The University of Calgary
Bachelor of Health Sciences
Cumming School of Medicine

Academic Year 2023-2024

MDSC 569.02
THE GUT-BRAIN-MICROBIOTA AXIS: REDEFINING MAMMALIAN PHYSIOLOGY

Instructors:

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Dr. Quentin Pittman pittman@ucalgary.ca

Office Hours/Policy on Answering Student Emails

Office hours are available by appointment. Email communications with the course coordinators are welcome. All efforts will be made to respond to emails received during working hours within 24 hours (excluding weekends and statutory holidays).

Time and Location:

Wednesday 6th September – Wednesday 6th December (Term break: week of Nov 12-18, 2023).

Classes take place Mondays and Wednesdays from 13.00-14.15. For location see D2L. The Friday classes (held at the same time) will be used for independent study and additional tutorials if they are required. Teaching will be "in person" to encourage discussion and student engagement.

Prerequisite/Co-Requisite:

Open to students having successfully completed MDSC 404 or ZOOL 463; OR with consent of the Course Coordinator and Co-Coordinator (Dr. Marie-Claire Arrieta – marie.arrieta@ucalgary.ca, Dr. Keith Sharkey ksharkey@ucalgary.ca)

Course Description:
Through analysis and discussion of research literature, this course will explore the concept of the gut-brain-microbiota axis, including the development of the concept, advances in the field, pathways and mediators of intercellular communication and aspects of physiology and pathophysiology.

Overarching Theme
This advanced course will cover many aspects of the gut-brain-microbiota axis. The course is designed for senior under-graduate or junior graduate students in the biomedical sciences.

Through lectures, student-led journal club presentations, student-led presentations on selected topics and written work ("lay summaries" and "news and views articles" of journal articles), students will appreciate the complexity and sophistication of signaling between the gut microbiota, immune cells and the neural elements of the gut (intrinsic and extrinsic nerves and enteric glia) and the brain. The course will explore microbial ecology of the gut, microbial mediators, pathways and mediators of communication in the gut and the between the gut and the brain, interoceptive systems in the brain, synaptic plasticity, and the impact of the gut microbiome on behaviour, neurological disorders, psychiatric conditions and diseases of metabolism and the gut and lung.

Participants should be motivated, enthusiastic, questioning, critical and conversant senior undergraduates or junior graduate students who are prepared to discuss basic science and clinical research papers with highly qualified course instructors with significant content expertise.

Global Objectives

- To facilitate development of critical and analytical skills in an advanced topic in physiology
- To create and develop an interactive, supportive and inclusive learning environment

Course Learning Outcomes

By the end of this course, students will be able to:

This course expects that an interactive environment for learning will be established to facilitate the ability to analyse, critically appraise and discuss scientific papers.

At the end of the course, students will have gained:

- The ability to identify, analyse, critically appraise and discuss scientific papers
- Advanced skills in the presentation (written and oral) of complex material for a broad audience
- Knowledge of gut microbial ecology, microbial mediators of communication and the factors the affect the gut microbiome
- Insights into the intercellular signaling mechanisms in the gut-brain-microbiota axis
- An understanding of the communication pathways between the gut microbiota and the brain
- Knowledge of the CNS systems and mechanisms involved in the gut-brain-microbiota axis
- An appreciation of the range of neurological, psychiatric, neurodevelopmental and peripheral disorders impacted by the gut microbiota

Transferable Skill Development:
Many of the skills and abilities that you are developing in your coursework are transferable to the workforce, graduate and professional studies and other facets of life. Employers seek applicants with transferable skills because they can be an asset in the workplace, regardless of industry or sector. Transferable skills are core skills for your success in building your future career.

The work that you will do in MDSC 569.02 will help you build the following transferable skills:

- **Collaboration**: Work respectfully with others from different backgrounds, cultures, and countries.
- **Verbal Communication**: Learn and share information by presenting, listening, and interacting with others.
- **Critical Thinking**: Actively and skillfully conceptualize, apply, analyze, synthesize, and/or evaluate information (data, facts, observable phenomena, and research findings) to make a reasoned judgement or draw a reasonable conclusion.
- **Information Literacy**: Find, understand, and use information presented through words, symbols, and images
- **Numeracy**: Use mathematical information such as numbers, symbols, words, and graphics to do tasks.
- **Problem solving**: Identify an issue, find and implement a solution, and assess whether the situation has improved.
- **Project Management:** Conceptualize, initiate, plan and execute a plan to achieve a predetermined goal (project) by effectively prioritizing activities and meeting deadlines.
- **Written Communication**: Share ideas and information by using words, images, and symbols.

