GENERAL BIOLOGY I (Biology 006)

5.00 units (UC:CSU)
Section 0412
Spring 2014
Professor: Patricia Zuk, PhD
email: zukp@wlac.edu

LECTURE: MSA Rm. 303
9:35am – 11:00 am

LABORATORY: MSA Rm. 303
1:00pm – 4:15pm

OFFICE HOURS: by appointment or from:

1. 11:00 to 11:30 AM Tuesday and Thursday
2. 4:30 to 5:30 PM Tuesday and Thursday
3. Office is MSB Room 210

PREREQUISITES: Chemistry 101 with a grade of 'C' or better; intermediate Algebra with a grade of 'C' or better

COURSE DESCRIPTION: General Biology I is the first of a two semester general biology series for Biology Majors, pre-Medical, pre-Dental, pre-Pharmacy. The principles of molecular biology, cell structure and function, genetics, reproduction and organization at the tissue level in plants and animals are covered. Biology 6 and 7 satisfy requirements of lower division biological science majors.

ATTENDANCE: Attendance is mandatory (see Administration Regulation E13). If enough absences occur throughout the semester, I can exclude you from the course. Be aware that your grade in this course depends on your performance – which is dependent upon your attendance. **I guarantee if you miss too many classes and labs – you <u>will</u> fail the course.**

Lectures begin at 9:35am and run until 11:00am. You have a lunch break until 1:00pm.
At this point, the laboratory section of the course begins. Each laboratory is preceded by a lecture portion and will cover the concepts of the laboratory for that day. These lectures are often an extension of the morning session. So being late for lab means you will miss part of this lecture. Labs run until 4:15pm.

Since biology labs cannot be duplicated outside the class it is very important for you not to miss any labs if possible. You also must plan on attending the entire lab period. When you are finished the labs – to my satisfaction – you may leave quietly without disturbing your fellow lab mates.

I consider extreme tardiness or early departure from lab/lecture without a valid cause to be very disrespectful conduct. However, I realize traffic and life gets in the way sometimes. So being late and having to leave early is fine – every now and then. **Do NOT insult me or your classmates by consistently showing up late to lecture/lab everytime!!!**

DO NOT EVEN CONSIDER BEING LATE IF THERE IS AN EXAM SCHEDULED. I will NOT give you the exam if you are more than 10 minutes late and have provided me with a valid excuse for your tardiness that day!! If you have conflicts in your schedule – come and talk to me. I am very understanding about many things and do not bite my students (much!). Also, exchange numbers with your lab-mate so that if you are running late for an exam you can relay a message to me through them.

WITHDRAWING FROM THE CLASS: Any student withdrawing from the class must inform the admissions office and complete the required steps. Students failing to follow the correct procedure for withdrawing will receive an 'F' at the end of the semester. I will not be held responsible for your grade if you fail to correctly withdraw from this course. Therefore, confirm your registration status. Finally, there are deadlines for withdrawing without a "W", with a "W" and a deadline where withdrawing is no longer possible. Be aware of these dates.

COURSE CONSTRUCTION: This course is comprised of two weekly lectures/labs that total over 9 hours per week! This is a lot of lecture time and a lot of lab time. Breaks will NOT be given during these sessions. However, you will have 120 minutes in between the morning and afternoon sessions to recharge your batteries. The first 30 minutes of this break has been set aside as my office hours.

The morning session is approximately 90 minutes of lecture. These lectures cover the major topics in your biology textbook and will coincide with what we will be studying in the afternoon laboratory session. The afternoon session is 3hrs and 15 minutes of lab time. However, the first 60 to 90 minutes will be a lecture that covers the specific concepts of that lab topic or continues on what we were covering in the morning session. The last 2 hrs will be devoted to individual or team lab research. This material will be covered in your lab manual or in handouts that I distribute to you.

