

**BI405**  
**Aquatic Bio-monitoring**

**3 Credits**

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## **BI405 Version: 16**



# **Aquatic Bio-monitoring**

## **Calendar Description**

This course is designed to introduce the student to various concepts and techniques associated with environmental biomonitoring, the analysis of samples collected during biomonitoring work, and the analysis of environmental samples using bioassay tests. Current methods used by environmental monitoring agencies and laboratories for the detection of pollutants are emphasized.

## **Rationale**

This is a required course for Applied Environmental Sciences students. The first part of this course is designed to introduce students to the use of living organisms as indicators of environmental quality, and to give them the opportunity to collect and analyze samples from the field in an appropriate way for biomonitoring work. The second part of the course introduces the students to bioassay tests and provides them with the opportunity to conduct a number of different bioassays that are now widely accepted as alternatives and/or adjuncts to chemical/instrumental methods of measuring toxicity in environmental samples. Students write reports presenting the results of both biomonitoring work and bioassay tests. Finally, this course also familiarizes students with the biology and identification of various freshwater organisms commonly used in biomonitoring work.

## **Prerequisites**

BI205

## **Co-Requisites**

None

## **Course Learning Outcomes**

Upon successful completion of this course, students will be able to

1. identify and use equipment and various sampling devices to collect data and quantitative samples for environmental biomonitoring.

2. analyze data collected during environmental biomonitoring work and produce a technical report presenting these results.
3. recognize the importance of natural assemblages of organisms as indicators of environmental health and quality.
4. recognize organisms that can be used as indicator species of environmental health and quality and explain why this is so.
5. collect representative samples of freshwater invertebrates.
6. identify freshwater invertebrates using the appropriate taxonomic keys.
7. define the term bioassay and explain when it is appropriate to use bioassays for environmental monitoring and when it is appropriate to choose chemical/physical/instrumental techniques.
8. describe the importance of conducting more than one type of bioassay when analyzing environmental samples.
9. describe the theory of, methods for, and proper set up, running, and take down of the following bioassay tests: short-term root elongation test, Microtox™.
10. analyze and interpret the data generated from bioassay tests and produce a technical report presenting these results.

### **Essential Employability Skills**

Essential employability skills are critical for workplace success and lifelong learning. Lakeland College prepares its graduates for the workplace and lifelong learning by integrating and promoting essential employability skills development in its curricula. Each credit course offered at Lakeland College emphasizes one or more of the following five essential employability skills:

- A. **Communication Skills** that enable individuals to listen, interpret, express, and convey knowledge and ideas so that they are received and understood.
- B. **Teamwork Skills** that enable individuals to respect the thoughts and opinions of others as they work together to plan activities, meet deadlines, complete projects, and contribute to an organization's goals.
- C. **Critical Thinking Skills** that enable individuals to conceptualize and analyze issues from various perspectives while rationally evaluating the strengths and limitations of each perspective and deciding what action to take.
- D. **Adaptability Skills** that enable individuals to respond quickly, willingly, and positively to new conditions and changing times.
- E. **Positive Attitude and Behavioural Skills** that enable individuals to be confident about themselves and to deal with people, problems, and situations with honesty, integrity, and personal ethics.

Please refer to the Knowledge/Skills Matrix of this course outline to review the essential employability skills emphasized in this course.

## Resource Materials

Relevant materials referring to biomonitoring work, specific bioassay procedures and providing information to aid in the identification of natural assemblages of organisms will be provided throughout the course.

For the identification of aquatic invertebrates, the following text is recommended.

Clifford, H.F. 1991. Aquatic invertebrates of Alberta. Department of Zoology, University of Alberta, Edmonton, Alberta:

## Conduct of Course

The course is presented using a combination of lectures and laboratory/field exercises (3-0-3). Students are encouraged to ask questions and participate in discussion throughout the course.

## Evaluation Procedures

Lecture exams may contain discussion-type, short answer, true/false, justify, and/or multiple choice questions. There is a midterm practical laboratory exam and laboratory assignments. Some of the laboratories where actual bioassays are run require students to come in on days other than the scheduled laboratory day in order to monitor the bioassay being conducted. The final grade for the course is weighted according to the following schedule:

Midterm Examination	
Written	30%
Final Examination	
Written	30%
Laboratory Assignments	30%
Freshwater Invertebrate Collection	10%
Total	100%

To obtain credit in this course, all assignments must be completed and handed in on time. Late assignments are not marked, and a grade of "0" is assigned. All marks are awarded on a 0 to 4 basis as outlined in the Lakeland College Calendar.

## Knowledge/Skills Matrix

### Students apply and demonstrate their knowledge and skills to use

#### A. Communication Skills

##### A1. by listening, reading, interpreting information, and communicating effectively

<p><b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 6, 7, 8, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6; Collection</p>
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<b>A2. by using written, spoken, and/or visual formats and media to communicate and meet needs of each particular audience</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 4, 6, 7, 8, 9, 10; Laboratory Assignments Labs 2, 3, 4, 5, 6; Collection
<b>A3. by using libraries, internet, technical publications, journals and other sources to find pertinent information</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 6, 10; Laboratory Assignments Labs 4, 6

## B. Teamwork Skills

<b>B1. by using interpersonal skills to create an atmosphere that maximizes the strengths of group members to accomplish tasks</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 9, 10; Laboratory Assignments Labs 1, 6
<b>B2. by using interpersonal skills to resolve conflict, relate to others, and assist others</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 9, 10; Laboratory Assignments Labs 1, 6
<b>B3. by contributing and listening to others as group determines realistic objectives, prioritizes tasks, and identifies resources and timelines</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 9, 10; Laboratory Assignments Labs 1, 6
<b>B4. by treating other members of the group open-mindedly and fairly</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 9, 10; Laboratory Assignments Labs 1, 6
<b>B5. by developing tactics/strategies to accomplish tasks</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 9, 10; Laboratory Assignments Labs 1, 6; Collection

