Faculty of Science Course Syllabus
Department of Earth and Environmental Sciences
ERTH 2110: Field Methods
Fall, 2024

Instructor: *Mike Young* *mike.young@dal.ca* *Office: Room 2055A LSC*

Lectures: *M 935-1125* *LSC-Room 2055*
WF 935-1025 *LSC-Room 2055*

Laboratories: *M 11:35-14:25* *LSC-Room 2055*

Teaching Assistant: *Emily Theben* *Emily.Theben@dal.ca*

Course Description

This is intended as an introduction to field techniques useful to the practicing geologist, particularly those concepts essential for the accurate field description and identification of rocks and the use and construction of geological maps. Computer techniques and elementary structural geology are also considered.

Course Objectives/Learning Outcomes

- Describe and identify rocks, primary structures, and tectonic structures in outcrop
- Learn to take effective and organized notes and sketches in the field
- Recognize and measure planar and linear features in outcrop.
- Record and plot structural features (e.g. bedding, cleavage, intersection lineation) on a map from first person observations
- Map lithologic, intrusive and fault contacts in the field
- Map folds in the field using cleavage-bedding relationships
- Identify true geometry of geological bodies in the field and from map pattern
- Use structural contours as an aid to field mapping and desktop map analysis
- Draw a geological cross section (unbalanced) using direct field observations and from published geological maps
- Make a geological map and cross section from field data collected by the student during the course
- Using the field skills and knowledge acquired through the course, write and present a report describing and analysing a geological map

Course Materials

Required Text:

1. Field Sheets course pack for ERTH 2110. Available at the bookstore at the front counter.

Optional Texts (both available as downloadable pdf's):

1. Structural Analysis & Synthesis, by Rowland, Duebendorfer, and Schiefelbein (3rd or 4th edition)
2. Geological Field Techniques, by Angela Coe

Supplies Required:

Compass with inclinometer, hand lens with lanyard, field notebook, geologic protractor, grain size scale card, clipboard, geologic hammer (all sold at the front counter or online at the university bookstore –

https://bookstore.dal.ca/Catalogue/shop/school-supplies/field-equipment). See below the course schedule for a detailed description of required and optional equipment.

A computer with Google Earth Pro is recommended but not required. We will primarily use the Google Earth Web and ArcGIS Online apps which are both best on Chrome and the new Microsoft Edge browser. Safari does not support WebGL so Mac users should install and use Chrome. Computer labs are readily accessible across campus including in the department down the hall from our lab room.

Course Assessment

This is a project-based course. Many of the projects will be done with partners, or in groups, but each person will hand in their own final piece of work for most of the projects. Most projects will be graded using a rubric and will take into account not only accuracy and thoroughness of field data, but also neatness, completeness, and presentation (i.e., PROFESSIONALISM). Final grades will be calculated on the following basis:

Component	Weight (% of final grade)	Date
Weekly Labs	*20%*	***See schedule below***
Field trips	*5%*	***See schedule below***
Midterm (1 hour in-class)	*10%*	***Oct 18th in Room 2055***
York Redoubt Mapping Project	*5%*	***Due Oct 25th***
Halifax Peninsula Mapping Project	*10%*	***Due Nov 22nd***
Field Notebook *(Your field notebook will be submitted at the end of term for final grading. It will be submitted periodically during term for feedback and grading)*	*5%*	***Due Nov 22nd***
Map Analysis Project & Pres.	*10%*	***in-class Dec 2nd and 3rd***
Lab Quiz	*10%*	***in-class Dec 4th***
Field Grade*	*5%*	***ongoing***
Final exam (2-3 hours)	*20%*	*(Scheduled by Registrar)*

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

***FIELD GRADE CRITERIA**

Field courses are challenging. It is especially tricky to have so many students working together under stressful conditions. In this course you will live in close quarters with a lot of others, work together in various groups for various tasks, and be challenged in many ways. It is essential that we all strive to make our own experience a rewarding and positive one. It is also important to work hard to make and maintain a constructive group experience. A single, consistent irritation to an otherwise positive group environment hurts everyone. In a similar way, a single act of cooperation, generosity or kindness can lift the entire group. Because your own actions heavily determine your ability

to master the subjects of the course as well as influence everyone around you, a field grade will be part of your evaluation in the course. Here are the main subjective criteria used to determine your field grade.

- Independence: shows “attack”, self-motivation and initiative in problem solving
- Attitude: does not complain, helps others, exhibits a positive attitude at all times
- Participation: is punctual, follows directions, demonstrates safety in the field
- Competence: proficient, careful and respectful with field equipment
- Professionalism: respectful of yourself, fellow students, TAs and instructor
- Preparedness: is ready and willing for any situation or changes the field environment and class contingencies may pose

DEADLINES AND MISSED COURSE TIME

We work hard to make the grading in this course fair. In the professional world, "there are no finished products, there are only deadlines." So, we require everyone to turn in their reports at the imposed time.

