HOWARD UNIVERSITY
COLLEGE OF ARTS AND SCIENCES
COMPREHENSIVE SCIENCES

Fall 2016

COURSE: LIFE SCIENCES **COMP 001-Section: _____**

PROFESSOR: _____ OFFICE: _____

LECTURE ROOM: E.E. Just Hall Auditorium LABORATORY ROOM: E.E. Just Hall, Room 117

LECTURE DAY(S) and TIME _____ LABORATORY DAY and TIME _____

OFFICE TELEPHONE: _____ WEB ADDRESS: www.comprsci.howard.edu

CONFERENCE HOURS: _____ FACSIMILE: 202-806-5786

TEXT: **Lecture – Starr, Biology: Concepts and Applications, Wadsworth Co., Belmont, CA., 9th Edition.**

Laboratory Material – Handouts

OTHER Course Materials: Supplemental Handouts

COURSE RATIONALE:

Comprehensive Sciences Lecture-Laboratory courses are Life Sciences (COMP-001), Planetary Science (COMP-002), Physical Science (COMP-003) and Computer Science (COMP-004). These courses are designated among the introductory natural science course offerings. These courses are requirements in the general education curricula of the College of Arts and Sciences and by some programs in the Schools of Business, Communications, and Education; The Divisions of Nursing and Allied Health; and Programs in the School of Engineering and Architecture. These academic units have determined the necessity of a Natural Science component in the schedule of courses that students must complete in order to receive a degree from the University.

COURSE RELATIONSHIP TO OTHER COMPREHENSIVE SCIENCES COURSES:

Life Sciences (COMP-001) is linked with Planetary Science (COMP-002) in that all the types of living systems found in life forms on this planet function off of chemical energy which is derived from solar energy. Life forms on this planet reside in/on some parts of the earth and utilize selected gases of the atmosphere for survival.

Life Sciences (COMP-001) is linked with Physical Science (COMP-003) in that the matter/substance of all of the types of living systems found in life forms is composed of organic and inorganic molecules. The functions of these molecules, (which comprise life forms), are affected by the laws of chemistry and physics. These laws also govern all matter.

Life Sciences (COMP-001) use technology information that is provided in Computer Sciences (COMP-004).

COURSE OVERVIEW/DESCRIPTION:

This course is designed to explore the basic concepts of the biological (life) sciences. These concepts will be presented by focusing on the principal characteristics that all living things (life forms) have in common.

This study is intended to be an intellectually stimulating adventure that will take the students from the chemical and cellular basis to the global, structural and functional aspects of life. This exploration will be accompanied by some key laboratory applications and observations, in hope that the students will comprehend and appreciate the levels of biological organization in nature.

COURSE LABORATORY FEES STATEMENT:

The laboratory fee that is assessed for this course is used to supplement the expenditures for the purchase of equipment; permanent, temporary, and fresh consumable supplies; for the repair and the maintenance of equipment, and replacement of supply items that are used in the laboratory.

COURSE POLICIES AND REQUIREMENTS:

Synopsis:

Life Sciences Lecture and Laboratory is a three (3) credit course with multiple sections.

The lecture is comprised of two (2) 50-minute meetings (lectures) per week each semester.

The laboratory is comprised of one (1) two-hour meeting per week.

Attendance at all lecture and laboratory sessions is crucial to success in passing the course, as well as success in obtaining a conceptual overview of the biological (life) sciences.

Students are held fully responsible for all of the information that is covered in the lectures and laboratories at all times.

The use of any type of electronic device during lecture or laboratory examinations/quizzes is strictly prohibited.

COURSE GRADING SYSTEM:

The final course grade will be determined based on performance (scores) in the following categories:

1. Lecture exams, quizzes and assignments scores 40%
2. Laboratory exams, quizzes and assignments 40%
3. Final exam (no exceptions) 20%

Make-up exams and/or tests in lecture and/or laboratory, respectively, may be given at the discretion of the professor.

Opportunities for extra credit work in the course may be given at the discretion of the professor.

Be sure to keep all of the returned lecture examinations, quizzes, assignments and laboratory tests for your records. Please note that you must sign the register before leaving all major exams.

