

Biology 216 - Fall 2013 - Biology Second Year Laboratory

Laboratory Sections. CRNs 17667-17669 M 12:30 pm - 3:20 pm, ISC 302, 147, 306

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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 (Cell, Physiology, Immunology, Molecular Techniques 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 Ecology, Genetics and Cell Biology.

Supplies:

Students will need a labcoat for the first week of the lab.

General structure of Course:

This course is designed to introduce second year students to the three core areas of the Biology curriculum. It will be structured in three 4-week modules, with one module each representing cell biology, genetics and molecular biology, and ecology. Each module will be taught in a different room by a faculty member with interests in the field being covered. After a month in one laboratory, students will rotate to another room and another part of the course.

Students will have a common first week and last week experience.

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, 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:

Cell Biology Section	30%
Genetics Section	30%
Ecology Section	30%
Lab Practical	10%

Accommodations:

SUNY Geneseo will make reasonable accommodations for persons with documented physical, emotional, or cognitive disabilities. Accommodations will also be made for medical conditions related to pregnancy or parenting. Students should contact Dean Buggie-Hunt in the Office of Disability Services (tbuggieh@geneseo.edu or [585-245-5112](tel:585-245-5112)) and their faculty to discuss needed accommodations as early as possible in the semester.

Academic Policies of the Biology Department- ACADEMIC DISHONESTY

Students are expected to be aware of and to obey the College policies concerning academic dishonesty. Any alleged cheating and/or plagiarism may be dealt with by the School as a disciplinary problem in accord with College policies as stated in the Bulletin. Be especially aware that academic honesty includes putting your name on a group project that you did not contribute to and turning in lab reports where material has been copied from reports from previous semesters' classes. Group members beware--if your name is on a project you need to be sure that the work is authentic and properly referenced; you are responsible if one of the group has plagiarized material. The faculty of the School will take all necessary steps to deter academic dishonesty, all cases of which will be reported to the Dean of the School for possible disposition as a College disciplinary matter.

Tentative Schedule

Common Activities

<u>Week</u>	<u>Date</u>	<u>Day</u>	<u>Topic</u>
1	Aug. 26	M	Introduction, Assessment, Tools, Pre-lab for each section
15	Dec. 9	M	Laboratory Practical Exam

Laboratory ModulesCell Biology

<u>Week</u>	<u>Topic</u>
1	Background, Introduction to cellular fractionation, enzyme assays
2	Cellular Fractionation and Enzyme Assay to Localize SDH
3	Protein Assay, Enzyme rate calculations, Introduction to enzyme kinetics
4	Mitochondrial isolation, Determining SDH enzyme kinetics, K_M , V_{MAX}

Genetics

<u>Week</u>	<u>Topic</u>
1	Bacterial Transformation
2	Plasmid DNA Isolation and Quantification
3	Restriction Mapping I: Restriction Digest and PCR
4	Restriction Mapping II: Agarose Gel Electrophoresis

Ecology

<u>Week</u>	<u>Topic</u>
1	Forest succession, population size, species diversity, and spatial dispersion. Field data collection and entry into excel.
2	Field Data collection and data entry into excel. Begin data analysis.
3	Data Analysis, summarize data in tables and figures.
4	Statistical test, Group Presentations.

Cell Biology Module: Mitochondrial Isolation and Function

Cells are very complex places. 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. Some events are compartmentalized even within the cytosol of prokaryotic cells, but compartmentalization is much more extreme in eukaryotes. One of the problems that face biologists is that this complexity can make analysis of cellular events more difficult. 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. This technique has played an important role in cell biology and continues to be used to study a wide range of problems.

Although mitochondria carry out multiple functions within the cell, they are most famous for their ability to produce ATP through oxidative phosphorylation. The words “oxidative phosphorylation” suggest a single process, but it really requires several sequential but mechanistically distinct types of events. First, Glycolysis and the Krebs cycle enzymes oxidize foods to CO_2 while transferring electrons onto FAD and NAD^+ , creating the high-energy electron carriers FADH_2 and NADH. Secondly, the electron transport system passes these electrons through successively more electronegative molecules to oxygen. Much of the free energy released in this process is used to pump protons across the inner mitochondrial membrane and against a steep energy gradient. In the third step, the ATP synthase complex uses this PMF to power the synthesis of ATP molecules.

In this module we will isolate mitochondria and then use a mitochondrial enzyme Succinate Dehydrogenase (SDH) as a marker for the purification of these organelles. We will then examine the enzymatic characteristics of 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
- interpret graphical data to solve questions;
- understand the biochemical and thermodynamic interaction between the Krebs cycle, electron transport and ATP synthase in mitochondria.

Genetics and Molecular Genetics Modules: Bacterial Transformation

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 a microorganism 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 an *E. coli* strain with a plasmid. The *E. coli* strain is sensitive to ampicillin (and most other antibiotics) but the plasmid contains the gene for ampicillin resistance. After obtaining strains which we tentatively believe have taken up the plasmid, we will perform plasmid DNA isolation. You will learn to measure the amount and purity of the DNA that you have isolated. How can we convince ourselves that the transformants contain the predicted plasmid and is not simply a random mutant to ampicillin resistance? One way is to confirm its presence in transformed bacteria via a restriction mapping experiment. Another way is to analyze transformed bacteria for the presence of the ampicillin resistance gene using PCR.

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 is determined following plasmid DNA isolation;
- differentiate genetic transformation from gene mutation;
- develop experience in microbial culturing techniques, bacterial transformation, plasmid DNA isolation, restriction digests and PCR (polymerase chain reaction);
- to understand the principles behind each techniques

Ecology Module. 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).

Expected Learning Outcomes

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

- Identify and describe the biology of the tree species that occur in old field forests in Western New York and describe the physiognomy of the forests;
- 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))
- Determine and compare tree species density, plot frequency, coverage, and Importance Values on two adjacent old field forests;
- Describe the spatial dispersion pattern of two adjacent old field tree populations using Morisita's dispersion index and Morisita's index of community similarity;
- Determine the successional stage of tree species in old fields based on DBH-size class histograms;
- Quantify the biodiversity of a community by fitting a species-area curve to data and calculating the Shannon diversity index;
- Use excel to organize and analyze the data;
- Use *descriptive* and *inferential* statistical tests to interpret data collected in the field;
- Develop and give an oral presentation of your results to a group in a standard scientific form (Introduction, Methods, Results, and Discussion);