# Biology Second Year Laboratory

**Laboratory Sections**. BIOL 216-04, BIOL 216-05, BIOL 216-06,
M 1:30 pm – 4:20 pm ISC 147, 302, 306

Instructors: ***Regina Clinton***, Office ISC 139A: Ecology Instructor, Room 147
Office Hours: MW 9:30-11:00 am, T 2:00-3:00 pm
E-mail for appointments at any other times. Phone: 6051;
E-mail : clinton@geneseo.edu

***Dr. Hristina Nedelkovska,*** Office ISC 139B: Cell Biology/Biochemistry Instructor, Room 302
Office Hours: M 10:00 – 11:00 am, T 11:00 - 12:00 pm, W 1:30-2:30 pm
E-mail for appointments at any other times. Phone: 6396;
E-mail: nedelkovska@geneseo.edu

***Dr. Harold Hoops***, Office ISC 353: Genetics Instructor, Room 306
Office Hours: Office Hours: M 8:30-9:30, T 3:00-4:00, W 4:00-5:00, R 9:30-10:30, & F 8:30-9:30
E-mail for appointments at any other times. Phone: 5378;
E-mail: hoops@geneseo.edu

**Overall Goals for this Course**.

1. To give you the intellectual, physical and technical skills that will enable you to succeed in more advanced Biology labs (Ecology, Genetics, Cell, Physiology etc.), in independent research with Biology faculty members, in summer research experiences and in technical jobs.

2. To introduce you to selected technical and intellectual approaches used by biologists in Genetics, Cell Biology and Developmental Biology.

**General structure of Course**:

This course is designed to introduce second year students to three core areas of the Biology curriculum. It will be structured in three 4-week modules, with one module each representing Ecology, Genetics and Cell Biology/Biochemistry. Each module will be taught in a different room by faculty member with interests in the field being covered. After a month in one laboratory, students will rotate to the next module of the course.

The modules are not meant to cover all of their respective fields, but rather to introduce you to one or two in-depth examples of modern approaches to answering contemporary questions in each. This lab does not replace the 1-credit laboratories that are offered in Ecology, Genetics and Cell, and Developmental Biology all of which will be available for students who wish to obtain more laboratory exposure to those areas. In contrast to our first-year laboratory (which emphasizes process skills), the second-year laboratory will introduce student to techniques used in the respective fields. We hope this lab will give you increased intellectual and technical skills

that allow you to excel in upper level lab laboratories, in summer research experiences and in the workplace.

**Grading**:

Your final grade will be based on the average of each of your three lab sections (Cell, Ecology and Genetics), with each section contributing equally to your overall grade.

Grades will be assigned according to the following point distribution:

| | |
|---|---|
| > 93% | A |
| 90-92% | A- |
| 87-89% | B+ |
| 83-86% | B |
| 80-82% | B- |
| 77-79% | C+ |
| 73-77% | C |
| 70-72% | C- |
| 60-69% | D |
| < 60% | E |

SUNY Geneseo will make reasonable accommodations for persons with documented physical, emotional or learning disabilities. Students should consult with the Office of Disability Services (Ms. Leah Houk, Interim Coordinator for the office of disability services, Erwin 22, disabilityservices@geneseo.edu) and their individual faculty regarding any needed accommodations as early as possible in the semester.

**Tentative Schedule**

*Common Activities*

| Week | Date | Day | Topic |
|---|---|---|---|
| 1 | August 26 | M | Introduction, Pre-lab for each section |
| 12 | December 9 | M | Laboratory Practical Exam |

Laboratory Modules

Ecology Module: Population Size, Spatial Dispersion Patterns and Biodiversity

Cell Biology Module: Mitochondrial Isolation and Function

Genetics and Molecular Genetics Module: Bacterial Transformation

**Ecology Module** Room 147

Instructor: Regina Clinton

**Population Size, Spatial Dispersion Patterns and Biodiversity**

Ecology is the study of the interactions of organisms with their physical and biotic environments. In this lab we will learn how to estimate how many organisms there are in a population, quantifying how organisms are spread out in their environment and, ultimately, quantify the diversity of organisms in a community. Our analyses will use samples to estimate population parameters and, therefore, will require statistics. To accomplish these analyses you will become familiar with descriptive and inferential statistics.

