CAMOSUN COLLEGE
CHEMISTRY 259: COURSE OUTLINE: WINTER, 2003

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1.0 INTRODUCTION

This course focuses on the steps required to ensure quality data when undertaking an aquatic environmental monitoring program. It consists of a series of field and laboratory-based instruction and exercises that will provide students with an understanding of aquatic environmental monitoring, ranging from the design of a program to the analysis and presentation of field and laboratory data. The laboratory components are designed to function as a working analytical lab. The course is composed of three units: i) overview of environmental monitoring and quality control/quality assurance protocols; ii) applied laboratory techniques on samples collected in the field; and, (iii) data analysis and reporting.

Students will utilize the data generated in the field and lab to learn various computer applications associated with environmental data, including spreadsheets, graphical presentation, statistical analysis and report preparation. A final data report is required that will incorporate all of the techniques learned, and data collected, during the course.

2.0 COURSE OBJECTIVES

2.1 Overview of Environmental Monitoring

This component includes classroom instruction and in-class exercises. At the end of this component students will be able to:

- Develop a program of quality assurance/quality control protocols for a field and laboratory lake monitoring study.
- Identify and avoid potential sources of contamination of samples through the application of quality control and quality assurance methods.

2.2 Preparation for Field Monitoring

This component will focus on the preparation and calibration of actual handling of limnological instruments and equipment and the preparation and cleaning of sampling containers for the collection of water and sediment samples, which will be analyzed in the laboratory.

Two approximately half day field trips (on a Saturday or a Sunday) are required to collect water and sediment samples for analysis back in the laboratory. Two lake sites and one stream site will be sampled and compared in the final report.

2.3 Laboratory Techniques and Quality Control/Quality Assurance

The laboratory component will feature hands-on analysis of the samples collected during the field component. Students will work in groups of two. A list of equipment that will be used includes:

- atomic Adsorption spectrophotometer (copper in sediments)
- UV/VIS spectrophotometer (phosphorus in water)
- ion selection electrodes (calcium in water)
- titration apparatus (dissolved oxygen in water)
- pH meters

At the end of the laboratory component students will be able to:

- Identify and use appropriate QA/QC procedures for field collection, laboratory analysis and reporting of environmental data.
- Use laboratory equipment for samples and parameters important in environmental monitoring programs.
- Develop and interpret laboratory control charts.

2.4. Data Analysis and Reporting for Chemistry

At the end of this component students will be able to:

- Use the spreadsheet Excel for organizing , copying and deleting data, and preparation of tables and graphs for report presentation.
- Use graphical packages with Excel to produce linear regressions, vertical profile plots of field data and control charts of laboratory quality assurance data.
- Perform basic statistical analysis on field and laboratory data including standard deviation, limit of quantification, limit of detection, mean, median and mode and comparison of two sets of data (students t-test).
- Prepare a quality data report on the combined results of the field and lab data collected during the course.

EVALUATION

1. Final Report: 35%
2. Computer Lab Exercises: 30%
3. Chemistry Lab Quality & Routine: 20%

1. Chemistry Lab Exercises: 15%

GRADING SYSTEM:

The correlation between your final percent score and a letter grade is approximately as follows:

A+	95-100%	B-	70-74%
A	90-94%	C+	65-69%
A-	85-89%	C	60-64%
B+	80-84%	D	50-59%
B	75-79%	F	<50%

3.0 CHEMISTRY LAB SCHEDULE

WEEK	DATE	GROUP	ACTIVITY
1	Jan. 10	ALL	- Introduction to course; selection of student groups. - Introduction to QA/QC. - Monitoring strategies; field protocols; introduction to field equipment. - Field mobilization for Trip I: check lists; bottle preparation; instrument calibration.
2	Jan. 17	A	- Introduction to Methods: Copper in sediments (Atomic Adsorption).
(Dry Run)		B	- Introduction to Methods: Phosphate (UV/VIS Spectrophotometer).
		C	- Introduction to Methods: pH; Ca; Dissolved Oxygen.
3	Jan. 24	C	- Introduction to Methods: Copper in sediments (Atomic Adsorption).
(Dry Run)		A	- Introduction to Methods: Phosphate (UV/VIS Spectrophotometer).
		B	- Introduction to Methods: pH; Ca; Dissolved Oxygen.
3	Jan. 25/26	-	- Field Trip I
4	Jan. 31	B	- Introduction to Methods: Copper in sediments (Atomic Adsorption).
(Dry Run)		C	- Introduction to Methods: Phosphate (UV/VIS Spectrophotometer).
		A	- Introduction to Methods: pH; Ca; Dissolved Oxygen.
		ALL	- Wet weight measurements of sediments; dry sediments from Trip I (esp. GpA)
5	Feb. 07	A	- Digestion of sediments for copper analysis and AA (Trip I)
(Trip I)		B	- Analysis of water samples for phosphates from Trip I; dry sediments (Trip I)
		C	- Analysis of water samples for dissolved oxygen, pH and calcium (Trip I)
6	Feb. 14	ALL	- Reading Break. No lab this week.
7	Feb. 21	C	- Digestion of sediments for copper analysis and AA (Trip I)
(Trip I)		A	- Analysis of water samples for phosphates; dry sediments (Trip I)
		B	- Analysis of water samples for dissolved oxygen, pH and calcium (Trip I)
8	Feb. 28	B	- Digestion of sediments for copper analysis and AA (Trip I)
(Trip I)		C	- Analysis of water samples for phosphates; dry sediments (Trip I)
		A	- Analysis of water samples for dissolved oxygen, pH and calcium (Trip I)
		ALL	- Prepare for Trip II.
8	Mar. 01/02	-	- Field Trip II
9	Mar. 07	ALL	- finish Trip I analysis; complete data entry.
(Trip I & II)		ALL	- Wet weight sediments and begin drying sediments from Trip II (Gp A) - visit to Axys Analytical Laboratories in Sidney.
10	Mar. 14	A	- Digestion of sediments for copper analysis and AA (Trip II)
	(Trip II)	B	- Analysis of water samples for phosphates; dry sediments (Trip II)
		C	- Analysis of water samples for dissolved oxygen, pH and calcium (Trip II)

