

Instructor	Dr. Asem Abdulahad	Instructor	Prof. Leanna House
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Office Hours	T,Th 11-1pm	Office Hours	By appointment
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Office hours: Office hours will be held every Tuesday and Thursday from 11am – 1pm in 5003 Derring Hall. If you would like to schedule individual/group office hours please contact the instructor via email at least 24h in advance.

Course Description

The Integrated Science Laboratory (ISL) offers a unique opportunity to perform project-based experiments in an interdisciplinary and team-oriented environment. Using a modular program that consists of multiple week experiments, this laboratory course will provide the student with the necessary experience to pursue research careers in academic, industrial, or government labs. We will integrate fundamental concepts from physics, chemistry, biology, and mathematics to solve complex scientific questions within four discovery modules designed to supplement the complementary Integrated Science lecture course.

Discovery Modules

1. **Tools of Scientific Research:** this module will focus on skills necessary for success in science and understanding fundamental scientific principles through experimentation. These include (but are not limited to) brainstorming on current topics, literature searching, instrument and glassware familiarity, data handling and analysis, statistical design of experiments as well as identifying and quantifying sources of experimental error.
2. **Surfactants:** the surfactants module is designed to give each student basic experience in organic chemistry as well as in the characterization of self-assembling organic molecules. In this module we focus on the ability to control the size of surfactant molecules on the nanoscale through organic synthesis.
3. **Plant genetics:** this module serves as an advanced introduction to plant biology through the genetic transformation of the model plant *Arabidopsis thaliana*; here we will study the effect of having high expression of the mitochondrial malate dehydrogenase gene in the growth of *Arabidopsis thaliana*.
4. **Nano-medicine:** integrating concepts and skills from the previous modules we will develop nanoscale gene delivery vehicles for the transfection of DNA to cells. The nano-medicine module provides a unique opportunity to use cutting-edge instrumentation for culturing cells while introducing the basics of polymer synthesis and purification.

The Integrated Science lab II course is not a typical freshman laboratory experience. As in a “real” research project, correct answers are not always known prior to performing an experiment. For each module, we will propose hypotheses and formulate experiments intended to test these hypotheses. At

the conclusion of the experiments, we will often find that we need to reevaluate the initial hypotheses and redesign future experiments. Throughout this laboratory experience your instructors may not have answers to every question; rather, they will serve as facilitators and learn alongside you.

The ISL is a pilot course and is intended to provide a unique, research-based laboratory experience while investigating the same concepts examined in introductory chemistry, biology, and physics laboratory courses. Your constant feedback and input is vital to helping us improve this course and the future modules. Please let us know of any suggestions you have to help ensure an enjoyable laboratory experience for everyone.

Learning Outcomes

- ✓ Refine observational skills
- ✓ Present and analyze your own experimental data
- ✓ Graphically represent data and interpret the results
- ✓ Learn to design experiments to test research hypotheses
- ✓ Compile a set of basic experimental and laboratory techniques
- ✓ Work efficiently in interdisciplinary teams
- ✓ Improve your communication skills (both written and oral)
- ✓ Develop an interdisciplinary way of thinking
- ✓ Learn how to access reliable literature resources

Grade Scale

A-/A	90-100
B-/B/B+	80-89
C-/C/C+	70-79
D	60-69
F	<60

Grades for all work in ISL II are point based

Assessment

Laboratory performance (attentive, engaged, safety, equal collaboration)	10%
Laboratory notebook (available at bookstore; tear-out carbon copy style)	10%
Assignments (quizzes, reading, preparatory questions, DUE AT BEGINNING OF CLASS)	30%
Reports (three 10% each; due one week after data review for each module)	30%
Capstone paper/presentation (team presentation with individual scores)	20%

Laboratory Performance

Your participation and performance in the lab will be 10% of your grade. This portion of your grade will also encompass your level of engagement during pre-lab discussions, your preparedness for lab, data review and summary sessions, as well as your involvement in the lab experiments and your ability to work safely alongside your peers. You are expected to come to lab prepared for each day's experiments in order to ensure that you gain the appropriate understanding in a safe and timely manner.

Laboratory Notebooks

Lab notebooks must be a "tear-out" carbon copy style notebook. These are available at the university bookstore. Lab notebooks will be checked at the beginning of each class prior to beginning the day's experiment. Students are expected to submit the carbon copy from their lab notebook at the conclusion of each experiment. Lab notebook grades will make up 10% of your grade.

Assignments

Assignments include pre-labs, post-labs, quizzes and preparatory questions. These are due at the beginning of class or as designated in assignment instructions (this primarily applies to Scholar assignment submissions). Late submissions are accepted with a penalty of 10% per class period.

