CENTRAL TEXAS COLLEGE
SYLLABUS FOR PHYS 1415
PHYSICAL SCIENCE I

Semester Hours Credit: 4

INSTRUCTOR: ________________________

Office Hours: __________________________

I. INTRODUCTION

This course, is designed for the first-year college non-science major, emphasizes the basic concepts in Physics, Chemistry, Earth Science and Astronomy. A student who completes this course satisfactorily receives four semester hours credit that should be applicable towards degrees which require four semester hours of science. This course will definitely stimulate student interest in the sciences and present the information and skills students need to cope in today's world. The course provides real-world examples of physical science to enhance the student's understanding of their natural world. A number of hands-on activities and demonstrations are designed to help students to learn their lessons in this course.

II. OVERALL OR GENERAL OBJECTIVES OF THE COURSE

Upon successful completion of this course, Physical Science I, the student will be able to:

A. Perform basic mathematical operations associated with Physics, Chemistry, Geology, and Astronomy.

B. Discuss motion and apply it in solving real life problems.

C. Describe the relationship between force and motion, work, energy momentum and impulse.

D. Discuss the difference between temperature and heat.

E. Explain matter in terms of atoms and molecules.

F. Describe Electric & Magnetic phenomenon in nature.

G. Explain the concepts of waves & vibrations, sound & music, electromagnetic waves & light.

H. Discuss various chemical reactions among various inorganic materials.
I. Define organic chemistry and describe different organic reactions.

J. Describe atmosphere and its dynamics.

K. Discuss Geology, Geologic time and Rock Cycle.

L. Describe the origin of the solar system.

M. Explain the origin of the Universe.

N. Understand the critical mass of the Universe and its Fate.

O. Comprehend the Special and General relativity.

P. Explain the geometry of the Universe.

III. INSTRUCTIONAL MATERIALS

Text:
The instructional materials identified for this course are viewable through www.ctcd.edu/books


B. A scientific Calculator.

C. Other materials assigned or provided by the instructor.

IV. COURSE REQUIREMENTS

A. Normally a grade of "C" or better must be earned for transfer to other colleges or universities.

B. The final exam will be comprehensive. The student must begin to prepare for this exam at the first class meeting.

C. The course grade is determined primarily by grades on unit exams and the final exam. Class participation and initiative will also be reflected in the grade.

D. The student should plan to spend two to three hours of study for each class period. This time should be devoted to completing class assignments, reviewing class notes, re-reading the material in the book, previewing material for the next class and
reviewing errors made on past assignments and exams.

E. The student is expected to take adequate lecture notes and to review them as soon as possible after they are taken. Do not attempt to write every word, use key phrases and a logical method of organization.

V. EXAMINATIONS

There will be five unit exams given at the times announced. Lowest exam score will be dropped. Missed exams will not be made up under any circumstances. There will also be a comprehensive final exam. The final exam cannot be missed.

VI. SEMESTER GRADE COMPUTATION

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Exams</td>
<td>50%</td>
<td>90 - 100 = A</td>
</tr>
<tr>
<td>Final</td>
<td>10%</td>
<td>80 - 89 = B</td>
</tr>
<tr>
<td>Quizzes</td>
<td>10%</td>
<td>70 - 79 = C</td>
</tr>
<tr>
<td>Home Works</td>
<td>10%</td>
<td>60 - 69 = D</td>
</tr>
<tr>
<td>Labs</td>
<td>20%</td>
<td>0 - 59 = F</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM COURSE INSTRUCTOR

A. Withdrawal from course: It is the student's responsibility to officially drop a class if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file an Application for Withdrawal or an Application for Refund. The withdrawal form must be signed by the student.

Application for Withdrawal will be accepted at any time prior to Friday of the 12th week of classes during the 16 week fall and spring semesters. The deadline for sessions of other lengths is as follows.

- 11 week session: Friday of the 8th week
- 8 week session: Friday of the 6th week
- 51/2 week session: Friday of the 4th week

The equivalent date (75% of the semester) will be used for session of other lengths. The specific last day to withdraw is published each semester in the Schedule Bulletin.

