LAKEHEAD UNIVERSITY
ANTH 3138 / BIOL 3138 FAO
Introduction to DNA Molecular Methods

Fall 2020

Course Title:	**Introduction to DNA Molecular Methods**
Course Code:	**BIOL 3138 / ANTH 3138 FAO**
Course credit hours:	**0.5**
Lectures contact hours equivalent	**24 (60min each)**
Lab contact hours equivalent	**12 (180min each)**
Pre-requisite(s):	**Two of: Anthropology 2110, Biology 2171, Biology 2230, Biology 2910, Chemistry 1210; or permission of the Chair of the Department of Anthropology (as per course catalog)**
Classroom location and hours:	**Zoom (1.30pm-2.30pm; Wednesday, Friday)**
Laboratory location and hours:	**Zoom (8.30am-11.30am; Friday)**

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Personnel, office hours, contact, and other logistic information
List of Course Lecturer Name(s) and contact:

Dr. Ivo Boudakov iboudako@lakeheadu.ca

Course Director Office Hours: Friday (2:30pm-3:30pm) and by appointment
Office: ZOOM Link by appointment
Phone: ZOOM Link by appointment
Classroom location and hours: ZOOM Link (1.30pm-2.30pm; Wednesday, Friday)
https://lakeheadu.zoom.us/j/93143609529?pwd=bzlvRnNTdXhxdWFaeC9adHVCSm9YUT09
Meeting ID: **931 4360 9529**
Passcode: **DNALU**

Laboratory location and hours: ZOOM Link (8.30am-11.30am; Friday)
https://lakeheadu.zoom.us/j/97870143603?pwd=VDY2V3d4YlFtbjBuK2VDUC9pdGoxdz09
Meeting ID: **978 7014 3603**
Passcode: **DNALU**

Course learning management tool: Brightspace by D2L Web-based LMS will be used to communicate course updates, monthly quizzes, and other details. All relevant announcements will be placed on the course Brightspace website.
Social media communication: TBD

Course Description (as per Academic Calendar):
An introduction to methods used in molecular biology, biochemistry, and molecular anthropology with an emphasis on the techniques and their application. The laboratory component covers the analysis of nucleic acids particularly DNA, and includes basic techniques such as gel electrophoresis, DNA extraction, and the polymerase chain reaction. Methods of DNA data analysis and interpretation are also introduced, including forensic science, molecular anthropology, molecular biology, and molecular archaeology.

Course Outline:

This course teaches the diversity of DNA based molecular techniques and links them to anthropology, forensic, and broader biological studies. Upon completion students will acquire nucleic acid analytical skills and technical knowledge in addition to their basic theoretical knowledge on molecular concepts already learned in the prerequisite courses.

The course starts with an introduction to DNA methods used in molecular biology and anthropology. The lectures contrast the difference between mitochondrial and nuclear gene transfer, their mode of inheritance, and the importance to the anthropological sciences. The course teaches the base of DNA polymorphism, the concept of single nucleotide polymorphism (SNP analysis), and the research application of genome-wide repetitive elements such as short interspersed nuclear elements (SINE) and long interspersed nuclear elements (LINE). Conventional PCR techniques are presented in detail and are contrasted to real-time PCR methods in terms of application and

mechanism of action. The classical Sanger DNA sequencing method is compared to the more recently developed NGS (next-generation sequencing) techniques. Both technologies are discussed in terms of scientific application with direct examples of their use.

The laboratory is predominantly focused on the bioinformatical analysis of DNA. It includes *in-silico* DNA manipulation, a BLAST search of available database, DNA sequence alignment, design of DNA amplification primers, study evolutionary distance among genes from related species, building phylogenetic trees, and other techniques that support gene manipulation, cloning, and analysis.

The course also includes an active learning component that allows students to present seminars to their peers. The seminars will cover a variety of topics in the field of anthropology, molecular biology, and forensic sciences that utilize DNA based molecular techniques as part of their research methodology.

Method of Instruction

The course includes:

1. Lectures; (2 times per week; a total of 24 lecture sessions);
2. Laboratory exercises; (1 time per week; a total of 12 laboratory sessions);
3. Students' seminars and group discussions; (4 block sessions);
4. Self-paced quizzes (formative assessments) open for the duration of 72hours from Thursday (9 pm EST): (total of 2 online based quizzes);
5. Two exams (summative assessments) that are scheduled after October mid-semester study break (Midterm Exam) and at the end of the course.

