

BIO 447/547: Standard Methods and Quality Assurance of Water Analysis

Lecture/Lab (Cowley 316): M 1:10 – 2:05 pm
WF 1:10 – 3:10 pm

Instructor:

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Course Purpose and Goals:

The primary objective of this course is that students gain experience in Good Laboratory Practices (GLPs), especially Quality Assurance (QA). In addition, this laboratory-orientated course will instruct students on the use of standard analytical methods for constituents commonly included in water analysis. Each week the students should strive to learn and apply the following:

- Learn and apply the fundamental concepts and terminology of water analysis.
- Application of QA protocols including GLPs to the analyses conducted.
- Learn how to report, analyze, and interpret experimental data.
- Principles of analytical methods.
- Environmental sources and significance of constituents analyzed.

Required Materials:

- APHA, AWWA, WEF. 2005. Standard Methods for the Examination of Water & Wastewater. 21st Edition. Available from textbook rental.
- Bound laboratory notebook with consecutively numbered duplicate pages, can be purchased from university bookstore (one notebook per lab group).
- Pen with permanent ink.
- Laptop computer (we have a few available in the lab for you to use, but if you have your own that would be best)
- Lab coat and eye protection are recommended (some lab coats are available for your use in the lab if you do not have your own).

Water quality constituents to be analyzed:

- Physical Constituents: color, total suspended solids, total dissolved solids, specific conductance, and turbidity.
- General Chemical Constituents: pH, alkalinity, hardness, and dissolved oxygen (titration and meter).
- Common Limiting Nutrients: soluble reactive phosphorus, ammonia, nitrate+nitrite analysis.
- Biochemical oxygen demand.

Initially, we will conduct several analyses each period. However, as analyses become more complex, it may take two or more periods to conduct a single analysis. Your textbook contains information on the (1) source and significance of each constituent; (2) principle of the method; (3) potential interferences; and (4) QA data to which you can compare your data. You must read this information prior to coming to the laboratory. I will provide introductory remarks prior to your beginning each analysis.

Evaluation

You will be given (A) two calculation quizzes; (B) a Standard Operating Procedures exercise; (C) a Contract Laboratory exercise including Chain-of-Custody; (D) a written exam; (E) a statistics/graphing assignment; and (F) a final poster presentation. In addition, each laboratory group will work as a team to maintain a laboratory notebook on a day-to-day basis. Learning to work as a team is important because it simulates the way laboratory work is conducted in the workplace. Communication, cooperation, initiative, and dependability are all necessary for a laboratory team to function effectively. Maintenance of the laboratory notebook will include the following activities:

- Preparation of the notebook for each laboratory analysis (there are 13 analyses)
- Data collection during the analysis
- Verification of accuracy of data recorded in the notebook
- Evaluation of quality of the data collected
- Reading of the notebook for clarity
- Signature (including date) as evidence that the notebook has been read and understood

These maintenance activities for the notebook must be shared (rotated) among team members so each team member contributes approximately equally and gains proficiency in all aspects of proper note-taking procedures. Team members will have to meet outside of class to coordinate and accomplish notebook maintenance activities. One copy of each exercise will be submitted to me within one week of completion of the work (each late submission will lower your total final score by 3 points). I will critically evaluate six (out of the 13) of the lab exercises during the semester. Each lab exercise evaluated is worth 20 points.

Other factors such as attendance, class participation, and laboratory proficiency will also be considered in assessing your final grade. For example, if you are just below a grade cut-off, strong performance may earn you the higher grade. Make up examinations will not be given unless you have a very good reason and you have made arrangements with the instructor before the examination.

Standard Methods of Water Analysis is a “slash” course; therefore, graduate students will help prepare some of the later laboratories (gather chemicals and equipment and prepare reagents). Your performance on this activity will not be graded, but satisfactory or unsatisfactory participation could either raise or lower your final grade (especially if you were on the borderline of a grade cut-off point).

The types of assignments and their point values are summarized in the table below.