Students who officially withdraw will be awarded the grade of "W", provided the student's attendance and academic performance are satisfactory at the time of official withdrawal. Students must file a withdrawal application with the college before they may be considered for withdrawal.
A student may not withdraw from a class for which the instructor has previously issued the student a grade of "F" or "FN" for non attendance.

B. **An Administrative Withdrawal:** An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on the Administrative Withdrawal Form for submission to the registrar.

*The following specific rules apply to absences:* Each instructor shall keep a record of class attendance. An administrative withdrawal will be submitted when student’s absences exceed **eight (8)** class meetings, and in the opinion of the instructor, the student cannot satisfactorily complete the course. The final decision rests solely with the instructor. The instructor will note administrative withdrawals as the grade of “F Non-Attendance” on the roll and record book. As a matter of policy, administrative excuses from classes are not provided for any reason. Regardless of the nature of the absence, students are responsible for completing all course work covered during any absence.

C. **An Incomplete Grade:** The College catalog states, "An incomplete grade may be given in those cases where the student has completed the majority of the course work but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course..." Prior approval from the instructor is required before the grade of "I" is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an "F" for the course.

D. Disability Support Services provide services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Explore the website at [www.ctcd.edu/disability-support](http://www.ctcd.edu/disability-support) for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

VIII. COURSE OUTLINE

A. Unit One: Mechanics

1. **Unit Objectives:** After completing this unit the student will be able to:
   a. distinguish between scalar and vector
   b. distinguish between speed and velocity
   c. solve problems that involve distance, time and speed
   d. distinguish between average and instantaneous velocity
e. describe how acceleration is related to velocity  
f. give the units of speed, velocity, linear acceleration, and centripetal acceleration in the SI system  
g. state Galileo's observation on freely falling objects  
h. state Newton's first law of motion  
i. discuss the significance of the second law of motion, \( F = ma \)  
j. use the third law of motion to relate action and reaction forces  
k. explain the significance of centripetal force in motion along a curved path  
l. define the terms work, energy and power  
m. distinguish between kinetic energy and potential energy  
n. state the principle of conservation of energy  
o. define and use the following terms: inertia, mass, motion, position, displacement, speed, velocity, scalar, vector, acceleration, force, gravity, momentum, impulse, weight, torque, work, energy, joule, kinetic energy, potential energy, power, watt  

2. **Learning Activities:**

a. Classroom lectures/discussions  
b. Student homework study  
c. Demonstration  
d. Laboratory exercises  

3. **Unit Outline:**

a. motion in a straight line  
b. distance, time and speed  
c. displacement, time and velocity  
d. scalar and vector quantities  
e. acceleration  
f. acceleration in the free fall, air resistance  
g. acceleration in uniform circular motion  
h. projectile motion  
i. Newton's first law of motion  
j. mass, a measure of inertia  
k. Newton's second law of motion  
l. force, mass and acceleration  
m. weight is a force  
n. Newton's Law of Gravity  
o. Newton's third law of motion  
p. meaning of action-reaction force  
q. circular motion  
r. artificial Satellites
s. the meaning of work
t. the rate of doing work, power
u. the Kinetic energy
v. the Potential energy
w. the Energy Transformation
x. the Conservation of Energy.
y. forms and sources of energy.
z. linear momentum.
aa. momentum conservation
bb. angular momentum
cc. Relativity

