Course Outline

Introduction to Physical Science — Course Title

SC119 — Dept. and Course No.

I. Course Description:
This course provides students with an introduction to the physical environment. The course covers introductory concepts in the areas of physics, chemistry, and earth and space sciences. Concepts covered in the physics unit of this course include quantitative measurements and calculations of forces and motion, work and energy, temperature and heat, and waves. Chemistry unit introduces students to the theories of atomic structure, fundamentals of matter, periodic table, and the general types of chemical reactions. The course concludes with the evolution of the universe and our solar system, and understanding of the tectonic geological processes that shapes our planet Earth.

II. Semester Credits: 4

III. Contact Hours Per Week: 3 Lec | 3 Lab | 6 Total

Total Course Hours: 96

IV. Prerequisites: MA103 and EN100

V. Student Learning Outcomes:
Upon completion of this course, students will be able with 65% Accuracy to:

1. Define ***science*** and explain its limitations; identify and describe the two major divisions of natural sciences; identify and describe the five major divisions of physical science
2. Apply the same processes that professional scientists use (scientific method of investigations) to solve problems; learn and apply laboratory safety rules that demonstrates sense of maturity and respect for self, peers, and the college properties and facilities; when performing experiments; communicate investigation findings in formal written science reports
3. Measure and describe objects and phenomena in the physical world using metric system and British system; know the most common pre-fixes in the metric system, their symbols and values;

VI. Course Content

A. Science
   1. The Physical Science
   2. Methods of scientific investigations
   3. Communicating results of investigations

B. Measurements
   1. Systems of Measurements
   2. Derived Units & Conversion Factors
   3. Significant Figures

4. Define derived units; apply conversion factor to convert measurements between different measurement systems

5. Explain the purpose of significant figures; explain why mathematical results are rounded; apply the rules of significant figures and rounding to express calculated values in problem-solving, and express measurements and calculations from lab investigations

C. Physics

1. Motion

6. Explain what is needed to describe a position; describe motion; compare distance and displacement; differentiate between speed and velocity;

7. Calculate average speed, velocity, and acceleration of objects moving horizontally, vertically, in circular motion, as projectile, and in free-fall

8. Discuss causes of motion

2. Force and Motion

a. Newton's three Laws of Motion

9. Discuss Newton's three laws of motions, Newton's law of universal gravitation, laws of linear and angular momentum, and buoyant force

b. Newton's Law of Gravitation

c. Law of Conservation of Momentum (linear and angular)

10. Define ***force***; describe the different types of forces (weight, friction, gravity, and buoyancy)

d. Archimedes' Principle and Buoyancy

e. Momentum

11. Calculate acceleration with two applied force; compute weight; state the value of gravity on Earth;

12. Calculate and demonstrate the applications of the following laws in everyday situations: Newton's law of gravitation in calculations, conservation of linear and angular momentum

3. Work & Energy

a. Work

13. Give scientific definitions to the following, and relate by computations these properties and apply appropriate units of measurements for each: work, potential energy, and kinetic energy

b. Potential & Kinetic Energy

c. Power

14. Relate work and power; calculate power; compute energy consumed

d. Forms of Energy & Consumption

(1) Alternative

15. Describe the common forms of energy

16. Differentiate between alternative and renewable sources of energy and provide examples

17. Differentiate between *temperature* and *heat*.

18. Describe the differences between the three common temperature scales (Celsius, Kelvin, & Fahrenheit); convert temperatures between these three scales

19. Give scientific definitions to the following terms: *heat, specific heat, latent heat*; quantify these properties and use the appropriate units of measurements for each; use specific heat of substances to compute amount of heat absorbed by or released from a system; use latent heat to calculate heat required to change phases of a substance; describe the three methods of heat transfer and give examples of each

20. From a molecular point of view, define the three common phases of matter in terms of shape and volume

21. Summarize the Kinetic Theory of Gases; relate temperature and pressure of gases; relate temperature and molecular speed of gases;