Lab Reports

You will have three major lab reports due this semester – one for each of our discovery modules. Lab reports must be submitted in the required format and guidelines specified for each module. These will be graded using the rubric posted on the Scholar site. Lab reports will comprise 30% of your grade (10% per report). Late submissions are accepted with a penalty of 10% per class.

Capstone Project

At the end of the course each team will participate in a capstone project. Each team must prepare a 15 minute oral presentation of their project and each team member must participate in the oral presentation. A final written report will be prepared by each student. Please check the Scholar Website for details on the format of the presentation and final paper.

Bonus Points

Bonus point assignments may be announced throughout the semester by the instructor. These assignments will be relevant to the discovery modules and will supplement the laboratory learning experience.

Safety

As a part of learning proper lab technique, observation of safety protocols is paramount. Being a good scientist means being a safe scientist. It is important to work safely with chemicals and to exercise proper precautions to limit exposure to persons and the environment. Proper lab attire must be worn at all times which include safety goggles, lab coat, and closed-toed and closed-heel shoes. Persons not wearing the proper safety attire will not be allowed to start the lab and result in an incomplete (zero) grade of the exercise for that day. There should also be no food or drinks in the lab. More safety information will be discussed at the start of the course and before the start of each lab.

Attendance

Attendance to the labs is mandatory. Absences for illness, school sponsored events (sporting events, club socials, etc.), family emergencies, and unforeseeable conflicts are generally excused. Illnesses require documentation from Schiffert Health Center or other health care providers. Special circumstances will be addressed on an individual basis.

Honor Code

Students are encouraged to discuss issues, troubleshoot, and collaborate with team members and between teams. The Honor Code at Virginia Tech applies to all written assignments (i.e. lab reports, lab notebooks, final paper, etc.). The Virginia Tech Honor Pledge is: "I have neither given nor received unauthorized assistance on this assignment" and should appear on all written work. Definitions for cheating, plagiarism, falsification, academic sabotage, and misconduct in research and teaching may be found by selecting the corresponding title found at the University website. Remember sometimes you might not be aware of conducting plagiarism!!! Paraphrasing is also plagiarism. Be sure to read about this topic!

Special Needs

If you have any special needs including learning disabilities or athletic obligations please set up an appointment within the first two weeks of classes. Any learning disabilities or athletic obligations will require the appropriate university documentation.

Class Website

Consult the Scholar website routinely to obtain announcements, handouts, and a detailed syllabus with learning outcomes for each individual module.

Tools of Scientific Research

01/22	Welcome back and introduction
01/24	Brainstorming with Mindjet
01/29	Statistics (project-based learning) with Dr. House
01/31	Azeotropic distillation
02/05	Connecting art and science: molecular folding and origami
02/07	Protein folding

Surfactants

02/12	Surfactant Organic Synthesis (Nucleophilic Substitution)
02/14	Surfactant Purification and Characterization (Precipitation/Infrared Spectroscopy)
02/19	Genetics intrusion: Transformation of Arabidopsis thaliana (Day 3)
02/21	Genetics intrusion: Transformation of Arabidopsis thaliana (Day 4)
	Critical micelle concentration determination by conductivity and UV-Vis measurements
02/26	Thermodynamics of micellization
02/28	Derivations of thermodynamic parameters for micellization and data review
03/05	Revisiting brainstorming...in preparation of Capstone
03/07	Statistics with Dr. House and lab report discussion (Surfactants report due)
03/12	Spring Break!!!
03/14	Spring Break!!!

Genetics

03/19	Collection of Transgenic Seeds and Selection of Transgenic Plants
03/21	Characterization of Transgenic Plants
03/26	Segregation Analysis
03/28	Statistics (project-based learning) with Dr. House

Nano-medicine

04/02	Vector Synthesis
04/04	Vector Purification (Genetics report due)
04/09	Binding, Gel Electrophoresis, and Dynamic Light Scattering
04/11	Group A: pKa Determination Group B: Transfection of COS7 cells
04/16	Group A: Competitive Heparin Binding Assay Group B: Protein and Luciferase Assays
04/18	Group A: Transfection of COS7 cells Group B: pKa Determination
04/23	Group A: Protein and Luciferase Assays Group B: Competitive Heparin Binding Assays
04/25	Statistics with Dr. House and Nano-medicine data review
04/30	Instructor meeting with Capstone groups and lab cleanup
05/02	Capstone Event!!! Capstone report due 05/09 (Nano-medicine report due today)

*****This schedule is dependent on the flow of the course and is therefore subject to change*****
