2026 NMD4C Basic Research Summer School Schedule

Day 1: Monday June 8, 2026

Time	Event	
8:00-8:30	**REGISTRATION**	
8:30-8:45	Intro/Opening Remarks	
8:45-9:55	Participant Flash Talks	
9:55-10:30	**COFFEE BREAK**	
10:30-11:00	Patient Partner presentation	
11:00-11:30	Industry presentation - Lucid Scientific	
11:30-12:00	**Tutorial 1** – Metabolomics – Dr. Shama Naz	
12:00-1:00	**LUNCH**	
1:00-2:00	**Demo 1**: Muscle Organoids – Dr. Vahab Soleiman (3 x 20 min sessions)	
2:00-2:30	**BREAK**	
2:30-4:30	**Tutorial 2**: Histopathological Basis of Muscle in NMD: From Normal Structure to Pathological Changes – Led by Dr. Jean-Philippe Leduc-Gaudet	**Interactive Computer Session 1:** Bioinformatics and Genetic Reference Populations – Dr. Keir Menzies
6:00-9:00	NETWORKING EVENT – Career Network Panelists: • Lucid Scientific • Patient Partner • Dr. Jean-Philippe Leduc-Gaudet – Early Career Investigator • Government sector	

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Day 2: Tuesday June 9, 2026

TIME	TOPICS	
9:00-10:00	**Workshop 1:** 3D Muscle Cultures – Drs. Keir Menzies & Alex Green	**Workshop 2:** Human Muscle Biopsy – Dr. Michael DeLisio **Group I:** Presentation on Theory **Group II:** Observe Biopsy
10:00-10:30	BREAK	
10:30-11:30	**Workshop 1:** 3D Muscle Cultures – Drs. Keir Menzies & Alex Green	**Workshop 2:** Human Muscle Biopsy – Michael DeLisio **Group I:** Observe Biopsy **Group II:** Presentation on Theory
11:30-12:00		Shuttle to RGN
12:00-1:00	LUNCH	
1:00-2:30	**Workshop 3:** Muscle Function **Group I: 3A** Ex vivo Muscle Function – Dr. Junio Dort **Group II: 3B** Resipher Team	**Workshop 4:** Immuno / Histo Labelling of Muscle Sections **Group I:** Dr. Sally Spendiff **Group II:** Dr. Jean-Philippe Leduc-Gaudet
2:30-3:00	BREAK	
3:00-4:30	**Workshop 3:** Muscle Function **Group I: 3B** Resipher Team **Group II: 3A** Ex vivo Muscle Function – Dr. Junio Dort	**Workshop 4:** Immuno / Histo Labelling of Muscle Sections **Group I:** Dr. Sally Spendiff **Group II:** Dr. Jean-Philippe Leduc-Gaudet
6:00-9:00	**DINNER & NETWORKING EVENT**	

Day 3: Wednesday June 10, 2026

TIME	TOPICS	
9:00-10:00	**Tutorial 3:** Single cell transcriptomics – Dr. Vahab Soleimani	**Interactive Computer Session 2:** Image analysis using FIJI, MiraVision, and NMJ-morph. – Drs. Sally Spendiff & Jean-Philippe Leduc-Gaudet
10:00-11:00	**Tutorial 4:** Analysis of muscle stem cell function and muscle regeneration – Dr. Mireille Khacho	
11:00-12:00	**3D Muscle Cultures Workshop Follow-up:** Students checking on their muscle cultures from the previous day – Drs. Keir Menzies & Alex Green	
12:00	**END**	

Description of workshops, demos, tutorials, and interactive computer sessions

Workshop 1: 3D Muscle Cultures – Led by Dr. Keir Menzies and Alex Green

This interactive, laboratory-based workshop introduces participants to the fundamentals of three-dimensional (3D) muscle cell culture, an emerging model for studying muscle function. The course focuses on how to establish, maintain, and analyze 3D myogenic cultures derived from muscle stem cells (satellite cells) or myoblasts. Trainees will gain practical experience with matrix-assisted approaches that recapitulate native muscle architecture and function.

Students will learn how to:

- Prepare/store/sterilize reagents.
- Seed and differentiate cells into 3D myofiber bundles.
- Assess 3D myofiber bundles using microscopy.

Workshop 2: Human Muscle Biopsy – Led by Dr. Michael DeLisio

Students will observe the muscle biopsy and then learn how to preserve the collected skeletal muscle for downstream immunohistochemistry/immunofluorescence analysis, by mounting the muscle and storing in liquid nitrogen. Tissue is limited.

