LECTURE OUTLINE (subject to change with notification)

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture topic</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>Intro/basic chemistry (chapters 1 and 2)</td>
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<tr>
<td>Week 2</td>
<td>Biological chemistry, macromolecules, cells and cell membranes (Topics from chapters 2-6, 8)</td>
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<tr>
<td>Week 3</td>
<td><strong>QUIZ 1 (ch 1-6, 8)</strong>, Cell structure and function (chapter 7), Cell respiration (Chapter 9)</td>
</tr>
<tr>
<td>Week 4</td>
<td>Cell respiration continued (chapter 9), Photosynthesis (chapter 10)</td>
</tr>
<tr>
<td>Week 5</td>
<td><strong>QUIZ 2 (ch 7, 9, 10)</strong>, Cell Cycle and Mitosis (chapter 12), Meiosis (chapter 13)</td>
</tr>
<tr>
<td>Week 6</td>
<td>Principles of Mendelism (chapter 14), DNA synthesis (Chapter 15)</td>
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<tr>
<td>Week 7</td>
<td><strong>MIDTERM (ch 11-10,11-14)</strong>, How genes work (ch 16), Transcription (chapter 17)</td>
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<tr>
<td>Week 8</td>
<td>Transcription continued (chapter 17), Translation (chapter 17), Control of gene expression in Prokaryotes (chapter 18)</td>
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<tr>
<td>Week 9</td>
<td><strong>QUIZ 3 (ch 15-18)</strong>, Eukaryotic gene expression (chapter 19), Introduction to genetic engineering (chapter 20),</td>
</tr>
<tr>
<td>Week 10</td>
<td>The Genome (chapter 21)</td>
</tr>
</tbody>
</table>
| Week 11       | **QUIZ 4 (ch 19-23)**
|              | Principles of Evolution (chapter 25),
|              | Evolutionary Processes, Speciation (chapter 26-27) |
| Week 12      | **Quiz 5 (ch 25-27)**
|              | History of life (chapter 28) |
| Finals week  | **FINAL EXAM (ch 15-23, 24-28)** |

**GRADING CRITERIA**

Attendance: Students are strongly encouraged to attend all lecture sessions. Text study alone is insufficient since many topics may be augmented or additional topics may be covered in lecture. Students are required to take all exams and no make-up quizzes will be given (without consultation). Laboratory attendance is mandatory.

Grades: Seven exams will be given in lecture: 5 quizzes, a midterm exam and a final exam. The midterm and final exams are each counted as two quizzes. Four exams will be given in laboratory. Both the lecture average and laboratory average contribute to a single final average. The final grade is computed from the combined lecture and laboratory average, with 66% of the final grade from the lecture average and 34% from the laboratory average. Effort in the laboratory will be considered in borderline cases.

Each Quiz = 8.25% of final grade (Total 33%) [the lowest quiz is dropped before averaging]

Midterm and Final each = 16.5% of final grade (Total 33%)

Laboratory exams each = 8% of final grade (Total 24%) [the lowest lab exam grade is dropped before averaging]
Laboratory worksheets and lab effort = 10% of final grade

<table>
<thead>
<tr>
<th>Total Points/Percentage</th>
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<tbody>
<tr>
<td>94-100</td>
<td>A</td>
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<tr>
<td>90-93</td>
<td>A-</td>
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<tr>
<td>87-89</td>
<td>B+</td>
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<td>84-86</td>
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**LABORATORY OUTLINE (subject to change by lab instructor)**