You are welcome to tape my lectures. I also have my own personal website – www. patriciazuk.com where the lecture presentations can be found along with additional learning materials. These lectures are "student lectures" and do NOT contain every detail you will find in my lecture presentations or will hear throughout my lectures. This is so that you are required to pay attention and write some things down. Therefore, please print out these lectures and bring them to class so that you may supplement them throughout the lecture/lab period with your own notes taken during class. You will also be required to re-create simple figures and diagrams that I will present to you throughout lecture.

Videos shown in lecture and lab are to be considered as important as lecture and you should pay close attention to the material presented in them.

Handouts will be given in class so be sure to pick them up the day they are offered. I am not guaranteeing that these handouts will be available after the day I offer them.

LABORATORIES: Each afternoon session is 3 hours and 15 minutes long. The first 60 to 90 minutes will be lecture material pertinent to that lab session. Please bring your lab manual to each lab as your assigned material will be in that lab manual. If no lab is planned, then the first 60 to 90 minutes will be used as a continuation of your morning lecture section.

You will work in teams of 2 or 3 for each lab but are also encouraged to interact with other groups throughout the lab. Each student will keep a lab manual for their observations and conclusions. This lab manual should be a spiral bound notebook of at least 200 pages and must be kept as a separate notebook. Each lab session will be recorded in this book. Use the format below for each lab:

1. each lab must be titled and dated
2. the first pages of each lab may be used for notes from the introductory lecture given at the start of the lab. Label this section as Introduction.
3. each lab should list a statement of purpose and any objectives of the lab. Label this section as Specific Aims.
4. following the instructions for each lab outlined in your lab manual, create the required graphs, charts and diagrams in your notebook and answer each question in a clear and succinct manner. Label this section as Data & Observations.
5. conclude each lab with some brief statements as to how your data and observations related to the introductory lecture. Label this section as Conclusions

PROGRAM SLOs: At the end of the semester, the students should understand and be able to explain the fundamental concepts of the following: the chemical composition of life, the four organic macromolecules found in organisms, the major components of both prokaryotic and eukaryotic cells and the function of eukaryotic organelles. In addition, students should understand and be able to explain the cellular processes such as membrane transport, cell division/mitosis, DNA replication, RNA transcription, protein translation, cellular organization and secretion and energy production in both plants and animals. Finally, students should understand and be able to explain Mendelian genetics and the chromosomal basis of inheritance.

SUBJECT SLOs: At the end of the semester the students should demonstrate proficiency in understanding and explaining the following:

1. The concept of concentration and molarity, including how to determine molar mass and how to prepare specific solutions if given molarity
2. The structure of an atom and how it influences the creation of a chemical bond
3. The types of chemical bonds and chemical reactions
4. The structure and function of the four major macromolecules: carbohydrates, lipids, proteins and nucleic acids
5. The major components of a cell, both prokaryotic and eukaryotic
6. The structure and function of the plasma membrane, including how the membrane controls transport and the types of transport capable of occurring across a membrane
7. The structure and function of the nucleus, including how DNA is organized in both prokaryotes and eukaryotes, how DNA is replicated and how RNA is transcribed.
8. The composition of the cytoplasm, including the components and function of the cytosol and cytoplasm
9. How cells divide through mitosis, including the roles of the centrioles and spindle
10. The process of protein synthesis, including protein translation, the four levels of protein organization
11. The structure of function of the following organelles: the endoplasmic reticulum, Golgi apparatus, lysosomes and peroxisomes
12. The control of DNA replication and RNA transcription, including the cell cycle and its role in abnormal processes like cancer
13. The control of both prokaryotic and eukaryotic gene expression

14. The role of the mitochondria and ATP in the bioenergetics of a eukaryotic cell, including understanding the steps of glycolysis, Kreb's cycle and the electron transport chain
15. The process of photosynthesis in plants, including the structure of a chloroplast, the role of chlorophylls and other photosynthetic pigments, the photosystems and Calvin cycle
16. How organisms produce gametes through meiosis and how this process results in genetic diversity
17. The concepts of Mendelian genetics: phenotype, genotype, alleles, homozygous and heterozygous
18. How Mendelian genetics can explain how DNA and phenotypic traits are passed through generations
19. The more advanced concepts of genetics and chromosomal inheritance such as co-dominance, multi-allele traits, sex-linked traits and gene linkage
20. How alterations in chromosomal number can occur and result in genetic disorders
21. How cells interact and communicate with one another, including the production and function of hormones, growth factors and the cell signaling pathways
22. How cells interact to produce tissues and the major types of tissues observed in organisms
23. The concepts and stages of embryonic development, including the early stages of cleavage, blastula and gastrula formation, morphogenesis and organogenesis.

