
- Recall the rules for rounding numbers, learn the rules for writing numerals in science, and learn the rules for working with significant figures.
- Learn how to solve problems using dimensional analysis.
- Understand how to use conversion factors when solving problems involving measurements.
- Review how to use scientific notation when writing very large or very small numbers.
- Describe the scientific methods that lead to theories and scientific laws.
- Learn the steps in the scientific method.
- Read and answer questions about scientific concepts.
- Know the pieces of basic safety equipment in the laboratory.
- Understand the important of safety procedures in the laboratory.
- Be able to identify certain safety signs and symbols.
- Know the Rules for Laboratory Safety.
- Match pictures of laboratory equipment with their names.
- Understand the importance of writing lab reports.

Unit 2: It Really Does Matter About Matter

- Understand the differences between physical and chemical properties of matter.
- Know the definitions of elements, compounds, and solutions.
- Be familiar with the law of conservation of mass.
- Know the symbols for common elements.
- Know the difference between the atomic number, mass number, and atomic mass of an element and be able to determine each.