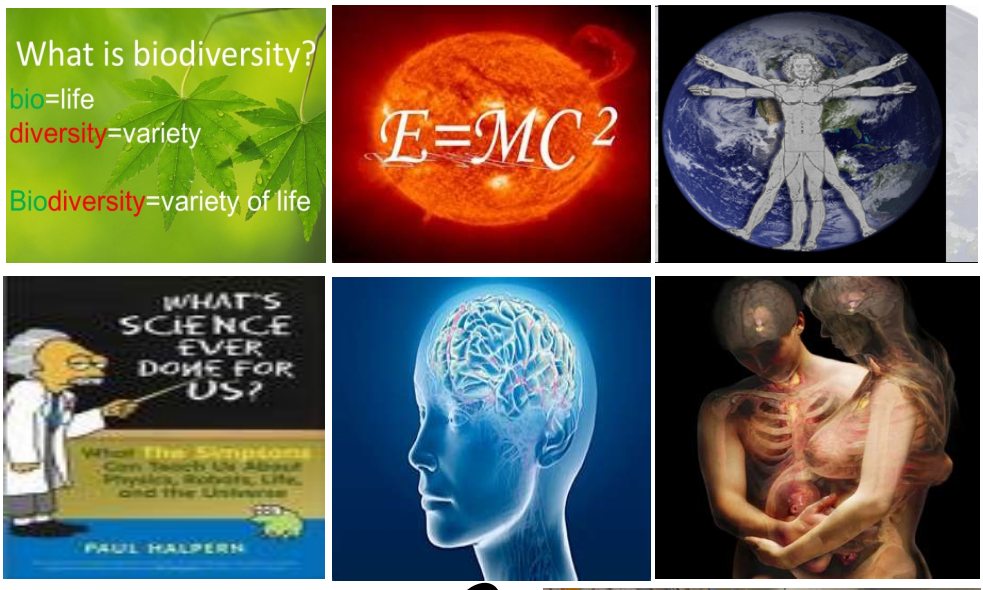
Faculty of Science



Division of Natural Science

Mini-Calendar

Fall/Winter 2017-2018

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218 Bethune College
natsci@yorku.ca
www.nats.yorku.ca

Note: Any changes to courses will be posted on the Division of Natural Science website

http://natsci.info.yorku.ca/
e-mail inquiries to: natsci@yorku.ca

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WHY TAKE A NATURAL SCIENCE COURSE?

Ever wondered why it rains or how a tornado is generated? What is a genetically modified food and are they really dangerous? Can too much artificial light at night cause cancer? What is Dark Energy and will the universe expand forever? What is the difference between a science and a pseudo-science? Have you ever wondered about the rise of technology and its relationship to civilization? How well do we understand the human body and the diseases that affect it? What is an aurora? At some point in your life, you have probably asked one of the above questions. Indeed, as you read the daily newspaper or listen to a news broadcast, questions always arise that require some science background in order to assess the information in an informed manner.

In an era when science and technology impinges upon virtually every aspect of life, it is important for a well-educated university student to have some academic experience in science. This need not involve an in-depth study of a specialty in science, since there is also merit in learning about the manner in which science is carried out, its impact and interaction on society and the way in which scientists are trained to think and work.

Courses in the Division of Natural Science cover a broad range of topics across the scientific disciplines, including environmental issues, and the historical development of scientific concepts and theories. The Natural Science courses are designed for students who have not had a science or mathematics background. However, a willingness and enthusiasm for learning fundamental principles and interesting ideas is required. The course instructors will keep you abreast of the current changes occurring in their disciplines, thereby bringing science to life.

HOW TO SELECT A NATURAL SCIENCE COURSE

- **Select your course(s) based upon your own interest in a subject.**
  - Read the course descriptions in this Mini – Calendar and check out the course outlines from last year's courses (see http://natsci.info.yorku.ca/).
  - Contact the Natural Science Office if you feel you need more information
- Consider the course format (see below) and your own personal study habits.
- Do **not** make a selection based upon your perception of the math content.
  - No Natural Science course requires calculus and only some use algebra and trigonometry. Many require little more than arithmetic skills learned in Grade 10. See course descriptions in this book for details regarding math content.
- Avoid selecting a course based solely upon your lecture schedule. Your choices are best based on personal interests.

A word of caution: if you completed a Grade 12 science course, or equivalent, this should **not** be considered a pre-requisite or even good preparation for taking a Natural Science course of a similar nature. For example, taking Biology in your final High School year does not mean necessarily that you will enjoy or be successful in a life science based course. Select a course that interests you and not one that you think you will ace based upon a course you have taken at High School.

COURSE FORMATS

The Natural Science courses run in a number of formats.

- 3.0 and 6.0 credit courses.
- Double speed courses (*e.g.* a 6.0 credit course offered during the winter term only).
    - Please note double speed courses are by their nature very intense and require much more time per week from the student.
- Classroom, blended or online delivery.
    - Be sure you know which type of course delivery you are enrolling into and what it may mean for your personal study and learning habits. Online courses are no easier than classroom based courses and often require more "discipline" from students in terms of allocating sufficient time per week to read and study the course material. Know how you study and learn and be sure to select a course accordingly.
- Note: some of our courses have multiple sections. These sections may occur at different times and in different formats. There may even be a different content focus. **Thus be sure to read all course descriptions carefully.**
- No NATS course can be taken on a Pass/Fail basis when fulfilling the general education criteria.

NATS ACADEMIC RESOURCES

NATS-Aid

NATS-Aid is a peer tutoring resource that is run by previous NATS students. The Peer Tutor volunteers are available for many of the NATS courses and may work with the Class Representatives to offer study group sessions.
See http://natsci.info.yorku.ca/nats-aid/ for more information.

M-AID in NATS (Math help)

The math tutors are graduate students who are available at various times to help students with general or specific math challenges.
See http://natsci.info.yorku.ca/m-aid-in-nats/ for more information.

TEXTBOOKS

Do not buy books until you have been advised appropriately by the lecturer after classes start.

C.B. CRAGG PRIZE FOR EXCELLENCE IN NATURAL SCIENCE

A fund was set up in 1979 to honour Professor C. Brian Cragg, a founding director, lecturer and advocate of the Natural Science program. Students who demonstrate strong commitment to their course or the Natural Science program are eligible. Full details on how this prize is awarded are available on the Division's website.

COURSE DESCRIPTIONS

Please note that the course descriptions in this mini-calendar are more complete with respect to current course content than the more general brief course descriptions found in the main York Calendar. **The following course descriptions are for guidance only**. Minor changes can and do occur when a course commences. Therefore, the following information should be considered **TENTATIVE**.

Detailed course outlines will be available during the first week of classes; these will include a more detailed and accurate description of the course content, a description of term work and composition of the final grade. They will also be posted on The Division of Natural Science website as they become available.

CCE: Course Credit Exclusion.

CCE notes may appear in some course descriptions.

From the University Academic Calendar: "These are pairs of courses which may not both be taken for degree credit since their content overlaps significantly. If degree requirements specify that one of the pair is required to fulfill a program requirement, you may not enrol in the other - it cannot be used to fulfill degree requirements. Course credit exclusions are listed in the course descriptions found online on the Courses website or in the Courses of Instruction section of the Undergraduate Calendar."

NCR: No Credit Retained.

NCR notes may appear in some course descriptions.

Some courses may not be taken for credit or grade if another course(s) have already been successfully completed. These courses are denoted as NCR.

NATS 1500 3.00 M - Statistics and Reasoning in Modern Society (Winter term)

Logic is the science of reasoning from premises that are either true or false. Statistics is the science of reasoning under uncertainty. Understanding the principles of statistical reasoning is becoming increasingly crucial, not only for professionals like scientists, engineers and financial analysts but also for anyone striving to be an informed and intelligent citizen. Knowing statistical reasoning will help you see through the fog of information like claims for new products ranging from drugs to air bags. It will also help you understand key social controversies such as why the world financial meltdown is being blamed on a poor understanding of statistical concepts. The course will emphasize ideas and graphics instead of formulas. Some computing will be required, but all of it will be taught during the course. Evaluation is based on assignments, a class test, a project involving the analysis of real data and a final exam.