B. Unit Two: Matter, Temperature and Heat.

1. Unit objective: Upon successful completion of this unit the student will be able to:

a. distinguish between heat and temperature
b. explain how a temperature scale is constructed with reference to the three major scales
c. convert from one temperature scale to another using the appropriate formulas
d. explain the units of heat and the food calorie
e. define density and calculate the mass of a body of matter given its density and volume
f. define pressure and account for the increase in pressure with depth in a liquid or gas
g. state Archimedes' principle and explain its origin
h. use Boyle's law to relate pressure and volume changes in a gas at constant temperature
i. use Charles' law to relate temperature and volume changes in a gas at constant pressure
j. explain the significance of the absolute temperature scale and the meaning of absolute zero
k. show how the ideal gas law is related to Boyle's law and Charles' law
l. state the three basic assumptions of the kinetic theory of gases
m. discuss the connection between temperature and molecular motion
n. explain the molecular structure of the solid, liquid, and gas phases of matter
o. distinguish between evaporation and boiling
p. explain what is meant by heat of vaporization and by heat of fusion
q. distinguish between heat engines and heat pumps, and compute ideal efficiency of a heat engine
r. state and explain the three laws of thermodynamics
s. define and explain the important words and terms listed below:
temperature, heat, heat engine, radiation, thermometer, calorie,
thermal efficiency, solid, thermal expansion, kilocalorie, ideal
efficiency, lattice, ice point, BTU, 2nd law, liquid, steam point,
specific heat, 3rd law, gas, Fahrenheit scale, latent heat of fusion, heat
pump, pressure, EF, melting point, entropy, isothermal process,
Celsius scale, latent heat of vaporization, conduction, Boyle's law,
EC, boiling point, thermal conductivity, perfect gas law, Kelvin scale,
sublimation, thermal insulator process, isometric, Kelvin, 1st law,
convection, Charles' law

2. Learning Activities:
a. Classroom lectures/discussions
b. Student homework study
c. Demonstrations
d. Laboratory exercises

3. Unit Outline:
a. temperature, its meaning and measurement in various temperature
   scales
b. heat, a form of energy
c. units of heat
d. the energy of people and animals - metabolism
e. solids, liquids and gases
f. volume and density
g. pressure, unit of pressure & barometers
h. buoyancy and Archimedes' principle
i. Boyle's law, Charles' law and ideal gas law
j. kinetic theory of gases
k. molecular motion and temperature
l. the changes of State of Matter
m. intermolecular forces
n. evaporation and boiling
o. heat of vaporization
p. melting
q. heat of fusion
r. turning heat into work - heat engine
s. the laws of thermodynamics
t. fate of the universe - order into disorder
u. entropy

C. Unit Three: Electricity and Magnetism
1. **Unit Objectives:** Upon successful completion of this unit the student will be able to:

   a. discuss what is meant by electric charge
   b. describe the structure of an atom
   c. state Coulomb's law for electric force and compare it with Newton's law of gravity
   
   d. account for the attraction between charged object and an uncharged one
   e. distinguish among conductors, semiconductors and insulators
   f. define ion and give several ways of producing ionization
   g. explain why grounding the metal shell of an electrical appliance makes its use safer
   h. define superconductivity and discuss its potential importance
   i. describe electric current and potential difference (voltage) by analogy with the flow of water in a pipe
   j. use Ohm's law to solve problems that involve the current in a circuit, the resistance of the circuit, and the voltage across the circuit
   k. relate the power consumed by an electrical appliance to the current in it and the voltage across it
   l. describe what is meant by a magnetic field and discuss how it can be pictured by field lines
   m. state the connection between electric charges and magnetic fields
   n. explain how an electromagnet works
   o. describe the force a magnetic field exerts on an electric current
   p. discuss the operation of an electric motor
   q. describe electromagnetic induction and explain how a generator makes use of it to produce an electric current
   r. distinguish between direct and alternating current
   s. explain how a transformer works and why it can only be used with alternating current
   t. explain how a tape recorder works

2. **Learning Activities:**

   a. Classroom lectures/discussions
   b. Student homework study
   c. Demonstration
   d. Laboratory exercises

3. **Unit Outline:**
a. positive and negative charge
b. protons, electrons and neutrons
c. the law of force for static electric charges known as Coulomb's law
d. force on an uncharged object
e. electricity and matter
f. conductors and insulators
g. superconductivity
h. electric current - the ampere
i. potential difference
j. Ohm's law - relationship among current, voltage, and resistance
k. electric power
l. magnetic poles
m. magnetic field
n. Oersted's experiment
o. electromagnet
p. magnetic force on a current
q. electric motors: mechanical energy from electric energy
r. generator: electric energy from mechanical energy
s. transformers: stepping voltage up or down
t. tape recorders: storing and reproducing sights and sounds