*Come prepared to go in the field in all kinds of weather (rain or shine) with the appropriate gear (dressed in layers, rain coat, hat, gloves and boots).*

| Week | Topic |
|---|---|
| 1 | Population and Spatial Pattern Analysis |
| 2 | Field Techniques and Data Analysis |
| 3 | Biodiversity |
| 4 | Data Analysis and Presentations |

Expected Learning Outcomes

After successfully completing this four-week module you should be able to:

- Estimate the size and spatial dispersion pattern of a population;
- Quantify the biodiversity of a community by fitting a species-area curve to data and calculating the Shannon diversity index;
- Use *descriptive* and *inferential* statistical tests to interpret data collected in the field
- Demonstrate use of some the basic laboratory tools and field research skills pertinent to the field of ecology (e.g. DBH tapes, dichotomous keys, sampling methods (quadrats, transects)
- Develop and give an oral presentation of your results to a group in a standard scientific form (Introduction, Methods, Results, and Discussion);
- Describe what you did and found to someone who is not a scientist.

**Cell Biology/ Biochemistry Module: Mitochondrial Isolation and Function**

Instructor: Dr. Hristina Nedelkovska Room 302

Cells are complex both structurally and functionally. One way in which cells can carry out very different kinds of tasks is by compartmentalization, where some reactions and events are sequestered away from others that might interfere or inhibit them. Cell biologists therefore often start by separating organelles or other compartments so that they can study a less complex system. Such separations are often based on differential centrifugation – a technique where cells are broken up and the resultant homogenate is subjected to increasingly greater sedimentation forces in a centrifuge. In this module of the course, we will first isolate mitochondria from cauliflower florets. Using an assay of the mitochondrial specific enzyme succinate dehydrogenase (SDH), we will measure the relative levels of mitochondria in our isolated fractions. We will also measure the protein levels in each isolated fractions so that we can better determine the characteristics of our isolated mitochondria.

Given that we now have the ability to isolate a fraction of mitochondria and do an enzyme assay, we will then use these techniques to examine the kinetics of the SDH reaction. You will be introduced to the Michalis-Menten equation which describes the relationship between the rate of an enzyme reaction and concentration of enzyme substrate. We will then actually measure the kinetic parameters $K_M$ and $V_{MAX}$ for SDH. Finally, we will learn something about enzyme inhibitors and examine the effects of different inhibitor types on the SDH reaction.

| Week | Topic |
|---|---|
| 1 | Mitochondrial Fractionation, Enzyme Assay |
| 2 | Protein Assay, Enzyme rate calculations, Introduction to Enzyme kinetics |
| 3 | Mitochondrial isolation, Determining SDH enzyme kinetics, $K_M$, $V_{MAX}$, Introduction to enzyme inhibitors |
| 4 | Characterizing inhibitors of Mitochondrial SDH |

Expected Learning Outcomes

After successfully completing this four-week module you should be able to:

- Use differential centrifugation to isolate cellular organelles;
- Use spectroscopy to follow the progress of enzymatic reactions;
- Graph data to promote effective analysis and interpret graphical data to solve questions;
- Understand the basic properties of enzyme kinetics and be able to determine the kinetic parameters $K_M$ and $V_{MAX}$ experimentally;
- Understand nature of enzyme inhibitors, and use an enzyme assay to characterize inhibitors

**Genetics and Molecular Genetics Module. Bacterial Transformation**

Instructor: Dr. Harold Hoops Room 306

Introducing DNA molecules into organisms is at the core of both molecular genetics and genetic engineering, and is one of the most common "techniques" used by biologists. There are numerous reasons why an investigator will introduce a DNA molecule into an organism such as generating multiple copies of the DNA molecule for applications such as cloning or sequencing and engineering a microorganism to produce a specific protein for biochemical studies. In this section, you will transform *E. coli* with a plasmid. This strain of *E. coli* is sensitive to ampicillin (and most other antibiotics) but the plasmid contains the gene for ampicillin resistance. After obtaining strains which we tentatively believe to have taken up the plasmid, we will do a plasmid DNA isolation. You will learn to measure the amount and purity of the DNA that you have isolated. But how can we convince ourselves that the transformants contain the predicted plasmid and is not simply a random mutant to ampicillin resistance? One way to determine if the plasmid is truly the one we thought we added via a restriction mapping analysis. Another way is to analyze the isolated plasmid for the presence of the ampicillin resistance gene using polymerase chain reaction (PCR).

| Week | Topic |
|---|---|
| 1 | Bacterial Transformation |
| 2 | Plasmid Isolation and DNA Measurement |
| 3 | Restricting Mapping I- Restriction Digest and PCR |
| 4 | Restriction Mapping II- Agarose Gel Electrophoresis |

Expected Learning Outcomes

After successfully completing this four-week module you should be able to:

- Explain the parameters relevant for design of a transformation experiment including strain genotype and selection/screening strategies;
- Describe how DNA yield and DNA purity are determined following plasmid DNA isolation;
- Differentiate genetic transformation from gene mutation;
- Develop experience in microbial culturing techniques, plasmid isolation and transformation;
- Understand the principles behind the restriction digest, polymerase chain reaction (PCR), and agarose gel electrophoresis.