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE**)

- Assignments - 25%.
- Project - 10%.
- Class test - 30%.
- Final exam - 35%.

Format:
Three lecture hours and one-hour tutorial or computer lab.

Course Credit Exclusions:
SC/MATH 1532 3.00. NCR Note: Not open to students who have passed or are taking AP/HH/SC/PSYC 2021 3.00, AP/HH/SC/PSYC 2022 3.00, AK/PSYC 2510 3.00 (prior to Summer 2002), AK/PSYC 3110 3.00 (prior to Summer 2002), SC/BIOL 2060 3.00, SC/BIOL 3090 3.00 (prior to Summer 2000), AP/ECON 2500 3.00, AP/ECON 3470 3.00, AP/ECON 3480 3.00, AP/ECON 3500 3.00.

Mathematical Content:
The course assumes high school algebra to the level of grade 11.

NATS 1505 3.00 M - Understanding Cyberspace (Winter term)

This course examines the development, impact and use of current information and communications technologies (ICTs) that we use in our everyday lives. We will explore how social values have shaped these systems, and how these technologies have helped transform the way we communicate, work, play, think and process information. Topics that will be examined include phone and cyber sociability, ICTs and cognitive and behavioral change, digital information multitasking, online privacy and internet management and control.

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE**)

- ICT Controversy Paper (30%).
- Midterm Exam (25%).
- Final Exam (35%).
- Attendance (5%).
- Tutorial Assignments (5%).

Format:
Three lecture hours per week.

Degree Credit Exclusions:
SC/NATS 1700 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about the Grade 10 level.

NATS 1510 3.00A – History of the Environment (Fall term)

This course looks at the history of human impact on the environment through the lens of technology and science. It is posited that technology has magnified our impact on the environment, both in scale and in scope (e.g. the magnitude of impact and new kinds of impacts – e.g. new technologies). Science has contributed to creating new materials (e.g. plastic) that are harmful to the environment, but science is also our primary tool to determine how we are damaging the environment, and possibly how to fix it. Thus science and technology both hinder and help the environment. We will look closely at the claim that the tendency of science and technology to be appropriated by business and government undermines the ability of environmentalists to enact positive change. The course will consider examples of human interaction with the environment (so-called anthropogenic impacts) from the earliest of human civilizations to present day.

Required Course Material:
Course Kit and/or readings.

Evaluation: (**TENTATIVE**)

- Summary & Critique -10%.
- Annotated Bibliography - 10%.
- Midterm - 20%.
- Essay - 30%.
- Final Examination - 30%.

Format:
Three lecture hours per week.

Degree Credit Exclusions:
SC/NATS 1840 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about the Grade 10 level.

NATS 1515 3.00A – Atmospheric Pollution (Fall term)

The course commences with the evolution of the Earth's atmosphere from its creation and moves to its development to the present throughout several stages. The cyclical climate change of Earth has been due to changes in orbital obliquity, eccentricity and precession (related to the change of Earth's rotation axis, distance from the sun and rotation rate respectively). The course proceeds to examine the history of atmospheric pollution from natural causes such as volcanoes, natural fires, desert dust, etc., to pollution caused by humans prior to the industrial revolution arising from the burning of wood and the clearing of land. Subsequently, modern day pollution due to the burning of fossil fuels and production of other anthropogenic harmful chemicals will be discussed. Different forms of pollution such as manifested as smog and acid rain are discussed and past successes in dealing with these types of pollution are recounted. The course concludes with topics on new policies and technologies that can be considered to ameliorate the deleterious effects of atmospheric pollution, such as the usage of green energy (solar, wind, fuel cell, geo-thermal, biomass, etc.).

Required Course Material:
Book by Marc Z. Jacobson. Title: Air Pollution and global warming, history, science and solutions. Second edition, 2012. Published by Cambridge University Press.

Evaluation:

- 3 assignments, each 10% (30% total).
- 2 Midterms, 20% each (40% total).
- Final (30%).

Both Mid-term and final have 80 multiple choice questions and 10 fill-in the blanks. Final has 0 multiple choice questions, 10 fill-in-blanks and 10 True-False questions.

Format:
Three hours lecture per week.

Course credit exclusion:
SC/NATS 1840 6.00, SC/NATS 1750 6.00.

Mathematical Content:
Basic math, division, multiplication, addition, subtraction. Very basic algebra of grade 11 level. All needed mathematics will be explained in the class and examples will be worked out.

NATS 1525 3.00 A – Extraterrestrial Life (Fall term)

This course explores the history of humankind's search for life beyond Earth. With an introduction to the beliefs of ancient Greeks, we will embark on a journey to explore the ideas of many famous scientists such as Galileo, Kepler, Newton and Darwin on the existence of extraterrestrials. We will then examine some of the interesting topics that have resurfaced in the field of science and religion following the recent discoveries in the fields of exoplanetary science and astrobiology. We will explore the spectrum of modern positions of different religions with regard to a potential discovery of extraterrestrial life. Finally, we will discuss some of the cultural, political and sociological aspects of a discovery of extraterrestrial life.

Required Course Material:
Course Pack for NATS1525.

Evaluation: ***(TENTATIVE)***
To be announced.

Format:
Three hours lecture per week.

Course credit exclusion:
SC/NATS1880 6.00 and SC/NATS1745 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about the Grade 10 level.

NATS 1530 3.00 A - Space Flight and Exploration (Fall Blended)

This course will discuss the science and technology of space flight and the discoveries and expansion of our knowledge through space exploration. Topics include: the history of space flight, planetary exploration, orbital science, rocket science, the space environment and sending humans to space. No previous science background is required.

Required Course Material:
Selected readings (to be announced).

Evaluation: (**TENTATIVE**)

- Short essay assignments – 10%.
- In-class assignments – 35%.
- Midterm test – 25%.
- Final exam – 30%.

Format:
Approximately 60% of the course material will be presented in online lectures and readings. The other 40% will be delivered via in-class activities held in 3-hour sessions approximately every other week. The midterm test and final exam will be held on campus on the specified dates.

Course credit exclusion:
NATS1570 Exploring the Solar System.

Mathematical Content:
In-class assignments involve making measurements from graphs, using scientific notation and solving simple equations involving addition, subtraction, multiplication, division and exponents. Assistance will be provided in class for students who require help with the mathematical concepts. There will be no calculations on the midterm test and final exam.

NATS 1530 3.00 M - Space Flight and Exploration (Winter Blended)

This course will discuss the science and technology of space flight and the discoveries and expansion of our knowledge through space exploration. Topics include: the history of space flight, planetary exploration, orbital science, rocket science, the space environment and sending humans to space. No previous science background is required.

Required Course Material:
Selected readings (to be announced).

Evaluation: (**TENTATIVE**)

- Short essay assignments – 10%.
- In-class assignments – 35%.
- Midterm test – 25%.
- Final exam – 30%.

Format:
Approximately 60% of the course material will be presented in online lectures and readings. The other 40% will be delivered via in-class activities held in 3-hour sessions approximately every other week. The midterm test and final exam will be held on campus on the specified dates.

Course credit exclusion:
NATS1570 Exploring the Solar System.

Mathematical Content:
In-class assignments involve making measurements from graphs, using scientific notation and solving simple equations involving addition, subtraction, multiplication, division and exponents. Assistance will be provided in class for students who require help with the mathematical concepts. There will be no calculations on the midterm test and final exam.

NATS 1540 3.00 A – Theories of Dinosaur Extinction (Fall term)

About 65 million years ago, dinosaurs, one of the most prominent species on Earth, vanished suddenly. This course will focus on attempting to introduce students first to the theories behind the creation of the solar system and first life on Earth, the concept of a major or mass species extinction event and the more prominent mass species extinction events that have occurred over geological time. It will then proceed to discuss the current theories used to explain the mass extinction of the dinosaurs which occurred at the end of the Cretaceous Period (145 to 65 Million years ago), including the evidence and objections relating to each, ending with a discussion of what many authorities consider to be the most current and ongoing mass extinction event which has coincided with the rise of humanity.

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE**)

- An in-class midterm test/examination worth 30% to 35% of the grade.
- Test or series of tests or term work in the form of an assignment valued at 40% of the grade.
- A final test/examination or other culminating activity worth 20 to 30% of the grade.

