Integrated Science 1001X (Winter 2022–23) Exploring Science

Course Description & Prerequisite Requirements

Calendar description: Explore foundational topics in astronomy, biology, chemistry, computer science, earth science, mathematics, and physics through an integrated questions-based approach. Small-group interactions and interdisciplinary laboratory experiments are designed to foster teamwork, interdisciplinary thinking, and the development problem-solving and critical-thinking skills.

Extra information: 13 lecture hours and 10 laboratory/tutorial hours per week, 2.0 course.

Prerequisites: Enrollment in Year 1 of the Western Integrated Science program and a minimum of 60% in each of Calculus 1000A/B or 1500A/B, Chemistry 1301A/B, and Physics 1201A/B or 1501A/B.

Antirequisites: Chemistry 1302A/B; Physics 1102A/B, Physics 1202A/B, Physics 1502A/B, the former Physics 1029A/B, and the former Physics 1302A/B; Biology 1002B; Mathematics 1225A/B; Calculus 1301A/B and Calculus 1501A/B; Computer Science 1026A/B; Data Science 1200A/B.

Unless you have either the prerequisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Learning Outcomes

Broadly speaking, a student receiving credit for the course will be expected to reliably demonstrate competence in their ability to:

- Think critically about, explain, integrate, and apply scientific principles, laws, and theories.
- Solve a variety of novel problems, whether qualitative, quantitative, or mathematical.
- Draw scientific conclusions from experimental results or data.
- Examine, integrate, and assess any provided or collected scientific data.
- Communicate scientific thoughts and ideas both verbally and in writing.
- Obtain, evaluate, and integrate information from various sources, and determine its relevance.
- Analyze and critically assess problems, and take a systematic approach to solving them.
- Use a variety of laboratory equipment and instrumentation.
- Safely execute a variety of experimental procedures and explain the theory behind them.
- Form productive and collaborative working relationships with other individuals.
- Prioritize a set of tasks and manage the use of their time.

Diversity and Inclusion

In an ideal world, science would be objective. However, much of science is subjective and is historically built on a small subset of privileged voices.

In 1001X, we will try to acknowledge a diverse group of scientists, but limits still exist on this diversity. It is possible that there may be both overt and covert biases in the material due to the lens with which it was written, even though the material is primarily of a scientific nature. Integrating a diverse set of experiences is important for a more comprehensive understanding of science.

We would like to discuss issues of diversity in science as part of the course from time to time. Please contact us (in person or electronically) or submit confidential feedback if you have any suggestions to improve the quality of the course materials.

Furthermore, we would like to create a learning environment for everyone that supports diverse thoughts, perspectives, and experiences, and honours your identities (including race, gender, gender identity, class, sexuality, religion, ability, etc.). To help accomplish this: If you have a name and/or set of pronouns that differ from those that appear in your official Western records, please let us know. If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with us. We want to be a resource for you. Remember that you can also submit confidential feedback (which will lead to us making a general announcement to the class, if necessary, to address your concerns – without identifying you).

If you prefer to speak with someone outside of the course, your academic counsellors are an excellent resource. We, like many people, are still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, please talk to us about it. Again, your feedback will always be confidential. As a participant in course discussions, you should also strive to honour the diversity of your classmates.

Course Website

News, course updates, and relevant materials will be posted on Western's learning management system, OWL (http://owl.uwo.ca). This is the primary method by which information will be disseminated to all students in the class, so you are responsible for checking OWL on a frequent basis.

If you need technical assistance with OWL, seek support on the OWL Help page. Alternatively, contact the Western Technology Services Helpdesk by phone at 519-661-3800 or extension 83800.

Class and Personnel Information

Classes take place at the times and locations specified below.

