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| **Course Outline** |

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| **Department & Number** | BioSc 159 | **Number of Weeks** | 18 |
| **Course Title** | Foundations in Biotechnology Laboratory | **Lecture Hours** |  |
| **Prerequisite** |  | **Lab Hours** | 54 |
| **Challenge Policy** |  | **\*Hours By Arrangement** |  |
| **Co-requisite** | BioSc 157 | **Units** | 1 |
| **Challenge Policy** |  |  |  |
| **Advisory** |  |

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| **COURSE/CATALOG DESCRIPTION** |

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| This course is designed to provide students with training in the skills and applications commonly used in Biotechnology and Molecular Biology laboratories. It will provide technical practice with analytical instruments, the formulation and use of reagents, and the culture and study of model organisms. Students will learn and apply the Scientific Method, perform data analysis, keep a laboratory notebook according to cGMP, follow Standard Operating Procedures and practice good communication and teamwork skills as they carry out laboratory experiments that reveal foundational concepts of biology, biotechnology, and molecular biology. |

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| **COURSE OBJECTIVES** | |
| At the completion of the course the student will be able to: | |

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| Use laboratory investigations and appropriate procedures to generate accurate and meaningful data and derive reasonable conclusions from them. |
| Interpret the pH scale and distinguish between acids and bases. Understand and write emperical and structural formulae for basic biological molecules. Identify, and discuss structures and functions of the four major classes of biological molecules: carbohydrates, lipids, proteins, and nucleic acids |
| Compare and contrast the distribution, structure, and functions of Eukaryotic and Prokaryotic cells. |
| Interpret the general equation for photosynthesis. Demonstrate knowledge of chloroplasts and how they are arranged in the plant. Demonstrate knowledge of various environmental factors limiting photosynthesis. Interpret the general equation for cellular respiration. Explain the process of fermentation in animal, plant, and fungal cells. |
| Define and explain cellular reproduction in prokaryotes and eukaryotes. Compare and contrast mitosis and its events with meiosis and its events. Interpret the life-cycles of various eukaryotes. Define, explain and discuss floral anatomy, pollination, seeds, fruit, and seed dispersal. Demonstrate knowledge of the evolutionary purpose of sexual reproduction. |
| Explain and discuss how genetic material is encoded in molecules of DNA, expressed through the process of transcription and translation, and subject to gene regulation. Demonstrate knowledge and interpret the process of DNA replication. Define and apply the basic vocabulary of genetics. Explain the molecular aspects of genetics and mutations. |
| Explain recent advances in genetic engineering and biotechnology involving the introduction of new or modified genetic material into the organismal genome and the cloning of organisms. |
| Discuss the movement of energy and materials through ecosystems. List and interpret factors defining the growth rate of population and other factors limiting population growth. Evaluate and understand ecological phenomena including interspecific interactions, succession, and niches. |
| Define, explain, and interpret evolution and natural selection. Explain how our understanding of natural selection and evolution is applied in Biotechnology and Molecular Biology. |
| Define, explain, and interpret characteristics of life. Demonstrate knowledge of the purpose and history of classification systems. Define and give examples of the Kingdoms of life. |
| Demonstrate knowledge and use of model eukaryotic and prokaryotic organisms, including appropriate culture conditions, cellular and/or organismal structure, reproduction, and development. |
| Demonstrate the ability to use dissecting, compound, and fluorescence microscopy with appropriate stains to analyze cells and organisms |
| Demonstrate understanding of principles of commonly used techniques of biotechnology (for example; molecular biology, biochemistry, microbiology, bioinformatics, etc.) |
| Analyze proteins using size exclusion and ion exchange chromatography, SDS-PAGE, and ELISA technologies. Determine protein concentration with a microtiter plate format assay. |
| Analyze DNA molecules using the polymerase chain reaction and agarose gel electrophoresis, determine the relative sizes of DNA molecules using standards. |
| Grow, monitor, and harvest samples from a bioreactor over a time course. Produce and analyze a batch record of these samples. |
| Demonstrate proficiency with precision measuring devices (for example; micropipettors, analytic balances, pH meter, etc) and other general lab techniques |
| Demonstrate understanding of good practice in the biotechnology industry by following Standard Operating Procedures, complying with documentation requirements, and producing a laboratory notebook according to cGMP conventions. |
| Demonstrate the ability to establish, maintain, and manipulate plant tissue culture in sterile conditions using aseptic technique (using the tissue culture hood/biological safety cabinet), dissection, preparation of media, and by providing appropriate growth conditions and hormones. |
| Demonstrate an ability to communicate effectively and work as part of a team. |

