

## Integrated Science Laboratory III

Tuesdays and Thursdays 2:00-5:00 PM

Derring Hall Laboratory 5005

### Instructors:

<p><b>Prof. Timothy E. Long</b> Department of Chemistry 2108 Hahn Hall South telong@vt.edu</p>	<p><b>Prof. Gary Long</b> Department of Chemistry 117 Surge Bldg. glong@vt.edu</p>	<p><b>Dr. Asem Abdulahad</b> Department of Chemistry 1013 Hahn Hall South aabdula6@vt.edu</p>
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**Office hours:** Office hours will be held every Tuesday and Thursday from noon to 1:30pm in 5003 Derring Hall. If you would like to schedule individual/group help sessions please contact the instructor via email.

### 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 fundamental skills such as glassware familiarity, data analysis and curve fitting, as well as identifying and quantifying sources of experimental error.
2. **Forensics:** in this module the student will gain experience with common analytical instrumentation and qualitative analysis of unknown compounds.

3. **Nanoscience:** this module will provide an interdisciplinary introduction to nanotechnology through the synthesis of nanoparticles and their use in electro-active applications.
4. **Sensing and Sensors:** by combining physics, biology, and chemistry the student will actively learn the importance of physics in the characterization of biological macromolecules.

ISL III is not a typical sophomore 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. Often, at the conclusion of the experiments, we will find that we need to reevaluate the initial hypotheses and redesign future experiments. Throughout this laboratory experience your instructors will 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 you with 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

### Grades

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

### Assessment

Laboratory performance (attentive, engaged, safety, equal collaboration)	10%
Laboratory notebook (available at bookstore; tear-out carbon copy style)	10%
Pre-lab 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%

### **Participation and 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. 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.

### **Assignments, Pre-labs, and Reports**

All assignments, pre-labs, and reports must be submitted at the beginning of lab on their respective due dates. If you think there is an error with grading and would like any of your assignments, pre-labs, or reports to be re-graded you must contact the instructor within 1 week of the assignment being returned to you. Extra credit is possible for lab reports which are resubmitted within 1 week of being returned to you and will be re-graded for up to 90%.

### **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 will 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.

**Computing**

It is strongly recommended that students have their own laptops that may be used for data acquisition in the laboratory and for presentations and data analysis during our data review sessions.

**Current Information**

Information pertinent to the course will primarily be announced through Scholar. Email will be used in conjunction with Scholar announcements in the event of class cancellations or special requests from students.

### Tentative Course Schedule for the Semester

<b>Tools of Scientific Research</b>	
08/28	Welcoming, Safety, Literature Searching, Technical Writing
08/30	Brain Storming on Current Topics in Science
09/04	Electrochemical Thermodynamics with Galvanic Cells
09/06	Spectro-electrochemistry: Beer's Law and the Nernst Equation
09/11	Handling Data Sets in Matlab with Statistical Analysis
09/13	Thin-Layer and Column Chromatography: Recrystallizing Aspirin from Excedrin
09/18	Thin-Layer and Column Chromatography: Recrystallizing Aspirin from Excedrin...continued
<b>Forensics</b>	
09/20	Environmental: Examining Toxins in Soil Samples with GC-MS
09/25	Environmental: Investigating Heavy Metal Pollution in 'Wastewater'
09/27	Environmental: Spectrophotometric Determination of Nitrate Levels in Soil and Water
10/02	Crime Scene: Qualitative Analysis of Biological Compounds and Fingerprint Analysis
10/04	Crime Scene: Quinine Concentration in Tonic Water with Fluorescence Spectroscopy
10/09	Summary and Data Review (environmental report; crime scene presentation)
<b>Nanoscience</b>	
10/11	Characterizing Gold Nanoparticles Synthesized using Tea Leaves
10/16	Controlling the Thickness of Ionic Self-Assembled Monolayers with pH
10/18	Electro-Active Actuators with Gold NP Doped Proton Conducting Membranes
10/23	Electrochromic Device Fabrication: Characterizing Cycle Times of 'Smart Glass'
10/25	Imaging Surfaces on the Nanoscale: Sputtering and Scanning Electron Microscopy
10/30	Gold Nanoparticle 'Window Sticky' (or visit to Nanoscale Characterization Lab)
11/01	Summary and Data Review for Nanoscience lab report
<b>Sensing and Sensors</b>	
11/06	Introduction to Biosensors using Enzymatic and Non-Enzymatic Glucose Assays
11/08	Preparing Enzyme Immobilized Xerogel Monoliths
11/13	Assessing Leaching and Porosity of Xerogels
11/15	Determining Glucose Concentration in Energy/Sports Drinks: Optical Biosensor
11/20	NO LAB
11/22	NO LAB
11/27	Determining Glucose Concentration in Energy/Sports Drinks: Electrochemical Biosensor
11/29	Summary and Data Review for Capstone Assignment
12/04	Electromagnetic Induction using Magnetotactic Bacteria
12/06	Laboratory Clean-Up and Assessment
12/11	Capstone Presentations and Final Report Due

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