- Mon and Fri 9:30–11:30 PAB 106
- Wed 9:30–12:30 PAB 106
- Tue and Thu 9:30–12:30 PAB 148

Contact information for the course personnel:

Instructor	**Office**	**Email**
Gurpaul Kochhar	MSA 1201	gkochhar@uwo.ca
Adrienne Larocque	BGS 1000E	alaroc2@uwo.ca
Felix Lee (course coordinator)	MSA 1202	flee32@uwo.ca
Denis Maxwell	NCB 223	dmaxwell@uwo.ca
Gregory Reid	MC 281	reid@uwo.ca
Bryan Sarlo	MC 361	bsarlo@uwo.ca
Zahra Sharif (lab supervisor)	CHB 380A	zmohama@uwo.ca
Olga Trichtchenko	PAB 112	otrichtc@uwo.ca

Remember, we are here to support you! If you find yourself not understanding the lectures, assigned readings, or problems, please come to our scheduled office hours, which will be posted on OWL, or set up an appointment by sending an email **from your Western email account**.

Laboratory and Tutorial Sections

There are up to two laboratory sessions and two tutorial/teamwork sessions per week. The days and times for these sessions depend on your lab/tutorial section. For most (but not all) activities:

Section 002

- Mondays and Wednesdays: laboratory from 1:30–4:30 in CHB 380
- Tuesdays and Thursdays: tutorial/teamwork from 1:30–3:30 in UCC 60

Section 003

- Tuesdays and Thursdays: laboratory from 1:30–4:30 in CHB 380
- Mondays and Wednesdays: tutorial/teamwork from 1:30–3:30 in TC 342

Course Materials

All of the materials below are required. Some of these materials are the same as the ones you had used in the first term. **Laboratory manuals do not need to be purchased.** Experiments, tutorials, exercises, etc. will be available on OWL for download.

1. CLP Calculus Textbooks at https://personal.math.ubc.ca/~CLP/
2. *Chemistry 1302B Course Workbook*, 2022–23 edition. It is only available in paper format at the Western bookstore.
3. Physics textbook used in Physics 1201A or 1501A
4. *Programming in Python 3 with zyLabs*, an online book
    - Sign in or create an account at learn.zybooks.com
        - Be sure that your account uses your official name and your uwo.ca email
    - Enter zyBook code UWOINTEGSCI1001XSarloWinter2023
    - Choose your desired package (school term only, or school term + 1 year), enter your payment information, and click Subscribe.
5. Proper laboratory attire, including lab coat, safety glasses, pants, socks, and shoes without any openings or holes.
6. Non-programmable scientific calculator (brand or model does not matter)
7. USB flash drive for transferring data from lab computers

Overview of Course Topics – by Question

Integrated Science 1001X takes a different approach to science education by addressing four broad questions, each one of which addresses the learning outcomes found in the traditional, first-year science courses. A non-exhaustive list of the topics in each question is provided below. The approximate start dates for each question are subject to revision.

1. How did Earth evolve? (starts January 9)
    - Evolution of the universe
    - Formation and evolution of planets and atmospheres
    - Rocks, minerals, plate tectonics, and geophysics
    - Evolution of the periodic table
    - Climate change
    - Evolution of life

2. What is energy, and how do we harness it? (starts February 6)
    - Mechanical energy, including wind and water
    - Fossil fuels and combustion
    - Solar energy
    - Electrical energy and magnetism
    - Nuclear energy
    - Photosynthesis and biological energy

3. What is life? (starts March 17)
    - Structure, function, and regulation of proteins and nucleic acids
    - Thermodynamics of life and equilibrium processes
    - Cellular metabolism
    - Adaptation to extreme environments
    - Bioinformatics

4. How does my smartphone work? (starts January 9 and lasts the duration of the course)
    - Computing and applications
    - Fundamentals of programming and programming structures
    - Methods of input and output
    - Debugging code
    - Visualization
    - Machine learning
    - Minerals, materials, and semiconductors
    - Batteries, energy management, and overheating

Because mathematics (especially calculus) is an essential tool in science and in these topics, a certain number of classes has been dedicated to mathematics.

Overview of Course Topics – by Subject

The Faculty of Science considers Integrated Science 1001X to be an acceptable substitute for Biology 1002A/B, Calculus 1301A/B, Chemistry 1302A/B, and Physics 1202A/B. Listed below is a non-exhaustive summary of the topics in the four above subject areas that are covered in 1001X. A list of the topics in the computer science component of 1001X is also provided.

