

SINCE 1823
UNION
UNIVERSITY

Syllabus for Physical Science

Basic Information

Course: Phy 111 - Principles of Physical Science I
Credit: 4 semester hours (lecture & lab)
Prereq: High School algebra II or college math class

Instructor: Dr. Robert E. Duncan
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Dept: Physics

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Note: This is a tentative syllabus and may be revised at the instructor's discretion at any time.

Scope of the Course

The impact of science and technology on modern culture has been so pervasive that some degree of scientific literacy is required to be an informed citizen of today's society. An understanding of the methodology of scientific investigation and the nature of science is important for the comprehension of our modern culture. Science gives rise to technology which increases our standard of living and drives the economies of the world. Understanding interactions between science and other disciplines such as religion, art, philosophy, and music can greatly enhance our appreciation of these areas.

Physical Science encompasses many fields including physics, chemistry, astronomy, and geology. This class focuses on physics and chemistry and provides the basic concepts, which underlie the other sciences, thus providing the foundation blocks upon which all the other sciences can be built. Not only will the great ideas of physical science be studied but attention will also be given to their historical context.

Course Objectives

Simply stated, the general goals for the course are:

1. To become familiar with the great concepts of physics and chemistry.
2. To learn the relationship between observation, experiment, and theory.
3. To understand the role of models in studying the inaccessible world of atoms and galaxies.
4. To acquire the most fundamental laboratory skills of data gathering and develop the ability to logically and mathematically interpret the results of experiments.
5. To appreciate the role mathematics plays in science.
6. To begin to understand the role of science in adding to man's body of knowledge and its relationship to other paths to TRUTH.
7. To understand that there is order and beauty to God's creation, and help us understand our place in it.
8. To appreciate the role of faith in many scientists' lives.

Specific learning objectives are listed at the end of this syllabus. *Review these daily!*

Textbooks and Materials

Required Textbook: *An Introduction to Physical Science* (12th edition) by Shipman, Wilson, Todd

Laboratory manual: *Physical Science Laboratory* Manual by the Physics department

Possible aid - Schaum's Outline Series - *Physical Science* - not required, but contains hundreds of example problems and can be a good supplement if used.

Special Activity

Students will write a 3 page double-spaced typewritten essay entitled: "Science and Faith: Friends or Foes?" Within the body of this report you *must* clearly define the terms 'science' and 'faith'. The essay should cite a minimum of 3 different independent references that were consulted in producing the essay. References may be Scripture, no more than one Internet source, and the remaining source(s) must be books or journal articles.) The essay MUST contain your answer to the question posed in the title. Your opinion will have no effect on your grade.

This report will be graded for grammar, spelling, neatness, and content. The Science & Faith essay will be due **Friday Oct. 3, 2008**. This report will count as 100 homework points. Structure of Essay: 1. Title Page; 2. Three pages of Text; 3. List of References.

Method of Instruction

The course is taught by the lecture/demonstration method. The instructor relies heavily on student participation and this course requires that students thoroughly review class notes after each class meeting and read the portions of the textbook pertinent to the topics that will be discussed before class. Excused missed tests will be made immediately upon returning to school.

Several concepts will be reinforced by experimentation in the laboratory. The student should be familiar with the experimental procedures that will be performed in each experiment before the laboratory period begins. Review each procedure in the laboratory manual before coming to class. Each laboratory experiment will be preceded by a pre-lab lecture (15-20 minutes). Lab reports will be due at the end of each laboratory period or the beginning of the next lab period, and will be the principal determinant of the laboratory component of the course grade. *Failure of the lab is automatic failure of the course.*

Due to the nature of the course, close supervision is required in laboratory. Students are expected to perform the experiment the week it is scheduled. If a student finds it necessary to be absent, arrangements can be made to perform the missed experiment provided the absence is excused (sickness or family trauma). Students are responsible for performing all assigned experiments. Three or more unexcused absences in lab result in an F in the course.

Method of Evaluation

Activities are weighted as follows:

<u>Activity</u>	<u>Percent</u>
3 Major Tests @ 15% each	45.0
Activities/Homework/Quizzes/Participation	20.0
Laboratory Reports/Quiz	15.0
Final Examination	<u>20.0</u>
Total	100.0

Course grade will be assigned utilizing this scale

<u>Total Percentage</u>	<u>Course Grade</u>
At least 90.0	A
80.0	B
70.0	C
60.0	D
Less than 60	F

Late papers will be docked 10% per school day for three (3) days. After three (3) days, a grade of zero will be assigned. No extra credit work will be given. If you have time for extra work, spend it on the course content.

Attendance Policy

It should be recognized that courses of study that are most worthwhile are those that evoke much participation on the part of the student. It is the instructor's opinion that each class meeting will be worthy of the student's attendance. Excessive absences reduce participation and will render impossible the achievement of the course objectives. Students are responsible for all material covered in class and should obtain class notes from fellow class members if absences do occur. It is the student's responsibility to contact the class and laboratory instructor before an impending absence and as soon as possible after an unforeseen absence. A student who is absent from lecture more than two times during the semester will receive a 1% deduction from their semester total for each unexcused absence thereafter. The student should bring a written excuse for excused absences.

