## Medical Biophysics 3518B – Introduction to Molecular Imaging

# 1. Course Information

This is an introduction to the discipline of Molecular Imaging. Research areas include genetic engineering of imaging contrast, molecular probes for positron emission tomography, cell tracking using magnetic resonance imaging, and optical molecular imaging of tissue dynamics. Students will apply knowledge gained from lectures by reading and critically analyzing original research articles in Molecular Imaging.

Antirequisite(s): Medical Biophysics 4518B

**Prerequisite(s):** [Biochemistry 2280A](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_003075_1&SelectedCalendar=Live&ArchiveID=) ; 1.0 course from [Applied Mathematics 1201A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_022954_1&SelectedCalendar=Live&ArchiveID=) [Calculus 1000A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_013890_1&SelectedCalendar=Live&ArchiveID=) [Calculus 1301A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_013892_1&SelectedCalendar=Live&ArchiveID=) [Calculus 1500A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_023735_1&SelectedCalendar=Live&ArchiveID=) [Calculus 1501A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_013891_1&SelectedCalendar=Live&ArchiveID=) [Mathematics 1225A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_020937_1&SelectedCalendar=Live&ArchiveID=) [Mathematics 1228A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_009084_1&SelectedCalendar=Live&ArchiveID=) [Mathematics 1229A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_020938_1&SelectedCalendar=Live&ArchiveID=) [Mathematics 1600A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_023092_1&SelectedCalendar=Live&ArchiveID=) [Statistical Sciences 1024A/B](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_013832_1&SelectedCalendar=Live&ArchiveID=) ; and 1.0 course from [Physics 1028A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_018554_1&SelectedCalendar=Live&ArchiveID=) [Physics 1029A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_018555_1&SelectedCalendar=Live&ArchiveID=) [Physics 1301A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_023133_1&SelectedCalendar=Live&ArchiveID=) [Physics 1302A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_023134_1&SelectedCalendar=Live&ArchiveID=) [Physics 1501A/B,](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_023136_1&SelectedCalendar=Live&ArchiveID=) [Physics 1502A/B](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_023138_1&SelectedCalendar=Live&ArchiveID=) .

Pre-or Corequisite(s): Biology 2581A/B

Extra Information: 3 lecture hours per week , 0.5 course.

This course is open to third-year students. Senior students interested in taking Biophysics 3518B as an elective may do so with permission of the course coordinator.

The objective of the course is to help students to apply and develop the knowledge gained in first year physics courses and second year biochemistry and biology to concepts in molecular imaging. Topics explored in this course will be supported by other third year courses (3505F, 3645A), and will provide the necessary background for 4518B.

**Course Overview and Important Dates:**

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|  | |  |  |  | | --- | --- | --- | | **Delivery Mode** | **Lecture Days** | **Time** | | In person lecture |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Classes Start** | **Reading Week** | **Drop date** | **Classes End** | **Study days** | **Exam Period** | | January 8 | February 19-23 | March 14 | April 8 | April 9, 10 | April 11-30 | |

## Senate regulation regarding the student’s responsibility regarding requisites:

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

# 2. Instructor Information

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| **Instructors** | **Contact** |
| (Course Co-Coordinator) | Contact all instructors through OWL Messages |
|  |  |
| (Course Co-Coordinator) |  |
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| Guest lecturers | At the instructor’s discretion |

# 3. Course Syllabus

## Course structure

The course consists of 29 lectures, 4 problem-based assignments and 1 team presentation. It will cover four topics within the discipline of Molecular Imaging: genetic engineering of imaging reporter genes, cellular and molecular MRI, PET molecular imaging, and optical molecular imaging.

### Topic 1: Genetic Engineering of Imaging Contrast

Instructor:

Lecture Dates: 8 lectures Jan 8-26

* 1. Jan : Introduction to Molecular Imaging
  2. Jan : Concepts in non-invasive imaging
  3. Jan : Using molecular cloning to image gene expression *in vivo*
  4. Jan : Transcription factor/DNA interactions that regulate molecular imaging
  5. Jan : Imaging reporter gene expression
  6. Jan : Factors influencing detection of transcription factor activity
  7. Jan : Measuring changes in gene expression using non-invasive modalities
  8. Jan : Module 1 review and discussion

Jan : Module 1 Assignment due date

* 1. Jan Module 5 assignment #1

### Topic 2: Detecting Cellular and Molecular Processes with MRI

Instructors:

Lecture Dates: 7 lectures Jan 29-Feb 14

1. Jan : History of Biomedical Imaging
2. Jan: Basic principles: The MRI Signal
3. Feb : Basic principles: Contrast and Contrast Agents
4. Feb : Cell Tracking with MRI
5. Feb : Cell Tracking with MRI
6. Feb: MRI Reporter Genes Guest Lecturer Dr. John Ronald
7. Feb : Module 2 review and discussion

Feb : Module 2 Assignment due date

1. Feb : Module 5 assignment #2

### Topic 3: Molecular Imaging with Positron Emission Tomography

Instructor:

Lecture Dates: 7 lectures Feb 16 - Mar 11

1. Feb : Introduction to PET molecular imaging (pre-recorded lecture only, no in- person lecture)

Feb 19-23 Reading Week

1. Feb : Principles of radioactivity
2. Feb : Designing tracers for PET
3. Mar : Principles of PET Imaging (part 1)
4. Mar : Principles of PET Imaging (part 2)
5. Mar : Using PET to image the living human brain
6. Mar : Total Body PET

Mar : Module 3 Assignment due date

1. Mar : Module 5 assignment #3

### Topic 4: Optical Molecular Imaging of Tissue

Instructor:

Lecture Dates: 7 lectures Mar 13-Apr 1

1. Mar : Light and tissue interaction
2. Mar : High resolution optical imaging: Confocal Microscopy
3. Mar : High resolution optical imaging: Confocal Microscopy
4. Mar : High resolution optical imaging: Two-photon Excitation Microscopy
5. Mar : High resolution optical imaging: Two-photon Excitation Microscopy
6. Mar : Super-resolution optical imaging: Optical nanoscopy
7. Mar : Module 4 review and discussion

Mar : Module 4 Assignment due date

1. Mar : Good Friday holiday
2. Apr : Module 5 assignment #4

### Topic 5: Devising Solutions to Problems in Molecular Imaging

### Instructors: All

Lecture Dates: 6 lectures Jan 26-Apr 5

a. Apr : Group presentations

b. Apr Group presentations

# 4. Course Materials

## Course website

## Textbook

none

## Laboratory Tours

none

## Contact with Instructors regarding course materials

We encourage students to approach and discuss any course-related problems with the relevant instructor. Please make an appointment utilizing the contact information provided above.

## Collaborative work

Students are encouraged to work together, but each student must take total responsibility for their submitted work. **Note on Plagiarism**: “Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence” (see Scholastic Offence Policy in the Western Academic Calendar).

# 5. Evaluation

The final grade will be based on 100% contribution from Modules 1-5. The mark will be obtained from problem assignments (Modules 1-4) and an in-class (group) presentation (Module 5. Note that Module 5 requires in-class participation and is marked progressively throughout the term. There will be NO final exam.

## Final grade breakdown

Assignments: 20% X 4 = 80%

Group Presentation: 20%

Assignments will be in written format, in short-answer style.

**Information about late or missed evaluations:**

Late assessments without self-reported absences will be subject to a late penalty of **1%/day**

Late assessments with self-reported absences should be submitted within 24 hours of the end of the 48-hour period

An assessment cannot be submitted after it has been returned to the class

If a make-up assessment is missed, the grade for this module will be marked as 0

## Assignment Schedule

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|  | Topic | Assignment Handed Out | Due Date |
| Assignment 1 | Topic 1 | Jan 10 | Jan 25 |
| Assignment 2 | Topic 2 | Jan 31 | Feb 13 |
| Assignment 3 | Topic 3 | Feb 26 | Mar 9 |
| Assignment 4 | Topic 4 | Mar 15 | Mar 28 |
| Presentation | Topic 5 | Progressively during course | Apr 3 and 5 |

**Communication:**

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| **Chat** | Students should check the OWL site every 24 – 48 hours  A weekly update will be provided on the OWL announcements  Students should email their instructors using OWL “messages”  Emails will be monitored daily; students will receive a response in 24 – 48 hours  The online portion of the course will use Zoom for live discussions  Students should post all course-related content on the discussion forum so that everyone can access answers to questions  The discussion forums will be monitored daily by instructors or teaching assistants |

**Office Hours:**

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| **Meeting** | Students will be able to email the TA and/or instructors |

**Resources**

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| Books | All resources will be posted in OWL |

**Professionalism & Privacy:**

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| **Lock** | Western students are expected to follow the [Student Code of Conduct](https://www.uwo.ca/univsec/pdf/board/code.pdf). Additionally, the following expectations and professional conduct apply to this course:  Students are expected to follow online etiquette expectations provided on OWL  All course materials created by the instructor(s) are copyrighted and cannot be sold/shared  Recordings are not permitted (audio or video) without explicit permission  Lecture recordings are not to be distributed  All recorded sessions will remain within the course site or unlisted if streamed |