Format:
Three lecture hours per week.

Course Credit Exclusion:
None.

Mathematical Content:
Minimal simple arithmetical calculation at about the Grade 10 level.

NATS 1560 3.00 M – Understanding Food
(Winter term)

This course is an introductory exploration of the nature of food and food systems from an interdisciplinary point of view. We will review the basics of the current scientific understanding of nutrition. We will also survey the techno- science of food production, preservation, and processing, putting it in historical perspective and peering into the future. We will consider the social, economic, and political implications of the food industry. Finally, we will examine several major controversies that center upon food. No prior experience in science is assumed.

Required Course Material: (**TENTATIVE**)
Richard Jarrell, Understanding Food (2012).

Evaluation: (**TENTATIVE**)
- 2 term tests: 25% and 20%.
- In-class assignments 30%.
- 2 Quizzes @ 12.5% each.
- Quizzes will be short answer, exams consist of objective questions.

Format:
Three hour class, a combination of lecture and in- class group assignments.

Course Credit Exclusion:
NCR Note: No Credit Retained (NCR) if SC/NATS 1910 6.00 has been completed.

Mathematical Content:
Minimal simple mathematical calculation; not beyond a grade 8 level.

NATS 1565 3.00 A – Plant Life, Human Life
(Fall term)

The plant world is essential for human life, and shapes human culture. Plants are food, fuel and raw materials. They transform and sustain the soil, air and water of our ecosystems. They produce molecules that are the active ingredients in herbal medicine, modern pharmacology and psychoactive drugs. Humans alter plants using breeding and biotechnology, and use them to enhance their enviroments and their cultural activities. Using introductory concepts from the life sciences, this course explores these vital relationships between humans and plants.

Required Course Material:
Levetin, Estelle & McMahon, Karen (2016). Plants and Society, 7th edition. New York: McGraw-Hill Education.

Evaluation: (**TENTATIVE**)

- In class participation/quizzes 10%.
- 8 short online exercises 20%.
- Midterm 15%.
- Project 1 (Plant Observation Exercise) 15%.
- Project 2 (Personal Field Trip) 15%.
- Final Exam in exam period 25%.

Format:
Three lecture hours per week and one hour online exercise per week.

Course credit exclusion:
This course is not open to any student who has passed or is taking SC/BIOL 1000.

Mathematical Content:
Minimal simple arithmetical calculation at about the Grade 10 level.

NATS 1570 3.00 M – Exploring the Solar System
(Winter term)

This course will look at the solar system. We will start with earth as our template for a planet, and then look at the nature of the other planets. This will include looking at the various missions we have used to explore the solar system and their results. We will look at the smaller solar system bodies like moons, asteroids and comets as well. We will look at the current models of how we think the solar system formed and how it has evolved over time.

Required Course Material:
To be announced

Evaluation: (**TENTATIVE**)

- Term work 50%.
- Test & Exams 50%.

Format:
Three lecture hours per week.

Course Credit Exclusion:
SC/NATS 1740 6.00, SC/NATS 1880 6.00, SC/NATS 1750 6.00. **NCR Note**: No credit will be retained if this course is taken after the successful completion of SC/PHYS 1070 3.00. Not open to any students enrolled in the Astronomy Stream.

Mathematical Content:
No mathematical ability beyond essential grade 10 math.

NATS 1570 3.00 N – Exploring the Solar System (Winter term FULLY ONLINE)

This course will look at the solar system. We will start with earth as our template for a planet, and then look at the nature of the other planets. This will include looking at the various missions we have used to explore the solar system and their results. We will look at the smaller solar system bodies like moons, asteroids and comets as well. We will look at the current models of how we think the solar system formed and how it has evolved over time.

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE**)

- Term work 50%.
- Test & Exams 50%.

Format:
All work will be submitted electronically, with the exception of the two proctored term exams, which will be held on campus on the specified dates.

Course Credit Exclusion:
SC/NATS 1740 6.00, SC/NATS 1880 6.00, SC/NATS 1750 6.00. **NCR Note**: No credit will be retained if this course is taken after the successful completion of SC/PHYS 1070 3.00. Not open to any students enrolled in the Astronomy Stream.

Mathematical Content:
No mathematical ability beyond essential grade 10 math.

NATS 1575 3.00 M – Forensic Science An Introduction (Winter term)

This course uses the versatile and fascinating field of Forensic Science to introduce the science in drug analysis, toxins, soil, glass, paint and fire residues. Topics such as blood spatter evidence, chromatography, DNA testing, gunshot residues, fibres, and fingerprinting will be covered. Case studies will range from use of forensic entomology in estimation time of death to tracing explosives in bomb blasts, plant DNA, heavy metal poisoning, use of hair analysis in solving a crime, importance of bite mark evidence and the role of Forensic Odontology in DNA. Videos featuring investigative techniques in crime and the societal relevance and legal ramifications involved will be considered.

Required Course Material:
Forensic Science, An Introduction, by Richard Saferstein, Second Edition, 2011. Pearson Education Inc. ISBN 13#978-013-507433-6. Molecules of Murder-Criminal Molecules and Classic Cases, John Emsley, 2008. RSC Publishing. ISBN# 978-0-85404-965-3.

Evaluation: (**TENTATIVE**)

- Assignments - 15 + 20 = 35%.
- Midterm - 25%.
- Final exam - 40%.

Format:
Three hours lecture per week.

Course Credit Exclusion:
NCR Note: This course is not available for credit for any students who have taken or who are taking SC/CHEM 1000 3.00 or SC/CHEM 1001 3.00 or the equivalents.

Mathematical Content:
Minimal simple arithmetical calculation at about the Grade 11 level.

NATS 1580 3.00 A – Space Weather (Fall term)

The term "Space Weather" refers to variations of near-Earth space conditions originating in Solar activity which could potentially cause damage to astronauts, critical technology and infrastructure. This course introduces students to the science of Sun-Earth interactions, the magnetic field of the Earth, how natural variations of the Sun can affect society and technology on Earth and in the near-Earth space environment. Students are exposed to a subject of intense recent interest and of high potential impact to future policy makers and society at large. Students will learn to make connections made between natural phenomena such as Earth as a magnet and how this magnetic field sustains life on Earth as we know it.

Required Course Material:
The course textbook and the workbook is to be announced.

Evaluation: **(TENTATIVE)**
- One midterm test: 30%.
- Two assignments (2 x 20%) 40%.
- Final Exam 30%.

Format:
Three lecture hours per week.

Course Credit Exclusion:
None.

Mathematical Content:
High School Algebra (grades 9 and 10) is assumed.

NATS 1585 3.00 A – Exploring the Universe (Fall term)

This course explores the universe beyond our solar system. We will learn how stars shine, how stars group together in galaxies, and how galaxies change over time. We will learn how to measure the mass of galaxies and infer the existence of dark matter, and how to measure the expansion of the universe and infer the existence of dark energy. Finally, we will explore both the earliest instants and the far future of the history of our universe.

Required Course Material:
The course textbook and the workbook is to be announced.

Evaluation: (**TENTATIVE**)
- 34 % Final exam.
- 25 % Midterm exam.
- 12 % Homework assignments
- 16 % Online quizzes.
- 8 % Participation and in class activities.
- 5 % Independent study activity (term project).

Format:
Three lecture/activity hours per week. Attendance at lectures, homework assignments, online quizzes and term project are essential parts of the course.

Course Credit Exclusions:
Course credit exclusions: NATS 1740 6.00. NCR Note: No credit will be retained if this course is taken after SC/PHYS 1070 3.00. Not open to any student enrolled in the Astronomy stream.

Mathematical Content:
Although the mathematics is kept to a minimum, it is recommended that students be familiar with the basic principles of geometry and algebra up to the level of Grade 11 (no calculus is required). Simple algebra and geometry is needed at times. Key numerical concepts are always discussed in class when needed.

NATS 1610 6.00 A - The Living Body

This course examines the human body from the molecular, cellular, and physiological perspectives. The biological requirements of life and how the human body is designed to fulfill these will be explored through studies of cell function, tissues, and the body's organ systems. Key topics that will be examined are: (1) the structural and functional organization of the human body, (2) the functions of cells and their roles in forming body tissues and organs, (3) the cellular basis of physiology, and (4) how the body's organ systems contribute to the maintenance of the body as a whole.
A number of organ systems will be studied during the lecture portion of the course, while others will be studied in the laboratory portion of this course. The laboratories also will introduce students to some important biological techniques, material, and information relating to the human body.