22. Summarize the three laws of thermodynamics and demonstrate their applications

23. Describe the causes of waves; explain how and what they propagate

24. Distinguish differences between longitudinal and transverse waves; describe and calculate, using proper units, the following properties of a wave: wavelength, amplitude, frequency, period, and velocity; relate frequency and period of a wave;

25. Explain how the electromagnetic spectrum is arranged and state the speed of light in vacuum; compute wavelength of different types of light waves on the EM spectrum

26. Provide the technical description of *sound*; describe the sound spectrum and determine frequency range of human hearing; define sound *intensity (I)* and give

    (2) renewable

4. Temperature & Heat
    a. Temperature
    b. Heat
        (1) Specific heat
        (2) Latent heat
        (3) Heat transfer
    c. Phases of matter
    d. Kinetic Theory of Gases
    e. Thermodynamics

5. Waves and Sound
    a. Waves & Energy propagation
    b. Wave Properties
    c. Light Waves
    d. Sound Waves

its proper unit; describe the following: *Doppler Effect, standing waves, resonance*

27. State the speed of sound in air at 20°C and calculate the speed of sound at different temperatures

D. Atomic Physics

1. Early Concepts of the Atom
2. Dual nature of Light
3. Bohr's Theory of hydrogen atom
4. Heisenberg's Uncertainty Principle
5. Matter Waves or de Broglie waves
6. Electron Cloud Model

28. Explain the developments in physics that led to the early models of the structure of the atom: ***Dalton's model, Thomson's model,*** and ***Rutherford's model***

29. Describe the studies of nature of light conducted by Max Planck and Albert Einstein and how they contributed to the development of the modern atomic structure

30. Describe Bohr's theory of a hydrogen atom and how a hydrogen atom emits radiant energy; explain the ***principal quantum number*** (*n*) in Bohr Theory and what it designates

31. Describe the Heisenberg's Uncertainty Principle and the de Broglie waves and how they contributed to the development of the modern atomic structure

32. Describe the principle of the Electron Cloud Model

E. Nuclear Physics

1. Symbols of the Elements
2. Atomic nucleus
   a. Protons, neutrons, nucleons, and electrons
   b. Atomic number, neutron number, mass number, isotopes,
   c. Atomic mass
   d. Nuclear force

33. Explain how the concept of the element arose and how elements and their nuclei are expressed in symbols; know the names and symbols of the thirty-five (35) most common elements

34. Describe the fundamental particles of an atom (nucleus, proton, neutron, electron), who and when each was discovered each; describe nucleons

35. Use the following to determine the number of protons, electrons, and neutrons in an atom: atomic number, mass number; define isotope and ion; explain atomic mass and how it differs from atomic number; explain how the nucleus of an atom is held together

F. Chemistry

1. Chemistry in Life
2. Classification of Matter
3. Discovery of Elements
4. Occurrence of Elements
5. Periodic Table
6. Groups of Elements
7. Naming Compounds

36. Define chemistry; describe applications of chemistry in everyday life; and identify some of the careers in the field chemistry

37. Define matter; differentiate and give examples of the following: element, compound, homogeneous mixture or solution, heterogeneous mixture

38. Describe and give examples of the following: saturated solution, unsaturated solution, and supersaturated solution; define solubility and explain how it varies with temperature of solution

39. State the number of known elements at the present; state the number of naturally occurring elements and their occurrence on the Modern Periodic Table; describe Dmitri Mendeleev's first table of elements—its usefulness and weaknesses; describe the relationship between valence electrons and chemical groups;

40. Describe properties of the following groups and their placement on the modern periodic table: alkali metals, alkaline earth metals, transition metals, inner transition metals, metalloids, halogens, noble gases, and hydrogen

41. Describe the trends on the periodic table of elements as you move across a period, and up and down in a group: number of valence electrons, electron configuration, atomic size, atomic radii, ionization energy, electron affinity

42. Apply IUPAC nomenclature guidelines to name compounds of metal and nonmetal, two nonmetals, polyatomic ions, organic compounds, and compounds with special names