Learning Resources

There is no assigned textbook for this course. All readings / links to readings will be posted on D2L Access to library resources will be required. Supplemental reading will be posted on D2L as required

A Note regarding readings

A list of required readings will be outlined on D2L and links will be made available, where possible. Required readings have been chosen carefully to inform you and enhance the lecture material**. Students are REQUIRED to complete assigned readings BEFORE each lecture, if they are provided in advance.** Instructors will proceed in class on the assumption that students have read completely the assigned readings. Students should be aware that many of the readings they will be assigned may be of an unfamiliar nature and style. Students should allot sufficient time to allow for several reads of the assigned material.

Learning Technology Requirements

Brightspace (by D2L) is located on the University of Calgary server and will be used extensively for communication with students. **It is the student's responsibility to ensure that they receive all posted communications and documents and that they receive emails sent by instructors or fellow students through D2L.** Only your @ucalgary.ca email address may be linked to D2L. Please ensure that you are regularly checking your @ucalgary.ca account.

Evaluation

The University policy on grading and related matters is described in section F of the 2023-2024 Calendar.

In determining the overall grade in the course, the following weights will be used:

Description	**% grade**	**Due Date**
Participation in the course	15%	
Lay summary	15%	October 16 (paper approval September 20)
News and Views Article	20%	December 1st (paper approval October 25)
Topic presentation	25%	Nov 22, Nov 27, Nov 29 or Dec 4 (paper approval October 25)
Journal Club host	25%	Oct 4, Nov 1, Nov 8 or Nov 20 (paper approval 2 weeks prior: Sept 20, Oct 18, Oct 25 or Nov 6)

Rubrics for each component will be provided on D2L.

There is no final exam for this course. Because of the nature of the course, participation is mandatory.

A student's final grade for the course is the sum of the separate assignments. It is not necessary to pass each assignment separately in order to pass the course. However, students who do not complete each component of the course will be considered as not having completed the course; this will be reflected on the students' official transcript as an F grade. In the absence of medical or other documented reasons, the instructor reserves the right to award an F grade.

A Note regarding Writing Assignments:
Writing skills are important to academic study in all disciplines. In keeping with the University of Calgary's emphasis on the importance of academic writing in student assignments (section E.2 of 2023-24 Calendar), writing is emphasized, and the grading thereof in determining a student's mark in this course. The Bachelor of Health Sciences values excellence in writing. Competence in writing entails skills in crafting logical, clear, coherent, non-redundant sentences, paragraphs and broader arguments, as well as skills with the mechanics of writing (grammar, spelling, punctuation). Sources used in research papers must be properly documented. The University of Calgary offers instructional services through the Students' Success Centre's Writing Support Services (http://www.ucalgary.ca/writingsupport/) for students seeking feedback on assignments or seeking to improve their general writing skills. Students are **strongly encouraged** to take advantage of these programs.

Grading Scheme:

Letter Grade	Description	Percentage
A+	Outstanding performance	96-100
A	Excellent performance	90-95.99
A-	Approaching excellent performance	85-89
B+	Exceeding good performance	80-84
B	Good performance	75-79
B-	Approaching good performance	70-74
C+	Exceeding satisfactory performance	65-69
C	Satisfactory performance	60-64
C-	Approaching satisfactory performance	57-59
D+	Marginal pass	54-56
D	Minimal pass	50-53
F	Does not meet course requirements	0-49

Missed Components of Term Work:
At the Course Coordinator's discretion, students may lose 5% per day late past the deadline for all written assignments. However, assignments will **NOT** be accepted more than 72 hours after the posted deadline and students failing to submit any assignment within this time frame will receive a mark of zero. **Exceptions to this policy may be granted on a case-by-case basis.**

It is the agreement of all Faculty involved in MDSC 569.02 that **extensions will NOT be granted** on any assignment or presentations, with the exceptions in keeping with the University Calendar (debilitating illness, religious conviction, or severe domestic affliction) that are received in advance by email. Traffic jams and late or full buses are common events in Calgary and are NOT acceptable reasons for late arrivals to class, meetings and examinations. Please note that while absences are permitted for religious reasons, students are responsible for providing advance notice and adhering to other guidelines on this matter, as outlined in the University Calendar (https://www.ucalgary.ca/pubs/calendar/current/e-4.html).