D. **Unit Four: Wave Motion**

1. **Unit Objective:** Upon successful completion of this unit the student will be able to:

   a. state what a wave is and give examples of different kinds of wave
   b. distinguish between transverse and longitudinal waves
c. discuss the nature of sound
d. use the formula $v = \lambda f$ to relate frequency and wavelength of a wave to its speed
e. explain what is meant by the refraction and the reflection of waves
f. distinguish between constructive and destructive interference
g. describe the diffraction of waves at the edge of an obstacle
h. state what the Doppler effect is and explain its origin
i. describe the various ways in which musical instruments produce sound
j. discuss the nature of electromagnetic waves and give examples of different types of such waves
k. distinguish between amplitude and frequency modulation
l. state what the ionosphere is and explain its role in radio communication
m. explain how a radar works
n. describe what is meant by a light ray
o. explain how a mirror produces an image
p. explain how refraction makes a body of water seem more shallow than it actually is
q. describe internal reflection and its use in piping light through a glass fiber
r. define lens and distinguish between converging and diverging lenses
s. account for the dispersion of white light into a spectrum when it is refracted
t. discuss the origin of rainbows
u. explain why the sky is blue
v. explain why thin films of soap or oil are brightly colored
w. describe the effect of diffraction on the sharpness of the images produced by optical instruments

2. **Learning Activities:**

a. Classroom lectures/discussions
b. Student homework study
c. Demonstration
d. Laboratory exercises

3. **Unit Outline:**

a. definition of wave
b. categories of waves: mechanical waves and electromagnetic waves
c. water waves: crest and troughs
d. transverse and longitudinal waves
e. sound: pressure waves in a solid, liquid or gas
f. wavelength, frequency and speed of a wave
g. refraction: a change in direction produced by a change in speed
h. reflection: rebounding from an obstacle
i. constructive and destructive interference
j. diffraction
k. Doppler effect
l. musical sounds
m. electromagnetic waves
n. amplitude modulation and frequency modulation
o. how radar works
p. light and light rays
q. reflection of light
r. refraction of light
s. lenses, prisms: bending & dispersion of light
t. interference of light
u. diffraction of light

E. Unit Five: Nucleus & Atoms

1. Unit Objective: Upon successful completion of this unit the student will be able to:
   a. discuss the connection between the Rutherford experiment and the modern picture of atomic structure
   b. distinguish between nucleon and nuclide and between atomic number and mass number
   c. state in what ways the isotopes of an element are similar and in what ways they are different
   d. describe the various kinds of radioactive decay and explain why each occurs
   e. define half-life
   f. discuss the sources and hazards of the ionizing radiation we are exposed to in daily life
   g. explain the significance of the binding energy of a nucleus
   h. draw a graph of binding energy per nucleon versus mass number and indicate on it the location of the most stable nucleus and the range of mass numbers in which fusion
   i. discuss nuclear fission and the conditions needed for a chain reaction to occur
   j. describe how a nuclear reactor works
   k. explain why there is much interest in breeder reactors
   l. discuss the good and bad feature of nuclear reactors as energy sources
   m. describe nuclear fission and identify the conditions needed for a successful fusion reactor
   n. compare a particle with its antiparticle
   o. describe the processes of annihilation and pair production
   p. state what is meant by antimatter and give the reason why little, if any, antimatter is thought to be present in the universe
   q. list the four fundamental interactions and identify the aspects of the universe that each governs
   r. distinguish between leptons and hadrons and discuss the quark model of hadrons
   s. describe the photoelectric effect and discuss why the wave theory of light cannot account for it
   t. explain how the quantum theory of light accounts for the photoelectric effect
   u. compare the quantum and wave theories of light and discuss why both are needed
   v. describe x-rays and interpret their production in terms of the quantum theory of light
w. discuss what is meant by the matter wave of a moving particle
x. state the uncertainty principle and interpret it in terms of matter waves
y. distinguish between emission and absorption spectra
z. give the basic ideas of the Bohr model of the atom and show how they follow from the wave nature of moving electrons
aa. define quantum number, energy level, ground state, and excited state
bb. explain how a laser works
cc. list the three characteristic properties of laser light
dd. compare quantum mechanics and Newtonian mechanics
e. describe what is meant by the probability cloud of an atomic electron
ff. state the exclusion principle

2. Learning Activities:
   a. Classroom lectures/discussions
   b. Student homework study
   c. Demonstration
   d. Laboratory exercises

