Course Syllabus

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THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Education

School of Kinesiology

KIN 438:

Skeletal Muscle Physiology: Molecular Adaptions to Training, Disuse and Aging

(Term II, 2022W)

3 Credits

> *UBC's Vancouver Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on in their culture, history, and traditions from one generation to the next on this site.*

Course Structure: Friedman Building 153 M/W/F 2:00-3:00pm

Your Instructor: Dr. Cameron Mitchell

Your TA: Lucas Wien**s** **wiensl55@student.ubc.ca (mailto:wiensl55@student.ubc.ca)**

Previous course code: Kin 462

Contact Information: **cameron.mitchell@ubc.ca (mailto:cameron.mitchell@ubc.ca)** Email if question relates to only to you. **Please use the discussion forums for questions about course material.** More focused questions will be answered directly in the online discussion forms while broader more open ended questions will be answered in class.

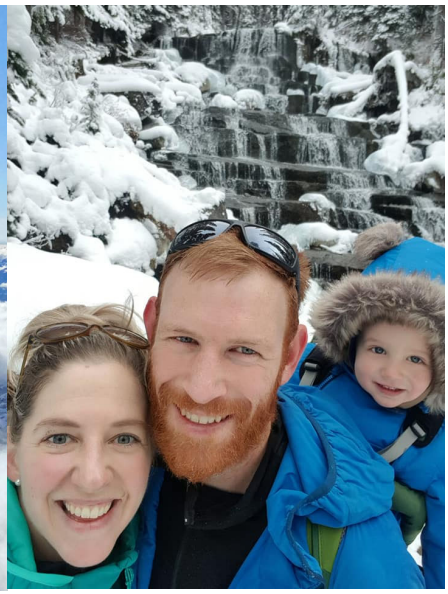
Response time: I aim to respond to emails/ discussion posts within 24 hours but will not respond on evenings or weekends. Response times may be slower in the days immediately before the midterm and final exam due to last minute questions so please ask questions early!

You can navigate to specific sections of the syllabus using these links.

Course Description | **Course Assignments** | **Course Schedule**

Instructor Bio

Dr. Cameron Mitchell Ph.D., School of Kinesiology

Dr. Mitchell has been an Assistant Professor in the school of Kinesiology since 2019, his research focuses on how and why we lose muscle mass as we age and what we can do about it. His lab uses techniques which range from resistance exercise and nutrition interventions to molecular biology techniques. He is a former rugby player who enjoys being active in the mountains and cycle commuting to work.

Course Description

This course will explore the cellular and molecular response of human muscle to exercise aging and inactivity. Muscle cells sense a number of contraction related events which control the transcription of genes and protein translation resulting in altered muscle phenotype. In addition to muscle fibers, muscle tissue contains a number of other cell types including stem cells, endothelial cells and fibrotic cells which work together to allow muscle to adapt to stimuli such as exercise training. In this course you will lean about the similar and divergent adaptations to muscle injury, aerobic training, resistance training, old age and inactivity. We will also addressed some possible explanations for interindividual variability in response to exercise training. You will also have the opportunity to practice criticality reading and evacuating recent literature as well as claims made by so called 'experts' on the internet.

High Level Learning Objectives:

- Apply basic molecular biology principles to explain exercise adaptation

- Identify the level of uncertainty when discussing what is currently 'known' about muscle adaptations
- Evaluate interventions which might modulate muscle adaptation
- Critically evaluate recent literature and discuss its practical applications
- Use evidence to respond to media claims related to muscle

Specific Learning Objectives:

- Identify the different cell types within muscle and their functions
- Explain how aerobic and resistance exercise initiate different signaling events
- Describe the regulations of mitochondrial biogenesis
- Explain the role of satellite cells in human muscle
- Explain the relationship between ribosomes, translational capacity and exercise adaptations
- Describe how protein turnover regulates muscle size
- Discuss possible mechanisms which allow for extreme levels of muscle hypertrophy
- Identify common age related changes in muscle as well as the response to exercise
- Explain the negative effects of inactivity on muscle function and metabolism

Additional Materials

Online Communications

In this course, and throughout your program, you are expected to communicate in a respectful and professional manner. You may find it helpful to review **UBC's Distance Learning Communication Online: Netiquette (https://distancelearning.ubc.ca/learner-support/communicating-online-netiquette/)** web page.

Course Assignments

This is an overview of the assignments for this course. For more information about each of these assignments, use the **ASSIGNMENTS (https://canvas.ubc.ca/courses/131559/assignments)** link in the course navigation to read the details and expectations for each assignment.

Assessment Title	**Grading**
Tests 15% X 2	30 %
Hard Choices Assignment (19% + 1% outline)	20 %
Video Response assignment (https://canvas.ubc.ca/courses/131559/assignments/1727450)	15 %
Final exam	35 %

Course Schedule

Regular lectures M/W/F will cover the follow modules:

1. Introduction/ Muscle repair
2. Adaptations to aerobic training
3. Adaptations to resistance training
4. Variability in training response (responders/ non-responders)
5. Aging muscle
6. Adaptations to inactivity/ muscle disuse

Term test 1: February 7th

Video response assignment due: February 16th

Hard choices outline due: March 1st

Term test 2: March 18th

Hard choices presentations: March 20 - April 10th

Review class: April 12th

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available from the **UBC Senate Website. (https://senate.ubc.ca/policies-resources-support-student-success)**

Please make sure you are familiar with the academic policies and procedures.

Academic Integrity

Students are expected to follow UBC policies for academic integrity and academic misconduct, which includes practices around plagiarism, referencing and citation, and copyright. For more see, UBC's

Learning Commons Academic Integrity resources (https://learningcommons.ubc.ca/academic-integrity/) .