- Biology
    - Molecular genetics and evolution
    - Proteins: structure, denaturation, enzymes, evolution
    - Membranes: structure, function
    - Photosynthesis, cellular respiration, and bioenergetics
- Calculus
    - Differential equations: an introduction to their solutions and centrality in the sciences
    - Integration techniques
    - Series with constant coefficients and the representation of functions as power series
    - Parametric and polar curves
    - Brief introduction to multi-variable calculus
    - Connections with, and applications in, the various sciences
- Chemistry
    - Gases: ideal gases, gas stoichiometry, kinetic molecular theory
    - Thermodynamics: heat and work, calorimetry
    - Thermochemistry: enthalpy, entropy, free energy
    - Equilibrium: equilibrium constant, solubility, weak acids/bases, buffers
    - Electrochemistry: redox, voltaic cells, electrolytic cells, batteries
    - Kinetics: rates and rate laws, Arrhenius theory, mechanisms
- Physics
    - Energy: units of measurement, laws of thermodynamics, Joule's experiment
    - Electricity: electric fields, point charges and dipoles, potential difference
    - Circuits: voltage, current, Ohm's Law, power, capacitance
    - Waves: SHM, wave parameters, energy, superposition
    - Magnetism: motion of charged particles, magnetic flux, Faraday's and Lenz's laws
- Computer science
    - Variable types: primitive types, containers
    - Conditionals and loops: truth tables, if-else statements, while loops, for loops
    - Functions: variable scope, return statements, recursion
    - I/O: reading from files, writing to files, user input, exception handling
    - Machine learning: supervised and unsupervised methods
    - Visualizations: graphs, plots, image processing

Evaluation

Breakdown by Subject

The overall course grade will be calculated out of 200 points. Of the 200 points, 85 will be based on various deliverables (such as assignments and lab reports), while the remaining 115 points will be based on assessments (quizzes, tests, and exams). The grade submitted to the Registrar at the end of the term will be expressed as a percentage of the 200 points.

The 200 points are allocated to the various subject areas in 1001X according to the following table. At the end of the term, you will receive your course grade based on the 200 points as well as the points earned in each of the subject areas.

Subject	Deliverables	Assessments	Total
Astronomy	7	3	10
Biology	13.5	16.5	30
Chemistry	18.5	21.5	40
Computer Science	14	6	20
Earth Sciences	15.5	4.5	20
Mathematical Sciences	16	24	40
Physics	22	18	40
Total	**106.5**	**93.5**	**200**

The points within each subject are allocated to the four questions, but not necessarily with equal weight. The “Weekly Summary of Points” on page 9 provides more details. The *Master Schedule* on OWL shows the important dates and point values for the various components.

Deliverables

Deliverables include assignments, exercises, lab reports, and all other learning activities *other than* quizzes, tests, and exams.

Most students complete their deliverables before the deadline. If you are unable to complete a deliverable prior to the deadline, you may submit it up to three days late (including weekends) without penalty and without obtaining academic consideration. After three days, academic consideration will need to be obtained (see section on Student Absences), or else a mark of zero will be assigned to the deliverable.

Assessments

Quizzes, midterm tests, and exams are listed below.

- In-class Math quiz on Friday, February 3
- In-class Computer Science quiz on Wednesday, February 15
- In-class midterm tests
    - Chemistry on Tuesday, February 28
    - Biology and Earth Sciences on Wednesday, March 1
    - Math on Thursday, March 2
    - Physics and Astronomy on Friday, March 3
- In-class Math quiz on Thursday, March 30
- In-class Computer Science quiz on Wednesday, April 5
- Four 3.0-hour cumulative final exams to be scheduled by the Registrar during the April exam period. The four exams are Biology, Math, Chemistry, and Physics, and they will be at the same time as the exams for Bio 1002B, Calc 1301B, Chem 1302B, and Physics 1202B, respectively. These times will *not* appear on your exam schedule, so we will provide more details as they become available.

Requirements for Passing Course

To obtain credit for 1001X as a whole, all three requirements below must be met:

1. Obtain a minimum of 50% on the overall course grade.
2. Obtain a minimum of 50% on the total of all of the points associated with lab activities.
3. Obtain credit for each of the chemistry, biology, physics, and math components of 1001X, as described below.
    a. Obtain at least 50% of the points allocated to the subject itself.
    b. Obtain at least 50% of the points associated with the laboratory activities in that subject, if that subject has laboratory activities.
    c. Miss, whether excused or not, no more than one-third of the laboratory activities associated with the subject, if that subject has laboratory activities.