3. Unit Outline:
   a. Rutherford model of the atom
   b. nuclear structure
   c. radioactive decay
   d. half-life
   e. radiation hazards
   f. unit of mass and energy
   g. binding energy
   h. binding energy per nucleon
   i. nuclear fission
   j. how a reactor works
   k. plutonium
   l. a nuclear world
   m. nuclear fusion
   n. antiparticles
   o. fundamental interactions
   p. leptons, hadrons, and quarks
   q. photoelectric effect
   r. photons
   s. What is light?
   t. x-rays
   u. De Broglie waves
   v. Waves of what?
w. Uncertainty Principle
x. atomic spectra
y. the Bohr model
z. electron waves and orbits
aa. the laser
bb. quantum mechanics
c. quantum numbers
dd. Exclusion Principle

F. Unit Six: Chemistry & Chemical Reactions

1. Unit Objective: Upon successful completion of this unit the student will be able to:

a. distinguish among the three classes of matter: elements, compounds, and mixtures
b. state the law of definite proportions
c. explain the meanings of the letters, numbers, and parentheses in the chemical formula of a compound, for instance, Al₂(SO₄)₃
d. compare the properties of metals and nonmetals
e. list some of the characteristic properties of the halogens, the alkali metals, and the inter gases
f. state the periodic law and describe how the periodic table is drawn up
g. distinguish between the groups and periods of the periodic table
h. state what is meant by atomic shells and subshells
i. distinguish between metal and nonmetal atoms in terms of their electron structures
j. explain the origin of the periodic law in terms of the electron structures of atoms
k. compare covalent and ionic bonds
l. state what is meant by a polar covalent molecule
m. discuss the nature of an atom group
n. explain what a chemical equation represents and does not represent
o. recognize whether a chemical equation is balanced or unbalanced
p. balance an unbalanced chemical equation
q. distinguish between crystalline and amorphous solids
r. list the four classes of crystalline solids and identify the nature of the bonds in each class
s. explain the origin of Van der Waals forces
t. distinguish between solvent and solute
u. define the solubility of a substance
v. describe what is meant by unsaturated, saturated, and supersaturated solutions
w. discuss how the solubilities of gases and solids in water vary with
temperature and, in the case of gases, with pressure

x. compare the behavior as solvents of polar and non-polar liquids

y. give some of the reasons why an ionic crystal is believed to dissociate into ions when it dissolves

z. explain how dissociation occurs

aa. discuss some of the chief causes of water pollution

bb. define acid and distinguish between strong and weak acids

cc. define base and distinguish between strong and weak bases

dd. describe the pH scale

ee. explain what happens when an acid and a base neutralize each other

ff. describe how to prepare a salt

gg. give some examples of acids, bases, and salts

hh. discuss the phlogiston hypothesis and explain how Lavoisier's experiments showed it to be incorrect

ii. define oxide

jj. distinguish between exothermic and endothermic reactions

kk. identify the nature of chemical energy

ll. describe the relationship between the chemical energy absorbed or given off in a chemical change and the stabilities of the substances involved

mm. explain what is meant by activation energy

nn. compare gas, liquid, and solid fuels from the point of view of the pollution they produce when burned

oo. list the four factors that affect the speed of a chemical reaction

pp. explain why reaction rates depend strongly on temperature

qq. describe what is meant by a chemical equilibrium

rr. list the three main ways in which a chemical equilibrium can be altered to favor one direction to the other

ss. distinguish between oxidation and reduction in terms of the electrons transferred in each case

tt. describe electrolysis

uu. explain the basic principle behind the operation of electrochemical cells

vv. compare batteries and fuel cells

ww. define organic chemistry

xx. discuss the covalent bonding behavior of carbon atoms

yy. define hydrocarbon and alkane and explain why the alkane series of hydrocarbons is so important

zz. describe how fractional distillation works

aaa. compare the ways in which cracking and polymerization increase the yield of gasoline from petroleum

bbb. discuss the properties of alkane molecules that make oil spills so serious

ccc. compare molecular and structural formulas and explain why the latter
are so useful in organic chemistry

ddd. define isomer

ee. compare saturated and unsaturated compounds and explain why the latter are more reactive

fff. draw the structural formula of benzene

ggg. explain what is meant by a functional group and list several important functional groups