Course Evaluations and Student Feedback
Student feedback will be sought at the end of the course through the Universal Student Rating of Instruction (USRI) and a qualitative student evaluation. Students are welcome to discuss the process and content of the course at any time with the instructor. Students may also address any concerns they may

have with Dr. Fabiola Aparicio-Ting, Associate Dean (Undergraduate Health and Science Education) in the Cumming School of Medicine (feaparic@ucalgary.ca).

Attendance
As 15% of the final mark is based on participation, attendance is mandatory.

Conduct During Lectures
The classroom should be respected as a safe place to share ideas without judgement - a community in which we can all learn from one another. Students are expected to frame their comments and questions to lecturers in respectful and appropriate language, always maintaining sensitivity towards the topic. Students, employees, and academic staff are also expected to demonstrate behaviour in class that promotes and maintains a positive and productive learning environment.

As members of the University community, students, employees and academic staff are expected to demonstrate conduct that is consistent with the University of Calgary Calendar, the Code of Conduct and Non-Academic Misconduct policy and procedures, which can be found at https://www.ucalgary.ca/student-services/student-conduct/policy .

Students are expected to take notes during class and should not rely solely on material supplied by the instructors. Instructors may or may not post lectures notes to D2L, at their individual discretion. Instructors may cover concepts or examples in class that may not be posted to D2L but may be assessed.

Use of Internet and Electronic Communication Devices in Class
The Bachelor of Health Sciences program aims to create a supportive and respectful learning environment for all students. The use of laptop and mobile devices is acceptable when used in a manner appropriate to the course and classroom activities. However, research studies have found that inappropriate/off-topic use of electronic devices in the classroom negatively affects the learning of others during class time.

Students are responsible for being aware of the University's Internet and email use policy, which can be found at https://www.ucalgary.ca/policies/files/policies/electronic-communications-policy.pdf .

UNIVERSITY OF CALGARY POLICIES AND SUPPORTS

Copyright
All students are required to reach the University of Calgary policy on Acceptable Use of Material Protected by Copyright (https://www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright-policy.pdf) and requirements of the Copyright Act (https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html) to ensure they are aware of the consequences of unauthorized sharing of course materials (including instructor notes, electronic versions of textbooks, etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy https://www.ucalgary.ca/pubs/calendar/current/k.html.

Instructor Intellectual Property
Course materials created by instructors (including course outlines, presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may **NOT** be reproduced, redistributed or copied without the explicit consent of the professor. **The**

posting of course materials to third-party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course ***at the same time*** may be allowed under fair dealing.

Academic Accommodations
It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The Student Accommodations policy is available at https://ucalgary.ca/student-services/access/prospective-students/academic-accommodations. Students needing an accommodation based on disability or medical concerns should contact Student Accessibility Services (SAS) in accordance with the Procedure for Accommodations for Students with Disabilities (https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf). SAS will process the request and issue letters of accommodations to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/ .

Students who require an accommodation in relation to their coursework based on a protected ground other than disability should communicate this need in writing to Dr. Fabiola Aparicio-Ting, Associate Dean (Undergraduate Health and Science Education) in the Cumming School of Medicine (feaparic@ucalgary.ca).

Academic Misconduct
The University of Calgary is committed to the highest standards of academic integrity and honesty. The University of Calgary has created rules to govern all its members regarding the creation of knowledge and the demonstration of knowledge having been learned.

Academic Misconduct refers to student behaviour that compromises proper assessment of a student's academic activities and includes (but is not limited to): cheating, fabrication, falsification, plagiarism, unauthorized assistance, failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses, and failure to comply with exam regulations applied by the Registrar. **It also includes using of third-party websites/services to access past/current course material, essay/assignment writing services, or real-time assistance in completing assessments, seeking answers to assessment questions and similar, whether paid, bartered or unpaid.**

For information of the Student Academic Misconduct Policy and Procedures, please visit;
https://ucalgary.ca/policies/files/policies/student-academic-misconduct-policy.pdf
https://ucalgary.ca/policies/files/policies/student-academic-misconduct-procedure.pdf

Additional information is available on the Academic Integrity website at: https://ucalgary.ca/student-services/student-success/learning/academic-integrity.