Required Course Material: (**TENTATIVE)**
The course textbook is to be announced. A laboratory manual will be available for purchase in the York University Bookstore.

Evaluation: (**TENTATIVE)**
- Labs: 25%.
- Four lecture tests, each worth 18.75%.

Format:
Three lecture hours per week. Ten 2 hour labs, approximately every other week. The laboratory will deal with general biological principles and a number of body systems, and will not be directly related to the lecture material.

Course Credit Exclusions:
SC/NATS 1650 6.00, SC/NATS 1660 6.00, SC/NATS 1675 6.00, SC/NATS 1690 6.00.
NCR Note: This course is not open to any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00, SC/BIOL 1010 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about the Grade 10 level.

NATS 1650 6.00 A – Human Anatomy for the Fine Arts

This is an introductory course in human anatomy especially for students in Fine Arts. In the first half of the course the skeletal and muscular systems will be studied, beginning with cellular structure and the organization of the body. Surface features of the body, the structure and articulations of the skeleton, skeletal muscle actions and the biomechanics of motion will be emphasized. The structure and function of the organ systems of the body will be studied in the second half of the course, including the nervous, circulatory, respiratory, digestive, urinary and reproductive systems.

Laboratories will involve the study of human bones and the **examination of dissected cat and sheep anatomical structures**. If students believe they will not be able to cope with this laboratory material, they should not enrol in this course

Required Course Material:
The course textbook is McKinley, M. & O'Loughlin V. Human Anatomy, McGraw Hill, U.S.A. fourth Edition, 2015. A laboratory manual will be available for purchase in the York University Bookstore.

Evaluation: (**TENTATIVE**)

- Mid-term 1and 2 worth 20% each.
- Final exam worth 30%.
- 3 lab tests worth 10% each.

Note: The lab tests will require a significant amount of memorization.

Format:
Two-hour lecture and one two-hour laboratory per week.

Course Credit Exclusion:
AS/KINE 2031 3.00, HH/KINE 2031 3.00, SC/NATS 1610 6.00, SC/NATS 1660 6.00, SC/NATS 1690 6.00.
NCR Note: This course is not open to any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00 or SC/BIO 1010.6.00

Mathematical Content:
Counting skills - 2 lungs, 1 heart, 4 limbs.

NATS 1660 6.00 A - The Biology of Sex

Sex is widespread in the living world, but many organisms do well without it and the methods of sexual reproduction vary. What is sex? How does sex develop and what are its advantages? How is the sex of individuals determined? Other topics include the genetics of sex, the influence of sex on population dynamics, the evolution of sex, sexual strategies, sexual conflict between partners, sexual techniques used by different organisms (both plant and animal), sexual behavior, and human sexuality. Current research will be explored to answer some of the questions raised in this course.

Required Course Material:
The course textbook is to be announced. A laboratory manual will be available for purchase in the York University Bookstore.

Evaluation: (**TENTATIVE**)

- Labs: 25%.
- Term tests: 60%.
- Class participation: 5%.
- Online quizzes: 10%.

Format:
Three lectures per week. Approximately 10, 2 hour laboratory exercises will be completed in this course. The labs complement course material and are an essential part of the course. Attendance at lectures and active participation in all course components (labs, in-class/online activities) is expected.

Course Credit Exclusion:
SC/NATS 1610 6.00, SC/NATS 1650 6.00, SC/NATS 1675 6.00, SC/NATS 1690 6.00.
NCR Note: This course is not open to any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00 or SC/BIO 1010 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1670 6.00 A - Concepts in Human Health and Disease

The main objective of this course is to develop the understanding of important concepts and principles related to the susceptibility to diseases, and to broaden students' knowledge of medical biology in a multi-disciplinary manner. This course gives students an overview of medical biology, consolidating knowledge on basic and applied biology with social and ethical issues related to human health, in a manner that is applicable and relevant to practical health decisions made by young people. Topics will include the immune system in health and disease, vaccination and passive immunization; infectious diseases(sexually transmitted diseases, blood-blood transmitted disease such as HIV and hepatitis B); human cancer (smoking tobacco products, DNA

mutations and cancer): social and economic issues related to human health (antibacterial and antiviral drug discovery and drug resistance, acceptance and rejection of vaccines).

Required Course Material:

- Free online resources as specified in the course outline.
- Use the search box http://www.ncbi.nlm.nih.gov/sites/entrez?db=Books with keywords specified in class and in the course.

If you want to use a hardcopy you can try:

- Microbiology, by Robert Bauman. Any edition is fine. Copies can be found in Steacie Science Library.
- Microbiology: A Human Perspective by Nester.
- Microbiology: Principles and Explorations, by Black.
- Any other "Microbiology" text you can find in the Steacie Science Library is likely to be a good reference (there are quite a few over there).

Evaluation: (**TENTATIVE**)

- Mid-Term Exam 1- 20%.
- Mid-Term Exam 2 -20%.
- Mid-Term Exam 3 -20%.
- Final Exam - 35%.
- Participation: Attendance to lecture -5%, contribution to the wiki -2% (bonus).

Format:
Three lecture hours weekly, accompanied by one tutorial hour.

Course Credit Exclusion:
NCR Note: This course is not open to any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00, or SC/BIO 1010 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

**** NATS 1675 has Multiple Sections. Content may vary. ****
Read Descriptions Carefully

NATS 1675 6.00 A - Human Development

This course focuses on the biological development of the human, from the formation of germ cells, and fertilization, through embryological and fetal development and growth, to birth, growth, puberty and aging. Topics will include the cellular and molecular features of development, patterns of inheritance, and the role of the digestive, endocrine and circulatory systems. Related issues in medical biotechnology and ethics will also be explored.

Required Course Material:
McGraw-Hill Custom textbook with Connect.

Evaluation: **(Tentative)**

- 4 Tests at 15% each = 60 %.
- Learn Smart online reading assignments (through McGraw-Hill Connect) = 5%.
- In Class Assignments and Online Quizzes = 15%.
- 2 projects at 10% each = 20%.

Format:
Three lecture hours per week.

Course Credit Exclusions:
SC/NATS 1610 6.00, SC/NATS 1650 6.00, SC/NATS 1660 6.00, SC/NATS 1690.6.00.
NCR Note: This course is not open to any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00, or SC/BIO 1010 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 11 level.

NATS 1675 6.00 B - Human Development

The objective of this course is to familiarize the student with the structure and function of the human organism. Early in the course the concept of natural selection and modern theories of evolution will be discussed to place humans in perspective with other organisms. Subsequently, the human organism will be examined from a cellular level. The relationship of cells to tissues, organs and organ systems will follow. Cell division including both mitosis and meiosis will be studied. This will be followed by the formation of gametes, reproduction and fetal development.

Genetics, including genetic diseases and chromosomal aberrations**,** will form an important component of this course. The topic of genetic engineering will be introduced. The remainder of the course will discuss various organ systems and relevant diseases associated with these organ systems including a section on cancer. Some lectures will be supplemented by films that provide either related information or material from a slightly different perspective. Sometime will be set aside at the end of lecture for discussion and/or questions.

Required Course Material: (**TENTATIVE)**
Mader, Sylvia S. & Windelspecht, Michael, Human Biology, 13th edition, McGraw Hill, 2014, ISBN 0077705688, Loose Leaf Version.

Evaluation: (**TENTATIVE)**

- Four exams, each worth 20% (including the final).
- 8 pop quizzes over lecture material worth 10%.
- Term project worth 10%.

Format:
Three-hour lectures each week.

Credit Exclusions:
SC/NATS 1610 6.00, SC/NATS 1650 6.00, SC/NATS 1660 6.00, SC/NATS 1690 6.00.
NCR Note: This course is not open to any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00, or SC/BIO 1010 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 11 level.

