

ANAT 541

**CELLULAR &
MOLECULAR BIOLOGY
OF AGING**

**Lecture Outlines
and
Selected Readings**

2024

Health and Wellness Resources at McGill

Student well-being is a priority for the University. All of our health and wellness resources have been integrated into a single Student Wellness Hub, your one-stop shop for everything related to your physical and mental health. If you need to access services or get more information, visit the Virtual Hub at mcgill.ca/wellness-hub or drop by the Brown Student Services Building (downtown) or Centennial Centre (Macdonald Campus). Within your faculty, you can also connect with your Local Wellness Advisor (to make an appointment, visit mcgill.ca/lwa).

Check the Wellness Hub website for the most up to date information on these resources.

Academic Integrity

“McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the [Code of Student Conduct and Disciplinary Procedures](#).” (Approved by Senate on 29 January 2003) (See McGill’s [guide to academic honesty](#) for more information.)

« L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le [guide pour l'honnêteté académique de McGill](#).»

Language of Submission

“In accord with McGill University’s [Charter of Student Rights](#), students in this course have the right to submit in English or in French any written work that is to be graded. This does not apply to courses in which acquiring proficiency in a language is one of the objectives.” (Approved by Senate on 21 January 2009)

« Conformément à [la Charte des droits de l'étudiant](#) de l'Université McGill, chaque étudiant a le droit de soumettre en français ou en anglais tout travail écrit devant être noté, sauf dans le cas des cours dont l'un des objets est la maîtrise d'une langue. »

University Policy on Reassessments and Rereads

Please see the eCalendar for policies regarding reassessments of coursework and rereads of final exams:

https://www.mcgill.ca/study/2022-2023/university_regulations_and_resources/undergraduate/gi_final_examinations

Departmental Grading Policy

The Department of Anatomy & Cell Biology will **NOT** revise/upgrade marks except on sound academic grounds. Once computed, the marks in this course will **NOT** be altered/increased arbitrarily. Decimal points will be “rounded off” as follows: if the final aggregate mark is computed to be 79.5%, the mark will be reported as 80% (an A-); a final aggregate mark of 79.4% will be reported as 79% (a B+). These marks are **FINAL and non-negotiable**.

Departmental Midterm Exam/In-Course Assessment Deferral Policy

A midterm exam or other in-course assessment (i.e. quiz, assignment, paper, etc.) in a course administered by the Department of Anatomy & Cell Biology may only be deferred in the case of a **justified absence** due to serious illness or significant extenuating circumstances AND when **valid documentation** is received by the Course Coordinator within FIVE working days of the original midterm exam or due date.

If the deferral request is accepted by the Course Coordinator, students may be offered one or both of the accommodations below, depending on the grading structure of the course:

For ANAT541, In the case of one missed quiz due to a justified absence, the quiz mark for the course will be based on the other 4 quizzes. In the case of a second missed quiz due to a justified absence, a deferred quiz will be scheduled within 10 days of the original quiz date. Note that if you attend class on a quiz day, you must write the quiz.

Additional Statements

- The University Student Assessment Policy exists to ensure fair and equitable academic assessment for all students and to protect students from excessive workloads. All students and instructors are encouraged to review this Policy, which addresses multiple aspects and methods of student assessment, e.g. the timing of evaluation due dates and weighting of final examinations.
- Note that to support academic integrity, your assignments may be submitted to text-matching or other appropriate software (e.g., formula-, equation-, and graph-matching).
- © Instructor-generated course materials (e.g., lectures, handouts, notes, summaries, exam questions) are protected by law and may not be copied or distributed in any form or in any medium without explicit permission of the instructor. Note that infringements of copyright can be subject to follow up by the University under the Code of Student Conduct and Disciplinary Procedures.
- As the instructors of this course we endeavor to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with us and the Office for Students with Disabilities, 514-398-6009; disabilities.students@mcgill.ca

- McGill University is on land which has long served as a site of meeting and exchange amongst Indigenous peoples, including the Haudenosaunee and Anishinabeg nations. We acknowledge and thank the diverse Indigenous people whose footsteps have marked this territory on which peoples of the world now gather.

L'Université McGill est sur un emplacement qui a longtemps servi de lieu de rencontre et d'échange entre les peuples autochtones, y compris les nations Haudenosaunee et Anishinabeg. Nous reconnaissons et remercions les divers peuples autochtones dont les pas ont marqué ce territoire sur lequel les peuples du monde entier se réunissent maintenant.

- End-of-course evaluations are one of the ways that McGill works towards maintaining and improving the quality of courses and the student's learning experience. You will be notified by e-mail when the evaluations are available. Please note that a minimum number of responses must be received for results to be available to students.