43. Discuss the two laws that describe mass relationships in compounds; explain why Antoine Lavoisier called "The Father of Chemistry"

44. Summarize Dalton's Atomic Theory

8. Chemical Bonds
   a. Law of Conservation of Mass
   b. Law of Definite Proportions
   c. Dalton's Atomic Theory

45. Identify, describe, and predict the different types of chemical bonds that form between atoms: ionic bond, nonpolar covalent bond, and polar covalent bond; describe hydrogen bond

46. Show Lewis symbols of cations, anions, and nonmetal atoms; predict bonding type formed; write formulas for compounds and molecules; name the compounds and molecules;

47. predict type of covalent bonding; show polarity of bonds; Use VSEPR to predict molecular shapes of molecules

d. Ionic Bonding

e. Covalent Bonding

G. Structural Geology and Plate Tectonics

1. Earth's Interior Structure
2. Continental Drift and Seafloor Spreading
3. Plate Tectonics
4. Plate Motions and Volcanoes
5. Earthquakes
6. Crustal Deformation and Mountain Building

48. Define ***geology***; identify and describe composition of the four regions of the Earth's interior

49. Describe the continental drift and seafloor spreading; identify evidences used to support these theories; explain the limitations of continental drift when it was proposed

50. Summarize the theory of plate tectonics; explain how tectonic plates are able to move; describe the geologic features created at the different plate boundaries

51. Define ***volcano***; explain why they occur near boundaries of ocean and continental plates; describe and give examples of the different types of volcanoes

52. Explain the causes of earthquakes; define *focus* and *epicenter* of earthquakes; explain how earthquake focus and epicenter are locates; describe how earthquake magnitudes are measured

53. Explain primary cause of mountain building; describe the three principle kinds of mountains and give examples of each

H. Mineral, Rocks, & Volcanoes

1. Minerals
2. Rocks

54. Describe the properties of a mineral; differentiate between silicates and non-silicate minerals; perform the following field test of properties to identify

minerals: degree of hardness using the Mohs scale, cleavage, fracture, color, streak, luster

55. Define *rock*; explain and illustrate the rock cycle; describe the characteristics of the three types of rocks (igneous, sedimentary, and metamorphic) and give examples

56. Describe what erupts from a volcano; describe the different types of magma and eruptive style; explain hot spots;

a. Igneous Rocks

(1) Igneous Activity and Volcanoes

b. Sedimentary Rocks

c. Metamorphic Rocks

VII. MATERIALS AND EQUIPMENT

A. Science Laboratory and related equipments
B. Audio Visual Equipments (TV, VCR, DVD player)
C. Standard classroom teaching supplies & equipment
D. Laptop
E. LCD Projector
F. Prepared handouts
G. Internet access for instructor and students

VIII. TEXTS

A. Student Textbook:

Shipman, James T., Jerry D. Wilson, Charles A. Higgins, Jr., and Omar Torres. (2016) An Introduction to Physical Science 14th ed. Boston, MA: Cengage Learning.

IX. METHODS OF INSTRUCTION

A. Lectures
B. Online course website companion
C. Class demonstrations
D. Lab investigations/experiments
E. Individual and small group problem-solving assignments
F. Use of multimedia resources

X. METHOD OF EVALUATION

A. At the end of the semester all points will be totaled and properly weighted based on the following scale:

Quizzes & Tests	15%
Assignments	10%
Laboratory	25%
Midterm Exam	20%
Final Exam	25%

Participation	05%
Total	100%

B. Weighted semester grade will correspond to the following conversions:

90-100%	A
80-89%	B
70-79%	C
65-69%	D
00-64%	F

Form NC-2

Task List Sheet

SC119 Introduction to Physical Science — Credits: 3 (Lec) 1 (Lab) 48 (Total Lab Hrs.)