<table>
<thead>
<tr>
<th>Lab</th>
<th>Topic</th>
<th>Lab Review Questions*</th>
<th>Lab Text Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Microscope and Measurements</td>
<td>Pg. 21, 1-5</td>
<td>pp. 15-21 and 23-33</td>
</tr>
<tr>
<td>2</td>
<td>Organic Molecules</td>
<td>Pg. 43, 1-8</td>
<td>pp. 35-43</td>
</tr>
<tr>
<td>3</td>
<td>Diffusion and Osmosis</td>
<td>Pg. 66-67, 1-4</td>
<td>pp. 45-68</td>
</tr>
<tr>
<td>4</td>
<td>Exam I on Labs 1, 2 and 3 Enzymes</td>
<td>Pg. 88, 1-5</td>
<td>pp. 73-90</td>
</tr>
<tr>
<td>5</td>
<td>Cell Respiration</td>
<td>Pg. 113, 1-4</td>
<td>pp. 95-115</td>
</tr>
<tr>
<td>6</td>
<td>Exam II on Labs 4 and 5 Photosynthesis</td>
<td>Pg. 127, 1-3 and 5-6</td>
<td>pp. 119-125</td>
</tr>
<tr>
<td>7</td>
<td>Mitosis and Meiosis</td>
<td>Pg. 153, 1-5</td>
<td>pp. 131-168</td>
</tr>
<tr>
<td>8</td>
<td>Mendelian and Human Genetics</td>
<td>Pg. 186, A and B</td>
<td>pp. 169-189</td>
</tr>
<tr>
<td>9</td>
<td>Exam III on Labs 6, 7 and 8 Chromosomes</td>
<td>Assigned Karyotype</td>
<td>pp. 191-221</td>
</tr>
<tr>
<td>10</td>
<td>Biotechnology</td>
<td>Pg. 241, 1-4</td>
<td>pp. 223-250, pp. 176-177</td>
</tr>
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<td>11</td>
<td>DNA Restriction Analysis and Evolutionary Mechanisms</td>
<td>Pg. 263, 1-3</td>
<td>pp. 251-263</td>
</tr>
<tr>
<td>12</td>
<td>Evolution and Taxonomy</td>
<td>Pg. 307, 1-6</td>
<td>pp. 275-309</td>
</tr>
</tbody>
</table>

Finals Week

Exam IV on Labs 9, 10, 11 and 12

The College’s regulations regarding cheating will be strictly enforced. The policy on academic integrity is available at the following address: http://library.laguardia.edu/files/pdf/academicintegritypolicy.pdf

**FUNDAMENTALS OF BIOLOGY I -- SCB 201 COURSE OBJECTIVES**

**NOTE:** Each session corresponds to 1 class hour

**SESSION 1 - INTRODUCTION Chapter 1**

State the Cell Theory and describe the experiments that support it.

Describe the Darwinian theory of Evolution.
Describe the levels of organization in living systems and some of the methods of classification.

List the steps of the scientific method and apply them to a specific problem.

Define hypothesis, experiment, control, theory, and scientific law.

SESSION 2 - BASIC CHEMISTRY Chapter 2

Describe how the Universe formed and the origin of the molecules of life.

Define what is meant by the terms, matter and energy.

List the stages in the development of the Earth and the formation of Life on Earth.

Define the terms, elements, atom, proton, electron, neutron, isotope and ion.

Define atomic number, and atomic mass.

SESSION 3 - BASIC CHEMISTRY (cont'd) Chapter 2

Draw and describe an electron shell configuration.

Define molecule, compound, single and double bonds.

Describe ionic, covalent, polar, non-polar, hydrogen bonds.

Describe how bonds are formed and broken through the transfer of energy.

Define the term chemical energy and how it relates to bond strength.

Describe the properties of water and its importance in chemical evolution.

SESSION 4 - BIOLOGICAL CHEMISTRY Chapters 2

Describe the relationship and properties of acids, bases and salts.

Describe the importance of the carbon atom to organic chemistry.

List the four main classes of biological macromolecules (carbohydrates, lipids, proteins and nucleic acids), stating
their chemical elements, subunits, and role they play in living systems.

Describe the structure of the functional groups: amino, carboxyl, sulfhydryl, aldehyde, alcohol, and ketone.

SESSION 5 – PROTEINS AND NUCLEIC ACIDS Chapters 3 and 4

Define monomer, polymer, amino acid, peptide bond, polypeptide, and protein.

Describe the four levels of protein structure.

Describe the mechanism by which enzymes work as organic catalysts.

Define nucleotide, nucleic acid, complementary base pairing.

Compare and contrast the structures of RNA and DNA.

Describe the role of RNA and DNA in the synthesis of macromolecules.

SESSION 6 – CARBOHYDRATES Chapters 5

Define carbohydrate, monosaccharide, disaccharide, polysaccharide, starch, glycogen, cellulose, pentose and hexose sugars.

Describe the role of carbohydrates in cell structure and metabolism.

SESSION 7 - CELLS AND MEMBRANES Chapter 6

Describe the basic chemical structure of the biological membrane.