COURSE SYLLABUS INFORMATION:

The course work is divided into nine topic units that survey the principles of the biological (life) sciences through lecture information and laboratory exercises. These units are entitled as follows:

Unit	I	Introduction to the Sciences (Methods and Concepts)
Unit	II	Taxonomy
Unit	III	Structure and Physiology
Unit	IV	Genetics
Unit	V	Reproduction and Development
Unit	VI	Metabolism
Unit	VII	Homeostasis
Unit	VIII	Evolution
Unit	IX	Ecology

HOWARD UNIVERSITY

Statement on American Disabilities Act (ADA) Procedures:

Howard University is committed to providing an educational environment that is accessible to all students. In accordance with this policy, students in need of accommodations due to a disability should contact the Office of the Dean for Special Student Services for verification and determination of reasonable accommodations as soon as possible after admission to the University, or at the beginning of each semester. The Office of the Dean for Special Student Services can be reached at (202) 238-2420.

UNIT 1: INTRODUCTION TO THE SCIENCES (METHODS & CONCEPTS)

Information provided includes a broad survey of science as a discipline of knowledge; the various types of the sciences (social, natural, political, etc.); the natural science disciplines (physical and biological sciences); scientific ideas and methodology; and natural scientists and their endeavors. Scientific and non-scientific disciplines are highlighted, compared and contrasted. A distinction between animate (living) and inanimate (non-living) things is defined, as well as the shared characteristics of all life forms.

Reading Assignment: NOTES and Chapter I

Study Questions: As assigned

Laboratory Exercises:
(1) Laboratory Equipment & Safety
(2) Laboratory Procedures
(3) Laboratory Materials
(4) The Metric System - collection of data
(5) Scientific Investigations
(6) Making Graphs

UNIT II: TAXONOMY

The scientific discipline, taxonomy, involves the universal, uniform system that is used to name and classify all of the types of living things. This classification of life forms is based primarily on the anatomical/morphological/structural and the physiological/functional features that life forms exhibit. The name that a life form has is constant and universal among all scientists. Every/all life forms have a scientific name.

Reading Assignment: NOTES
Chapter 19 - bacteria (pp. 320-325); Archaeans (pp. 325-326)
Chapter 20 - protozoans (pp. 332-340)
Chapter 21 - plants - survey
Chapter 22 - fungi - survey
Chapters 23, 24 - animals - survey

Study Questions: As assigned

Laboratory Exercise: Scientific classifications of life forms and the identification of distinctive characteristics of the five major Kingdoms of Life: Monera – bacteria, Protista – protozoans, Fungi, Plantae, Animalia

UNIT III: THE STRUCTURE AND PHYSIOLOGY OF LIFE FORMS

A study of the structural and physiological features of life forms through the levels of organization of life is presented. These features are examined as they pertain to all forms of life on the following LEVELS of ORGANIZATION:

A. Molecular Level – periodic table – Appendix I, Chapters 2, 3
-quarks
-atoms
-elements
-unit molecules (organic and inorganic) - Appendix 2-3
-macromolecules (all are organic)

B. Microscopic Level – Chapter 4
-cell organelles
-cells
-tissues – plants (Chapter 25); animals (Chapter 28)

C. Macroscopic/Gross Level
-organs – plants – (Chapter 25.3); animals – (Chapter 28)
-organ systems
-individual (unicelled or multi-celled)/organism

The manifestation of these features as they are apparent and functional in life forms (plants, animals, fungi, protozoans, bacteria) will be surveyed.

Reading Assignment: NOTES and Chapters 2, 3, 4, 25, 28

Study Questions: As assigned

Laboratory Exercises: (1) Biological Molecules
(2) The Microscope
(3) The Study of Cells and Tissues
(4) Plant Organ Systems and Organs
(5) Animal Organ Systems and Organs

UNIT IV: GENETICS

The fascinating study of genetics includes a survey of the inheritance mechanisms of life forms, an analysis of the genetic molecule (DNA), and patterns that are expressed by this material (traits) from one generation to another. The common systems of genetic information stored by the DNA molecule, the copying of the molecule, the transmission of coded information contained within the molecule from one generation to another, and other processes are reviewed in this unit. A comparison is made between the classical genetic ideas of Mendel and the modern molecular principles of Inheritance and the consequences of genetic the technology and engineering. Human genetic diseases and disorders are highlighted. Mitosis, meiosis, traits, chromosomes, genes, DNA self-duplication capacities, recombinant DNA and protein synthesis are a few of the topics that will be discussed.