Lectures:

Lectures will be a mixture of didactic and dialectic teaching style. Unless otherwise advised lecture attendance is highly recommended. Attendance will be awarded with up to 5% of the final course grade (min of 80% attendance to be eligible to receive the points) and class participation. Any effort will be made to produce recordings and posting of the lectures on the D2L course website. The video recordings are designed for students to watch either prior, after, or in some cases during the designated course time-slots.

Disclosure of Lectures Recording:

In the Introduction of DNA Methods, BIOL 3138 /ANTH 3138 FAO course, in the context of remote instruction and participation, video and audio recordings of class activities will be made to ensure students' and instructors' easy and comprehensive access to those activities. The recordings are confidential and are intended only for the use of the course students and instructors. They may otherwise not be used or disclosed. During recording, to protect others' privacy, each student should ensure that no one else is present in the location where they are being recorded without that non-student's consent. The recordings are made under the authority of sections 3 and 14 of The Lakehead University Act, 1965. Questions about the collection of the images and sounds in the recordings may be directed to Dr. Randall Todd, Dean of: Science & Environ Studies, Thunder bay campus; CB 4012A, +1 (807) 343-8289.

Laboratory exercises:
Laboratory training will require active participation from students. All students should come prepared by pre-reading the provided protocols for the laboratory exercises. Up to 30% of the final course grade will be awarded for lab-related activities.

Seminar preparation:
Every student will have the opportunity to prepare and present a seminar that will be coupled with a Q&A session and based on one more recent publications.

1. Each presentation should be 20-25 min long containing 15-20 slides and followed by 5min of questions and discussion.
2. The seminar will be presented on Zoom, but in some cases may need to be pre-recorded and posted to the rest of the participants.
3. The use of Kahoot or another real-time response system as part of an interactive Q&A session is encouraged.
4. Citations should be appropriately referenced and the presentations should be based on a peer-reviewed article(s).
5. Presentations should be submitted to publishing through D2L and made available to the rest of the class as preparatory material for the exams.
6. Exams may include 1-2 questions from the presentation seminars.
7. Students are encouraged to submit at least one potential exam question based on their presentation to be included as part of the exams.
8. A set of available topics is provided below for students to choose from, but there is also the flexibility for students to select any topic outside of the supplied list in the broader field of molecular biology techniques and their application in Gene manipulation, Evolutionary studies, Anthropology or other fields of interest.

Suggested seminar topics:

1. Genome Editing and CRISPR Technologies;
   Suggested article: A scalable CRISPR/Cas9-based fluorescent reporter assay to study DNA double-strand break repair choice; Nature Communications volume 11, Article number: 4077 (2020); Paris Roidos, et al. | https://doi.org/10.1038/s41467-020-17962-3
2. CAR-T technology
   Suggested article: Li, D., Li, X., Zhou, W. et al. Genetically engineered T cells for cancer immunotherapy. Signal Transduction and Targeted Therapy volume 4, Article number: 35 (2019) | https://doi.org/10.1038/s41392-019-0070-9
3. Ancient DNA extraction techniques and analytical approaches:
   Suggested article: Performance of a next generation sequencing SNP assay on degraded DNA; Katherine ButlerGettingsKevin M.KieslerPeter M.Vallone; | http://dx.doi.org/10.1016/j.fsigen.2015.04.010
4. **Suggested article:** Kinship and Y-Chromosome Analysis of 7th Century Human Remains: Novel DNA Extraction and Typing Procedure for Ancient Material; Croat Med J. 2009 Jun; 50(3): 286–295. Daniel Vanek,1 Lenka Saskova, and Hubert Koch | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2702742/