Recording of Lectures
Audio or video recording of lectures (or similar) is prohibited except where explicit permission has been received from the instructor.

Freedom of Information and Protection of Privacy Act
Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary

Appeals
If there is a concern with the course, academic matter or a grade, first communicate with the instructor. If these concerns cannot be resolved, students can proceed with an academic appeal, as per Section I of the University Calendar. Students must follow the official reappraisal/appeal process and may contact the Student Ombuds' Office (http://www.ucalgary.ca/ombuds) for assistance with this and with any other academic concerns, including academic and non-academic misconduct. Students should be aware that concerns about graded term work may only be initiated **within 10 business days** of first being notified of the grade. https://www.ucalgary.ca/pubs/calendar/current/i-2.html

Sexual and Gender-Based Violence Policy
The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Sexual-and-Gender-Based-Violence-Policy.pdf.

Resources for Support of Student Learning, Success, Safety and Wellness

Student Success Centre	http://www.ucalgary.ca/ssc/
Student Wellness Centre	http://www.ucalgary.ca/wellnesscentre/
Student Advocacy and Wellness Hub (CSM)	https://cumming.ucalgary.ca/student-advocacy-wellness-hub/home
Distress Centre	http://www.distresscentre.com/
Library Resources	http://library.ucalgary.ca

Wellness and Mental Health Resources
The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the excellent mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (https://www.ucalgary.ca/wellnesscentre/services/mental-health-services) and the Campus Mental Health Strategy (http://www.ucalgary.ca/mentalhealth/).

Student Ombuds' Office
The Student Ombuds' Office supports and provides a safe, neutral space for students. For more information, please visit www.ucalgary.ca/ombuds/ or email ombuds@ucalgary.ca

BHSc Student Faculty Liaison Committee (SFLC)
The BHSc SFLC, with elected representatives from all majors, serves to raise issues of interest to BHSc students to the program administration, including items pertaining to curriculum, scheduling and events. A list of current representatives can be found on the BHSc website.

Student Union (SU) Information
The SU Vice-President Academic can be reached at (403) 220-3911 or suvpaca@ucalgary.ca; the SU representatives for the Cumming School of Medicine can be reached at medrep1@su.ucalgary.ca or medrep2@su.ucalgary.ca.

Student Success Centre
The Student Success Centre provides services and programs to ensure students can make the most of their time at the University of Calgary. Our advisors, learning support staff, and writing support staff assist students in enhancing their skills and achieving their academic goals. They provide tailored learning support and advising programs, as well as one-on-one services, free of charge to all undergraduate and graduate students. For more information visit: https://www.ucalgary.ca/student-services/student-success

Emergency Evacuation/Assembly Points
As part of the University of Calgary Emergency Evacuation plan, students, faculty, and staff should locate the closest Assembly Point in case of Fire Alarm. Safety signage is posted throughout the campus showing the locations and the possible route to these locations. All students, faculty, and staff are expected to promptly make their way to the nearest Assembly Point if the Fire Alarm is activated. No one is to return into campus facilities until an all clear is given to the warden in charge of the Assembly Area. For more information, see https://www.ucalgary.ca/emergencyplan/building-evacuation/assembly-points

Safewalk
Campus security will escort individuals, day or night, anywhere on campus (including McMahon Stadium, Health Sciences Centre, Student Family Housing, the Alberta Children's Hospital and the University LRT station). Call 403-220-5333 or visit http://www.ucalgary.ca/security/safewalk. Use any campus phone, emergency phone or the yellow phone located at most parking lot pay booths. Please ensure your personal safety by taking advantage of this service.