Students are paired for most of their projects. It is expected that each student contributes equally to the field work and maps/reports due for each project. It is very difficult to make up a missed day in the field. Obviously, if you have a serious medical problem, a contagious illness, or another emergency, do not come, but realize that you will most likely not be able to complete the project.

Labs and weekly field trip reports will generally be due on Thursday afternoons following the lab period or field trip. Late submissions of labs, reports or projects will lose 10% of their value each day they are late and will not be accepted after submissions are graded and returned.

IN THE FIELD

For Monday field trips, be ready to leave promptly at 9:35 am. Gather on the lawn outside the Earth Sciences entrance to the LSC. Sturdy water-resistant field boots are a must; don't rely on sneakers. Dress for the weather. Layers are best, which will allow you to adapt to changing conditions. Don't forget a hat and gloves. Keep a rain jacket or poncho in your day pack. Carry a bottle of water and a snack to see you through. Sun protection is a good idea, and insect repellent can be helpful.

Course Content

Please note: This course is often weather dependent! We will not be deterred by light rain or cold temperatures. However, we may have to rearrange the schedule due to heavy rain or snow-covered rocks. We will hope for sunny, warm Mondays, but will deal with whatever comes!

Week of	***Topic***	***Lab/Field Trip***
Sept 2-6 *Labour Day*	M: No class (Labour Day) Syllabus, Field Equipment, Field Safety, Rock & Mineral Review	*No Lab, Monday Sept 2nd*

Sept 9-13	M: Lab 1 in 2055 W/F: Topographic/base maps, mapping principles, geological map symbols, strike/dip concepts	Lab 1: Rock & Mineral review; rock description
Sept 16-20	M: Lab 2 in 2055 W/F: Notetaking in the field, compass use (navigation, measuring strike/dip); plotting symbols	Lab 2: Intro to Geological Maps and Cross Sections
Sept 23-27	M: Field Trip 1 W/F: Intro to Google Earth and take-home lab; Sedimentary rocks in the field	Field Trip 1: Point Pleasant Park part I: Compass Work, Strike & Dip, and Mapping Intro Field Trip 2 (Saturday, Sept 28): Rainy Cove: Folds, faults, unconformities. *Late Return*
Sept 30-Oct 4 *Day of T&R*	M: No class (Day of Truth & Reconciliation) W/F: Structure Contours & 3-Point Problems	*No Lab, Monday Sept 30th* Lab 3 (in-class & take-home lab): Remote mapping using Google Earth
Oct 7-11	M: Lab 4 in 2055 W: Introduction to deformation: Folds, bedding, cleavage.	Lab 4: Structure contours & 3-point problems Field Trip 3 (Saturday, Oct 12): Bramber Flower Pot Rock: Folds, faults, cleavage, lineation. *Late Return*
Oct 14-18 *Thanksgiving*	M: No class (Thanksgiving) W/F: midterm review & prep for York Redoubt & Hfx mapping exercises **F, Oct 18: Midterm exam** (in class; 2055)	*No Lab, Monday Oct 14th* Field Trip 4 (Sunday, Oct 20): York Redoubt: semi-independent mapping project. *Late Return*
Oct 21-25	M: Field Trip 5 W/F: Stereonets	Field Trip 5: Campus to Oxford St to Regina Terrace +/- Point Pleasant Park part II: Halifax Peninsula Mapping Project
Oct 28-Nov 1	M: Lab 5 W/F: Apparent dip, structure contours, Topographic profiles	Lab 5: Stereonets Apparent dip & structure contours
Nov 4-8	M: Lab 6 W/F: Map unit thickness calculations & Stratigraphic columns	Lab 6: Cross Sections part I
Nov 11-15	**Reading Week**	

Nov 18-22	M: Lab 7 W/F: Geological Map Analysis	Lab 7: Cross Sections part II and Intro to Map Analysis
Nov 25-29	M: Lab 8 W/F: Geological Map Analysis	Lab 8: Geological Map Analysis
Dec 2-4	M: Map Analysis Presentations T: Map Analysis Presentations W: Lab Quiz	**Wed, Dec 4: Lab Quiz**

Course Fees:

To conduct our field work, we will be chartering a bus for most field trips. Fees will be collected with tuition to cover some of these costs. **Fees are estimated at $300**. Check with student accounts to confirm.

Field equipment costs are additional and include a reference book (Field Sheets), notebook, compass, hand lens, geologic protractor, grain size scale card, and a photo scale card with geologic timescale. A geologic hammer is optional. These items are available for purchase at the bookstore.
https://bookstore.dal.ca/supplies/course-supplies/field-equipment
These are the main references and equipment we will use in the class. Hence, the textbooks are optional. And this reference material will be used in all other field-based courses.