5. **Suggested article:** Massively parallel sequencing of 17 commonly used forensic autosomal STRs and amelogenin with small amplicons ; Eun HyeKimabHwan YoungLeebIn SeokYangbSang-EunJungbWoo IckYangbKyoung-JinShinab | https://doi.org/10.1016/j.fsigen.2016.01.001
6. Genetic analysis of ancient Homo sapiens species:
   Suggested article: Reconstructing the genetic history of late Neanderthals. Nature 555, 652–656 (2018) ; Hajdinjak, M., Fu, Q., Hübner, A. et al. | https://doi-org.ezproxy.lakeheadu.ca/10.1038/nature26151
7. Mitochondrial clock.
   Whole mitochondrial genome diversity in two Hungarian populations. Mol Genet Genomics 293, 1255–1263 (2018) ; Malyarchuk, B., Derenko, M., Denisova, G. et al. | https://doi-org.ezproxy.lakeheadu.ca/10.1007/s00438-018-1458-x
8. Study of Denisovan and their relationship with modern humans.
   Suggested article: A fourth Denisovan individual; Viviane Slon, et. al. ; Sci Adv. 2017 Jul; 3(7): e1700186. | https://www-ncbi-nlm-nih-gov.ezproxy.lakeheadu.ca/pmc/articles/PMC5501502/
9. RNAi and application of siRNA in gene therapy.
   Suggested article: A randomized, double-blind, placebo-controlled study of an RNAi-based therapy directed against respiratory syncytial virus; John DeVincenzo et al. ; Proc Natl Acad Sci U S A. 2010 May 11; 107(19): 8800–8805 | https://dx-doi-org.ezproxy.lakeheadu.ca/10.1073%2Fpnas.0912186107
10. Application and current advancement in using retroviruses in gene therapy.
11. Application and current advancement in using adenoviruses in gene therapy.

Course topics

Week	Topic	Date	TOPICS	Kit ID #
1	1	Sept 09 ; W	Overview of DNA and DNA based methods.	
	2	Sept 11 ; F	DNA Extraction methods and specifics of aDNA (ancient DNA). Ethics of ancient DNA (aDNA) research and sampling.	
	Lab1	Sept 11 ; F	Introduction to ANTH/BIOL3138 Labs, Laboratory Rules, and Safety.	
2	3	Sept 16 ; W	Nuclear vs. mitochondrial DNA inheritance applied in anthropology	
	4	Sept 18 ; F	DNA polymorphism, SNP analysis, SINE (Alu), LINE and other repeated genetic elements.	
	Lab2	Sept 18 ; F	**Self guided task:** Popular Molecular Databases	
3	5	Sept 23 ; W	DNA fingerprinting and hybridization techniques	
	6	Sept 25 ; F	DNA amplification techniques	
	Lab3	Sept 25 ; F	Instructional Video on **Lab4** and students are also expected to use the time to collaboratively work on **Lab 3:** Available Bioinformatics Tools	
4	7	Sept 30 ; W	Comparison between different PCR technologies	
	8	Oct 02 ; F	Seminars #1 (3 students)	
	Lab4	Oct 02 ; F	**Self guided task:** Analysis of Ancient and Evolutionary Extinct Species.	
5	9	Oct 07 ; W	Seminars #2 (2 students)	
	10	Oct 09 ; F	Seminars #3 (2 students)	
	Lab5	Oct 09 ; F	DNA Alignment and Sequence Analysis.	
6		Oct 14 ; W	**MID-SEMESTER READING / STUDY WEEK / Thanksgiving Day Monday, October 12, 2020**	
		Oct 16 ; F		
7	11	Oct 21 ; W	**MIDTERM EXAM**	
	12	Oct 23 ; F	DNA based trees, evolution, and molecular clock	
	Lab6	Oct 23 ; F	**Self guided task:** Bioinformatics Analysis of the Individual Genes Assigned to Students.	
8	13	Oct 28 ; W	Sanger based DNA sequencing technique	
	14	Oct 30 ; F	NGS sequencing techniques	
	Lab7	Oct 30 ; F	DNA Primer Design and Analysis.	
9	15	Nov 04 ; W	Recombinant DNA Technologies	
	16	Nov 06 ; F	Recombinant DNA Technologies (continue)	
	Lab8	Nov 06 ; F	**Self guided task:** Completion and upload of Lab 7 and any other late report.	
10	17	Nov 11 ; W	Seminars #4 (3 students)	
	18	Nov 13 ; F	Seminars #5 (2 students)	
	Lab9	Nov 13 ; F	Instructions on **Lab9** (Molecular Phylogenetic Analysis I) and **Lab 10** with the supplied model gene (vitamin K - gamma carboxylase)	