TECHNICAL SLOs: Add the end of the semester, the student should be able to perform the following within a laboratory setting:

1. Weighing a given substance using a balance beam
2. Determining the absorbance of a given solution using a spectrophotometer
3. Detection of a sugar, lipid, protein or nucleic acid using specific stains
4. The proper operation of a compound and dissecting microscope, including being able to properly visualize cells and tissues
5. The identification if some of the major components of a plant and animal cell, such as the cell wall, vacuole and nucleus
6. The set up and performance of an experiment to illustrate the processes of diffusion and osmosis, including being able to determine diffusion rate and how solute concentration can affect osmosis
7. The simulation of DNA replication, RNA transcription and protein translation if given specific DNA sequences
8. The identification of the stages of mitosis and meiosis using both prepared slides and models
9. The completion of genetic problems, including determining allele frequency, genotypes and phenotypes using Punnett squares and a pedigree chart
10. The identification of the major tissue types: epithelial, connective, muscular and nervous, including their subtypes
11. The isolation of DNA using cells taken from the inside of their own cheek
12. The production and analysis of a DNA fingerprint, including being able to make an agarose gel, run the DNA using that gel and analyze the resulting DNA migration pattern

COURSE MATERIALS: be sure to bring these to each class
1. Textbook: Campbell Biology – Campbell, Reece et al. 9th Edition. Benjamin Cummings Publishing.

2. Lab Manual: To be provided as handouts. This may be packaged together a made available to you in the bookstore. If so, you will be required to purchase this lab notebook for a small fee.
Additional lab manuals that correspond to your textbook will also be available in lab. These manuals often do a great job of distilling large amounts of information down to a manageable level. If you wish to purchase a used manual to supplement your learning, here is the information:
Investigating Biology – Morgan and Carter, 7th Edition. Benjamin Cummings Publishing.

3. Lab notebook: This will be a spiral bound notebook of at least 200 pages and is available at the bookstore. This book will be used to record your laboratory observations

4. Lecture notebook: This may be your own preference but purchase a separate notebook from that of your lab manual. This book will be used to supplement the lectures given in the morning and afternoon sessions. You should also print out the lecture slides prior to coming to class and put these in your notebook.

5. Numerous colored pens and pencils for lectures and labs
6. Scantron 882E forms for exams

EXAMINATIONS: You will have two different types of exams: Lecture exams and Laboratory exams. Lecture exams will be worth 100 points. These exams will be multiple choice, fill in the blank, short answers and may include figures from my notes and from the text that you will have to complete. These exams will range anywhere from 50 to 100 questions. You will use your lecture notes to study for this exam.

Each laboratory exam will be worth 50 points. These exams are based on your afternoon lab sessions. They will also include multiple choice and fill in the blank questions and may also include identification questions using images projected by the computer. The exams will range anywhere from 35 to 50 questions. You will use your laboratory notebook to study for this type of exam.

There will be a final exam held during the exam period. It will be a **cumulative exam worth 150 points.** This exam will encompass materials given during the lecture and lab sessions throughout this course. Like your previous exams, it will include multiple choice, true/false, fill in the blank and short answer questions.

I will discuss each exam and what to expect– so don't freak out! I may also provide you with some study guides to ensure you are keeping yourself on track during your study times. But don't count on it! This is a majors biology course so you are expected to know what could be on an exam.

Exam breakdown:
Lecture exams = 4 x 100 = 400 points
Laboratory exams = 2 x 50 = 100 points
Final cumulative exam = 150 points
Total points = 650 points

West LA College specifies the following ranges for grades:
90% - 100% = A
80% - 89% = B
70% - 79% = C
60% - 60% = D

I do not allow you to keep any tests so please keep track of your performance in the class by recording all your exam scores.