Type of assignment	Point Value	Grade	%
2 Quizzes @ 30	60	A	92-100
6 Lab Reports @ 20	120	AB	88-91
SOP	100	B	81-87
Chain of Custody	20	BC	77-80
Statistics Assignment	40	C	67-76
Midterm Exam	100	D	55-66
Poster presentation	200	F	<54
Total Possible Points	640		

Tentative Class Schedule:

Date	Day	Topic	Reading
Jan. 23	M	Introduction to class, Quality Assurance	
25	W	Quality Assurance	ASTM-3856
27	F	Quality Assurance (<i>bring laptop</i>)	1010; 1020; 1030; 1060 BC; 1080
Feb. 30	M	Quality Assurance (<i>bring laptop</i>)	1090 B
1	W	Quality Assurance (<i>bring laptop</i>)	
3	F	Standard Curve and QA Quiz (open notes with a laptop)	(<i>bring laptop</i>)
6	M	Intro. to Color*, Turbidity*, TSS*, and TDS*	2120 C; 2130 AB; 2540 CD;
8	W	Color, Turbidity, TSS, and TDS	
10	F	Finish Color, Turbidity, TSS, and TDS	
13	M	Intro. to Conductivity*, Hardness*, pH*, Alkalinity*	2510 AB; 2340 AC; 4500-H ⁺ AB; 2320 AB
15	W	Conductivity, Hardness, pH, and Alkalinity	
17	F	Finish Conductivity, Hardness, pH, and Alkalinity	
20	M	Intro. to Dissolved Oxygen* (Winkler and DO meter)	4500-O ABCG
22	W	Calculation Quiz (one page of notes & calculator)	
24	F	Dissolved Oxygen (Winkler titration and DO meter)	
Mar. 27	M	Intro. to SRP* and SOP's	4500-P AE
1	W	SRP Practice	
3	F	SRP Practice	
6	M	SRP Analysis	
8	W	SRP Analysis	
10	F	SRP Analysis	
13	M	Spring Break – No Class	
15	W	Spring Break – No Class	
17	F	Spring Break – No Class	
20	M	Review and work on SOP	
22	W	Finish SOP, SOP Due	
24	F	Midterm Exam	
27	M	Intro. to Ammonium Analysis* and Chain of Custody	4500-NH ₃ AF; 1060 B (#2)
29	W	Ammonium Analysis	
31	F	Ammonium Analysis	
Apr. 3	M	Intro. to Nitrate + Nitrite* Analysis	4500-NO ₃ ⁻ AE
5	W	Nitrate + Nitrite Analysis	
7	F	Nitrate + Nitrite Analysis	
10	M	No Class	
12	W	Data Analysis and Presentation	
14	F	Intro. to BOD and BOD set-up*	5210 AB
17	M	Data Analysis and Presentation	
19	W	Finish BOD	
21	F	Open Lab for Project,	
24	M	Open Lab for Project, Stats Assignment Due	
26	W	Open Lab for Project	
28	F	Open Lab for Project (no instructor)	
May 1	M	Open Lab for Project	
3	W	Open Lab for Project	
5	F	Poster Session	

*Lab reports need to be turned in for these 13 lab analyses. Six of them will be graded.

LABORATORY RULES AND REGULATIONS

- USE YOUR HEAD...THINK!
- Eating and drinking are prohibited in the laboratory.
- In this course, you will be handling hazardous chemicals; therefore, acceptable procedures must be followed. First, think about what you are working with and what you are doing with it. Be aware of its danger to you and to those around you. Use the fume hood for volatile solvents and acids. If you have any questions about proper handling of a chemical - **ask!** Read labels of reagent containers to acquaint yourself with potentially hazardous substances.
- Clean lab surfaces at the beginning and end of each lab period. This is important for two main reasons:
 - We work with strong acids and bases and other potentially hazardous substances
 - Clean surfaces are necessary to minimize contamination during analyses
- Wear safety goggles whenever working with hazardous substances, especially strong acids and bases in this course.
- Wear protective aprons when using strong acids and bases, especially when acid-washing glassware.
- Chemical spills on the skin should be rinsed immediately with cold water.
- Spilled chemicals should be cleaned up immediately. Powdered sodium bicarbonate should be used to neutralize acidic or basic materials before cleaning up the spills (note the location of spill kits in the laboratories).
- All accidents involving personal injury, no matter how small, must be reported to the laboratory instructor.
- Memorize the locations of the fire extinguisher, eye washer, shower, fire blanket, spill kit, and first aid kit.
- Experiments should not be left unattended for more than a few moments.
- Dispose of broken glassware in the proper waste container. Report breakage of glassware to the instructor so that it can be replaced.
- Dispose of toxic liquid reagents in the appropriate container. Keep a record of the type of hazardous material that is put into these containers.
- Clean your glassware at the end of each lab period.
- Wash your hands after each laboratory.