NATS 1675 6.00 M - Human Development (Winter double speed)

This course examines human development from several biological perspectives. Topics will include a review of the biological and molecular requirements of life, a survey of the human body's design, and the role of cells in forming and maintaining the body. Other topics will centre on the study of how the human body forms, from fertilization through to the formation of the fully functioning body. These topics will include ovulation, the stages of embryonic and fetal development, the placenta and fetal circulation, hormonal regulation of the male and female reproductive systems, and the role of DNA during growth and development, genetics, and inheritance of physical characteristics.

Required Course Material: (**TENTATIVE)**
An Introduction to the Biology of Human Development, Custom Textbook. Published by Nelson Education Ltd. Available in the York bookstore.

Evaluation: (**TENTATIVE)**
- Four exams, each worth 20%.
- Two assignment, each worth 10%.

Format:
Six lecture hours per week.

Credit Exclusions:
SC/NATS 1610 6.00, SC/NATS 1650 6.00, SC/NATS 1660 6.00, SC/NATS 1690 6.00.
NCR Note: This course is not open to any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00, or SC/BIO 1010 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about the Grade 10 level.

NATS 1690 6.00 A – Evolution

As an introduction to biological evolution, this course examines the biological mechanisms underlying evolutionary change, including the roles of cells, DNA, genes, and gene regulation during embryological development. Other topics will include the history of evolutionary thought, the cellular origins of life, the evolution of cells, and a survey of the forces that drive evolution, including microevolution, speciation, and extinction. The laboratories will introduce students to important biological techniques, material, and information relating to biological evolution.

Required Course Material: (**TENTATIVE)**
A custom-publication textbook and a laboratory manual will be available in the York University Bookstore.

Evaluation: (**TENTATIVE)**
- Labs: 25%.
- Four lecture tests @ 18.75% each.

Format:
Three lecture hours per week. Ten 2 hour labs, approximately every other week. The laboratory will deal with general biological principles as the apply to evolutionary biology and may not be directly related to the lecture material. The laboratory may require the manipulation of some living material.

Course Credit Exclusion:
SC/NATS 1610 6.00, SC/NATS 1650 6.00, SC/NATS 1660 6.00, SC/NATS 1675 6.00.
NCR Note: This course is not open to any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00, or SC/BIO 1010 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 11 level.

**** NATS 1700 has Multiple Sections. Content may vary. ****
Read Descriptions Carefully

NATS 1700 6.00 A- Computers, Information and Society

This course examines the development, impact and use of current computing and information systems that we use in our everyday lives. We will explore how social values have shaped these networks, and how these technologies have helped transform the way we communicate, work, play, think and process information. Topics that will be examined include: a) the early development and shaping of computing technology, b) computer and IT management and control issues (e.g. privacy, copyright, patents, standards and cybercrime);

c) IT and society (e.g. internet sociability, online multitasking, heuristics, information processing and cognitive functioning) and d) current computing controversies (e.g. video games and violence, AI versus human intelligence, computer reliability).

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE)**
- 4 Tests (4 x 15%).
- Computing Controversy Paper (30%).
- Attendance (6%).
- Tutorial Assignments (4%).

Format:
Three lectures hour per week.

Course Credit Exclusion:
SC/NATS 1505 3.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1700 6.00 B - Computers, Information and Society
(FULLY ONLINE)

This course examines the interplay between technology on the one side and society and culture on the other side in the context of one of the defining technologies of the late twentieth and early twenty-first century, that is, the computer technology. The relationship between computer technology and society being a complex one, we will study a broad range of issues from a multidisciplinary perspective. The critical examination of issues such as the evolution of computers, their impact on privacy, computer security and computer crime, the transformation of business, work and education, the new directions in the evolution of politics, the emergence of a digital culture -- to name but a few -- is needed if we are to enhance our understanding of the role that computers and information play in our society.

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE)**
- Fall exam - 20%.
- Winter exam - 20%.
- Term paper: draft - 5%.
- Term Paper: final - 25%.
- Final exam - 30%.

Format:
Three lecture hours per week.

Course Credit Exclusion:
SC/NATS 1505 3.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1720 6.00 A - Light & Sound

This course aims to convey an understanding of the basic nature of two very different (and yet in many ways very similar) physical phenomena - light and sound - as well as of our perception of these phenomena, that is of seeing and hearing. The physical concepts central to a modern understanding of both sound and light are introduced and used to understand selected applications such as musical instruments, architectural acoustics, optics, photography, and lasers. Description of observations and their theoretical interpretation is complemented by in-class demonstrations as well as laboratory exploration of selected concepts. The physiology of the ears and eyes, and how it influences the perception of pitch and colour, for example, is also discussed

Required Course Material:
1. Physics in the Arts (Revised Ed.), by P.U.P.A. Gilbert and W. Haeberli.
2. Let There Be Light (2nd Ed.), by A. Montwill and A. Breslin.

Evaluation: (**TENTATIVE**)
- 20% labs.
- 20% tests.
- 20% assignments.
- 40% exams.

Format:
Three lecture hours per week plus a total of eight two-hour laboratory periods.

Course Credit Exclusion
SC/NATS 1520 3.00, SC/NATS 1870 6.00.

Mathematical Content:
Physics has made use of the language of mathematics since at least the time of Sir Isaac Newton. While every attempt is made to use descriptive language in this course, some use of mathematics is unavoidable. More specifically, basic mathematical concepts at the grade 11 level are discussed and used. It is strongly recommended, in particular, that students be comfortable with the basic concepts of algebra, geometry, trigonometry, functions and simple graphs (calculus is not required). All necessary mathematical concepts beyond simple arithmetic will, nonetheless, be reviewed in class as they arise.

NATS 1730A 6.0 – Scientific Change

This course examines the diversity of ways that scientific change has unfolded in western culture over the past 2500 years. Ancient and modern scientific concepts will be introduced against the backdrop of social, technological, and cultural change. Topics may include: Hellenic science and medicine, science and Islam, the Copernican Revolution, natural history and the growth of evolutionary theory, bacteriology, and the rise of organic chemistry, the discovery of DNA, medical experimentation, and physics as "big science."

Required Course Material: (**TENTATIVE**)

1. Peter Dear, The Intelligibility of Nature: How Science Makes Sense of the World (Chicago: University of Chicago Press, 2006).
2. Bill McGuire, Global Catasrophes: A Very Short Introduction, updated edition (Oxford: Oxford University Press, 2014).
3. Michael Frayn, Copenhagen (New York: Anchor Books, 1998).

Evaluation: (**TENTATIVE)**

- First writing assignment - 20%.
- Fall term in class assignments - 5%.
- Mid-term examination in class - 20%.
- Second writing assignment - 20%.
- Winter term in class assignments - 5%.
- Final examination - 30%.

Format
One 3-hour lecture period per week.

Course Credit Exclusion:
SC/NATS 1710 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

**** NATS 1740 has Multiple Sections. Content may vary. ****
Read Descriptions Carefully

NATS 1740 6.00 A – Astronomy

This course embarks on an astronomical journey into the final frontier! A broad range of topics will be discussed including: the night sky, fundamental properties of light and matter, telescopes, planets and other solar system objects (in our own and other solar systems), stars and their birth and death, white dwarfs, neutron stars, black holes, galaxies, dark matter, dark energy, the origin and development of the universe, and the possibility of life beyond the Earth.

Required Course Material:
Textbook, workbook and clicker are REQUIRED.

Evaluation: (**TENTATIVE**)

- Laboratory exercises (including take-home computer labs) 17.5%.
- Term projects 20% (several hours spread over the year for observing the stars and moon, plus time to write up your reports).
- Class work 12.5%.
- Fall term examination 25%.
- Winter term examination 25%.

Format:
Three lecture hours per week and a total of six two-hour laboratory periods approximately every four weeks. Attendance at lectures and laboratory periods is an essential part of the course.

Course Credit Exclusion:
SC/NATS 1570 3.00, SC/NATS 1880 6.00. **NCR Note**: No credit will be retained if this course is taken after SC/PHYS 1070 3.00. Not open to any student enrolled in the Astronomy stream.

Mathematical Content:
Although the mathematics is kept to a minimum, it is recommended that students be familiar with the basic principles of geometry and algebra up to the level of Grade 11 (no calculus is required). Simple algebra and geometry is needed in some labs. Key numerical concepts are discussed in the lectures or laboratory periods.