Cheating will NOT be tolerated. ANY STUDENT FOUND CHEATING WILL RECEIVE THE GRADE OF 'F' FOR THAT EXAM AND MAY BE EXPELLED FROM THE COURSE!!!

Schedule of Topics

Section	Text Chapters	Date	Lecture Topic Lab Topic
Introduction	Ch. 1	02/11	An introduction to science ***Lab 1: The Metric System***
	Ch. 2 & 3	02/13	The chemical context of life ***Lab 2: Molarity***
	Ch. 4 & 5	02/18	Organic molecules ***Lab 3: Spectrophotometer lab***
	Ch. 4 & 5	02/20	Organic molecules cont… ***Lab 4: Chemical analysis lab***
	Ch. 6	02/25	An introduction to the cell ***Lab 5: Introduction to the cell***
		02/27	An introduction to the cell cont…..
The Cell – Cellular Processes and Cellular Control		03/04	**LECTURE EXAM 1** **LAB EXAM 1**
	Ch. 6	03/06	Cellular processes – the Plasma Membrane ***Lab 6: Diffusion Lab***
	Ch. 16	03/11	Cellular processes – the Nucleus DNA replication ***Lab 7: Osmosis Lab***
	Ch. 17	03/13	Cellular processes – DNA replication cont… ***no lab planned***
	Ch. 12	03/18	Cellular control – Control of DNA Replication The Cell Cycle ***Lab 9: Mitosis Lab***
	Ch. 6	03/20	Cellular processes – from the Nucleus to the Cytoplasm Transcription & Translation ***Lab 10: DNA Transcription & Translation***
		03/25	Cellular control – Control of gene expression Control in bacteria – the Operon Control in eukaryotes ***No lab planned – lecture only***
		03/27	Cellular control – Control of gene expression Control in eukaryotes ***No lab planned – lecture only***
	Ch. 12 & 18	04/01	Cellular processes – The Cytoplasm & Cytoplamic Organelles The Cytoskeleton Non-membranous vs. membranous organelles ***No lab planned***
		04/03	**LECTURE EXAM 2** **LAB EXAM 2**
		04/08 – 04/10	**SPRING BREAK – no classes**

		04/15	Bioenergetics – An introduction to metabolism ***No lab planned – lecture only***
The Cell - Bioenergetics	Ch. 8	04/17	Bioenergetics – Cellular Respiration ***No lab planned – lecture only***
	Ch. 9	04/22	Bioenergetics – Nutritional Facts and Fallacies ***No lab planned – lecture only***
	Ch. 10	04/24	Bioenergetics – Photosynthesis ***No lab planned – lecture only***
Genetics		**04/29**	**LECTURE EXAM 3** **NO LAB EXAM**
	Ch. 13	05/01	Genetics – Sexual life cycles Meiosis & genetic variation ***Lab 11: Meiosis Lab***
	Ch. 14	05/06	Mendelian Genetics ***Lab 12: Genetics Lab #1***
	Ch. 15	05/08	The chromosomal basis of inheritance ***Lab 13: Genetics Lab #2***
		05/13	**LECTURE EXAM 4** **LAB EXAM 4**
Miscellaneous	Ch. 47	05/15	Animal Development ***Lab 14: Vertebrate development***
		05/20	Animal Development cont… ***Lab 15: Tissue Identification***
	Ch. 20	05/22	Cellular Communication Hormones & Growth factors Signal transduction ***Tissue Review lab for Practical***
		05/27	**MEMORIAL DAY – no classes**
		05/29	**LECTURE EXAM 5** **LAB EXAM 5 – PRACTICAL EXAMINATION**
		06/03	**No Class**
		06/05	**FINAL EXAM**