Course No. & Title

LAB OBJECTIVES and TASKS	HOURS
1. **SLO #2:** Lab Safety and the Scientific Method a) Orient students on lab safety b) Demonstrate use of lab safety equipment	3
2. SLO #2-5: Demonstrate the scientific investigation process and discuss expectations for a formal written science report a) Test a hypothesis in a simple investigation b) Record observations c) Make tables and graphs to organize data d) Analyze results e) Draw conclusion f) Communicate findings of experiment in a science report following set guidelines for this course	3
3. **SLO #2-5:** Measurements, Ratio, & Graphing a) Use laboratory tools and instruments to measure fundamental properties (length, mass, and time) in the physical world and express quantities in fundamental units b) Use basic fundamental units of measurements to calculate derived quantities such as area, volume, velocity, density, and ratio c) Investigate how measurement data are simplified in order to generalize trends in the data; compare data concerning two quantities as a ratio d) Calculate percent error of calculated values e) Collect, analyze data, and communicate findings in scientific report	3
4. **SLO #2, 5-7:** Projectile Motion a) Analyze and describe motion with a constant velocity b) Analyze and describe motion with a non-constant velocity c) Split a projectile motion of a ball into horizontal and vertical parts d) Calculate and predict the distance that the ball will land when it is projected from a stationary point e) Collect, analyze data, and communicate findings in scientific report	3
5. **SLO #2, 5, 4:** Work & Power a) Conduct an experiment to measure work done and rate at which work is done when a person is walking and running over a determined distance b) Use data from experiment to calculate horsepower rating for a person walking and running. c) Collect, analyze data, and communicate findings in scientific report	3
6. **SLO #2, 5 & 19:** Specific Heat a) Determine the specific heat of three samples of different metals by using calorimetry b) Running at least two trials on each sample, make very careful temperature and mass measurements c) Record measurements and all calculations in the proper number of significant digits d) Calculate percent error of calculated specific heat values	3

e) Collect, analyze data, and communicate findings in scientific report

7. **SLO #2, 5, 23, 24, & 26:** Investigating Sound Waves — 3
   a) Study properties of waves
   b) Demonstrate the fundamental properties of waves
   c) Investigate the production and transmission of sound using tuning forks
   d) Understand the meaning of amplitude, frequency, and wavelength
   e) Demonstrate the phenomenon of beats and resonance using tuning forks
   f) Investigate the Doppler Effect using a tuning fork
   g) Collect, analyze data, and communicate findings in scientific report

8. **SLO #2, 5, 42, 45, & 46:** Physical and Chemical Changes — 6
   a) In a series of simple experiments, determine if certain changes in matter are physical or chemical changes
   b) For all chemical changes, draw Lewis structures for all reactants, and predict products; write the formula of each product; apply IUPAC rules and name the products
   c) Collect, analyze data, and communicate findings in scientific report

9. **SLO #30-32:** Quantum Mechanics and Electron Cloud Model — 3
   a) Describe the electron cloud model and the sets of quantum numbers used to locate electrons in an instant
   b) Determine complete and abbreviated electron configurations for various atoms

10. **SLO #33, 39-42**: Elements, Periodic Table, and Nomenclature — 6
    a) Complete supplemental activities that emphasize memorization of names of elements and their symbols
    b) Complete supplemental activities to illustrate the history and development of the Modern Periodic Table
    c) Construct a periodic table and using different colors perform the following tasks:
       i) Classify atoms as metals, nonmetal, metalloids, inner transition metals
       ii) Arrange the atoms in the following groups and label the group accordingly:
           (1) Alkali metals
           (2) Alkaline earth metals
           (3) Halogens
           (4) Nobles gases
    d) Identify elements that are gases and liquid at room temperature and at 1 atm
    e) Create a legend for your periodic table
    f) Apply nomenclature rules and practice naming ionic compounds and molecules
    g) Practice naming compounds and molecules from given formulas.