Please ensure you have acquired all the mandatory equipment by the beginning of classes.

Geological Equipment

You can also order these items online from a variety of retailers: Amazon (amazon.ca), Deakin Equipment (deakin.com), Chaltrek (chaltrek.com), and BAP Equipment (bapequipment.com).

Field Equipment sold by the bookstore.
https://bookstore.dal.ca/supplies/course-supplies/field-equipment

Required field equipment (sold at Bookstore):

1. Compass clinometer (Suunto MC-2)
2. Field Notebook (red hardcover)
3. Pencil for writing in notebook. *0.5mm mechanical pencils are best. But 0.7 and 0.9 are good supplements for shading when field sketching.*
4. Hand Lens (Belomo)
5. Field Sheets Reference Manual
6. Grain size card
7. Geologic Protractor
8. Vinyl Envelope
9. Technical pens – ultra fine tipped (0.25mm) *eg., Pigma Micron 01(sold at Bookstore)*
10. Clipboard (regular 8.5" x 11" size)
11. Pencil Crayons

Optional field equipment:

11. Rock Hammer *(will be required for ERTH 3001: Field School)*
12. Safety Glasses
13. Scriber with magnet
14. Small first aid kit
15. Acid bottle/dropper

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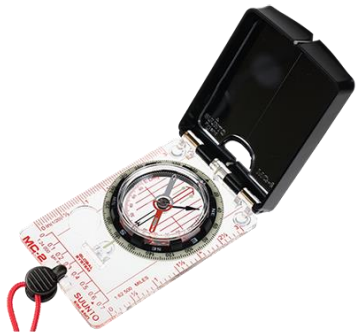
Description of Field Equipment:

Compass with inclinometer (required)

- $60 - $75
- When purchasing a compass, it should be Suunto MC-2, or Silva Ranger 15T, with inclinometers. If you are unsure ask a professional geologist or the instructor. Suunto MC-2 compasses are ***available at the university bookstore***.



Notebook (required)

- $7.50 - $25
- Hard cover – flat, hard surface for taking measurements with the compass
- No metal – metal binding will interfere with your compass when taking measurements
- Page size – approximately 5" x 7". This book fits nicely into the large pockets of cargo pants.
- At least 100 pages – numbered pages are best but you can add these yourself.
- Water-resistant paper is useful – so your notes and notebook lasts during all weather conditions
  - Red/Orange Forestry Suppliers hard cover notebooks are ***available at the bookstore***, and are excellent quality and a size that fits into a generously-sized side pocket of cargo pants.

Hand lens (sometimes called a Loupe; required)

- $15-$120. 10x hand lens.
- There are many options. Here are some of my favourites:
  - Belomo 10x triplet. Excellent value and highly recom-mended. ~$50. ***Available at the bookstore with lanyards***.
  - Iwamoto 10x/20x Achromatic. I splurged on this 8 years ago. It's an excellent lens with a wide field of view, no distortion and clear optics. ~$135
  - Bausch & Lomb Hastings 10x triplet. This is a favourite for many geologists. ~$70
  - You can also opt for an inexpensive lens. A lot are available for under $20. It may not last very long, but it will probably make it through this class.
  - A hand lens must be worn around your neck using a lanyard. A long (~30-36") shoe lace works well, as does a name tag lanyard. The Belomo lenses sold at the bookstore come with lanyards.

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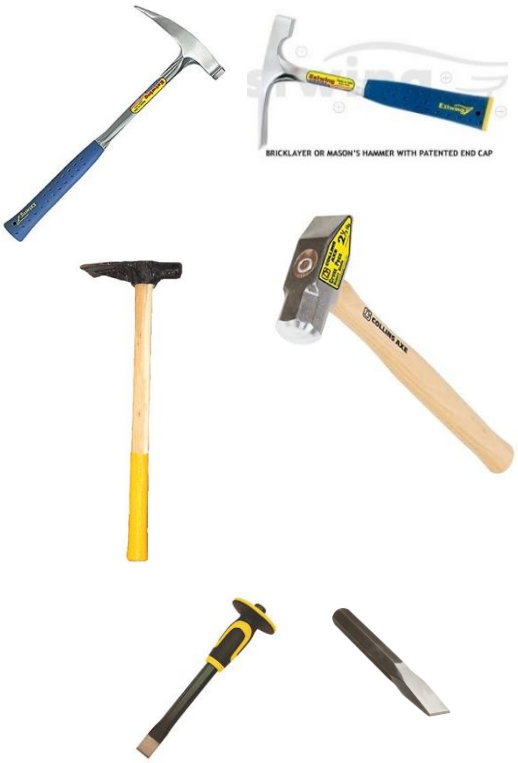
Hammer (optional)