Outline of Course

I. Introduction

- A. Definition/description of science
- B. Science, technology, and society
- C. The scientific method

II. Measurement

- A. Systems of measurement-British/metric
- B. Conversion of units
- C. Exponential/scientific notation
- D. Significant figures
- E. Methods of problem solving

III. Motion

- A. Vectors and scalars
 - 1. Displacement and distance
 - 2. Velocity and speed
 - 3. Acceleration
 - 4. Free-fall/sky-diving
 - 5. Circular motion
 - 6. Projectile motion
- B. Newton's laws of motion
 - 1. Concept of force
- C. Newton's law of gravitation
 - 1. Centripetal force-highway curves, satellites
- D. Momentum

IV. Work, Energy, and Heat

- A. Systems of measurement-British/ metric
- B. Conversion of units
- C. Exponential/scientific notation
 - 1. Kinetic and potential
 - 2. Chemical
 - 3. Electrical
 - 4. Solar
 - 5. Nuclear
- D. Heat and temperature
 - 1. Mechanical equivalent of heat
- E. Heat transfer
 - 1. Specific heat and calorimetry
 - 2. Latent heat and change of state
 - 3. Thermal expansion
 - 4. Global warming
- F. Laws of thermodynamics

V. Waves, Sound, Light

- A. Kinds of waves
- B. Sound waves
- C. Hearing and sound
- D. Doppler effect
- E. EM waves
- F. Wave properties for light
- H. Optics

VI. Electricity and Magnetism

- A. Charge and static electricity
- B. Current and electric circuits
- C. Magnetism
 - 1. Superconductivity
- D. Electronics

VII. Matter and its Atomic Properties

- A. Atomic particles and atomic models
 - 1. Democritus-atoms
 - 2. J. J. Thomson-electrons
 - 3. Ernst Rutherford-gold foil experiment
 - 4. Niels Bohr-quantized model
 - 5. Ervin Schrodinger-wave mechanics
 - 6. Electron configuration
- B. Elements and their classification
- C. Periodic chart
 - 1. Groups and periodic characteristics

VIII. Nuclear Physics

- A. The Atomic Nucleus
- B. Radioactivity
- C. Nuclear Reactions
- D. Fission and Fusion

IX. Chemical Bonding

- A. Compound formation
 - 1. Ionic bonding
 - a. Oxidation number and valence
 - b. Formulas (chemical words) and nomenclature
 - 2. Covalent bonding
 - a. Formulas (chemical words) and nomenclature

X. Chemical solutions and reactions

- A. Chemical weights and composition
- B. The mole
- C. Solutions
 - 1. Electrolytes-strong and weak
 - 2. Non-electrolytes
- D. Chemical reactions
 - 1. Chemical equations (chemical sentences)
- E. Rate of reaction
- F. Types of reaction
 - 1. Oxidation-reduction
 - 2. Acids, bases, and salts

XI. Organic and biochemistry

- A. Hydrocarbons-gasoline and its relatives
- B. Polymers
 - 1. Natural biomolecules
 - 2. Synthetic plastics
- C. Drugs and Biochemistry

XII. Current Issues

Laboratory Outline

1. Introduction, Graphing, Density
2. Motion, Velocity, Speed of a Bubble
3. Free Fall & Acceleration of Gravity
4. Newton's 2nd Law
5. Work, Energy, Power & the Pile Driver
6. Specific Heat
7. Electricity and Ohm's law
8. Waves on Strings, Laser Wavelength
9. Spectroscopy & Spectra
10. Nuclear Science & Radioactivity
11. Periodic Table and Chemical change
10. Types of Bonding
11. Percent (%) composition
12. Measurement of pH
13. Lab final

Notes:

The instructor will assume the student can use the computer for word processing and Internet searches. If students need help in this area, they can check with the instructor or the computer help desk.

A tutoring service is available for the student at Union. Check it out if you need help or see your instructor early in the semester. Please don't let pride or sloth make you wait until the last minute.