Overview of Covered Topics

Lecture #1: An introduction to Science (Chapter 1)
-themes in the study of life
-levels of biological organization
-Core theme: Evolution accounts for the unity and diversity of life
    -diversity of life
    -3 domains of life
    -natural selection
    -descent with modification – the tree of life
-Scientific method: asking questions and testing hypotheses
    -types of data
    -inductive reasoning
    -deductive reasoning & hypothesis testing
    -flexibility of the scientific method
    -proper experimentation – controls and repeatability
-Theories in science

Lecture #2: The chemical context of life (Chapters 2 & 3)
-the chemical connection to biology
-elements and compounds
-the elements of life
-atoms and its components
-isotopes and radioactivity
-molecules and chemical bonds
-chemical reactions
-Water: polar covalent bonds and hydrogen bonding
    -properties of water: cohesion, temperature modification, specific heat, density
    -water as a solvent: hydrophilic vs. hydrophobic
    -solute concentration in water – Molarity
-Acids & bases: pH scale
    -buffers
    -acidification

Lecture #3: Organic molecules (Chapters 4 & 5)
-Carbon: the backbone of life
    -properties of carbon
    -hydrocarbns & their isomers
-functional groups in biology
-organic molecules
-macromolecules & polymers:
    -diversity of polymers
    1. carbohydrates – types of polysaccharides
    2. lipids – fatty acid structure and the types of lipids
    3. proteins – amino acids and polypeptides
        -protein structure and levels of organization
        -protein function
        -chaperonins and protein folding

4. nucleic acids – types and structure
    -DNA and RNA structure
    -ATP - a modified nucleotide

Lecture #4: Introduction to the cell (Chapter 6)
-the cell theory
-types of microscopes
-four components of a eukaryotic cell:
    1) the plasma membrane – intercellular junctions & adhesions, membrane proteins
    2) the cytoplasm & cytoskeleton – cilia and flagella
    3) the nucleus – forms of DNA (ch. 12)
    4) cytoplasmic organelles – membranous and non-membranous

Lecture #5: Cellular processes – the Plasma Membrane
-the plasma membrane and transport mechanisms
    -passive mechanisms – diffusion, osmosis and facilitated diffusion
    -active mechanisms – primary and secondary transport, exocytosis, endocytosis

Lecture #6: Cellular processes – the Nucleus & DNA replication (Chapter 16)
-organization of DNA in the nucleus – chromatin & histones
-problems with DNA replication
-the machinery of replication – polymerases
-DNA repair mechanisms

Lecture #7: Cellular processes – from nucleus to cytoplasm – transcription & translation (Chapter 17)
-the transcription unit
-transcription: DNA to RNA
    -types of RNA
    -mechanisms of transcription – the RNA polymerase
    -modifications of mRNA – the cap and the polyA tail
    -promoters
-translation: mRNA to protein
    -the ribosome
    -tRNA function and structure
    -the genetic code and codon table

Lecture #8: Cellular processes – the Cytoplasm (Chapter 12)
-cilia and flagella – dynein motors
-actin microfilaments and cellular movement
-actin and myosin interactions – muscle contraction
-non-membranous organelles – the centriole
-the mitotic spindle
-mitosis and cytokinesis
-evolution of mitosis – prokaryotic binary fission

Lecture #9: Cellular processes - the Cytoplasm cont….
-membranous organelles
-protein synthesis: ribosomes, the RER and the Golgi
    -protein modifications – folding, glycosylation, proteases

-protein trafficking – sorting signals
-lipid synthesis: the SER
-lipid biosynthesis
-waste management: peroxisomes and lysosomes
-functions and diseases

Lecture #10: Cellular control – Control of DNA (Chapters 12 & 18)
-regulation of DNA replication – chromatin/chromosome structure and histone modification (ch. 18)
-histone acetylation
-regulation of DNA replication – the cell cycle (ch. 12)
-phases of the cell cycle
-checkpoints
-cyclins and cdks
-loss of control – cancer
-the G0 phase