NATS 1740 6.00 B – Astronomy (FULLY ONLINE)

Welcome to SC/NATS 1740 6.00 "Astronomy", the fully online section. This course embarks on an astronomical journey into the final frontier! A broad range of topics will be discussed including: the night sky, fundamental properties of light and matter, telescopes, planets and other objects in our solar system and in other solar systems, our Sun and other stars, black holes, galaxies, dark matter, dark energy, the origin and evolution of the universe, and the possibility of life beyond earth. No prior background in science is assumed.

Required Course Material:
The Cosmic Perspective' (Bennett, J.O., Donahue, M., Schneider, N. Voit, M.); 8th edition, with Mastering Astronomy access code. Textbook will be available in two formats: all electronic, or printed textbook and electronic access. Both formats will be available at the York University bookstore.

Evaluation: **(TENTATIVE)**

- On Line Assignments 10%.
- Research Project 12%.
- Moon Project 18%.
- Exam Nr.1 30%.
- Exam Nr 2 30%.

Format:
All work will be submitted electronically, with the exception of the two proctored term exams, which will be held on campus on the specified dates.

Course Credit Exclusion:
SC/NATS1570 3.00, SC/NATS 1880 6.00. **NCR Note**: No credit will be retained if this course is taken after SC/PHYS 1070 3.00. Not open to any student enrolled in the Astronomy stream.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1740 6.00 M – Astronomy (Winter double speed)

This course will provide a general introduction to the modern science of astronomy. The topics covered will include the motions of objects in the night sky, the history of astronomy, current missions to Mars and other planets in the solar system, extrasolar planets and the search for life beyond Earth, the birth and death of stars, black holes, galaxies, dark matter, the Big Bang theory of the formation of the Universe, current cosmological models.

Required Course Material:
The required textbook is Exploration of the Universe, 3rd edition, by R. I. Campeanu. ISBN-13: 978-1-256-38848-7. This book will be available for purchase in the York University Bookstore.

Evaluation: (**TENTATIVE**)

- Assignment 10%.
- Two tests 40%.
- *Final examinati*on 50%.

Format:
Two, three-hour lectures each week during the winter semester. Generally there will be a 10-minute break after 90 minutes.

Course Credit Exclusion:
SC/NATS 1570 3.00, C/NATS 1880 6.00. **NCR Note**: No credit will be retained if this course is taken after SC/PHYS 1070 3.00. Not open to any student enrolled in the Astronomy stream.

Mathematical Content:
Although the mathematics is kept to a minimum, it is recommended that students be familiar with the basic principles of geometry and algebra up to the level of Grade 11 (no calculus is required).

**** NATS 1745 has Multiple Sections. Content may vary. ****
Read Descriptions Carefully

NATS 1745 6.00 A - History of Astronomy

This course examines astronomical discoveries, theories and methodologies from pre-historic times up to the present day. We begin with the astronomical knowledge amassed by ancient cultures and civilizations, including those of Neolithic Britain, Egypt, China and Mesoamerica. We then look at how the Ancient Greek view of the cosmos differed from more ancient worldviews, laid the foundations for the development. Astronomy as a science, and was later built upon by Islamic astronomers. We look at key contributions to the Scientific Revolution, by Copernicus, Brahe, Kepler, Galileo and Newton, through to the birth of astrophysics and the development of the science of spectroscopy – the astronomer's ultimate tool. Continuing up to the present day, we cover important modern discoveries on the life and death of stars (including black holes), new planets beyond our Solar System, galaxies, dark matter, dark energy, and the birth and ultimate fate of our Universe

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE**)
- Assignments - 40%.
- Tests/exam - 60%.

Format:
Three lecture hours per week.

Course Credit Exclusion:
None.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1745 6.00 B - History of Astronomy
(FULLY ONLINE)

This course follows the evolution of discoveries and theories about Astronomy from pre-historic times up to the present. We begin by looking at sites like Stonehenge and Newgrange, where we find evidence that the motions of the Sun and stars were understood in prehistoric times. We then look at the astronomical knowledge amassed by ancient civilizations such as the Mayans, Babylonians and Egyptians, followed by the Greek explanations for the cosmos and the beginnings of Astronomy as a science. The first half of the course concludes with the early history of modern astronomy and covers figures like Copernicus, Brahe, Kepler, Galileo and Newton. The 2nd half of the course covers discoveries about our solar system, the stars, galaxies and the universe from the 19th century up to the present day. This includes the history of our missions to space, recent discoveries about the birth and evolution of the universe, discoveries of new planets beyond our solar system, and theories about black holes, dark matter and dark energy. No previous science background is required.

Required Course Material:
Selected readings (to be announced).

Evaluation: (**TENTATIVE**)

- Short essays assignments 20%.
- Astronomy exercises 10%.
- Midterm exam: 35% (25-30% on lecture videos, 5-10% on reading material).
- Final exam: 35% (25-30% on lecture videos, 5-10% on reading material).

Format:
All course material will be presented in online lectures and readings. All work will be submitted electronically, with the exception of the two proctored term exams, which will be held on campus on the specified dates.

Course Credit Exclusions:
None.

Mathematical Content:
The astronomy exercises involve making measurements from graphs, using scientific notation and solving simple equations involving addition, subtraction, multiplication, division and exponents. Free one-on-one tutoring is available for students who require help with the mathematical concepts. There will be no calculations on the midterm and final exam.

NATS 1745 6.00 M - History of Astronomy (Winter double speed)

This course will follow the evolution of the discoveries and theories about Astronomy from pre-historic times up to the present. We will begin with the astronomical knowledge amassed by ancient civilizations such as the Mayans, Egyptians and Chinese. We will then look at the Greek explanations for the cosmos and the beginnings of Astronomy as a science. In the second half of the course, we will cover the history of modern astronomy beginning with figures like Copernicus, Tycho Brahe, Kepler, Galileo and Newton. Continuing up to the present day, we will look at the composition and evolution of stars, discoveries about galaxies, theories about the birth and evolution of the Universe, discoveries of new planets beyond our solar system, and theories about exotic objects like black holes, quasars and dark matter.

Required Course Material:
The History of Astronomy, Couper and Henbest, Firefly Books (2007).

Evaluation: (**TENTATIVE**)

- Term project 16%.
- Assignments and quizzes 20%.
- Exams 64%.

Format:
Total of six lecture hours per week.

Course Credit Exclusion:
None.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1750 6.00 A - The Earth & Its Atmosphere

In this course, we describe the physical properties and characteristics of Earth as an active system. We will look at the overall structure of Earth, and how it is dynamic. Plate Tectonics and how Earth's crust (the lithosphere) is constantly changing, the nature of the oceans and water, as well as the nature of the atmosphere, and how all three of these 'spheres' interact, will all receive consideration. We will also touch briefly on the other planets in the Solar System, and how they are similar and different from Earth. We will look at how geology plays a role in mineral resources and how life and Earth have interacted to affect each other.

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE**)

- Term work – 40%.
- Test/exam – 60%.

Format:
Three lecture hours per week. Note: some course material may be covered online instead of in the traditional lecture format.

Course Credit Exclusion:
SC/NATS 1570 3.00, SC/NATS 1780 6.00, LE/SC/EATS 1010 3.00, LE/SC/EATS 1011 3.00.
Not open to any student who has passed or is taking a course in Earth and Atmospheric Science. Prior to Summer 2013: Course credit exclusions: SC/NATS 1780 6.00, SC/EATS 1010 3.00, SC/EATS 1011 3.00.

Mathematical Content:
Fairly mathematical in nature; uses math at about a grade 10 level; similar to what the student would have encountered in grade 10-11 science courses.

NATS 1760 6.00 B - Science, Technology & Society (FULLY ONLINE)

What is science? How has the idea of science, its relations to society and culture, and its practice and practitioners changed over time? This course seeks some answers to these questions through an introduction to the history of science and its social and cultural relations. The course consists of six major themes:

1. What makes us Human?
2. Development of Writing, Reason and Science.
3. Rise of Technology.
4. Age of Biology.
5. Spread of Information.
6. Global Ethics.

You can expect to learn a bit of science and quite a lot about science. The course aims to be illustrative rather than exhaustive.