hhh. distinguish between monomers and polymers and list several examples of polymers

iii. explain why nylon is called a polyamide and dacron a polyester

jjj. identify carbohydrates and discuss what they are used for by living things

kkk. describe photosynthesis and give the reason for its importance

lll. identify lipids and discuss what they are used for by living things

mmm. identify cholesterol and discuss its role in heart disease

nnn. identify proteins and discuss what they are used for by living things

ooo. account for the wide variety of proteins and explain why the matching of body tissues is important when they are transferred from one person to another

ppp. explain the importance of soil nitrogen and list the ways in which it is replenished

qqq. describe the structure of the nucleic acid DNA and list the three fundamental attributes of life it is responsible for

rrr. define gene, genome, and chromosome

2. **Learning Activities:**

a. Classroom lectures/discussions
b. Student homework study
c. Demonstration
d. Laboratory exercises

3. **Unit Outline:**

a. chemical change
b. three classes of matter
c. The Atomic Theory
d. metals and nonmetals
e. chemical activity
f. families of elements
g. the periodic table
h. groups and periods
i. shells and subshells
j. explaining the periodic table
k. types of bonds
l. covalent bonding
m. ionic bonding
n. ionic compounds
o. atom groups
p. naming compounds
q. chemical equations
r. ionic and covalent crystals
s. the metallic bond
t. molecular crystals
u. solubility
v. polar and non-polar liquids
w. ions in solution
x. Arrhenius
y. water
z. acids
aa. strong and weak acids
bb. bases
cc. the pH scale
dd. salts
e. Phlogiston Hypothesis
ff. Lavoisier - A pioneer Chemist
gg. oxygen
hh. exothermic and endothermic reactions
ii. chemical energy and stability
jj. activation energy
kk. liquid fuels
ll. gas fuels
mm. solid fuels
nn. temperature
oo. concentration and surface area
pp. catalysts
qq. chemical equilibrium
rr. altering an equilibrium
ss. electrolysis
tt. electrochemical cells
uu. carbon bonds
vv. alkanes
ww. petroleum products
xx. structural formulas
yy. isomers
zz. unsaturated hydrocarbons
aaa. benzene
bbb. hydrocarbon groups
G.  **Unit Seven:** Earth Science

1.  **Unit Objective:** Upon successful completion of this unit the student will be able to:

   a.  define atmosphere and hydrosphere
   b.  list in order of abundance the four chief ingredients of dry air near ground level
   c.  distinguish between the troposphere and the stratosphere
   d.  define ozone and explain why the ozone layer in the upper atmosphere is so important
   e.  list some of the uses of chlorofluorocarbons (CFC's) and describe their effect on the ozone layer
   f.  discuss the origin of the ionosphere
   g.  define saturated air and explain the use of relative humidity as a measure of the moisture content of air
   h.  list the ways in which clouds come into being
   i.  describe what causes rain and snow to fall from a cloud
   j.  define insolation and describe the greenhouse effect
   k.  discuss why temperatures vary around the earth
   l.  explain how the seasons of the year originate
   m.  describe what is meant by a convection current
   n.  state the influence of the Coriolis effect on wind direction in the northern and southern hemispheres
   o.  sketch on a map the main surface wind systems of the world and name them and the belts of relative calm that separate them
   p.  explain what a jet stream is
   q.  compare cyclones and anticyclones and describe the motion of air in each of them
   r.  compare warm and cold fronts and describe what happens when a cold front overtakes a warm front
   s.  distinguish between weather and climate
   t.  describe the ice ages and the variations in the earth's motions that may be responsible for them
u. discuss the relationship between the carbon dioxide content of the atmosphere and global warming
v. list the ways in which the oceans affect climates
w. list in order of abundance the four chief elements in the earth's crust
x. explain why the silicates can vary so much in composition and crystal structure
y. distinguish between rocks and minerals
z. briefly describe quartz, feldspar, mica, the ferromagnesian minerals, the clay minerals, and calcite
aa. distinguish among igneous, sedimentary, and metamorphic rocks
bb. compare the origins of fine-grained and coarse-grained igneous rocks and give several examples of each type
c. describe several fragmental sedimentary rocks
dd. state the main characteristics of limestone and indicate the ways in which it can be formed
e. describe several metamorphic rocks and give their origins
ff. distinguish among the four kinds of earthquake waves
gg. explain the evidence that suggests the division of the earth into core, mantle, and crust
hh. give several reasons for the belief that the earth's core is largely molten iron
ii. identify the main source of the heat that flows out of the earth's interior
jj. compare the earth's magnetic field with the magnetic field of a bar magnet and explain why no actual permanent magnet can give rise to the earth's field
kk. describe the chemical and mechanical weathering of rocks
ll. discuss the development of a valley carved by a river
mm. discuss the development of a valley carved by a glacier
nn. define groundwater, saturated zone, water table, spring, and aquifer
oo. discuss the deposition of stream and glacier sediments
pp. describe the process by which sediments become rock
qq. describe the events that occur in a typical volcanic eruption
rr. indicate on a map of the world the regions where volcanoes and earthquakes occur most often
ss. give the reasons why granite is believed to have hardened from a molten state underground
tt. draw a diagram that shows the rock cycle
uu. describe the various kinds of tectonic movement
vv. list the main steps in the development of the great mountain ranges of the world
ww. outline the evolution of today's continents from the former supercontinent Pangaea
xx. distinguish between the lithosphere and the asthenosphere
yy. explain how ocean-floor spreading accounts for present-day features of the ocean floor
zz. describe what happens at oceanic-continental, oceanic-oceanic, and continental-continental plate collisions
aaaa. identify the San Andreas Fault and indicate its origin
bbbb. state what is meant by the principle of uniform change
cccc. list the four basic principles of historical geology
dddd. describe how radiometric dating is used to find the ages of rocks
eeee. describe how radiocarbon dating is used to find the ages of biological specimens
ffff. explain why animal fossils are more common than plant fossils and account for the abundance of fossils on the floors of the ancient shallow seas
gggg. discuss the various ways in which fossils are useful in geology
hhhh. give the basis for the division of geological time into eras, periods, and epochs
iiii. list the four major divisions of geological time in order from past to present
jjjj. describe the formation of coal and petroleum
kkkk. identify dinosaurs and discuss what may have led to their sudden disappearance
llll. account for the survival of mammals when the dinosaurs disappeared
mmmm. discuss the most recent ice age and its role in early human history
nnnn. explain why overpopulation is the principal hazard facing the world of the future

2. Learning Activities:

a. Classroom lectures/discussions
b. Student homework study
c. Demonstration
d. Laboratory exercises

3. Unit Outline:

a. troposphere and stratosphere
b. mesosphere and thermosphere
c. atmospheric moisture
d. clouds
e. atmospheric energy
f. the seasons
g. winds
h. general circulation of the atmosphere
i. air masses, cyclones, and anticyclones
j. tropical climates
k. middle-latitude climates
l. climatic change
m. origins of climatic change
n. ocean basins
o. ocean currents
p. composition of the crust
q. minerals
r. igneous rocks
s. sedimentary rocks
t. metamorphic rocks
u. earthquakes
v. structure of the earth
w. the earth's interior
x. geomagnetism
y. weathering
z. stream erosion
aa. glaciers
bb. groundwater
c. sedimentation
dd. volcanoes
ee. intrusive rocks
ff. the rock cycle
gg. types of deformation
hh. mountain building
ii. continental drift
jj. Laurasia and Gondwanaland
kk. lithosphere and asthenosphere
ll. the ocean floors
mm. ocean-floor spreading
nn. plate tectonics
oo. Principle of Uniform Change
pp. rock formations
qq. radiometric dating
rr. fossils
ss. geochronology
tt. Precambrian Time
uu. The Paleozoic Era
vv. coal and petroleum
ww. The Mesozoic Era
xx. The Cenozoic Era
yy. The Ice Age
zz. population and the future
H. **Unit Eight: Astronomy**