Define lipid, glycerol, fatty acid, triglyceride, saturated, unsaturated, phospholipid, and steroid.

Describe how phospholipids assemble spontaneously to form the basic membrane.

Define what is meant by the terms permeability and semipermeability.

List and describe methods by which molecules cross the membrane; impermeable, selective permeability, passive transport, diffusion, facilitated diffusion, carrier proteins,
pores, osmosis, active transport, sodium-potassium pump, phagocytosis, and pinocytosis.

Describe the three relationships of solute concentration of solutions.

Describe the Fluid Mosaic Model.

SESSION 8 - CELL STRUCTURE AND FUNCTION Chapter 7

Define prokaryote, eukaryote, unicellular, multicellular, nucleus, cytoplasm, and organelles.

Describe the different methods used to study cells and their organelles.

Describe the main differences between prokaryotic and eukaryotic cells, as well as between plant and animal cells.

SESSION 9 - CELL STRUCTURE AND FUNCTION Chapter 7

Describe the structure and function of the following nuclear organelles: nucleus, chromosome, nucleolus, and nuclear envelope.

Describe the structure and function of the following organelles: ribosome, endoplasmic reticulum, Golgi complex, lysosome, peroxisome, mitochondrion, vesicle, vacuole, plastid, chloroplast and cell wall.

Define the three classes of transport vesicles.

Describe the structure and function of the following parts of the cytoskeleton: microtubules, microvilli, cilia, flagella, and centriole.

SESSION 10 - CELL RESPIRATION Chapter 9

Define the terms respiration, aerobic, anaerobic and fermentation.

Define the term coenzyme, list four and explain the function of each.

Diagram and describe the overall reaction for the oxidation of glucose stating the number of ATP's produced, and why oxygen is needed.
List the starting materials, the end products, and key chemicals in glycolysis and the formation of Acetyl-CoA.

SESSION 11 - CELL RESPIRATION (Cont.) Chapter 9

Describe the Chemiosmotic Theory of ATP synthesis, including the role of the electron transport system, the membrane, the electrochemical gradient, and ATP synthetase.

Summarize the number of ATP molecules produced from each step in fermentation.

Contrast aerobic respiration with yeast alcoholic fermentation and muscle lactate fermentation.

Explain how and why muscles go into oxygen debt.

Explain how other nutrients, such as lipids, proteins and polysaccharides enter into the glucose oxidative pathway.

SESSION 12 - PHOTOSYNTHESIS Chapter 10

Describe the relationship between cellular respiration and photosynthesis, autotroph and heterotroph, oxidation and reduction.

Name the three main groups of photosynthetic pigments and state the function of each.

Describe the structure of the plant leaf and chloroplast. Define cuticle, epidermis, mesophyll, stomata, vascular bundle, grana, thylakoid, and stroma.

State the colors of light most effective in promoting photosynthesis, and explain why.

Write the overall reaction summary for photosynthesis.

SESSION 13 - PHOTOSYNTHESIS (cont.) Chapter 10

Summarize the input and output for the four steps of photosynthesis: photochemical reactions, electron transport, chemiosmosis, carbon fixation (dark reaction), light reaction.

Describe the two photosystems, including chlorophyll a, P700, P680, antenna pigment, light trap, and reaction center.

Draw the two photosystems and show the energy flow relationships between them.
Explain the C3 cycle of carbon fixation, stating the importance of ribulose bisphosphate, RuBP carboxylase, and the number of turns of the cycle needed to produce a molecule of glucose.

Discuss how various environmental factors control the rate of photosynthesis.

Compare and contrast the C4 and C3 cycles and the relative benefits of each.

SESSION 14 – CELL CYCLE AND MITOSIS Chapter 11

Define mitosis, meiosis, haploid, diploid, somatic cell, germ cell, fertilization, zygote, chromatids, homologous chromosomes, gametes, autosomes, karyokinesis, and cytokinesis.

Describe the parts of the cell cycle and the three periods of interphase.

SESSION 15 - MITOSIS (cont.) Chapter 11

Describe the events in each of the stages of mitosis: prophase, metaphase, anaphase, telophase.

Define poles, centrioles, mitotic spindle, colchicine, cleavage furrow, and cell plate.

