High School Student Science Week

Centre for
Heart Lung Innovation
UBC and St. Paul's Hospital

St. Paul's Hospital
Vancouver, BC

PROVIDENCE HEALTH CARE
Research Institute
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Centre for
Heart Lung Innovation
UBC and St. Paul's Hospital

AGENDA

Location: Centre for Heart Lung Innovation (HLI), St. Paul's Hospital, Room 166 Burrard Building, 1081 Burrard Street, Vancouver, BC

Monday

Time	Group A and B
8:45 AM	Arrive at Centre for Heart Lung Innovation **Location:** Main reception, room 166 Burrard Building
9:00 AM - 10:00 AM	**Facilities tour around HLI**
10:00 AM - 11:30 AM	Orientation & Safety Session
	Group Photo
11:30 AM - 12:30 PM	Lunch break
12:30 PM – 1:45 PM (All 8 students) 1:45 PM AM – 4:00 PM (All 8 students)	**Lab**: **How cultured are you?** **Guide:** **Location:** Room 204 ---------- **Lab: Introduction to PCR** **Guides:** **Location:** Room 204

Tuesday

Time	Group A and B
9:00 AM – 12:00 PM (All 8 students)	**Lab**: **Molecular Phenotyping Core Lab** **Guide: Location:** Room 292
12:00 PM - 1:00 PM	Lunch break
1:00 PM – 4:00 PM (All 8 students)	**Lab**: **Cell Culture Lab** **Guides: Location:** Room 203 and 212

Wednesday

Time	Group A and B
9:00 AM - 12:00 PM (All 8 students)	**Lab: Biobanking and Histology** **Guides:** **Location:** Room 221
12:00 PM - 1:00 PM	Lunch break
1:00 PM - 4:00 PM (All 8 students)	**Lab**: **Introduction to ELISA** **Guides: Location:** Room 111

Thursday

Time	Group A and B
9:00 AM – 12:00 PM (All 8 students)	**Lab**: **Protein Lab** **Guide: Location:** Room M224
12:00 PM - 1:00 PM	Lunch break
1: 00 PM – 2:30 PM (All 8 students)	**Lab**: **Confocal Microscope and Micro CT** **Guides: Location:** Core 3 meeting Room
2:30 PM - 4:00 PM	**Lab**: **Training the Immune System** **Guides:** **Location:** Room 165

Friday

Time	Group A and B
9:00 AM -10.30 AM (All 8 students)	**Lab**: **Lung Function Testing** **Guide: Location:** Room 165
10:30 AM - 11:30 AM (All 8 students)	**Lab**: **Tour of the GEM facility** **Guide: Location:** GEM area
11:30 AM - 12:30 PM (All 8 students)	**Friday Seminar Series** **Location:** Gourlay Conference room
11:30 PM – 1:00 PM (All 8 students)	**Graduate Student Meet and Greet** **Hosts:** **Location**: Room 165
1:00 PM - 2:00 PM	**Wrap-up session and completion of evaluation forms** **Host**: **Location**: Room 165

Event Descriptions

Facility Tour:

Students will be provided a tour of the different laboratories and CORE facilities within the Centre for Heart Lung Innovation.

Orientation and Safety Session:
Students will learn about the history of the Centre for Heart Lung Innovation as well as the research that is actively being pursued today. This will be followed by an introduction to the week's events and a safety lesson. Identification badges, lab coats and goggles will be handed out to all participants during this session.

How "Cultured" are you? (Bacterial culture lab):

- Students will learn to use swabbed samples to grow bacterial culture on agar plates. They will learn to streak agar plates effectively to get single bacterail colonies.

Introduction to PCR:
PCR (Polymerase Chain Reaction) is a revolutionary method developed by Kary Mullis in the 1980s. PCR is based on using the ability of DNA polymerase to synthesize new strand of DNA complementary to the offered template strand. Because DNA polymerase can add a nucleotide only onto a preexisting 3'-OH group, it needs a primer to which it can add the first nucleotide. This requirement makes it possible to delineate a specific region of template sequence that the researcher wants to amplify. At the end of the PCR reaction, the specific sequence will be accumulated in billions of copies (amplicons).