## C. Critical Thinking Skills

<b>C1. by seeing critical thinking as a lifelong process of self assessment</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6
<b>C2. by examining problems closely</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 6, 7, 8, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6; Collection
<b>C3. by examining beliefs, assumptions, and opinions, and weigh them against the facts</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 6, 7, 8, 9, 10; Laboratory Assignments Labs 1, 4, 5, 6
<b>C4. by seeking out the truth</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 6, 7, 8, 9, 10; Laboratory Assignments Labs 3, 4, 6
<b>C5. by finding solutions; make decisions</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6; Collection
<b>C6. by incorporating new ideas that may not necessarily agree with previous thought on the topic</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 6, 7, 8, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6; Collection
<b>C7. by seeing connections between topics and use knowledge from other disciplines to enhance reading and learning experiences</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 7, 8, 9, 10; Laboratory Assignments Labs 1, 3, 6

**D. Adaptability Skills**

<b>D1. by working independently or as part of team</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6; Collection
<b>D2. by carrying out multiple tasks or projects</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 5, 6, 10; Laboratory Assignments Labs 1, 2, 3, 6; Collection
<b>D3. by being innovative and resourceful: identify and suggest alternative ways to get the job done</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 5, 10; Laboratory Assignments Labs 1, 6; Collection
<b>D4. by being open and respond constructively to change and uncertainty</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 5, 9, 10; Laboratory Assignments Labs 1, 6

**E. Positive Attitude and Behavioural Skills**

<b>E1. by dealing with people, problems, and situations with honesty, integrity, and personal ethics</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 5, 6, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6; Collection
<b>E2. by showing interest, initiative, and effort</b>
<b>Evaluation(s)/Goal(s):</b> Midterm and Final Exam; Goals 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6; Collection
<b>E3. by affirming the need for positive solutions and encourage positive interaction and feedback</b>
<b>Evaluation(s)/Goal(s):</b> Goals 1, 2, 5, 9, 10; Laboratory Assignments Labs 1, 2, 3, 4, 5, 6
<b>E4. by balancing personal and family activities with job-related activities</b>
<b>Evaluation(s)/Goal(s):</b> Goals 5, 9; Laboratory Assignments Labs 1, 5, 6; Collection

**Grade Equivalents and Course Pass Requirements**

*A minimum grade of D (50%) (1.00) is required to pass this course.*

Letter	F	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
Percent Range	0-49	50-52	53-56	57-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
Points	0.00	1.00	1.30	1.70	2.00	2.30	2.70	3.00	3.30	3.70	4.00	4.00

**Students must maintain a cumulative grade of C (GPA - Grade Point Average of 2.00) in order to qualify to graduate.**

**Attendance**

Classroom and laboratory attendance is considered vital to the learning process and as significant to the students' evaluation as examinations and reports, therefore absenteeism is recorded.

- a. Students having a combination of excused and/or unexcused absence of 20 percent or higher for the scheduled course hours can be required to withdraw and would then automatically receive a "RW" (required withdrawal) for the course, regardless of any other evaluation results. (RW is a failing grade).

- b. An excused absence is one that is verified with your instructor. Verification should be prior to the absence or the next class day following the absence. Verification of the absence may take the form of a note from your doctor/College nurse regarding illness, or a note from another instructor regarding a field trip or other activity, or authorization by your instructor following an in-person meeting. Be sure to contact your instructor and ask what they will require from you as verification of each absence. An unexcused absence is anything NOT verified by the instructor prior to the absence or the next class day following the absence.

NOTE: Any exceptions to the above attendance policy (e.g. timetable conflicts, work-related issues) must be approved in writing by the Department Chair prior to the beginning of the course.

It is the students' responsibility to know their own absentee record.

Normal hours are 8:30 a.m. to 6:30 p.m., with potential for evening courses, exams or extended field trips. Students are expected to be available for classes during these times.

## **Course Units/Topics**

### ***Lectures***

1. Introduction to the concept of biomonitoring and the use of natural assemblages of organisms as indicators of environmental quality.
2. Introduction to the design of biomonitoring studies.
3. Introduction to the concept of indicator species and their use in environmental monitoring.
4. Sampling techniques, and the proper collection, storage and identification of samples of freshwater invertebrates.
5. Characteristics and biology of various groups of freshwater invertebrates.
6. Introduction to bioassays.
7. Bioassays vs. chemical/instrumental tests.
8. Bioassay terminology and concepts, and types of bioassays.

9. Concept and significance of using a battery of tests.
10. Data collection and interpretation from bioassay tests.

***Laboratories/Field Material***

1. Field trip to collect physical, chemical and biological data required to conduct a biomonitoring exercise to evaluate the health of a freshwater system.
2. Field trip to a local aquatic system to collect freshwater invertebrates.
3. Analysis and interpretation of the biomonitoring data collected.
4. Identification of freshwater invertebrates collected in the field using the appropriate taxonomic keys.
5. Putting together a freshwater invertebrate collection.
6. Analysis of samples using a short-term root elongation bioassay, and the interpretation, and presentation of the results in a technical report.
7. Analysis of samples using the Microtox™ bioassay, and the interpretation, and presentation of the results in a technical report.



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