Reading Assignment:	NOTES and Chapters 8, 9, 10, 11, 12, 13, 14, 15
Study Questions:	As assigned
Laboratory Exercises:	(1) DNA, Mitosis, Meiosis (2) Inherited Traits (3) Genetic Problems

BIOINFORMATICS

Current effort in molecular biology is producing an abundance of data that provides exciting opportunities for knowledge discovery, as well as an increasing problem of information overload. The voluminous amount of data has mandated more powerful tools to handle such data.

Bioinformatics is the application of computational methods to interpret the rapidly expanding amount of biological information such as sequence analysis, genome database organization. Students will be introduced to the basic concepts behind bioinformatics and computational biology tools which will include hands on sessions.

Reading assignments: Molecular Biology Review
http://www.ncbi.nlm.nih.gov/Class/MLACourse/Modules/MolBioReview/index.html

Prerequisite Reading
http://www.ncbi.nlm.nih.gov/Class/MLACourse/Modules/MolBioReview/reading.html

Laboratory assignment:
1. Hands on sequencing
2. Web assignment

UNIT V: REPRODUCTION AND DEVELOPMENT

Each form of life has the capacity to perpetuate its kind through the transfer of DNA molecules from one generation to another. This occurs regardless of the simplicity or the complexity of the structural organization of the life form. The mechanism may be asexual (involving one set of DNA information) or sexual (involving two sets of DNA). The information in this unit is designed to survey the reproduction organs, tissues, cells, hormones, etc., that contribute to the sexual and/or asexual reproduction mechanisms in plants, animals, fungi, protozoa and bacteria.

Once the reproductive mechanisms have occurred, then development processes begin in many life forms, resulting in the stages of senescence or senility, and ultimately, ending with the death of the life form. Discussion topics include a review of mitosis and meiosis, types of asexual reproduction, types of sexual reproduction, stages of development in plants and animals, models and patterns of life cycles, the influence of hormones, temperature, and water on the development of life forms, and the specifics of human reproduction.

Reading Assignments: NOTES

Chapter 19 (pp. 320-325) bacteria
Chapter 20 (pp. 330) protists
Chapter 27 - plants (PP. 452)
Chapter 38 - animals (PP. 552)

Study Questions: As assigned

Laboratory Exercises: Plant and Animal Reproduction and Development

UNIT VI: METABOLISM

The original energy (solar energy), which operates the living systems on this planet, is derived from the sun. This energy conforms to the first and second physical laws of the thermodynamics that govern matter. Solar energy must be converted into chemical energy before it can be used by any form of life.

Review: Laws of Thermodynamics
1st law – matter can neither be created nor destroyed; the total amount of energy in the universe is constant
2nd law – in any spontaneous change, the entropy of the universe increases; energy can be transferred from one body to another; energy can be changed from one form to another; with each transformation, some energy is dissipated (in the form of heat)

Forms of life can be categorized based upon the ways by which they handle solar energy (i.e. trapping and transformation of solar energy into chemical energy). Chemical energy is derived from the bonds of organic molecules. The breaking of these chemical bonds at cellular levels releases the chemical energy (**ATP**) to do the work needed to sustain life. These **TASKS** that are facilitated by **ATP** and performed by all living cells included (1) division, (2) macromolecule biosynthesis, (3) production of pigments, hormones, and/or enzymes, (4) electrical impulse transmission, (5) muscle contraction, (6) secretion of substances, etc.

Life forms that are capable of trapping and transforming solar energy into chemical energy are those whose cells contain **CHLOROPLAST(S)** with the pigment, chlorophyll. These life forms are called autotrophs or phototrophs. Life forms that do not contain chloroplasts are heterotrophs and must obtain pre-formed organic molecules to oxidize thereby releasing chemical energy. Oxidation of organic molecules occurs in the cytoplasm and mitochondria of cells. Autotrophs contain chloroplasts and **MITOCHONDRION(A)**. Heterotrophs only contain mitochondria. The synthesis and decomposition of molecules by life forms is a function of the presence (or absence) of specific cell organelles (e.g. mitochondria, chloroplasts, ribosomes, etc.) and of specific types of enzymes.