Lecture #11: Cellular control – Control of gene expression (Chapter 18)
-control in bacteria – the operon model
-repressible and inducible – negative regulation
-cAMP and positive regulation
-control in eukaryotes – stages of control
-differential gene expression
-regulation of transcription – transcription factors & enhancers
-coordinately controlled expression
-post-transcriptional control – mRNA degredation
-splicing and the splicesome
-initiation of translation – the UTR and the polyA tail
-protein processing – phosphorylation, cleavage
-protein degredation – ubiquitin & the proteosome
-role of non-coding RNAs – miRNA & siRNA

Lecture #12: Bioenergetics – Metabolism (Chapter 8)
-forms of energy
-laws of thermodynamics
-free energy change – stability and equilibrium
-free energy and metabolism
-review of ATP and ATP hydrolysis
-activation energy – exergonic reactions
-activation energy & enzymes – substrate specificity
-catalysts and cofactors
-regulation of enzyme activity – allosteric regulation and regulatory molecules; feedback inhibition

Lecture #13: Bioenergetics – Cellular Respiration (Chapter 9)
-production of ATP – aerobic respiration vs. fermentation
-redox reactions
-NAD+ as an electron acceptor
-cellular respiration – review of the mitochondria
-glycolysis

-citric acid cycle
-chemiosmosis & the electron transport chain
-ATP "accounting"
-anaerobic respiration vs. fermentation
-types of fermentation
-anaerobes
-connections of glycolysis and the citric acid cycle to other metabolic pathways
-use of fats and proteins as energy
-connections to biosynthesis (anabolism)
-control of cellular respiration reactions

Lecture #14: Bioenergetics – Photosynthesis (Chapter 10)
-chloroplasts – a new organelle
-the reactions of photosynthesis
-light reactions – the nature of sunlight
-chlorophylls and carotenoids
-photosystems
-linear and cyclic electron flow
-chemiosmosis – chloroplasts vs. mitochondria
-dark reactions – the Calvin cycle
-reduction of CO_2 to sugar
-carbon fixation, reduction & regeneration
-C3, C4 and CAM plants - adaptations

Lecture #15: Genetics – Sexual Life Cycles (Chapter 13)
-inheritance of genes
-sexual vs. asexual reproduction
-chromosome types – diploid vs. haploid, karyotypes
-variety in sexual life cycles – alternation of generations
-meiosis – stages
-comparing mitosis with meiosis
-genetic variation by meiosis
–crossing over in recombinant chromosomes
-independent assortment
-random fertilization
-evolutionary significance of meiosis

Lecture #16 – Mendelian Genetics (Chapter 14)
-Mendel's experiments – pea plants, P and F generations
-Law of Segregation
-Mendelian model of inheritance
– genotypes, phenotypes, alleles
-Punnet squares and test crosses
-Law of Independent Assortment – monohybrid vs. dihybrid
-laws of probability – monohybrid crosses
-multiplication rule – i.e. the Product rule

-addition rule – i.e. the Sum rule
-probability and dihybrid crosses
-complex inheritance patterns – single genes
-degrees of dominance
-multiple alleles – blood groups
-pleiotropy and multiple phenotypes
-complex inheritance patterns –multiple genes
-multiple loci and epistasis
-polygenic inheritance
-nature and nuture: the impact of the environment
-pedigree analysis – analyzing the behavior of human traits

Lecture #17 – The Chromosomal Basis of Inheritance (Chapter 15)
-correlation behavior between a gene allele and its chromosome – Morgan and the fruit fly
-sex-linked genes
-inheritance of X-linked genes
-X inactivation in females
-linked genes and inheritance
-genetic recombination – crossing over
-linkage maps
-alterations in chromosome number
-non-disjunction – aneuploidy and polyploidy
-alterations in chromosome structure
-inversions, deletions and translocations
-genomic imprinting
-inheritance of organelle genes – extranuclear genes

Lecture #18: Animal Development (Chapter 47)
-fertilization mechanisms
-cleavage patterns
-gastrulation – sea urchin, frog, chick
-embryonic germ layers
-neural crest cells and the neural tube
-mechanisms of morphogenesis
-the role of the cytoskeleton
-apoptosis
-fate determination
-determination vs. specification
-fate mapping
-induction in embryogenesis
-Spemann's organizer
-chick limb bud development