Describe how the kinetochore controls chromosome partitioning.

List the regulatory factors of the cell cycle and the function of each.

SESSION 16 - MEIOSIS Chapter 12

Describe the events in meiosis; include tetrad, synapsis, and separation of homologous chromosomes.

Distinguish between spermatogenesis and oogenesis.

Describe the significance of 'crossing over' in heredity.

Describe how the process of meiosis influences genetic variation.

SESSION 17 - PRINCIPLES OF MENDELISM Chapter 13
Describe Mendel's experiments and give reasons why he was successful in discovering the laws governing the inheritance of genetic traits. State his three laws.

Define the terms genotype and phenotype, and their relationship to dominant and recessive.

Define parental (P1), first filial (F1), and second filial (F2) generations; homozygous, heterozygous, allele, monohybrid cross, dihybrid cross, homologous chromosomes, segregation, independent assortment, and linked genes.

SESSION 18 - PRINCIPLES OF MENDELISM (cont.) Chapter 13

Use the Punnett square to predict the results of monohybrid and dihybrid crosses, giving both genotype and phenotype ratios.

Describe the test cross and discuss its use as a genetic tool to distinguish between homozygous and heterozygous genotypes.

Describe how the discovery of linkage and the chromosome theory altered Mendel's original theory.

List and describe the mechanism of some non-Mendelian patterns of inheritance including incomplete dominance, multiple allelism and environmentally-influenced genes.

SESSION 19 - DNA SYNTHESIS Chapter 14

Describe the experiments of Griffith, Avery, and Hershey and Chase and how their results were able to relate DNA to heredity.

Review the structure of DNA. Define purine, pyrimidine, complementary bases, double helix, antiparallel strands, 3' and 5' ends.

Describe the semi-conservative model of DNA replication with reference to the Meselson and Stahl experiment.

Describe the process of DNA replication, including replication bubbles, helicase, DNA polymerase, direction of replication, Okazaki fragments, DNA ligase, leading strand and lagging strand.

Compare DNA replication in prokaryotes vs. eukaryotes.

Describe the significance of telomeres and the enzyme telomerase.
SESSION 20 - MIDTERM EXAMINATION on Chapters 1-7, 9-13

SESSION 21 - HOW GENES WORK Chapter 15

Review the differences between DNA and RNA.

State the "one-gene, one-enzyme" hypothesis.

Define what is meant by the genetic code.

Describe how the genetic code differs between DNA and RNA.

Describe the underlying principal of the Central Dogma and how it relates genotype to phenotype.

SESSION 22 - TRANSCRIPTION Chapter 16

Describe what is meant by transcription.

Describe the role of the promoter in transcription.

Describe the structure and origin of mRNA, tRNA and rRNA.

Describe the role of RNA polymerase and how it functions in transcription

Describe the structure of pre-mRNA

Describe the post-transcriptional processing of pre-mRNA

Define the terms start and termination signals, pre-mRNA, snRNAs, cap poly-A tail, introns, and exons.

Define mutation, list some kinds of mutations, and describe the importance of mutations.

SESSION 23 - TRANSLATION Chapter 16

Define what is meant by translation

Describe how the ribosome functions as the site for protein synthesis
Describe the basic structure of tRNA and its role in translation.

List the stages of translation and the processes that occur at each stage.

Define the terms, P site, A site and catalytic site

Describe what is meant by post-translational processing and its role in protein synthesis.

SESSION 24- CONTROL OF GENE EXPRESSION Chapter 17

Describe the experimental basis of the lac operon theory.

Define the terms operator, repressor, and functional genes.

Define negative control and positive control in the transcriptional regulation of lac operon.

Define the role of CAP in transcriptional regulation.

Describe the characteristics and significance of DNA-binding proteins.

SESSION 25 - EUKARYOTIC GENE EXPRESSION Chapter 18

Describe the structure of a typical eukaryotic gene and the DNA sequences involved in the regulation of that gene.

Describe how the altering of chromatin structure can be a regulatory mechanism.

Describe what is meant by 'flanking sequences' and what they do in gene regulation.

Describe how alternative splicing of mRNA enables one gene to direct the production of more than one protein.

Define RNA interference and describe how micro RNAs function in post-transcriptional regulation.

Identify some of the post-transcriptional and post-translational regulatory controls on gene expression.