- $30-$55; Blacksmith or Geology.
- Estwing hammers are the most popular among geologists.
  - Estwing Long Handle Rock Hammer ~$55 (***recommended and sold at the bookstore***)
  - Estwing Regular Handle Rock Hammer ~$52
  - Estwing bricklayer or mason's hammer
  - Estwing Geo Pick (expensive, long and heavy)
  - GeoTul (a Canadian invention for prospectors – a shovel and hammer in one)
  - A 2- to 3-lbs blacksmith hammer with a 12" to 16" handle. These are readily available at home improvement centres and are usually inexpensive. It does not have a chisel or pick end so you will eventually need to carry a cold-steel chisel for prying out samples.



- □ ALWAYS wear safety glasses while using a hammer on rock.
- □ NEVER strike hardened steel with a hammer. Hammers are made with hardened steel in order to hold their shape. But this type of steel is brittle and will produce small shards when struck with other hammers. It's very dangerous and there are many geologists who have lost their eyesight due to metal shards flying off a hammer head and lodging in their eyes.

- □ Also, NEVER use a carpenter's hammer in place of a geology or mason's hammer. The steel is too brittle and could produce metal shards when striking rock.

Footwear (required)

- Ensure you have sturdy hiking boots or shoes. Sneakers, sandals and dress shoes are not sufficient.
- If you don't own hiking boots/shoes, you can purchase a good quality, inexpensive pair from local outdoor stores such as Trail Shop or MEC. Make sure to break them in before we go on an excursion.

Other Equipment (required)

- Safety glasses (sunglasses ok; if you wear prescription glasses, make sure they're made of plastic or safety glass)
- Drafting equipment: clip board (8.5 x 11), lead pencils (0.5mm are best), pencil crayons, eraser, pens.
- Ultra-fine-tipped drafting black pens. You will use these to ink in your final maps. One black pen in each size of: 01 (0.25 mm) and 03 (0.35 mm). Steadler or Pigma Micron brands are best. ***Pigma Micron pens are sold at the bookstore.***

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Other Equipment (optional)

- plastic acid bottle (we provide the acid to put in these)
- pencil-style magnet. Another option is a pencil magnet with scribe. The scribe is a hardness of 8.5.

- Camera – a cell phone camera is sufficient. You will take and submit (upload to a network drive) photos (geology, rock shots, geologists in action, etc…) at the end of the course for a portion of your final grade. It will rain during field work so ensure you have a way to keep it dry.
- small first aid kit (we will have large kits in vehicles and with instructors and TAs)
- Water bottles (2-3 litres) & sandwich container
- day pack to carry all this stuff.

Hard hats and high visibility vests will be provided by the department when necessary.

Optional: A more appropriate, and industry-standard field vest is called a cruiser vest and can be purchased at surveyor suppliers. Cansel in Dartmouth, www.cansel.ca) or geology-specific stores such as Deakin Equipment in Vancouver (www.deakin.com) or Chaltrek in Thunder Bay (www.chaltrek.com) or BAP Equipment in Fredericton (www.bapequipment.com). Make sure the vest has the CSA or WCB-approved high visibility strips and plenty of pockets (14 is the standard). Expect to pay between $75 and $125 for a good quality vest. If you purchase a cruiser vest, choose a lightweight but high quality one. They can be quite hot and uncomfortable in the summer.

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University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: https://www.dal.ca/about-dal/internationalization.html

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and

inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: http://www.dal.ca/cultureofrespect.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: https://www.dal.ca/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.html

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

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Student Resources and Support

University Policies and Programs

Important Dates in the Academic Year (including add/drop dates): http://www.dal.ca/academics/important_dates.html

Classroom Recording Protocol: https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html

Dalhousie Grading Practices Policies: https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html

Sexualized Violence Policy: https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

Learning and Support Resources

General Academic Support – Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html

General Academic Support – Advising (Truro): https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Indigenous Connection: https://www.dal.ca/about-dal/indigenous-connection.html

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803: https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf

Black Student Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

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International Centre: https://www.dal.ca/campus_life/international-centre.html

South House Sexual and Gender Resource Centre: https://southhousehalifax.ca/about/

LGBTQ2SIA+ Collaborative: https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html

Dalhousie Libraries: http://libraries.dal.ca/

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Dalhousie Student Advocacy Services: https://www.dsu.ca/dsas?rq=student%20advocacy

Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Human Rights and Equity Services: https://www.dal.ca/dept/hres.html

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Faculty of Science Advising Support: https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html

Safety

Biosafety: http://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: http://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Laser Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html