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE**)

- 21 Weekly Assignments - 21%.
- Examination #1(covering Lectures 1 through 8) – 30.1%.
- Examination #2 (covering Lectures 9 through - 16) – 30.1%.
- Examination #3 (covering Lectures 17 through 21) – 18.8%.

The three examinations are held at York University.

Format:
Equivalent to three lecture hours per week, delivered online through online textual materials and some online audio and video. Chat Rooms and Forums are provided for consultation and collaboration. A high speed fully online connection is highly recommended.

Course Credit Exclusion:
SC/NATS 1765 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1765 6.00 A - Science, Experts and Citizens

NATS 1765, "Science, Experts and Citizens", fulfills your general science, general education, credit. This particular course gives you tools to better think *about* science and technology, *about* expertise, and *about* how claims to knowing technical scientific facts interact with political and social arguments about those claims. The course has three central themes: the tension between *scientific expertise* and *democracy*, different ways of thinking about *risk,* and knowledge and *ignorance*. We learn about these themes by covering three cases - antivaccinationism, anthropogenic climate change and climate policy, and genetically engineered food. In all three cases you'll receive a 'technical primer', but more importantly you'll learn how to ask the right questions about science, technology and society.

Required Course Material:
Only one textbook to purchase, available at the York University Bookstore and Amazon (paperback $16, Kindle $10). Harry Collins, *Are we all scientific experts now? TopHat personal response system cost about $30.* All other material is online and already paid for through your tuition (ie 'free').

Evaluation: (**TENTATIVE**)
Short examinations, in-class written summaries, and in-class exercises.

Format:
- Exams: 60%.
- In-class summarizing: 22%.
- TopHat responses: 18%.

Course Credit Exclusion:
SC/NATS 1760 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1775 6.00 A – Technology & Civilization

This course examines the history, development and use of key technologies from antiquity to present day. We will explore how social, political and economic factors can have an effect on the success or failure of new technologies, and the impact new technologies have on society. Key themes that will be surveyed in this course include.

- technology, culture, race and gender.
- religion and technology.
- the relationship between science & technology.
- the management of technology.
- how users shape new technologies.

Required Course Material:
To be announced.

Evaluation: ***(TENTATIVE)***

- Book Assignment- 8%.
- Midterm Exam - 20%.
- Technological Controversy Paper 30%.
- Final Exam 30%.
- Attendance 8%.
- In-class Assignments 4%.

Format:
Three lecture hours per week including tutorial discussion (all in-class).

Course Credit Exclusion:
SC/NATS 1810 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1780 6.00 A - Weather & Climate

Living in Canada, we all know that weather's vagaries and extremes affect where we live and how we live. We live on a planet with a very thin envelope of atmosphere that supports life as we know it. Have you ever wondered at the deadly force of a hurricane or the cooling effect of a lake breeze? Have you ever looked at a sunset and thought about what made it so spectacular? From the air we breathe to the ozone layer that protects us, from the gentlest rain to the most ferocious hurricane, these phenomena all occur in the atmosphere around us. Throughout history, stories have been written to explain these phenomena, and science has tried to unravel the mystery behind them.

We will look at the various layers of the atmosphere, from the surface where weather occurs to the stratosphere with its protective ozone layer. You will learn how the atmosphere on the earth originated and how it differs from the atmosphere on other planets. We will use the physical laws, upon which meteorology is based, to investigate clouds, winds, air masses, and storms, as well as to assess the possible long-term climatic effects arising from human activity.

Required Course Material:
Meteorology Today: An Introduction to Weather, Climate, and The Environment, First Canadian Edition, Ahrens, Jackson & Jackson, 2011.

Evaluation: (**TENTATIVE**)

- Assignments and term tests (50%).
- First-term, Second-term exams (25% each).

Format:
Three lecture hours plus one tutorial hour per week.

Course credit exclusions:
LE/SC/EATS 1011 3.00, SC/NATS 1750 6.00. Not open to any students enrolled in the Earth and Atmospheric Science program. Prior to Summer 2013. Course credit exclusions: SC/NATS 1750 6.00, SC/EATS 1011 3.00. Not open to any students enrolled in the Earth and Atmospheric Science program.

Mathematical Content:
The ability to do routine calculations is required to complete some of the assignments. Some problem solving is required at about grade 11 level. Graphical representations and scientific notation are taught in the tutorials and used in class.

NATS 1810 6.00 M – Energy
(Winter double speed)

Energy is a key resource in our modern society. Its generation, transmission and distribution are an important factor in the economic prosperity we have achieved in the western world. This course will look at some of the basic principles behind energy, the technology we use to generate it, and the side effects such as pollution and global warming that are a direct result of our energy usage. We will look in detail at the most common current energy sources such as fossil fuels and nuclear power, as well as looking at alternative energy sources such as the various renewable technologies as well as the possibility of fusion energy. The course will also take a look at how our politics both locally and globally are affected by the supply and demand of energy resources. Current events that are relevant to the course will be discussed.

Required Course Material:
To be announced.

*Evaluation: (**TENTATIVE)***

- 4 assignments - 4 x 5% each = 20%.
- In class quizzes - 8%.
- 1 project report - 12%.
- Mid-term Tests (2) - 20% each = 40%.
- Final Exam - 20%.

Format:
Six lecture hours per week.

Course Credit Exclusion:
None.

Mathematical Content:
Some facility with elementary mathematics is required.

NATS 1830 6.00 A – Mysteries of Everyday Materials

We live in a material world. To understand the matter that makes up this world around us, we need to appreciate and recognize that Chemistry- the study of matter is at the heart of it all. Our daily lifestyle tapping into energy, food, our clothing, medicines, our environmental concerns all have their connections to chemistry. From the moment you begin your day with that toothpaste, to travelling in your car, the clothes you wear, your food that you consume, your smart phone that you use you will reckon with the magic and wonder that is "Chemistry". Conversion of raw materials into valuable products requires knowledge of chemistry. How does a battery work? Why does nothing stick to Teflon®? The answers to these and many mysteries of daily life lie in Chemistry –the central science. The relationship between physical properties and usefulness of materials will be explored. The role of science in developing new material will be discussed. Through interactive lecture, in-class discussions and activities, we will journey through the chemical world and discover the power of chemistry and how the chemical structure of matter governs its reactivity and properties.

Required Course Materials:
Visualizing Everyday Chemistry, Douglas P. Heller & Carl Snyder, John Wiley & Sons, Inc, 2016. Chemistry in Context: Applying Chemistry to Society; A Project of the American Chemical Society, 8th edition, McGraw Hill Education, 2015.

Evaluation: *(**TENTATIVE)***

- Test (3) – 36%.
- Quizzes/Online – 10%.
- Case Studies – 10%
- Report – 10%.
- Final – 34%.

Format:
Three hours lecture per week.

Course credit exclusion:
SC/NATS 1820 6.00 No Credit will be retained if this course is taken after successful completion of SC/CHEM 1000 3.00 or SC/CHEM 1001 3.00. Not open to any students enrolled in the Chemistry program.

Mathematical Content:
Some facility with elementary Mathematics is required - Grade 10 level.

NATS 1840 6.00 B - Science, Technology and the Environment

Subject: The Science Behind the Hype

Humanity, and in particular technological advancements accompanying the development of humanity, have an impact upon the environment. Students need to be able to make more informed (and less emotional) decisions about environmental matters to make meaningful contributions to environmental debates. This course endeavours to convey basic knowledge concerning the interplay between science, technology, and the environment, and in the process develop scientific reasoning skills which will help students to better assess key environmental issues. Following an overview of the fundamental scientific principles underlying environmental issues, the course will examine the environmental threats to our planet, emphasizing underlying causes such as the population explosion and the growth in demand for food and energy. The concept of the ecosphere will be introduced, and topics such as the greenhouse effect, global warming, the ozone hole, pollution, agriculture, genetically-modified organisms, nuclear power, radioactivity, and recycling will be discussed extensively.

Required Course Material:
1) Living in the Environment (4th Cdn Ed.), by G.T. Miller, D. Hackett and C. E. Wolfe.

*Evaluation: (**TENTATIVE**)*
Grades will be awarded on the basis of term work (60%) and two end-of-term examinations (40%). Each term's work will include assignments, laboratories (see course format below), and one midterm test.