Compare regulation of gene expression in bacteria and eukaryotes.
Quiz 3 on chapters 14, 15, 16 & 17

Define genetic engineering and recombinant DNA.

Describe the use of reverse transcriptase to produce complementary DNA (cDNA).

Describe the use of restriction endonucleases and DNA ligase in manipulating DNA.

Describe how plasmids are used in cloning and how DNA libraries are produced and screened.

Describe the use of the polymerase chain reaction (PCR) to amplify DNA.

Describe the basic principles of DNA sequencing

SESSION 27 - THE GENOME Chapter 20

Define the term 'genome'.

Describe the characteristics of prokaryotic and eukaryotic genomes.

Define the term transposable element and describe its function.

List some of the uses that may be made of genomics.

SESSION 28 – PRINCIPLES OF DEVELOPMENT Chapter 21

Describe the four major processes that lead to the development of a multicellular organism: cell proliferation (and death), cell movement (or expansion), cell differentiation, cell-cell interaction.

Differential gene expression as the key process in cell differentiation.

Distinguish between maternal effect genes, zygotic genes and homeotic genes

Define the process of induction and apoptosis.

SESSION 29 - PRINCIPLES OF DEVELOPMENT (CONT.)

Drosophila development: Describe the function of bicoid and maternal effect genes in development.
Describe how the gap, pair-rule and segment polarity genes organize the embryo.

Explain how the differential expression of homeotic genes results in the formation of different structures from different body segments.

Describe the conserved and homologous nature of the genetic mechanisms that regulate development in animals.

Describe how changes in developmental pathways underlie evolutionary change.

SESSION 30 – ANIMAL DEVELOPMENT Chapter 22

Describe the major processes in animal development, including gametogenesis, fertilization, cleavage, gastrulation and organogenesis.

List the stages of fertilization with reference to the sea urchin and describe how each stage is regulated.

Describe fertilization in mammals. Compare and contrast fertilization in sea urchins and mammals.

Define cleavage and describe how this process differentially distributes cytoplasmic determinants in the embryo.

Describe gastrulation and the formation of the embryonic tissues.

Describe organogenesis with respect to vertebrates.

Describe the processes of determination and differentiation

SESSION 31 - PRINCIPLES OF EVOLUTION Chapter 24

Define evolution, gene pool, and natural selection.

Describe the four postulates of evolution by natural selection: variation, heritability, overproduction, selection.

Compare and contrast natural selection (Darwin/Wallace) and the inheritance of acquired characteristics (Lamarck).

SESSION 32 - PRINCIPALS OF EVOLUTION (cont.) Chapter 24
Define homologous, analogous, and vestigial structures, adaptive radiation.

Explain the following evidence for the occurrence of evolution: artificial selection, fossil record, comparative anatomy, embryology, and biogeography. Give an example of each.

SESSION 33 - EVOLUTIONARY PROCESSES Chapter 25

Explain why genetic diversity is essential in a species.

State the Hardy-Weinberg Principle and use it to determine allele frequencies in a population.

State and explain the five situations in which the Hardy-Weinberg Principle is invalid.
SESSION 34 - EVOLUTIONARY PROCESSES (cont.) Chapter 25

Describe evolution as deviation from the Hardy-Weinberg equilibrium through mutation, gene flow, genetic drift, founder effect, and natural selection.

Define what is meant by directional, stabilizing and disruptive selection and compare and contrast their respective mechanisms.

SESSION 35 - SPECIATION Chapter 26

Quiz 5 on chapters 21, 22 & 24

Contrast the morphological and biological concepts of "species."

Define speciation and distinguish between allopatric and sympatric speciation.

List the different types of premating and postmating isolating mechanisms.

Describe the mechanisms of polyploidy and hybridization.

SESSION 36 - HISTORY OF LIFE Chapter 27

Describe some of the techniques that are used to discover the evolutionary history of life.

Describe phylogenetic trees and the cladistic approach to estimating phylogeny.

Define synapomorphy, monophyletic, homoplasy, convergent evolution.

Describe the fossil record, the Cambrian explosion, adaptive radiation and mass extinctions.

THE FINAL EXAM COVERING CHAPTERS 14-22, 24-27 WILL BE GIVEN DURING THE FINAL EXAM WEEK