Accessibility

If you have any challenges accessing materials that will impact your success in this course, UBC's Centre for Accessibility can support your needs by providing appropriate accommodations to support you.

- Web: **UBC's Centre for Accessibility website (https://students.ubc.ca/about-student-services/centre-for-accessibility)**
- Email: **accessibility@ubc.ca (mailto:accessibility@ubc.ca)**

Reading List

MODULE 1: Introduction/ Muscle Regeneration
Review: Egan, B., & Zierath, J. R. (2013). Exercise metabolism and the molecular regulation of skeletal muscle adaptation. Cell metabolism, 17(2), 162-184.

Review: Wosczyna, M. N., & Rando, T. A. (2018). A muscle stem cell support group: coordinated cellular responses in muscle regeneration. *Developmental cell*, *46*(2), 135-143.

Journal club: Mackey, A. L., & Kjaer, M. (2017). The breaking and making of healthy adult human skeletal muscle in vivo. *Skeletal muscle*, *7*(1), 24.

MODULE 2: Adaptations to Aerobic Exercise
Review: Bishop, D. J., Hoffman, N. J., Taylor, D. F., Saner, N. J., Lee, M. J., & Hawley, J. A. (2023). Discordant skeletal muscle gene and protein responses to exercise. Trends in Biochemical Sciences.

Journal club: Granata, C., Caruana, N. J., Botella, J., Jamnick, N. A., Huynh, K., Kuang, J., ... & Bishop, D. J. (2021). High-intensity training induces non-stoichiometric changes in the mitochondrial proteome of human skeletal muscle without reorganisation of respiratory chain content. *Nature communications*, *12*(1), 1-18

MODULE 3: Adaptation to Resistance Exercise
Review: Lim, C., Nunes, E. A., Currier, B. S., Mcleod, J. C., Thomas, A. C., & Phillips, S. M. (2022). An Evidence-based Narrative Review of Mechanisms of Resistance Exercise-induced Human Skeletal Muscle Hypertrophy. *Medicine & Science in Sports & Exercise*, 10-1249.

Journal Club: Damas, F., Phillips, S. M., Libardi, C. A., Vechin, F. C., Lixandrão, M. E., Jannig, P. R., ... & Tricoli, V. (2016). Resistance training-induced changes in integrated myofibrillar protein synthesis are related to hypertrophy only after attenuation of muscle damage. *The Journal of physiology*, *594*(18), 5209-5222.

MODULE 4: Responders and Non-Responders to Exercise

Review: Roberts, M. D., Haun, C. T., Mobley, C. B., Mumford, P. W., Romero, M. A., Roberson, P. A., ... & McCarthy, J. J. (2018). Physiological differences between low versus high skeletal muscle hypertrophic responders to resistance exercise training: current perspectives and future research directions. *Frontiers in physiology*, *9*, 834.

Journal club: Marsh, C. E., Thomas, H. J., Naylor, L. H., Scurrah, K. J., & Green, D. J. (2020). Fitness and strength responses to distinct exercise modes in twins: S tudies of T win R esponses to U nderstand E xercise as a TH erapy (STRUETH) study. *The Journal of Physiology*, *598*(18), 3845-3858.

MODULE 5: Aging Muscle

Review: Wilkinson, D. J., Piasecki, M., & Atherton, P. J. (2018). The age-related loss of skeletal muscle mass and function: Measurement and physiology of muscle fibre atrophy and muscle fibre loss in humans. *Ageing research reviews*, *47*, 123-132.

Journal club: Tøien, T., Nielsen, J. L., Berg, O. K., Brobakken, M. F., Nyberg, S. K., Espedal, L., ... & Wang, E. (2023). The impact of life-long strength versus endurance training on muscle fiber morphology and phenotype composition in older men. Journal of Applied Physiology, 135(6), 1360-1371.

MODULE 6: Adaptations to Inactivity

Nunes, E. A., Stokes, T., McKendry, J., Currier, B. S., & Phillips, S. M. (2022). Disuse-induced skeletal muscle atrophy in disease and non-disease states in humans: mechanisms, prevention, and recovery strategies. *American Journal of Physiology-Cell Physiology*.

Journal club: Latham, C. M., Balawender, P. J., Thomas, N. T., Keeble, A. R., Brightwell, C. R., Ismaeel, A., ... & Fry, C. S. (2023). Overexpression of manganese superoxide dismutase mitigates ACL injury-induced muscle atrophy, weakness and oxidative damage. *Free Radical Biology and Medicine*.

Supplementary reading:

Egan, B., & Sharples, A. P. (2023). Molecular responses to acute exercise and their relevance for adaptations in skeletal muscle to exercise training. *Physiological Reviews*.

Furrer, R., Hawley, J. A., & Handschin, C. (2023). The molecular athlete: exercise physiology from mechanisms to medals. *Physiological Reviews*.

Course Summary:

Date	Details	Due
Wed Feb 8, 2023	Test 1 (https://canvas.ubc.ca/courses/131559/assignments/1727453)	due by 11:59pm
Sun Mar 5, 2023	Hard choices outline (https://canvas.ubc.ca/courses/131559/assignments/1727452)	due by 11:59pm
Wed Mar 15, 2023	Test 2 (https://canvas.ubc.ca/courses/131559/assignments/1727436)	due by 11:59pm
Fri Feb 16, 2024	ASSIGNMENT: Video Response (https://canvas.ubc.ca/courses/131559/assignments/1727450)	due by 11:59pm
	Final exam (https://canvas.ubc.ca/courses/131559/assignments/1727448)	
	Hard choices assignment (https://canvas.ubc.ca/courses/131559/assignments/1727451)	