- In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change

LECTURERS

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**COURSE NO: ANAT 541
DEPARTMENT OF ANATOMY AND CELL BIOLOGY**

COURSE COORDINATORS: STEPHANIE LEHOUX AND CHANTAL AUTEXIER

TIME / PLACE: Mondays 2:35 - 5:25 PM / SADB M/48

DATE	LECTURER
January 8	Stephanie Lehoux/ Chantal Autexier
January 15	Stephanie Lehoux
January 22	Adelyn Moore, Chantal Autexier and Abigail Gerhold
January 29	Colin Crist Quiz #1
February 5	Colin Crist-student presentations
February 12	François Mercier Quiz #2
February 19	François Mercier-student presentations
February 26	Peter Siegel Quiz #3
February 29 THURSDAY	Grant Proposal #1 Due
March 4	BREAK
March 11	Peter Siegel-student presentations
March 18	Maria Vera Ugalde Quiz #4
March 25	Maria Vera Ugalde-student presentations
April 8	Lisbet Haglund Quiz #5
April 11 THURSDAY	Maria Vera Ugalde-student presentations

CELLULAR AND MOLECULAR BIOLOGY OF AGING

ANAT 541

3 Credits

Instructors: Professors S. Lehoux and C. Autexier (coordinators),
C. Crist, A. Gerhold, L. Haglund, F. Mercier, P. Siegel, M. Vera Ugalde

Teaching assistant/Lecturer: Adelyn Moore

Content: This course focuses on how the complex aging process can be studied by modern cell and molecular approaches. Topics include theories and mechanisms of aging, animal model systems used to study aging, age-dependent diseases, including Alzheimer's, atherosclerosis, muscular dystrophy, osteoporosis, cancer, and age-related diseases, including dyskeratosis congenita.

Method: 1 lecture per week

Readings: References for the readings for the course are in the handout provided on MyCourses. These generally include references for one review article and several primary articles for each topic covered in class. Among the primary articles are those that will be presented in class by the students. **The articles for presentation will be available to the students for sign up the first day of class through MyCourses.**

Evaluation: 5% attendance / 5% participation
20% quizzes (based on review articles)
25% oral presentation of a primary research article
15%: Grant proposal, hypothesis assigned (Due February 29 at 11:59PM)
30%: Grant proposal based on primary research article of the oral presentation (Due **April 14th at 11:59PM**).

The previously untested or unanswered hypothesis for the first grant proposal will be assigned. The second assignment should be related to the topic of your paper presentation. For example, if you present an article on senescence and cancer, you should propose a previously untested or unanswered hypothesis related to senescence and cancer stemming from the article presented.

ORAL PRESENTATIONS

The students are responsible for preparing powerpoint presentations. Presentations should be **maximum of 15 minutes** and 5 minutes for discussion and questions. Typically, a 15-minute presentation will consist of 15 slides or less. Each student will be assigned one primary research paper to present. The main results using figures from the paper should be explained. **One** method used to obtain the results should be explained. An introduction and short conclusion/critique about the paper should also be prepared. The students should explain the introduction (rationale), methods, results, and conclusion for the figure(s) they present. See below for details.

Introduction:

Should give the background information, explaining **all** essential elements that will allow the audience to understand the context of the study and the specific experiments to be performed. Provide rationale for study, hypothesis of study. **Grading: 10/25**

Materials and Methods:

Should describe in detail **one** of the methods used. Describe the methods so that all can understand which steps are taken and why, rather than simply providing a list of steps. **Grading 5/25**

Results:

Should summarize the rationale, results, and conclusion for each selected figure. Not all figures or figure panels need be presented; students should decide what is best to support the final conclusions and fit within the time limit. **Grading: 5/25**

Discussion:

Should state the overall conclusion of the paper and the significance of the results. **Critique and limitations** of the study should also be included. Students should also be able to **answer questions** regarding any aspect of the paper **INCLUDING** methods and figures that are not presented during the 15 minutes. **Grading: 5/25**

GRANT PROPOSALS

Grant proposals are due at **11:59 PM on February 29th** and **April 14th**. Late assignments will be penalized by 10% every day they are late.

Grant proposals:

The grant proposals consist of 5-page double-spaced text (12-point font, 1" margin). A penalty will occur if the proposal is longer than this (up to 5.5 is acceptable) (-10%). References are not included in the page limit. Three to four self-generated figures i.e. not reproduced from a publication can be included as part of the assignment to illustrate the points under discussion. These figures are not included in the five pages of text. The text should be grammatically correct and easy to read, organized in the format of a scientific proposal, including Summary (Abstract), Introduction (Background and Significance), Hypothesis and Rationale, Experimental Design and Methods, Anticipated Results, Discussion of significance of results (including Future Directions of Research), and References.