11	**19**	Nov 18 ; W	Recombinant animals
	20	Nov 20 ; F	Recombinant animals (continue)
	Lab10	Nov 20 ; F	**Self guided task:** Molecular Phylogenetic Analysis II.
12	**21**	Nov 25 ; W	Recombinant plants
	22	Nov 27 ; F	Recombinant plants (continue)
	Lab11	Nov 27 ; F	DNA virtual cloning software / Q & Answer session.
13	**23**	Dec 02 ; W	Lectures completion and review session.
	24	Dec 04 ; F	Lectures completion and review session.
	Lab12	Dec 04 ; F	Finalizing and Submitting All Lab Reports.
		TBD	**FINAL EXAM**
		TBD	**SPECIAL EXAM (date to be determined)**

Course Assessment Structure

40% of final grade (2x20% each)	Summative Assessments / Exams**, *** (#2)
10% of final grade (2x5% each)	Formative Assessments /Quizzes* (#2)
15% of final grade	Seminars: preparation and presentation.
30% of final grade	Laboratory attendance, participation and laboratory reports preparation.
5% of final grade	Lectures attendance, participation and group discussions.

*There will be NO completion assessment for Quizzes
**A Special Exam will be offered to students who fail the course and their course performance falls between 40%-50%.
***A completion exam can only be considered and granted upon submission and approval of a valid request by the course director.

Course Support Material, Textbooks, and Handouts:

1. PDF lecture notes/handouts corresponding to the class sessions*
2. Ancient DNA Studies in Physical Anthropology; Author(s): Dennis H. O'Rourke, M. Geoffrey Hayes, Shawn W. Carlyle; Source: Annual Review of Anthropology, Vol. 29 (2000), pp. 217-242; **
3. Ancient DNA in Anthropology: Methods, Applications, and Ethics; Frederika A. Kaestle and K. Ann Horsburgh; Yearbook Of Physical Anthropology 45:92–130 (2002); **

*The main instructional material is based on the lecture notes.
**Pre-reading of the presented material and assigned papers is encouraged and helps with class participation.

Supplementary Readings/Resources:

Additional supplementary resources will be posted on the school's LMS portal (Brightspace) throughout the course. Students are responsible for familiarizing themselves with those supplementary materials and the information provided has the potential to be examined on the summative assessments.

Course Policy & Information

A. **Exams (summative assessments)** are delivered in a secure and proctored environment either in a format of multiple choice questions and/or open answer questions. The exams could be either computer-based (using the on-campus LMS) or paper-based scantron system. The format may include 3-6 MCQs (multiple

choice questions) per topic per exam. Each MCQ will have 90 seconds time allotment.

B. **Course passing grade** is equal or higher than 50% of the overall course performance.

C. **Attendance** of all scheduled sessions is highly recommended and is reflected as 5% of the final grade. The percentage point is assigned on the bases of "all-or-none" for those who attendance above 80% of the scheduled activities (lectures and laboratory exercises).

D. **A special exam** constitutes an exam that is taken to remediate a course failure between 40-50% of the maximum course grade (100%). The corresponding students will be notified as to the date, time and venue.

E. **A completion exam** constitutes an exam that has been missed by a student(s) for a valid reason; such exam will be scheduled within 96 hours only after prior approval of the valid reason by the course director. The student(s) will be notified as to the date, time and venue.

F. The **completion and/or special exam** format is at the discretion of the course director and may differ from the original exam(s). For example, the exam may require writing short essays addressing several selected course topics instead of multiple choice questions.

G. **On-line (formative assignments) quizzes** count towards the final grade. Missed assessments will be graded as 0% with no right to re-take.

H. **Plagiarism and cheating policy**: Plagiarism is an offense which constitutes of theft of someone else's work. A proper citation of the original author(s) and/or source(s) has to be included with the submission of the corresponding student's assessment(s). Both plagiarism and exam cheating will be dealt with according to the severity of the individual case.

I. **Professionalism and classroom etiquette:** Students should apply professionalism and follow established class etiquette as described here:
    a. Arrive to class on time and stay for the entire class;
    b. Turn off your cell phone during class time;
    c. Active participation during class discussions is expected;
    d. Avoid parallel or side conversations; address the professor properly.