Class Schedule

Fall term break: Nov 12-18, 2023 (no classes; no assignments due)
First day of classes: Tuesday Sept 5; last day of classes: Wednesday Dec 6
Thanksgiving Monday Oct 9
Registrar-scheduled final exam period: Dec 9-20, 2023

Dates	Topic	Instructor	
Wednesday 6 September	Course overview, class norms and expectations	Keith Sharkey (KS) and Marie-Claire Arrieta (M-CA)	Lecture 1
Friday 8 September	Independent reading and research; tutorial if required		
Monday 11 September	An overview of the gut-brain-microbiota axis	Keith Sharkey	Lecture 2
Wednesday 13 September	Microbial ecology, the gut as an ecosystem and measurement of the gut microbiome	Marie-Claire Arrieta	Lecture 3
Friday 15 September	Independent reading and research; tutorial if required		
Monday 18 September	How to give a superior presentation	Quentin Pittman	Lecture 4
Wednesday 20 September	Model systems and approaches to study the role of the gut microbiome	Marie-Claire Arrieta	Lecture 5
Friday 22 September	Independent reading and research; tutorial if required		
Monday 25 September	Stress and the HPA axis	Gerald Giesbrecht	Lecture 6
Wednesday 27 September	Pathways and mediators of neural communication – 1 (vagal afferents and efferents, vagal anti-inflammatory reflexes, gut-liver axis)	Keith Sharkey	Lecture 7
Friday 29 September	Independent reading and research; tutorial if required		
Monday 2 October	Pathways and mediators of neural communication – 2 (spinal afferent and sympathetic efferents)	Keith Sharkey	Lecture 8
Wednesday 4 October	Journal Club 1. Vagus nerve topics	KS	Student-led Journal Club 9
Friday 6 October	Independent reading and research; tutorial if required		
Monday 9 October	No class – Thanksgiving Day		
Wednesday 11 October	The interoceptive network (animal and human)	Quentin Pittman	Lecture 10
Friday 13 October	Independent reading and research; tutorial if required		

Monday 16 October	Immune signaling mechanisms (leukocyte trafficking, endothelial cell activation, microglial activation, TLRs)	Quentin Pittman	Lecture 11
Wednesday 18 October	Factors that affect the gut microbiome: diet, lifespan	Marie-Claire Arrieta	Lecture 12
Friday 20 October	Independent reading and research; tutorial if required		
Monday 23 October	Microbial mediators of host communication – aryl hydrocarbon ligands, bile acids and SCFAs	Marie-Claire Arrieta	Lecture 13
Wednesday 25 October	Brain: structure, function and synaptic plasticity (includes BDNF, dendritic spines, receptor plasticity)	Quentin Pittman	Lecture 14
Friday 27 October	Independent reading and research; tutorial if required		
Monday 30 October	Microbial endocrinology and neurotransmitter systems – 5-HT, GABA and catecholamines	Quentin Pittman	Lecture 15
Wednesday 1 November	Journal Club -2. The microbiome and cognition	KS	Student-led Journal Club 16
Friday 3 November	Independent reading and research; tutorials if required		
Monday 6 November	Energy metabolism and obesity	Keith Sharkey	Lecture 17
Wednesday 8 November	Journal Club -3. The microbiome and social behaviours	KS, M-CA	Student-led Journal Club 18
Friday 10 November	Independent reading and research; tutorials if required		
13-17 November	No classes or assignments due – Fall Break		
Monday 20 November	Journal Club -4. Topic from earlier.	KS, M-CA	Student-led Journal Club 19
Wednesday 22 November	Student-led topic presentation – Developmental diseases (ASD, Schizophrenia)	M-CA	Student-led presentation 20
Friday 24 November	Independent reading and research; tutorials if required		
Monday 27 November	Student-led topic presentation – Neurological diseases (MS, PD, Alzheimer's, ALS, stroke)	KS, M-CA	Student-led presentation 21
Wednesday 29 November	Student-led topic presentation – Neurological diseases (MS, PD, Alzheimer's, ALS, stroke)	KS, M-CA	Student-led presentation 22
Friday 1 December	Independent reading and research; tutorials if required		

Monday 4 December	Student-led topic presentation – Psychiatric conditions (depression and anxiety)	KS, M-CA	Student-led presentation 23
Wednesday 6 December	Student-led topic presentation – if needed	KS, M-CA	Student-led presentation 24

*Guest lecturer

Please note that Friday's or additional time slots may be used for the student-led journal clubs and presentations based on the final enrollment in the course.