Students who fail to meet requirement #2 will receive a course grade no greater than 40% (even if the calculated course grade is higher) and will not receive credit for 1001X.

Students who fail to meet requirement #3 will receive a course grade no greater than 40% (even if the calculated course grade is higher) and will not receive credit for 1001X. However, these students may take, in the summer of 2023, the “traditional” first-year course that most closely aligns with the subject for which credit in 1001X was not obtained. The grade obtained in the traditional course will be used to calculate a new 1001X grade. The eligible traditional courses are Chem 1302B, Physics 1202B or 1502B, Calculus 1301B or 1501B, and Biology 1002B.

Weekly Summary of Points

Week	Item	Discipline(s)	Total Points
1 Jan 9	Lab 1: Minerals	Earth Sci	2
	Tutorial: JWST	Astronomy	2
	Lab 2: Rocks	Earth Sci	2
	Tutorial: Python	Comp Sci and Astronomy	2
2 Jan 16	Lab 3: Exoplanets	Astronomy	2
	Tutorial: Excel	Comp Sci	1
	Lab 4: Epicentre and Magnitude	Earth Sci	2
	Assignment: Comp Sci	Comp Sci	1
	Tutorial: Math	Math	0.5
	Assignment: Math	Math	3
3 Jan 23	Lab 5: Simple Harmonic Motion	Earth Sci, Physics, and Comp Sci	2
	Tutorial: Writing Lab Report	Earth Sci and Biology	1
	Tutorial: Gases and Solubility	Chem	1
	Tutorial: Electricity, SHM, Waves	Physics	1
4 Jan 30	Tutorial: Math	Math	0.5
	Tutorial: Electricity Integrals	Physics	1
	Assignment: Electricity	Physics	1.5
	Lab 6: GIS (due week 5)	Physics	2
	Quiz: Math	Math	3
	Case Study: Habitable Planets	All	4
5 Feb 6	Lab 7: Acid Rain	Chem	2
	Tutorial: Energy	Chem	1
	Lab 8: Urea	Chem	2
	Assignment: Anthropocene	Earth Sci	1.5

6 Feb 13	Lab 9: Circuits	Physics	3
	Tutorial: Math	Math	0.5
	Assignment: Comp Sci	Comp Sci	2
	Quiz: Comp Sci	Comp Sci	3
	Tutorial: Chem and Physics Review	Chem and Physics	1
	Lab 10: Battery	Chem	2
	Assignment: Math	Math	3
Reading week			
7 Feb 27	Assignment: SHM and Waves	Physics	1.5
	Midterm: Chem	Chem	9
	Midterm: Biology and Earth Sci	Biology and Earth Sci	9
	Midterm: Math	Math	7
	Midterm: Physics and Astronomy	Physics and Astronomy	9
8 Mar 6	Labs 11 and 12: Metabolism (due week 12)	Biology	5
	Tutorial: Circuits	Physics	1
	Assignment: Comp Sci	Comp Sci	2
	Tutorial: Math	Math	0.5
	Assignment: Electricity Integrals	Physics	1.5
	Assignment: Math	Math	3
9 Mar 13	Assignment: Oil	Earth Sci	1.5
	Lab 13: Alternative Energy	Chem and Physics	3
	Tutorial: Relativity	Physics	1
	Tutorial: Electrochem and Kinetics	Chem	1
	Concept Maps	All	3.5
	Lab 14: Magnetometer (due week 11)	Earth Sci	3
	Assignment: Nuclear Energy	Earth Sci	1

