

PSE 20: INTRODUCTION TO PHYSICAL SCIENCE

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2023
Units:	5
Hours:	4 lecture, 3 laboratory per week (84 total per quarter)
Advisory:	Intermediate Algebra or equivalent.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Area III: Natural Sciences
Transferable:	CSU/UC
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Student Learning Outcomes

- Students will be able to explain the core concepts of physics and chemistry in a way that an audience of middle-schoolers would understand.
- Students will be able to: Utilize every-day materials to demonstrate scientific principles.

Description

This activity-based course provides an introduction to the basic concepts of physical science with emphasis on their practical importance and application in the real world. This course is intended for students who want to become primary school teachers.

Course Objectives

The student will be able to:

- Measure and report the physical properties of matter, including length, area, volume, mass, and density, including significant figures and conversion between units and scientific notation
- Describe basic atomic and molecular structure
- Classify matter as elements, compounds, and mixtures, and describe the properties of each
- Describe solutions, including their concentrations and acidity or basicity
- Apply understanding of the conservation of energy to solve problems in chemistry and physics
- Apply Newton's laws to describe the position and motion of an object
- Understand the wave nature of light and its interaction with matter
- Apply concepts of electricity and magnetism to the construction of simple electric circuits
- Describe basics of solar system astronomy

Course Content

- Measurement and scientific data
 - Fundamentals of measuring and reporting length, area, volume, and mass

- Density of materials
 - The Scientific Method
- Apply the Scientific Method to understand experimental procedures meant to answer defined questions in chemistry and physics
 - Safely generate data and evaluate experimental results
- Basic atomic and molecular structure
 - Atomic theory and basic atomic structure, including relationships between sub-atomic particles
 - Energy levels of an electron
 - Molecular structure: characterization of bonding as metallic, covalent, and ionic
 - Periodic Table of Elements
 - History
 - Organization
 - Periodic trends to atomic structure
 - Classification of matter
 - Elements, molecular compounds, and mixtures
 - Phases of matter (solids, liquids, and gases)
 - Chemical and physical changes
 - Solutions
 - Concentration measurements
 - Acids and bases: definitions and the pH scale
 - Energy and its conservation
 - Basic principles of chemical bonding and chemical reactivity
 - Energy changes during chemical reactions
 - Forms of energy, including solar, chemical, magnetic, electric, nuclear, and thermal
 - Modes of energy transfer from one form to another
 - Newton's laws: motion, forces and energy
 - Motion of objects as related through the concepts of position, displacement, speed, velocity, and acceleration
 - Interpretation of distance vs. time and speed vs. time graphs
 - The relationship between a net force and the motion of an object
 - Explain how action and reaction forces are related to each other
 - Basic forces in the universe, including electrostatic, gravitational, and magnetic
 - The relationship between net force, work, and kinetic energy
 - Electricity and magnetism
 - Electric charge and how charge is transferred from one object to another
 - Models of electric current, voltage, resistance, and their interrelationships
 - The construction and operation of simple electrical circuits and the difference between series and parallel combinations of resistors
 - Waves and light
 - Longitudinal and transverse waves
 - Properties of sound
 - Doppler effect and Interference
 - Electromagnetic radiation (light), the electromagnetic spectrum, and sources of light
 - Relationship between wavelength (or frequency) and color
 - Color perception
 - Reflection and refraction of waves

- i. Astronomy
 - i. Seasons
 - ii. Phases of the moon
 - iii. Eclipses

Lab Content

Laboratory work will include inquiry-based experiments that support the lecture content in each of the following. Chosen experiments meant for prospective teachers to perform in short class periods with minimal investment in materials or setup.

- a. Measurement and scientific data
 - i. Isolating variables and the Scientific Method
 - ii. Measurement and error (precision and accuracy): a simple pendulum
 - iii. Density measurement: density of cola and diet cola
 - iv. Distance and velocity: projectile motion of a dart gun
 - v. Data interpretation:
 - 1. Averages and errors of margin
 - 2. Graphing vectors
 - 3. Evaluating titration curves
- b. Atomic and molecular structure
 - i. Salts and ionic solutions: building a salt-water circuit
 - ii. Acids and bases: structure vs. reactivity: titrating vinegar solutions with standardized sodium hydroxide
- c. Compounds, mixtures, and their properties
 - i. Freezing point depression and boiling point elevation
 - ii. Heat of vaporization of water
- d. Solutions
 - i. Dilutions
 - ii. Measuring molar mass of a weak acid
- e. Conservation of energy
 - i. Roller coasters
 - ii. Build a windmill
- f. Apply Newton's laws to describe the motion of an object
 - i. Marshmallow projectiles
 - ii. Inertia and tablecloths
 - iii. Strings and bowling balls
 - iv. Constant velocity demos/constant acceleration demos
- g. Electricity and magnetism
 - i. Simple circuits with lightbulbs
 - ii. Voltages, currents, and resistors
 - iii. Mapping magnetic fields with iron filings
 - iv. Creating magnetic fields with currents
- h. Waves and light
 - i. The visual spectrum
 - ii. IR and UV: how can we detect light we can't see?
 - iii. Ray tracing and geometric optics
- i. Astronomy
 - i. Modeling the phases of the moon
 - ii. Observation of the phases of the moon
 - iii. Sizes and distance scales in the solar system
 - iv. Star charts: viewing the night sky

Special Facilities and/or Equipment

Physical science lab space for the laboratory portion.

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Exams: short answer and multiple choice
 Quizzes
 Oral presentations
 Cooperative learning assignments
 Lab reports
 Projects
 Computational work
 Computer assignments

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Lecture
 Discussion
 Cooperative learning exercises
 Oral presentations
 Laboratory
 Demonstration

Representative Text(s) and Other Materials

Tillery, B.W.. Physical Science, 12th ed.. 2019.

Nanes, R.. Inquiry into Physical Science: A Contextual Approach, 3rd ed.. 2013.

Hewitt, P., J. Suchocki, and L. Hewitt. Conceptual Physical Science, 6th ed.. 2017.

Hewitt, P., et al.. Laboratory Manual for Conceptual Physical Science. 2011.

Shipman, James T., Jerry D. Wilson, Charles A. Higgins, Jr., and Omar Torres. An Introduction to Physical Science, 15th ed.. 2019.

Shipman, James T., Jerry D. Wilson, Charles A. Higgins, Jr., and Omar Torres. Laboratory Manual to Accompany Introduction to Physical Science, 15th ed.. 2022.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

- a. Weekly reading assignments from text and outside sources ranging from 20-60 pages per week
- b. Completion of short homework sets of 5-15 problems a week
- c. Preparation for in-class oral reports

Discipline(s)

Physics/Astronomy or Chemistry