Reading Assignment: NOTES and Chapter 5 (pp. 76 – 85)
Chapter 6 – photosynthesis (pp. 99-110)
Chapter 7 - chemical respiration (pp.113-123)

Study Questions: As assigned

Laboratory Exercises: (1) Enzyme Action
(2) Oxidation/Reduction Reactions (photosynthesis and cellular chemical respiration)

UNIT VII: HOMEOSTASIS IN LIVING SYSTEMS

Homeostasis is a state of balance that is established and maintained in all of the types of living cells that comprise multi-celled organisms. This state is accomplished through the contribution of several biotic control factors. These factors act to correlate, integrate, and coordinate the many activities that occur inside of the cell. This is amplified up through the other levels of structural and functional organization in multi-celled organisms. The many activities of life that are influenced by these factors include the quality and quantity of hormones produced; growth; the production of gametes; flowering; sexuality; stimulus interpretations and concomitant responses that are elicited; and the rate at which biochemical reaction occur inside of a cell.

These important biological control factors are (1) enzymes, (2) membranes, (3) hormones, (4) nerves, (5) pigments, (6) immunity factors and defense mechanisms, (7) tropisms and taxis, (8) genes and DNA, (9) biorhythms and biological clocks.

Reading Assignment:	NOTES DEFINITIVE PORTIONS of CHAPTERS for homeostasis factors– refer to text index listings: enzymes, membranes, hormones, nerves, pigments, immune factors, tropisms, taxis, DNA and genes, biorhythms, biological clocks.
Study Questions:	As assigned
Laboratory Exercises:	(1) Cell Membrane Biophysics (2) Osmosis (3) Diffusion (4) Active transport

UNIT VIII: EVOLUTION

The on-going emergence of a new species of life from pre-existing life forms constitutes a basis for the sub-discipline, evolution. Fossils, in many forms, represent the evidence for the accepted modern versions of explanations as to the origin of life and the origins of the multimillion species of life. Theories that are supported by evidence maintain and give credence to the contemporary ideas regarding the evolution of organic molecules and complex life forms.

Information provided includes Charles Darwin's Theory of Natural Selection/The Origin of Species, animal evolution patterns (including humans), plant evolution patterns, microbial life forms, evidence of evolution and neo-Darwinism.

The roles of changes in genes, gene pools, and gene frequencies in contributing to the evolution of new species of life are explored here. Extinction of species of life and the causation mechanisms are also reviewed. Topics highlighted include A. I. Oparin's Theory, the Big Bang Theory, Lamarck's Theory, Hardy-Weinberg Theory, and Charles Darwin's Theory.

Reading Assignment: Chapters 16, 17, 18, 21, 23, 24

Study Questions: As assigned

UNIT IX: ECOLOGY

The scientific discipline, ecology, surveys the interesting inter- and intra-relationships that occur among and between living things. This discipline also encompasses the interactions that occur between the various life forms and the environments in which they exist. The aspects of ecological principles that are reviewed include GAIA, biomes, niches, and ecosystems; energy pathways via food chains, webs, and pyramids; the cycling of nutrients (biogeochemicals such as N_2, O_2, CO_2, H_2O) through the biotic and abiotic components of an ecosystem; population dynamics (characteristics, natural and artificial regulation); and environmental deterioration (air, land, and water pollution, species exploitation, etc.).

Reading Assignment: NOTES and Chapters, 40, 41, 42, 43

Study Questions: As assigned

Laboratory Exercises: Ecological Surveys
Howard University Campus Analysis:
Summer vs. Fall flora and fauna plus abiotic factors

Lecture Exams: There are four scheduled lecture exams, these follow:

Exam I

Unit	I	Introduction to the Sciences (Methods and Concepts)
Unit	II	Taxonomy
Unit	III	Structure and Physiology

Exam II

Unit	IV	Genetics
Unit	V	Reproduction and Development

Exam III

Unit	VI	Metabolism
Unit	VII	Homeostasis

Exam IV

Unit	VIII	Evolution
Unit	IX	Ecology

HELPFUL HINTS:

1**. Attend ALL scheduled lecture and laboratory classes**

2. Refer to the GLOSSARY of the text. Different words, the definition, and clarification of some concepts and ideas are made easier

3. Refer to DIAGRAMS and FIGURES included in the text for special notations

4. Answer all questions at the end of each unit in the handout materials and Study questions.

5. Take Notes in both lecture and labs