10 Mar 20	Lab 15: Polarimetry	Chem and Biology	2
	Tutorial: Electromagnetism	Physics	1
	Tutorial: Math	Math	0.5
	Assignment: Circuits	Physics	1.5
	Assignment: Comp Sci	Comp Sci	2
	Lab 16: Wine and Buffers	Chem	2
11 Mar 27	Lab 17: Enzyme Kinetics	Biology	2
	Tutorial: Equilibrium and Acid/Base	Chem	1
	Assignment: Magnetism	Physics	1.5
	Tutorial: Bioinformatics	Comp Sci and Biology	2
	Lab 18: Protein Folding	Biology	2
	Quiz: Math	Math	3
12 Apr 3	Tutorial: Kinetics	Chem	1
	Assignment: Comp Sci	Comp Sci	2
	Quiz: Comp Sci	Comp Sci	3
	Case Study: Definition of Life	All	4
	Assignment: Math	Math	3
Various	iClicker component Participate in at least 50% of the questions to receive 1.0. Academic consideration is not needed for missed questions. The 50% requirement accounts for occasional missed classes. Contact the instructor if extenuating circumstances result in missing more than 50% of the questions.	Chem	1
Final Exam Period	Chem	Chem	12.5
	Biology	Biology	12
	Physics	Physics	12
	Math	Math	11
		Total	**200**

Additional Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/.

Students with disabilities are encouraged to contact Accessible Education (http://academicsupport.uwo.ca/accessible_education/index.html), which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The university's policy on Accommodation for Students with Disabilities can be found here: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at https://www.uwo.ca/health/student_support/survivor_support/get-help.html. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Religious Accommodation: When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the Academic Counselling unit or Dean's Office of their home faculty or affiliated college. Please consult University's list of recognized religious holidays (updated annually) at https://multiculturalcalendar.com/ecal/index.php?s=c-univwo. The university's policy on Accommodation for Religious Holidays can be found here: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Students who are in emotional/mental distress should refer to Health and Wellness (https://www.uwo.ca/health) for a list of options about how to obtain help.

Additional student-run support services are offered by the USC, http://westernusc.ca/services.

Academic Policies and Legalities

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

It is university policy that a regularly scheduled class (lecture, lab, or tutorial) takes precedence over tests and exams. Therefore, if another course schedules a test or exam that takes place during your chemistry lecture or lab, the instructor for that course must accommodate you.

Audience response systems (“clickers”) may be used to collect information during class. The data collected using the devices will not be used for research purposes without your consent.

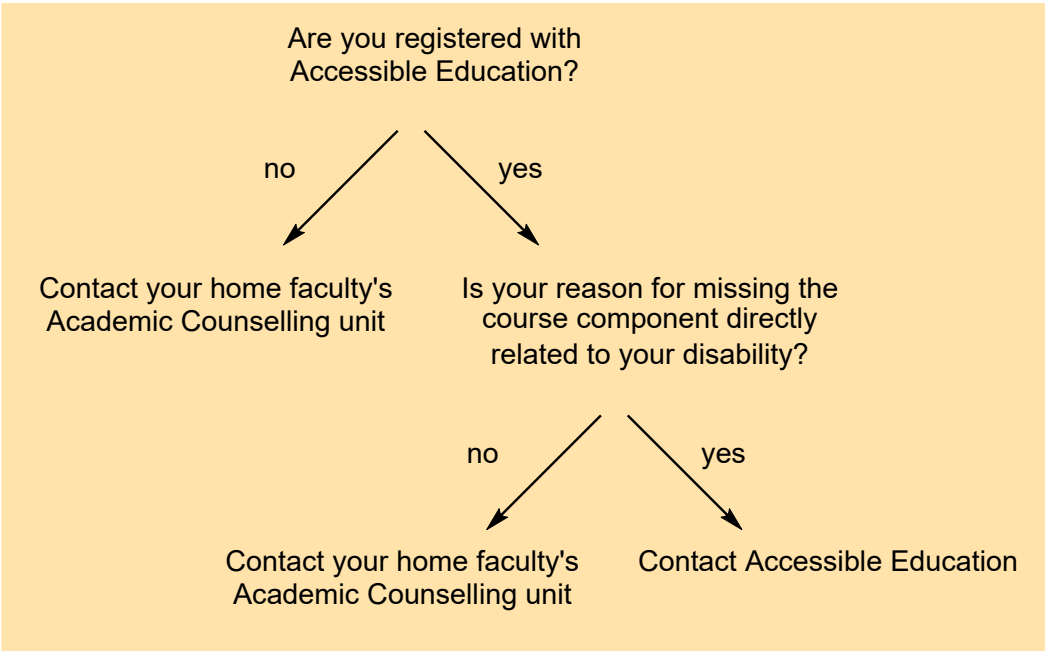
Aside from the specified calculator, no other electronic devices (phones, iPods, etc.) may be in your possession during tests and exams, even for timekeeping purposes. They may not be at your test/exam desk or in your pocket. Any student found in possession of these prohibited devices will receive a mark of zero on the test or exam.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at this website: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Computer-marked, multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