Workshop 3: Muscle Function

Workshop 3A: Ex vivo Muscle Function – Led by Dr. Junio Dort

This hands-on workshop will introduce trainees to the foundational principles and practical techniques of *ex vivo* skeletal muscle physiology. Participants will learn how isolated muscles, such as the extensor digitorum longus (EDL), are dissected, mounted, and assessed to measure contractile properties, fatigue resistance, and force production. Emphasis will be placed on optimizing experimental design, understanding sources of variability, selecting appropriate stimulation paradigms, and using the Aurora Scientific dual-mode lever system to generate high-quality data.

Trainees will:

- Develop familiarity with core *ex vivo* muscle measurements, including twitch responses, force-frequency relationships, and fatigue assays using the Aurora Dual-Mode Lever system.
- Learn how to analyze and interpret output data.

Workshop 3B: Resipher – Led by Lucid Scientific

This workshop, presented by Lucid Scientific, will introduce Resipher's platform for real-time measurement of cellular oxygen consumption and continuous metabolic monitoring. Attendees will learn how continuous metabolic readouts can deepen insights into cell function.

Workshop 4: Immuno/Histo Labelling of Muscle Sections – Led by Drs. Sally Spendiff and Jean-Philippe Leduc-Gaudet

This hands-on workshop will introduce trainees to the fundamentals of histological and immunohistochemical labelling in skeletal muscle. Participants will also learn how to properly collect and preserve tissues for histology/IHC, TEM, and related approaches. Trainees will gain practical experience labeling skeletal muscle sections using H&E, Myosin Heavy Chain immunostaining, and COX/SDH enzymatic staining. They will also learn how to design, optimize, and troubleshoot an effective IHC protocol.

Demo 1: Muscle Organoids – Led by Dr. Vahab Soleimani

Muscle organoids, different from conventional 3D cultures, are 3D, lab-grown mini-tissues that self-organize and mimic the structure and function of real human skeletal muscle. These miniature models are used to study muscle development, disease, and regeneration, and can be engineered to include functional neuromuscular junctions for more complex disease modeling.

In this demo trainees will:

- Understand what muscle organoids are
- Learn how muscle organoids are generated
- Observe key structural and functional features
- Understand applications in neuromuscular disease research

Tutorial 1: Metabolomics – Led by Dr. Shama Naz

This tutorial will introduce key metabolomics approaches, from experimental design and sample preparation to data acquisition and interpretation. Participants will gain practical insight into how metabolic profiling can illuminate cellular states and biological mechanisms.

Tutorial 2: Histopathological Basis of Muscle in NMD: From Normal Structure to Pathological Changes – Led by Dr. Jean-Philippe Leduc-Gaudet

This presentation will cover histopathological procedures, best practices, troubleshooting, etc. The trainees will be shown how to properly collect and preserve tissues for histology/IHC, TEM, etc. Potentially show in real time, how to dissect and process mice tissue.

Tutorial 3: Single cell transcriptomics – Led by Dr. Vahab Soleimani

Single-cell transcriptomics is a technique that isolates individual cells and sequences the RNA inside each one. It reveals the unique molecular identity, state, and function of each cell. This allows researchers to map cellular diversity by identifying cell types in a tissue, discovering unknown cell populations, studying disease at a cell-specific level, and understanding how cells respond to treatments.

In this tutorial trainees will learn:

- What single-cell transcriptomics is used for
- How data are generated
- The structure of single-cell data
- How to analyze and interpret single-cell data

Tutorial 4: Analysis of muscle stem cell function and muscle regeneration – Led by Dr. Mireille Khacho

This tutorial will provide an in-depth overview of experimental approaches to assess muscle stem cell function, including proliferation, differentiation, and self-renewal, and their impact on muscle regeneration. Participants will learn practical frameworks for designing and interpreting regeneration studies *in vivo* and *ex vivo*.

Interactive computer session 1: Bioinformatics and genetic reference populations – Led by Dr. Keir Menzies

This interactive, computer-based workshop will introduce participants to GeneNetwork (genenetwork.org), an open-access bioinformatics platform integrating genetic, genomic, and phenotypic data from a variety of model organisms and human studies. The course will focus on how to investigate gene–phenotype relationships in the BXD mouse reference

population using gene expression databases, and interactive visual tools available through GeneNetwork.

Students will learn how to:

- Navigate the GeneNetwork interface and datasets (e.g., BXD mouse reference population).
- Perform gene correlation analyses and interpret genetic linkage results.
- Explore tissue-specific gene expression data to identify candidate genes for traits of interest.
- Generate visual outputs such as correlation matrices, correlation tables and gene set analyses using webgestalt.
- Integrate findings with biological context and literature.

The workshop emphasizes hands-on exploration, allowing trainees to work directly with their own gene or phenotype of interest with guided exercises to perform their own mini-analysis by the end of the session.

*Trainees to bring own laptops

Interactive computer session 2: Image analysis using FIJI, MiraVision, and NMJ-morph – Led by Drs. Sally Spendiff and Jean-Philippe Leduc-Gaudet

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