- In this session, there will be a brief introduction about the principle of PCR, and also a hands-on activity enabling students to amplify a DNA fragment via PCR reaction and visualize the amplicons in agarose gel on their own.

Cell Culture Lab:
The investigation of a single cell type under defined conditions is a method used by researchers to help simplify and study complex systems. Students will be given an opportunity to see how this technique can be used, including the challenges and limitations of it. Specifically, students will learn about:

Tissue Culture room basics:
- biological safety level 2 definition and types of biological safety cabinets
- personal protective gear (PPE), (gown, gloves, shoes)

How to grow and observe cells:
- information on types of cells (adherent vs. suspension)
- different types of flasks used to maintain cells
- types of media used for cells and the function of each component
- cell growth – steps of the growth curve
- microscope technique

Sterile technique:
- Demonstration of experimental set-up in the biological safety cabinet

- Background information on cell line stimulation
- RNA stabilization of cells
- Passaging and plating of cells
- Trypsinizing cells (use of a chemical to remove adherent cells from the flask)
- Cell counting using a hemocytometer (each student can take turns counting cells in a square)

Freezing of cells (if time permits, otherwise verbal explanation)

- cryopreservation media
- freezing slowly, thawing fast
- liquid nitrogen tank safety

Introduction to Enzyme-Linked Immunosorbent Assay (ELISA):

Biological samples like blood and tissue contain many types of proteins and often researchers are interested in just one particular protein. One way of accurately measuring the level of a specific protein is ELISA.technique. There are many different kinds of ELISAs, including competitive and sandwich methods, but all are based on the same principle: specific binding between an antigen and an antibody.

In this lab students will learn

- about serum and plasma samples
- about antigens and antibodies
- the theory behind ELISAs and different types of ELISA techniques.

to perform an ELISA to measure the amount of a glycoprotein in unknown samples

Protein Lab (Introduction to Western Blotting):

Biological samples such as cultured cells and tissue samples contain many different types of proteins. In a cell culture setting, researchers often expose cells to different treatments to see how protein expression changes as a result of those exposures. Specific protein expression can be characterized from these cells based on the molecular weight of the protein. Western blotting is one way of doing this. Western blotting includes running SDS-PAGE gels, transferring of proteins to the special membranes and probing with specific antibodies.

In this lab students will learn:

- the theory behind Western blotting (running the gels and transferring proteins to nitrocellulose membranes)
- how to pour the gels based on protein size i.e. molecular weight
- how to separate the proteins by sodium dodecyl sulfate (SDS)-polyacrylamide gel electrophoresis (PAGE)
- hands-on experience loading the gels.

Molecular Phenotyping Core

The Molecular Phenotyping Core Laboratory (MPCL) is a fee-for-service, multi-user laboratory. The MPCL provides research tools and technical support to researchers and clinicians both within the HLI and Providence Healthcare as well as external groups from the Lower Mainland research community and beyond. The MPCL provides a unique environment for the complete characterization of biological samples. Members of the MPCL are involved in studies of cell phenotyping, protein profiling, genotyping and gene expression in order to further our understanding of the pathogenesis of cardiovascular, respiratory and systemic inflammatory diseases including transplant rejection, asthma and COPD. The MPCL consists of five integrated areas of focus: flow cytometry, genotyping, RNA analysis, multiplex protein analyses and laser capture microdissection. These core technologies combined with our specialized staff create an enhanced environment of synergy. This

ultimately leads to a greater understanding of cardiovascular and pulmonary diseases that can be effectively translated into improved patient care.
While in the MPCL the students

- will be working with human blood to explore various techniques for separating and counting white blood cells
- will be preparing blood smears to stain and look at under the microscope, running blood samples on a clinical hematology analyzer and staining blood cells to quantify various sub-population by flow cytometery.

Biobanking:
Students will get an introduction to biobanking, i.e. the collection of tissue for future research and education. They will also be given an opportunity to see real specimens from human hearts and lungs.

Introduction to Histology:
An introduction to what histology is and why we use it will be explained in this laboratory session. A common technique used routinely in clinical and research laboratories will be demonstrated.