Specific Learning Objectives

Upon completion of Physical Science 111, the student should be able to do the following:

Introduction

- Distinguish between phenomena and fact
- Define a physical law
- State the scientific method
- Explain three different types of explanations
- Explain the purpose of science in society

Measurement

- Explain the meaning of measurement of a physical quantity
- Define the seven SI (Metric) fundamental units
- Differentiate between derived and basic units
- Convert from SI to English units and vice versa
- Explain and work with powers often notation
- Explain what is meant by dimensional analysis
- Explain how to use dimensions and conversion in a practical way
- Explain and work with mass, volume, and density relationships

Motion

- Define displacement, speed, velocity, and acceleration
- Define motion, uniform motion, average motion, and instantaneous motion
- Distinguish between a scalar and a vector
- Work simple problems involving motion
- Explain what is meant by acceleration of gravity
- Explain projectile motion
- Comment on relative motion and planetary motion
- Explain how motion causes eclipses, day and night, seasons, and tides

Force

- Explain the difference between kinematics and dynamics
- State Newton's three laws of motion
- Give a physical interpretation of Newton's laws
- Define and explain the units of force
- Distinguish between mass, weight, and force
- Define angular velocity and centripetal force
- Distinguish between centripetal and centrifugal force
- Define Newton's law of gravity
- Explain when Newton's gravitational force is significant

Momentum, Energy, and Power

- Define, explain, and give physical interpretation of linear momentum, energy, work, and power
- State the laws of conservation of energy and momentum
- Define and explain kinetic and potential energy
- Distinguish between work and power
- Explain the units of work, energy, and power
- List six forms of energy and discuss energy conversion
- Define angular momentum and give example
- Define efficiency of energy conversion

Temperature and Heat

- Make a statement on the concept of temperature and heat
- Explain relationships between KE, temperature, and heat
- Define and explain three temperature scales
- Convert from one temperature scale to another
- Explain the concept of absolute zero
- Define heat, specific heat, heat capacity, and calorimetry
- Explain what is meant by change of state
- Define the units of heat; calorie, BTU
- Define heat of fusion and heat of vaporization
- Explain sublimation
- Explain three methods of heat transfer
- Discuss thermal pollution
- Discuss the mechanical equivalent of heat
- Define and comment on the first, second, and third laws of thermodynamics
- Define the concept of entropy

Waves, Sound, and Light

- Define different wave types
- Identify the terms used to describe waves
- Distinguish between light and sound waves
- Discuss sound levels and sound limits
- Explain the Doppler effect
- Discuss standing waves and resonance
- Describe reflection and refraction
- Discuss image formation by mirrors and lenses
- Define diffraction and interference and related phenomena
- Explain polarization

Electricity and magnetism

- Name the particles that make up the atom
- State and use Coulomb's law
- Describe two methods of charging a body
- Discuss polarity and charge
- Define electric current, potential, and resistance
- State the three units used in electricity
- Distinguish between a conductor and an insulator
- Distinguish between a series and parallel circuits
- Define electrical power and ohm's law
- Work practical problems using ohm's law and power formula
- Discuss electric shock
- Understand the units of an electric bill
- Explain the causes of a magnetic field
- State the properties of a magnet
- Discuss the earth's magnetic field and its effects
- Explain how an electric generator works
- Explain electromagnetic induction

Atomic Structure

- Define the concept of atomic structure
- Describe the composition of the atom and 4 models man has used
- Distinguish between element, compound, and mixture
- Discuss size, mass, and properties of particles in atom
- Define isotope
- Describe atomic weight, atomic number, isotopic weight, and mass number

Nuclear Physics

- Define an isotope, mass number, atomic number
- Define a stable nucleus
- List and define three types of natural radioactivity
- Discuss half-life
- Explain what is meant by chain reaction
- Explain in general how a nuclear reactor operates
- Distinguish between fission and fusion
- Discuss nuclear waste
- List the biological hazards of radioactivity

The Periodic Table

- List chemical symbols of several elements
- Explain the general character of the periodic table
- State the periodic law
- Distinguish between group and period
- Distinguish between metals and nonmetals
- Define an ion and ionization potential

Compounds and Bonding

- Define a chemical compound
- State the basic assumptions of compound formation
- State the octet rule
- Explain the ionic, covalent, and coordinate covalent bond
- Explain what holds compounds together
- Define oxidation and reduction
- Define a double and triple bond
- Define oxidation number and state its practicability
- Distinguish between a binary and ternary compound

Chemical Formulas and Equations

- Distinguish between a chemical formula and a chemical equation
- Define molecular weight, mole, Avogadro's number
- State the law of definite proportion
- Describe a molecule
- Distinguish between atomic weight and molecular weight
- State Gay-Lussac's law and Avogadro's law
- Write a chemical formula for a compound
- Explain what is meant by a chemical reaction
- Write and balance chemical equations
- Distinguish between endothermic and exothermic reactions

Chemical Reactions

- Distinguish between reactants and products
- List and discuss 5 things that affect reaction rates
- Discuss what is meant by chemical equilibrium

Solutions

- Discuss solubility
- Define a solution, solute, solvent
- Distinguish between chemical and physical changes
- Discuss the theory of ionization
- Distinguish between an acid, a base, and a salt
- Explain neutralization

Solutions (Continued)

- Explain the pH scale
- Calculate the molarity of a solution
- Discuss the soaps and detergents in terms of acids and bases
- Discuss environmental pollution from chemical viewpoint

Organic Chemistry

- Define organic chemistry
- List the alkane group
- Explain the nomenclature of alkanes

Environment

- Discuss three current environmental problems