11. **SLO #45-47:** Chemical Bonding — 3
    a) Write symbols for metal and nonmetal reactants in an ionic bond; draw Lewis structures for each reactant in a reaction; use arrows to show the transfer of valence electrons; write charges on the ions; write resulting formula; name the product of the ionic bond
    b) Write the symbols for each nonmetal reactant in a covalent bond; draw Lewis structures for each reactant; draw circles to show the sharing of electrons between pairs of atoms; draw the bond structure using chemical symbols and lines; write the chemical formula for each molecule formed; name the molecule

12. **SLO #49-53:** Plate Tectonics — 3
    a) Research the distribution of earthquakes and volcanoes and plot them on a map of the world
    b) Identify the different types of plate boundaries on the map of the world and associate

tectonic activities at these boundaries	
13. **SLO #2, 5, 54:** Minerals a) Perform the following tests on mineral samples and identify each sample based on the results of the tests: degree of hardness using the Mohs scale, cleavage, streak, luster b) Collect, analyze data, and communicate findings in scientific report	3
14. **SLO #2, 55**: Rocks a) Conduct an experiment to compare and contrast physical properties of basalt and granite rocks b) Collect, analyze data, and communicate findings in scientific report	3

COURSE LEARNING OUTCOMES
SC119 Introduction to Physical Science
PALAU COMMUNITY COLLEGE

During the course experience, the **course learning outcomes (CLOs)** will be assessed through the use of signature assignments. A rating scale will be used to determine the students' proficiency level of each CLO using specifically aligned assignments. The numerical ratings of 4, 3, 2, and 1 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on the level of student performance for each of the course learning outcomes listed below.

RATING SCALE:
4– Accomplished 3 – Competent 2 – Developing 1 – Beginning

CLO #1 – SCIENTIFIC INVESTIGATION: Students will be able to develop abilities that are necessary to properly conduct scientific investigations, gather and analyze data, and present findings in a formal written report

4	**70% or more of students completed the following with 90% accuracy or better:** applies all the steps of scientific inquiry to conduct scientific investigations: test a hypothesis, gather, organize in tables and graphs, and analyze results, discuss findings and draw conclusions, and present findings in a formal written report
3	70% or more of the students complete all of the above with 70-89% accuracy
2	70% or more of the students complete all of the above with 65-69% accuracy
1	70% or more of the students complete all of the above with less than 65% accuracy

CLO #2 – SCIENTIFIC MEASUREMENTS: Student is skilled in acquiring quantitative data from laboratory and field procedures to describe dimensional objects or events

4	70% or more of all students completed the following with 90% accuracy or better: apply and use SI units when gathering and reporting measurements; able to convert within and between the English and SI system of measurement using conversion-factor method; demonstrate ability to use equations and derive equations to calculate and describe quantitatively dimensional objects and events; able to record measured date, calculate quantitative data, and report calculations in scientific notations to the proper significant figures; capable to converting conventional numbers to scientific exponential forms.
3	70% or more of the students complete all of the above with 70-89% accuracy
2	70% or more of the students complete all of the above with 65-69% accuracy
1	70% or more of the students complete all of the above with less than 65% accuracy

CLO #3 – SCIENTIFIC KNOWLEDGE: Students integrate, analyze, and apply all of the basic scientific concepts and principles of physical science in the areas of physics, chemistry, and geology

4	**70% or more of students completed the following with 90% accuracy or better:** analyze and apply concepts of forces and motion, energy and work, temperature and heat, and waves; demonstrate knowledge of the nature of matter, its properties, and interactions; demonstrates knowledge of the structure of the earth and basic internal processes that shape our planet earth
3	70% or more of the students complete all of the above with 70-89% accuracy
2	70% or more of the students complete all of the above with 65-69% accuracy
1	70% or more of the students complete all of the above with less than 65% accuracy

CLO #4 – CRITICAL THINKING: Student demonstrates ability to use process skills, critical thinking, scientific reasoning and strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday contexts.

4	**70% or more of completed the following with 90% accuracy or better:** demonstrate ability to select and use appropriate problem-solving strategies to solve (unseen) problems; communicate and defend scientific arguments with clarity and precision.
3	70% or more of the students complete all of the above with 70-89% accuracy
2	70% or more of the students complete all of the above with 65-69% accuracy
1	70% or more of the students complete all of the above with less than 65% accuracy