- Tour of Histology lab
- Brief lecture of tissue processing and sample acquisition
- Demonstration of frozen tissue cryo-sectioning
- Demonstration of paraffin section and H&E staining
- Microscopic viewing of tissue structures

Training the Immune System:

Theory: Students will learn the basics of the immune system, be given an introduction on the function of various immune cells and be introduced to the concept of innate immune memory. They will then learn how various stresses such as cancer, cardiovascular disease and/or chronic infection can influence innate immune memory leading to tolerant or non-functional phenotypes and how other stresses (like exercise) can enhance innate immune function – effectively training the immune system. They will further learn about how exercise can be used clinically to predict patient outcomes (morbidity and mortality) and therapeutically to treat conditions and enhance rehabilitation.

Practical: Students will learn how to conduct a 6-minute walk test (6MWT), a non-invasive way estimating functional capacity. One or two students will undergo 6MWTs in which they will have their functional capacity measured as the rest of the students administer the test.

Cardiopulmonary Exercise Physiology (CPEP) Lab:
Students will learn how to conduct a pulmonary function assessment including spriometry, plethysmography and maximum respiratory pressure measures. Next students will learn how to properly prepare and place surface muscle electromyography electrodes to assess muscle activation. Lastly students will learn what equipment, environmental conditions, and procedures are required to perform a symptom limited incremental exercise test. A sub-maximal incremental exercise test will be performed on a member of the CPEP Lab whereby students will get to observe in real-time standard cardio-respiratory measures (e.g., oxygen consumption, carbon dioxide production, breathing patterns, heart rate, oxygen saturation, etc.).

Lung Function Testing

Spirometry is a common diagnostic test that measures how much air an individual can blow out from their lungs and how fast they can blow out. It is the most reliable way to test an individual's lungs for COPD and asthma thus it is a beneficial test for studies concerning such conditions.
Specifically, there three variables which are taken into consideration in a Spirometry Test:

- **FEV1:** Forced Expiratory Volume in the first second, the proportion of a person's vital capacity that they are able to expire in the first second of expiration. In other words, how much air you can get out in the first second of a forceful exhale
- **FVC:** Forced Vital Capacity, the maximum volume of air that can be forcefully expired
- **FEV1/FVC ratio:** The percentage of air in their lungs that then can blast out in the first second

- There is pre and post spirometry which means after a few initial trials (pre-spirometry), we give Salbutamol (Ventolin), a bronchodilator which is commonly used to treat or prevent bronchospasms in patients with asthma. It opens up the airways and helps open your lungs if there are any blockages and then we perform the post-spirometry.

In this session you will:

- Receive an explanation on why Spirometry testing is done and how it plays a crucial role in the CanCOLD Study as well as other studies
- Be able to see a demonstration of a Spirometry test being performed
- Have hands on experience performing a Spirometry test on your peers

Confocal/ Multiphoton, Micro CT Imaging Core Tour:

As a part of this session, students will have the opportunity to become aware of the novel high resolution imaging approaches in biomedical research.

GEM Facility tour:

The **G**enetically **E**ngineered **M**odels (GEM) facility is an animal research facility offering a wide variety of technical services and support to the investigators of the Centre for Heart Lung Innovation to facilitate animal based research required for preclinical research studies. Trained staff provide a high standard of animal care, technical services and monitoring which will ensure animal welfare and the best experimental results. You will tour the facility; hear about animal care committees and veterinary oversight and UBC's strict training requirements for all animal users. We may observe rats and mice and discuss behaviour.

Note: GEM tour is optional. There are restrictions around those who have rodent pets at home (to control transmission of disease) and anyone who has severe allergies. If any student not confortable visiting animal facility, he/she can opt out ☺

Friday Seminar Series:

This is an opportunity for students to learn about some of the current studies taking place in the field of cardiopulmonary research. The presentation will be delivered by invited speaker, Dr. John Hanrahan, in research field of CFTR in airway defense.

Graduate Student Meet & Greet:

- Graduate students will provide brief introductions on how they became interested in science and what life is like as a graduate student

- Bring your curiosity! Time will be available to ask the mentors any questions on career choices

Wrap-up session:

- Feedback from the students regarding the week
- Return of laboratory safety equipment (goggles, lab coat)
- Completion of school board evaluation forms