**How to Be Successful in this Class:**

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| **Trophy** | Students enrolled in this class should understand the level of autonomy and self-discipline required to be successful.   1. Invest in a planner or app to keep track of your courses. Populate all your deadlines at the start of the term and schedule time at the start of each week to get organized and manage your time. 2. Make it a daily habit to log onto OWL to ensure you have seen everything posted to help you succeed in this class. 3. Follow weekly checklists created on OWL or create your own to help you stay on track. 4. Take notes as you go through the lesson material. Keeping handwritten notes or even notes on a regular Word document will help you learn more effectively than just reading or watching the videos. 5. Connect with others. Try forming an online study group and try meeting on a weekly basis for study and peer support. 6. Do not be afraid to ask questions. If you are struggling with a topic, contact your instructors. 7. Reward yourself for successes. It seems easier to motivate ourselves knowing that there is something waiting for us at the end of the task. |

**Western Academic Policies and Statements**

**Absence from Course Commitments**

[Policy on Academic Consideration for Student Absences](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf)

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a **self-reported absence** or via the **Academic Counselling** unit. Students have two self-reports to use throughout the academic year; absence from course commitments including tests, quizzes, presentations, labs, and assignments that are worth 30% or less can be self-reported. Self-reported absences cover a student for 48 hours (yesterday + today or today + tomorrow). Your instructor will receive notification of your consideration; however, you should contact your instructor immediately regarding your absence. Students are expected to submit missed work within 24 hours of the end of the 48-hour period. Please review details of the [university’s policy on academic consideration for student absences](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf).

If you have used both their self-reported absences or will miss more than 48 hours of course requirements, a Student Medical Certificate (SMC) should be signed by a licensed medical or mental health practitioner and you should contact academic counselling. Academic Counselling will be operating virtually this year and can be contacted at [scibmsac@uwo.ca](mailto:scibmsac@uwo.ca).

**Accommodation for Religious Holidays**

The policy on Accommodation for Religious Holidays can be viewed [here.](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

**Special Examinations**

A Special Examination is any examination other than the regular examination, and it may be offered only with the permission of the Dean of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents. To provide an opportunity for students to recover from the circumstances resulting in a Special Examination, the University has implemented Special Examinations dates. These dates as well as other important information about examinations and academic standing can be found [here.](http://www.uwo.ca/univsec/pdf/academic_policies/exam/definitions.pdf)

**Academic Offenses**

“Scholastic offences are taken seriously, and students are directed [here](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf) to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence.

**Accessibility Statement**

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Accessible Education (AE) at 661-2111 x 82147 for any specific question regarding an accommodation or review [The policy on Accommodation for Students with Disabilities](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf).

**Correspondence Statement**

The centrally administered **e-mail account** provided to students will be considered the individual’s official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner. You can read about the privacy and security of the UWO email accounts [here](https://www.uwo.ca/univsec/privacy/faq.html#ShouldIUse).

**Turnitin and other similarity review software**

All assignments will be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. Students will be able to view their results before the final submission. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between Western University and [Turnitin.com](http://www.turnitin.com/).

1. **BMSUE Academic Policies and Statements**

**Copyright and Audio/Video Recording Statement**

Course material produced by faculty is copyrighted and to reproduce this material for any purposes other than your own educational use contravenes Canadian Copyright Laws. You must always ask permission to record another individual and you should never share or distribute recordings.

**Rounding of Marks Statement**

Across the Basic Medical Sciences Undergraduate Education programs, we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement. ***Final grades*** on this course, irrespective of the number of decimal places used in marking individual assignments and tests, will be calculated to one decimal place and rounded to the nearest integer, e.g., 74.4 becomes 74, and 74.5 becomes 75. Marks WILL NOT be bumped to the next grade or GPA, e.g. a 79 will NOT be bumped up to an 80, an 84 WILL NOT be bumped up to an 85, etc. The mark attained is the mark you achieved, and the mark assigned; requests for mark “bumping” will be denied.

1. **Support Services**

The following links provide information about support services at Western University.

[Academic Counselling (Science and Basic Medical Sciences)](https://www.uwo.ca/sci/counselling/)

[Appeal Procedures](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/appealsundergrad.pdf)

[Registrarial Services](http://www.registrar.uwo.ca/)

[Student Development Services](http://www.sdc.uwo.ca/)

[Student Health Services](http://www.shs.uwo.ca/)