**COURSE CONTENT:** (In detail; attach additional information as needed and include percentage breakdown)

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| **BASIC BIOLOGICAL CONCEPTS COVERED IN THE LABS** |
| Chemistry: pH scale, acids and bases. Structures, formulae and functions of simple compounds and basic biological molecules (carbohydrates, lipids, proteins, and nucleic acids). |
| Cell theory: Distribution, structure, and functions of Eukaryotic and Prokaryotic cells. |
| Cellular energetics: Photosynthesis, Chloroplasts, plant structure, and the environment. Cellular respiration and fermentation. |
| Cellular reproduction and development: Cellular reproduction in prokaryotes and eukaryotes. Mitosis and meiosis. Life-cycles of various eukaryotes. Floral anatomy, pollination, seeds, fruit, and seed dispersal. |
| Genetics: Sexual reproduction and evolution. DNA, transcription, translation, gene regulation. DNA replication. Vocabulary and molecular aspects of genetics and mutations. Genetic engineering, Biotechnology, and the cloning of organisms. |
| Ecology: Movement of energy and materials through ecosystems. Population growth rates and limiting factors. Interspecific interactions, succession, and niches. |
| Natural Selection and Evolution: Applications of knowledge of natural selection and evolution in Biotechnology and Molecular Biology. |
| Biological classification systems and the characteristics of life. |
| Biotechnology and Molecular Biology concepts: Recombinant protein production, UV spectrophotometry, column chromatography, microtiter plate format protein assay, SDS-PAGE, identifying technical errors by critical examination of batch records, critical examination and analysis of data, enzyme-linked immunosorbant assays (ELISA), development and design of an ELISA assay, genomic DNA extraction, polymerase chain reaction (PCR), agarose gel electrophoresis. |
| **BASIC LABORATORY SKILLS** |
| Practice and application of the Scientific method |
| Sterile and Aseptic Technique. Use of the autoclave and ultrafiltration technique. Use of the biological safety cabinet (tissue culture hood). |
| Preparation and use of different buffer systems and reagents. Practice with electronic balances, single and multichannel micropipets, calibrations. |
| Preparation of growth and selective media used in microbiological and eukaryotic cell culture |
| Microscopy -preparation and analysis of samples using of dissecting, compound, and fluorescence microscopes. |
| Good laboratory practices: Following SOP's, documentation, keeping a laboratory notebook, data analysis |
| Workplace skills: working as part of a team, problem-solving, record keeping according to cGMP, critically examining data |
| **ADVANCED LABORATORY APPLICATIONS** |
| Preparation and documentation (batch record) of a growth timecourse, UV spectrophotometry, gravimetric column chromatography (size exclusion and ion-exchange), SDS-PAGE, gel documentation. |
| Enzyme linked immunosorbent assays (ELISA), use of microtiter plate reader, using on-line reagent ordering systems. |
| DNA extraction, Polymerase chain reaction (PCR), agarose gel electrophoresis, agarose gel documentation |

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| **METHODS OF INSTRUCTION** |

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| Pre-lab lecture. |
| Small group and teamwork, laboratory experimentation, computer work. |
| Supervised practice with instrumentation used in assays of biological macromolecules and culture of model organisms. |

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| **INSTRUCTIONAL MATERIALS** |

Required

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| **Textbook Title:** | Foundations in Biotechnology Lab and Lecture Workbook |
| **Author:** | Katherine Krolikowski |
| **Publisher:** | Note: This lab and lecture workbook was generated by CCC faculty |
| **Edition/Date:** | 3rd Edition, 2013 |

Recommended, but not required:

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| **Textbook Title:** | *Introduction to Biotechnology* |
| **Author:** | Thieman, William J. and Palladino, Michael A. |
| **Publisher:** | Pearson Benjamin Cummings |
| **Edition/Date:** | 2nd edition, 2009 |

***OR:***

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| **Textbook Title:** | *Basic Laboratory Methods for Biotechnology* |
| **Author:** | Lisa A. Seidman and Cynthia J. Moore |
| **Publisher:** | Pearson/Benjamin Cummings |
| **Edition/Date:** | 2nd edition (2009) |

***OR:***

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| **Textbook Title:** | *Biotechnology: Science for the New Millennium* |
| **Author:** | Ellyn Daugherty |
| **Publisher:** | Paradigm |
| **Edition/Date:** | 1st edition (2007) |

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| **COURSE EXPECTATIONS** (Use applicable expectations) |

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| **Outside of Class Weekly Assignments** | **Hours per week** | | |
| Weekly Reading Assignments | | 1 |
| Weekly Writing Assignments | | 1 |
| Weekly Math Problems | |  |
| Lab or Software Application Assignments | |  |
| Other Performance Assignments | |  |

**STUDENT EVALUATION**: **(Show percentage breakdown for evaluation instruments)**

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| 25 | **%** | Quizzes (paper and practical) |
| 15 | **%** | Homework assignments |
| 60 | **%** | Evaluated laboratory notebook |

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| **GRADING POLICY (Choose LG, CR/NC, or SC)** |

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| X | **Letter Grade** |  | **Pass / No Pass** |  | **Student Choice** |
| 90% - 100% = A | | 70% and above = Pass | | 90% - 100% = A |
| 80% - 89% = B | | Below 70% = No Pass | | 80% - 89% = B |
| 70% - 79% = C | |  | | 70% - 79% = C |
| 60% - 69% = D | |  | | 60% - 69% = D |
| Below 60% = F | |  | | Below 60% = F |
| *or* |
| 70% and above = Pass |
| Below 70% = No Pass |

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| **Prepared by:** | Katherine Krolikowski, PhD |

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| **Content Review Date:** | October, 2013 |

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