Student Absences and Missed Course Components

Students who experience an extenuating circumstance (such as illness or injury) sufficiently significant to temporarily render them unable to meet academic requirements may submit a request for academic consideration. There are two ways to request academic consideration:



- For students who are registered with Accessible Education, and whose reason for missing a course component is related to a disability that is on file, please contact Accessible Education. They will then contact us to confirm the course component that you have missed. No further action is necessary, and there is no need to contact the Academic Counselling unit or Dean's Office of your home faculty or affiliated college.
- For students who are not registered with Accessible Education, or who are registered with Accessible Education but whose reason for missing the course component is not related to the disability on file, requests for academic consideration must be made through the Academic Counselling unit or Dean's Office of your home faculty or affiliated college regardless of the circumstances or the value of the missed work.

If you are a Science student, the Academic Counselling unit of the Faculty of Science is located in NCB 280, and can be contacted at 519-661-3040 or through the ticketing system on their website: https://www.uwo.ca/sci/counselling/

Students should note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences must be submitted to the Academic Counselling unit or Dean's Office of your home faculty or affiliated college, or to Accessible Education where appropriate.**

For more information, please consult Western's policy on academic consideration for absences: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

For the Student Medical Certificate (SMC), please see: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Missed Lab Session

Please obtain academic consideration from Academic Counselling.

There are no make-up labs, and it is not possible to reschedule them. If academic consideration has been approved, the other labs within the same subject as the missed lab will be reweighted.

Students are still responsible for the theoretical content associated with the missed labs.

Late Deliverable

Deliverables, such as assignments, submitted up to three days late will be marked without penalty. If your deliverable is more than three days late, please obtain academic consideration from Academic Counselling. Your late deliverable will then be marked as though it were submitted on time.

Missed Tutorial

Most students find that the tutorials are an incredible opportunity to learn and work together as a team. On the rare occasion that you are unable to attend a tutorial, it is not necessary to obtain academic consideration from Academic Counselling. You must, however, contact the instructor and explain your circumstances without divulging information that you deem private.

For participation-based tutorials where there is a submission at the end of the tutorial, you will be given the participation mark. Graded tutorials will be reweighted within the same subject.

Missed Quiz

Please obtain academic consideration from Academic Counselling.

Math: If the Quiz on February 3 is missed, a make-up will be available. If the March 30 quiz is missed, its weight will be shifted to the final exam.

Computer Science: If the February 16 quiz is missed, its weight will be shifted to the quiz on April 5. If the quiz on April 5 is missed, a make-up quiz will be available.

Missed Midterm Test

Please obtain academic consideration from Academic Counselling.

You will then be able to write a make-up test at a later date. If you are unable to write a make-up test, the weight of the missed test will be shifted to the final exam.

Missed Final Exam

Please obtain academic consideration from Academic Counselling. They will assess your eligibility to write a Special Exam in May.

You may also be eligible to write a Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

This course is supported by the Science Student Donation Fund. If you are a BSc or BMSc student registered in the Faculty of Science or Schulich School of Medicine and Dentistry, you pay the Science Student Donation Fee. This fee contributes to the Science Student Donation Fund, which is administered by the Science Students' Council (SSC). One or more grants from the Fund have allowed for the purchase of equipment integral to teaching this course. You may opt out of the Fee by the end of September of each academic year by completing paperwork in the Faculty of Science's Academic Counselling Office. For further information on the process of awarding grants from the Fund or how these grants have benefitted undergraduate education in this course, consult the chair of the department or email the Science Students' Council at ssc@uwo.ca.