First grant proposal (15%); Second grant proposal (30%)

Abstract (1 or 2)

The abstract is present and summarizes introduction, hypothesis, methods, expected results/future directions

Introduction/Literature Review (3 or 6)

The introduction is present and well written with appropriate and correct background including the significance of the field (both in terms of research and medically).

Hypothesis (0 or 3)

The hypothesis will be assigned for the first grant proposal. The hypothesis for the second proposal is based on a follow-up of the paper you presented orally in class. It should be clearly stated, reasonable, and previously unanswered.

Methods (3 or 5)

The experimental design will prove hypothesis and experiments are possible and logical. Include justification and validity of using the method to address the specific hypothesis

Expected Results (4 or 6)

Results are present and well written; some expected and alternative results should be stated. The expected results should be logical, that is consistent with hypothesis.

Discussion and Future Directions (4 or 8)

This section is present and well written. You should state the significance of the findings and propose future experiments, specifically answering questions that arise from results.

Points will be deducted for errors such as scientific error or error that affects understanding of proposal.

First grant proposal due February 29, 2024 11:59 PM

Based on:

Crozier, L. et al. 2023. CDK4/6 inhibitor-mediated cell overgrowth triggers osmotic and replication stress to promote senescence.

Abnormal increases in cell size are associated with senescence and cell cycle exit. The mechanisms by which overgrowth primes cells to withdraw from the cell cycle remain unknown. The authors demonstrate that cyclin-dependent kinase 4/6-inhibited cells overgrow during G0/G1, causing p38/p53/p21-dependent cell cycle withdrawal. Cell cycle withdrawal is triggered by biphasic p21 induction. The first p21 wave is caused by osmotic stress, the second wave results from replication stress. It is not known why osmotic stress occurs in large cells. The authors propose the possibility that widespread proteome remodeling and loss of proteostasis as one source of osmotic stress. Many studies have focused on understanding changes in proteostasis networks implicating chaperones, proteasome and autophagy pathways, with age and disease, and have validated interventions that reduce loss of proteostasis. Design experiments to test the hypothesis that improvement of proteostasis decreases the osmotic stress response in the cell model used in this study.

LEARNING OUTCOMES

1. Acquire knowledge of molecular and cellular biology techniques
2. Compare, relate, analyze the different basic theories, mechanisms and diseases of human aging and aging-related diseases
3. Read, understand, interpret, critically analyze, and present a primary research article relating to diseases of human aging or aging related diseases
 - a. identify the hypothesis and assess the validity of this hypothesis in the context of the current literature in the field
 - b. identify and evaluate the molecular and cellular methods used to test the hypothesis
 - c. critically evaluate the data and their significance
 - d. formulate and develop a new hypothesis based on the new data
4. Write a scientific proposal
 - a. Identify, access, and read relevant primary literature on diseases of human aging or aging related diseases
 - b. Formulate an unanswered hypothesis based on the current knowledge in the field
 - c. Design two or three experiments to test this hypothesis and rationalize the use of the methodology
 - d. Predict and interpret the possible results of the experiments
 - e. Formulate a new hypothesis based on the predicted results and identify and justify an appropriate method(s) to test this new hypothesis

SCHEDULE

1. January 8 Stephanie Lehoux/Chantal Autexier

Introduction to course, format and evaluation

Lecture on theories, mechanisms and models of aging

2. January 15 Stephanie Lehoux

Lecture on age and the vasculature/ Oral presentation of a paper

3. January 22 Adelyn Moore, Chantal Autexier and Abigail Gerhold

Lecture on grant proposal writing/ How to read and critique a journal article/
Premature Aging and the Telomere Syndrome Dyskeratosis congenita/Modeling
Aging in the Short Lived *C. elegans*

4. January 29 Colin Crist

Quiz 1 on review article

Lecture on regeneration and stem cell biology

5. February 5 Colin Crist

Short oral presentations of primary research articles by students

6. February 12 François Mercier

Quiz 2 on review article

Lecture on aging of the hematopoietic system

7. February 19 François Mercier

Short oral presentations of primary research articles by students

8. February 26 Peter Siegel

Quiz 3 on review article

Lecture on cancer progression to metastasis

First grant proposal due on February 29th

March 4 Reading Week

9. March 11 Peter Siegel

Short oral presentations of primary research articles by students

10. March 18 Maria Vera Ugalde

Quiz 4 on review article

Lecture on age-related neurodegenerative diseases and the activation of the stress response

11. March 25 Maria Vera Ugalde

Short oral presentations of primary research articles by students

12. April 8 Lisbet Haglund

Quiz 5 on review article

Lecture on translational research on the aging spine

13. April 11 Thursday Lisbet Haglund

Short oral presentations of primary research articles by students

Second grant proposal due on April 14th