Week	Date	Group	Activity
11	Mar. 21	C (Trip II)	- Digestion of sediments for copper analysis and AA (Trip II)
		A (Trip II)	- Analysis of water samples for phosphates; dry sediments (Trip II)
		B	- Analysis of water samples for dissolved oxygen, pH and calcium (Trip II)
12	Mar. 28	B (Trip II)	- Digestion of sediments for copper analysis and AA (Trip II)
		C	- Analysis of water samples for phosphates (Trip II)
		A	- Analysis of water samples for dissolved oxygen, pH and calcium (Trip II)
13	Apr. 04	ALL	- Finish Trip II analysis; complete data entry; report preparation.
14	Apr. 11	ALL	- Finish Trip II analysis; complete data entry; report preparation.

NOTES:

1. **Final Report**. Each student will prepare a separate report. An outline and a disk of all relevant data compiled in several spread sheet files will be provided. Relevant background papers and reports are available on a sign-out basis from the instructor. Sections of the report will be assigned as lab exercises to facilitate the preparation of the final version.

   NOTE: The report is due on April 25, 2003. This is the last possible date to submit marks to registration DO NOT BE LATE WITH THE REPORT. A grade based on course performance (without the report) will be submitted if a report is not handed in.

2. **Chemistry Lab Exercises**. Before each week's lab, a pre-lab assignment must be handed in. At the end of each lab period, the data sheets are to be correctly filled out and placed in the data binder and the data entered into the database. No original data sheets are to leave the lab!! Marks will be deducted for incorrect or absent data sheets or data entry - these will be assigned to the group responsible.

3. **Computer Lab Exercises**. A computer lab exercise will be assigned each week which are due the beginning of the chemistry lab on the Friday of the following week. Late assignments will be assigned a penalty of 20% of the lab mark. Labs will not be accepted after that time and a mark of "0" will be given.

4.0 COMPUTER LAB SCHEDULE

The computer lab component will include some lecture material on environmental chemistry and quality assurance. However, the main thrust will be a series of tasks which constitute the different data applications that are to be used in the preparation of the final report. In general, a different task will be covered during each week but time for data entry and report preparation will also be provided. You are to hand in both a paper copy of the assignment as well as a computer disk. **NOTE: Make sure all material is backed up in class onto two disks - a master that you keep for yourself and a copy which will be handed in (and returned). Full names on all materials please.**

WEEK **OBJECTIVE AND ASSIGNMENT**

1 Introduction to Excel. Data entry, copying and deleting formulas; simple math; use of Formula Wizard; confirmation of data entry.

Assignment 1. Preparation of Excel file; entry of lab data; use of formulas for calculations.

2 **Introduction to Graphs**. Organization of Data (x and y columns); introduction to Chart Wizard; graphing a linear regression (e.g., a standard curve).

Assignment 2. Preparation of a standard graph from a given set of standard. Use of the trend line formula to determine the concentration of several unknown solutions.

3 **Preparation of Control Charts.** Principles behind control charts; data entry; preparation of a control chart from a given set of data.

Assignment 3. Preparation of a Control Chart from selected copper standards from 2001 data set

4 **Chem 259 Data Entry Protocols**. Data entry of examples of laboratory data following Chem 259 data protocols.

Assignment 4. Completion of data entry and formulas.

5 **Preparation of depth profile graphs**. Setting up the x and y data columns; plotting the down and up data (two profiles in single graph); plotting the mean values for each parameter against depth; plotting of several parameters on one graph.

Assignment 5. Preparation of a depth profiles.

6 **Control Chart** Bases from Year 2003dry run data.

Assignment #6. Submit a full-sized control chart for pH, calcium, total phosphorus, dissolved oxygen and total copper, based on the combined data of all groups from the 2003 Dry Run.

WEEK **OBJECTIVE AND ASSIGNMENT**

7 **Basic Statistics**. Standard deviation, limit of quantification, limit of detection; calculation of mean, median and mode; calculation of standard deviation, LoQ and LoD from a data set; comparison of two sets of data (students t-test).

Assignment 7. Determine the LoQ and LoD from the copper standards data file provided. Compare different data sets to determine statistical differences..

8 **Analysis of Variance** (Anova) of simple data set.

Assignment 8. Determine whether there are differences between different lakes and rivers for phosphorus and sediment copper.

9. **Data Entry and Report Preparation**. Draft report preparation.

Assignment 9. Preparation of the "Methods" sections of the report.

10 **Data Entry and Report Preparation**. Entry of 2003 results.

Assignment 10 Preparation of the "Quality Assurance" Section of the report.

11 **Data Entry and Report Preparation**.

Assignment 11. Presentation of the Field Data from Trip I & II (data tables and graphs).

12 **Data Entry and Report Preparation**. Continued entry of 2003 results and draft report preparation.

Assignment 12. Data summary tables for calcium, pH, dissolved oxygen, phosphate, percent moisture and copper results from Field Trip I

13 Complete Data Entry and Report Preparation.

Assignment 13. Presentation of Trip II results - data summary tables for calcium, pH, dissolved oxygen, phosphate, percent moisture and copper results.

14 Complete Data Entry and Report Preparation