Format:
New for 2017-2018! Laboratory sessions held on campus and designed to deepen students' understanding of selected concepts through guided hands-on exploration. Three lecture hours per week, plus one ninety minute laboratory in roughly alternate weeks. A schedule of lab meetings will be available at the start of the course.

Course Credit Exclusion:
ES/ENVS 1500 6.00, SC/NATS 1510 3.00. Not open to any student enrolled in the Faculty of Environmental Studies.

Mathematical Content:
Minimal amount of descriptive math; modest calculations; scientific notation.

Some facility with basic arithmetical operations is expected and required (e.g. multiplication and division).

**** NATS 1870 has Multiple Sections. Content may vary. ****
Read Descriptions Carefully

NATS 1870 6.00 A - Understanding Colour

This course will take a cross- disciplinary approach in examining colour, with the aim of understanding colour and colour phenomena from the multiple viewpoints of art, physics, chemistry, physiology and history. No prior background in art or science is assumed. Mathematics is limited. Topics discussed include: light and colour; colour vision and perception; microscopic interactions between light and materials that create and influence colour; the chemistry of dyes and pigments; atmospheric colour phenomena including rainbows and the Northern Lights; and colour in minerals and gemstones. A trip to the Royal Ontario Museum is planned.

Required Course Material:
To be announced.

Evaluation: (**TENTATIVE**)
- Assignments (3) – 15% each.
- Midterm tests (2) – 7.5% total.
- Term exam (2) – 20% each.

Format:
Three lecture hours per week.

Course Credit Exclusion:
SC/NATS 1720 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1870 6.00 B - Understanding Colour (FULLY ONLINE)

Welcome to SC/NATS 1870 6.00 "Understanding Colour", the fully online section. This course will take a cross-disciplinary approach in examining colour, with the aim of understanding colour and colour phenomena from the multiple viewpoints of history, physics, chemistry, physiology and art. No prior background in art or science is assumed.

Required Course Material:
A course kit will be available for purchase at the York University bookstore.

Evaluation: (**TENTATIVE**)

- Work for the course will regular reading (5%).
- Participation quizzes (5%).
- 4 short assignments (12%).
- 1 major term project (library research exercise), (18%).
- Two exams (30% each, 60% in total).

Format:
All work will be completed electronically in Moodle, with the exception of the two proctored term exams, which will be held on campus on the specified dates.

Course Credit Exclusion:
SC/NATS 1720 6.00.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1870 6.00 M - Understanding Colour (Winter double speed)

Welcome to SC/NATS 1870 6.00 section M (winter course double speed). This course will take a cross-disciplinary approach in examining color with the aim of understanding color and color phenomena from multiple viewpoints of physics, chemistry, physiology and art. No prior background in art or science is assumed.
Required Course Material: (Tentative)
To be announced

Evaluation: (Tentative)
Assignments and short essays: 15%.
Quizzes: 15%.
Participation and in class activities: 10%.
Midterm exam: 30%.
Final Exam: 30%.

Format:
Six lecture hours per week.

Course Credit Exclusion:
SC/NATS 1720.

Mathematical Content:
Minimal simple arithmetical calculation at about Grade 10 level.

NATS 1880 6.00 A - Life Beyond Earth
(FULLY ONLINE)

Life Beyond Earth studies the possibility of life existing somewhere other than the planet Earth. It examines Science's search for life in the solar system and beyond. This course will look at how life arose on Earth, what conditions life needs to exist, and where these conditions might be found including the planets and moons in our solar system, planets around other stars, the nature of those stars and how likely they are to support life. It will also look at the issues of space flight, the detection of and communication with other civilizations, and our own attempts to explore the universe.

Required Course Material: (**TENTATIVE**)
Life in the Universe by Bennett and Shostak 4/e will be the textbook used.

Evaluation: (**TENTATIVE)**

- Short quizzes and assignments - 45%.
- Exams (2) – 55%.

Format:
All work will be completed electronically in Moodle, with the exception of the two exams, which will be held on campus on the specified dates.

Course Credit Exclusion:
SC/NATS 1570 3.00, SC/NATS 1740 6.00. NCR Note: Not open to any student in the Astronomy stream nor to any student who has passed or is taking SC/PHYS 1070 3.00, SC/BIOL 1010 6.00, SC/BIOL 1000 3.00, SC/BIOL 1001 3.00 or AP/ANTH 3270 3.00.

Mathematical Content:
Although the mathematics is kept to a minimum, it is recommended that students be familiar with the basic principles of geometry and algebra up to the level of Grade 11 (no calculus is required). Numerical concepts are discussed.

NATS 1920 6.00 A – The Nature & Growth of Ideas in Mathematics

This course explores some of the most important ideas in the history of mathematics. Rather than focusing on the technical content of theorems and equations, the course aims to an understanding of how mathematical thinking arose, what its character is, and how it relates to the social context and to our greater grasp of the world. The topics considered may include: the origins of counting and number systems; practical geometry and the emergence of demonstrative geometry; its application to understanding the mysteries of the heavens; how mathematics became the language of science, and the mathematical expression of natural laws; the theory of probability and the rise of statistics; the puzzle of infinity and infinitesimals; the history of computation.

Required Course Material:
Course textbooks will be announced.

Evaluation: (**TENTATIVE**)

- In class tests, 40%.
- Mid-term exam, 30%.
- Final examination, 30%.

Format:
Three lecture hours per week.

Course Credit Exclusion:
None.

Mathematical Content:
The entire course is about mathematics, but students are not expected to be proficient in mathematics beyond about a Grade 10 level. More familiarity will probably be helpful, though not mandatory.

NATS 1940 6.00 A – Biodiversity & Conservation

During the fall term, we consider Biodiversity at the genetic, species, and ecological levels. Topics include the importance of genetic diversity in populations, the measurement of species diversity, and an evolutionary perspective on past and present diversity, including the centrality of extinction. Students will learn the basic groups of organisms, with a focus on some of the larger, more familiar groups.

During the winter term, we consider issues that threaten species diversity, and we assess the extent of biodiversity loss globally. The challenges faced by small and by declining populations will be considered. Particular threats are considered: climate change, habitat destruction, over-exploitation, and invasive species. There may be a unit that focuses on one or more particular groups, such as amphibians, reptiles, or birds. We will consider some of the successes in halting or slowing biodiversity loss.
Required Course Material:
A textbook or course pack may be required or recommended at the York University Bookstore.

Evaluation: (**TENTATIVE**)
Four assignments totaling 28% and four tests totaling 72%.

Format:
Three lecture hours per week and one tutorial hour per week which will primarily be used for assignment work.

Course Credit Exclusion:
NCR Note: This course is not available for credit for any student who has passed or is taking SC/BIOL 1000 3.00, SC/BIOL 1001 3.00 or SC/BIOL 1010 6.00.

Mathematical Content:
Simple mathematical calculation; not beyond a grade 9 level.

NATS 1945 6.00 A – Physics for World Leaders (Blended)

This course presents the most interesting and important topics in the far-reaching realm of physics, stressing conceptual understanding rather than emphasizing the math, and with applications to current events and technologies. Upon completion of the course, students will be fluent in the critical topics of physics and the leading-edge technologies that are currently discussed in the media, and which effect our daily lives as well as the future of our planet. Topics include: Energy and power, atoms and heat, gravity and space, nuclear reactions, electricity and magnetism, sound waves, earthquakes and tsunamis, visible and invisible light, information transmission and digital technology, climate change, quantum physics, relativity, cosmology and space exploration. No prior knowledge of physics is required.

*Required Course Materia*l:
Physics and Technology for Future Presidents: An Introduction to the Essential Physics Every World Leader Needs to Know (2010, Princeton University Press) By Richard A. Muller.

Evaluation: (**TENTATIVE**)
- Short essay assignments - 20%.
- In-class assignments - 25%.
- In-class tests - 55%.

Format:
Approximately 60% of the course material will be presented in online lectures and readings. The other 40% will be delivered via in-class activities held in 3-hour sessions approximately every other week.

Course Credit Exclusion:
None.

Mathematical Content:
In-class assignments involve making measurements from graphs, using scientific notation and solving simple equations involving addition, subtraction, multiplication, division and exponents. Assistance will be provided in class for students who require help with the mathematical concepts. There will be no calculations on the tests.