1. **Unit Objectives:** Upon successful completion of this unit the student will be able to:

   a. distinguish between the rotation and revolution of a planet and state the regularities of these motions shared by most planets & satellites
   b. identify the inner and outer planets and list the common properties of the members of each group
   c. discuss why Pluto does not fit into either of the above groups
   d. discuss the nature and appearance in sky of comets
   e. give the two causes of the deflection of comet tails so they always point away from the sun
   f. describe the appearance in the sky and nature of meteors
   g. state which planets show phases like those of the moon and explain how these phases originate
   h. discuss the possibility of life on Mars
   i. state what asteroids are
   j. describe the Great Red Spot of Jupiter
   k. discuss the nature of Saturn's rings and explain how this was discovered before spacecraft visited Saturn
   l. use a diagram to account for the phases of the moon
   m. explain why eclipses of the sun and moon occur
   n. describe the surface features of the moon
   o. outline the evolution of the moon's surface
   p. discuss the various theories of the origin of the moon
   q. describe how analyzing the spectrum of a star can provide information on the star's structure, temperature, composition, condition of matter, magnetism & motion
   r. state what is meant by the photosphere of the sun
   s. explain why solar energy cannot come from combustion
   t. identify the basic process that gives rise to solar energy
   u. describe how the elements more massive than hydrogen are created and distributed throughout the universe
   v. describe the appearance in the sky and the origin of auroras
   w. discuss sunspots, the sunspot cycle, and some effects on the earth that are correlated with sunspot activity
   x. define light-year
   y. describe the parallax method of finding the distance to a star
   z. describe how the distance to a star can be found by comparing its apparent and intrinsic brightness
   aa. explain why Cepheid variable stars are useful in finding the distance of a star group
   bb. describe how the mass and size of a star can be found
cc. account for the relatively small range of stellar masses
dd. interpret in terms of stellar structure the observation that nearly all
   stars have absorption (dark line) spectra
ee. state what is plotted on a Hertzsprung-Russell (H-R) diagram
ff. draw an H-R diagram and indicate the positions of main-sequence
   stars, red giants, and white dwarfs
gg. compare the properties of red giant and white dwarf stars
hh. outline the life history of an average star like the sun
ii. outline the life history of a very massive star
jj. state what a supernova is
kk. define neutron star and pulsar and discuss the connection between
   them
ll. describe what black holes are and explain how they can be detected
mm. describe the Milky Way galaxy and indicate the sun's location in it
nn. compare population I and II stars
oo. explain what a radio telescope is
pp. list the three ways in which radio waves from space are produced
qq. distinguish between primary and secondary cosmic rays
rr. explain what red shifts in galactic spectra indicate about the motions
   of galaxies
ss. state Hubble's law and use it as evidence for the expansion of the
   universe
tt. outline the properties of quasars and what they suggest about the
   nature of these objects
uu. discuss the big bang theory of the origin of the universe
vv. explain what is meant by the big crunch and why the average density
   of the universe is such an important quantity
ww. outline the chief events after the big bang occurred
xx. explain the significance of the uniform sea of radio waves that fills
   the universe
yy. outline the origin of the earth
zz. discuss the possibility that other planetary systems exist and list the
   reasons why it is hard to find them
aaa. compare the likelihood of interstellar travel with that of interstellar
   communication

2. Learning Activities:
   a. Classroom lectures/discussions
   b. Student homework study
   c. Demonstration
   d. Laboratory exercises

3. Unit Outline:
a. The Solar System
b. comets
c. meteors
d. Mercury
e. Venus
f. Mars
g. Is there life on Mars?
h. asteroids
i. Jupiter
j. Saturn
k. Uranus, Neptune, Pluto
l. the phases of the moon
m. eclipses
n. the lunar surface
o. evolution of the lunar landscape
p. origin of the moon
q. the telescope
r. the spectrometer
s. spectrum analysis
t. properties of the sun
u. the aurora
v. sunspots
w. solar energy
x. stellar distances
y. variable stars
z. stellar motions
aa. stellar properties
bb. H-R diagram
cc. stellar evolution
dd. supernovas
ee. pulsars
ff. black holes
gg. the Milky Way
hh. stellar populations
ii. galactic nebulas
jj. radio astronomy
kk. spiral galaxies
ll. cosmic rays
mm. red shifts
nn. quasars
oo. age of the universe
pp. the oscillating universe
qq. the primeval fireball
rr. origin of the earth
ss. other planetary systems
tt. interstellar travel
uu. interstellar communication